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WHAT THE MAYOR DRINKS.

Some few months ago, when Commissioner Monroe, of the Department of Water, Gas and Electricity, began his agitation for the establishment of a New York municipal electric lighting plant, we took occasion to remark that if he would only see to it that the water now supplied by the city were made fit for drinking and bathing he would have enough to attend to without creating another city enterprise to be mismanaged. It is possible that some people thought this was a hypercritical objection, but if so they could not be familiar with the conditions of Croton water, or if New Yorkers, could not be in the habit of trying to absorb it. We now note that Mayor Low, of this city, is himself of the same opinion as we are with regard to the potable qualities of the city water supply. In the recent issue of the *City Record*, giving details of the city expenses as reported by the finance department for the quarter ending March 31, we find that the Mayor is allowed to pay $3 per month to the Clynta Water Company for drinking water, while Controller Grout is allowed to pay $73.50 to a filter company for the use of their filters to purify the water used in his office for drinking purposes. Such amusing little incidents as these give, it seems to us, renewed force and pertinence to our argument that before Commissioner Monroe takes on the responsibilities of another big department, he had better do what he can to regulate more efficiently the water supply under his care, so that the foremost officials of the city do not have thus to put themselves on record as either being unable to drink the Croton supply without filtering it, or else as being compelled to abandon its use altogether and drink some water brought from a remote point by ordinary commercial agency.

Incidentally to this, we cannot altogether refrain from calling attention to the present racket over the abuses and scandals in the government post office. Whenever an agitation is got up for municipal ownership or the governmental control of the telegraph or the telephone, reference is made to the post office and its success as a governmental institution. So far as we are concerned, it seems to us that the United States post office service is hardly a successful institution, and it is something to provoke the cynical to merriment to see some of the daily newspapers that are loudest in their advocacy of municipal and government ownership, now pounding the post office as hard as they can for the grave evils that have been opened up to publicity, and allowing vehemently that there is no good thing or person to be found in the government post office service. As is well remarked in one of the comic operas, "It is to Laugh."

TELEPHONE ENGINEERING AND THE A. I. E. E.

In a paper read last week at the Chicago meeting of the Independent Telephone Association, Mr. J. C. Kelsey referred in plain terms to the dereliction of telephone engineers with respect to contributions on their part to engineering literature—a dereliction which for years has been the subject of general comment. After sketching the development of telephony into a branch of electrical engineering, he said that to place telephone engineering where it rightly belongs, "one thing yet remains, and that is, the attention of the scientific world must be attracted by our deeds and words. The American Institute of Electrical Engineers is the body to which we look for the official expression of the electrical profession. Everything good, novel and interesting is brought before this body in the fullness of time. It is discussed freely and honestly, and if found meritorious is given a place in the records for all men to read and to think about. If all the telephone engineers had permission or had the inclination to take broad and comprehensive papers before that body—there is plenty of material—the engineering world would more fully realize the breadth of telephony and scientific men would take more interest in studying the various and vexatious problems now confronting the practice of telephone engineering. But all that has been thus far brought before the Institute is in general a sort of apology, an evasion of the subject by a prolonged discussion of rates, or an assurance that telephone engineering is a broad profession. It will take more than assurances to establish this fact. How much better it would be if an institute of telephone engineers could be organized and perpetuated." In connection with the latter suggestion, it may be remarked that the A. I. E. E. now includes in its membership the leading telephone engineers of the country, many of whom are persistently solicited for contributions to the *Transactions* of that body. Should these become active as members of a special Telephone Institute, we doubt if the result would compensate for the loss of prestige that would accompany the separation of telephone engineers from the electrical engineering profession at large, and the isolation of telephony as a branch of electrical engineering.

We are glad to note in this connection that the plans adopted for the continuance and expansion of the Independent Telephone Association at the Chicago convention last week, involve the fuller recognition of telephone engineering as distinguished from telephone finance. We shall see plenty of the latter without doubt during the next decade, but the only part of it that will be substantial and enduring will be based primarily upon the best work of the telephone engineer. The day of cheap telephone construction has gone by, and the future for the telephone engineer is as bright as that of his brethren in electric lighting, traction or power transmission.

THREE-PHASE POWER MEASUREMENT.

Last week we published an article by Mr. F. A. Fish, which embodies a useful suggestion. It is well known that the power transmitted in three-phase circuits can be measured either by three wattmeters, one in each line, or by two wattmeters, one in each of two lines, with their pressure-windings carried to the remaining line. The sum of the two readings in this case gives the power transmitted over the system, whether the system is balanced or not. In most instances the two wattmeter readings are of reasonably large magnitudes, and are nearly equal. In some instances, however, when the system is highly inductive, and particularly when it is unbalanced, one of the readings may become negative, and should be subtracted from, instead of added to, the other. This requires that the connections of the negatively-reading instrument must be reversed in order to make an observation possible with the ordinary form of apparatus. This reversal of wattmeter connections is, therefore, an indication that the power is the difference, and not the sum, of the two instrument readings. It often happens, however, that there is uncertainty in connecting the wattmeter leads, as to whether they have been reversed or not. In such a case there is necessarily uncertainty as to whether the power transmitted over the circuit should be interpreted as the sum or as the difference of the two instrument readings.

The plan suggested in the article is to apply a non-inductive shunt to the series coil of the doubtful instrument. This has the effect of retarding the phase of the residual current left in the series coil, since there is appreciable reactance in the coil, but inappreciable reactance in the non-inductive shunt. The effect of the extra phase difference of the series current may more than compensate for the shunting and the shunted wattmeter may indicate more than in the unshunted condition. It is shown that in general, when the instrument is working with the negative signification, the shunting is likely to increase the reading; whereas if the instrument is operating in the normal direction, the shunting is likely to decrease the reading, in the usual way. In order to make the test more definite, extra inductance may be permanently inserted in series with the series coil, of such magnitude as will strongly reinforce the inductance of that coil, but not so large as to exercise any appreciable influence upon the phase of the current in the circuit under test. It is very seldom that the question of sum or difference in the readings of the two wattmeter test can seriously arise; but when it does arise, such a simple expedient should be welcomed as a criterion.

THE METRIC SYSTEM.

As our columns are always open to every side of a question, we are glad to print in this issue two communications written from the standpoint of the opponents of the metric system. We may add that the pleasure is increased by the showing made of the weakness of the case of those who would continue to inflict upon the most progressive branch of the human race the monstrous medley of English weights and measures. One can pardon the conservatism of that minority which will always cling tenaciously to the conditions under which they wrought their life work; but when they would bind the younger generation and the generations to come to conditions alien to the spirit of new ages, this attempt to enforce the doctrine of mortmain—of the dead hand—in the realm of thought, is bound, sooner or later, to meet with failure. The reply to Mr. Colles's somewhat inelegant query, "Why is every electrical engineer a born metric crank"? is simple. The electrical engineer is of the younger generation, he is animated in the highest degree with the modern progressive spirit, and to him the utilitarian past is without interest beyond the lessons it holds for the present and for the future. Above all, the electrical part of his engineering work is taught in the metric system, and once he has learned this he is naturally as inimical to the English jumble of weights and measures as one who learns modern chemistry would be to an attempt to revive mediæval alchemy.

Mr. Colles charges inconsistency because the advocates of the metric system do not demand the decimalization of the unit of time. In reply it may be said that the question of the metric system is now a practical one, and its adoption is advocated because of its practical advantages as developed through use in countries where it has gone into legal effect. It is true that instead of being a sensible decimal fraction of the day, such as the one-hundred thousandth part, the second is a stupid sexagesimal fraction, the 86,000th part. But no effort is being made, or is likely to be made, to change this. The question is not what should be done to obtain theoretical simplicity, but what should be done to secure practical international simplicity. Admitting that the outstanding second of time is not decimal, the European metric system is, say, 95 per cent. decimal and simple; whereas our medley is only decimal and simple in its currency, or say 5 per cent. Is it not reasonable to adopt an international system which is 95 per cent. simple rather than withstand the progress of civilization because we cannot attain 100 per cent.? As regards the ohm, volt and ampere, it suffices to say that these and all other electrical units are essentially units belonging to the metric system. As regards the horse-power, that is a ridiculous old unit worthy of the dark ages, and is only perpetuated by electrical engineers under the convention of 746 watts, in order to meet commercial requirements. The watt is a sensible metric unit of power. The watt and kilowatt are rapidly displacing the absurd old horse-power, just as the metric system is steadily displacing the absurd old jumble.

Mr. Halsey, in his stout stand for the English inch, is unfortunate in coming after the doughty Mr. Piazzi Smith, who took the position that the great pyramid of Egypt was built by Cheops to perpetuate the English inch. As to pounds and ounces, the apothecary pound and ounce are the same as the troy pound and ounce, and are often so stamped. The smaller divisions of the two apothecary systems have no agreement with each other nor with the corresponding divisions of the avoirdupois system. How beautiful this is, and easy to remember! Mr. Halsey pretends that Europe does not use the metric units. We have ourselves lived in various parts of Europe and we never saw nor heard of any units used there but metric units, outside of Great Britain. There may be a few odd and rare cases of old units being still retained in metric countries. So there may be a few old Spanish dollars yet circulating in the currency of this country. It is simply self-deception to allege that Europe, outside of Russia and Great Britain, is not in the full and successful use of the metric system. Let one try to sell commodities there by other units and note the outcome. It is absurd also to compare the decimal multiples of the metric system, such as the milligramme, gramme, and kilogramme, with the heterogeneous English units, such as the ounce, pound and hundredweight. The three metric units cling together in the mind like the dollar, dime and cent; while the three English units are hitched together like the pound, shilling and penny, an absurd inconsistency. Is Mr. Halsey aware that the colonies of Great Britain have recently urged the British Government to throw over this mediæval hodge-podge and adopt the metric system? If there are not 64 of these old units in the English system, as Mr. Halsey claims, then why do our schools teach them? Take the standard primers of the country and count the units. Then take a German primer and see by contrast what the long-suffering English-speaking pupil and citizen has to bear. Is time worth less to us than to the Germans?

WATERING SCIENTIFIC STOCK.

It is with regret that we find the daily press, which ought to be of great service to science in bringing it clearly before the non-technical public, taking serious as a well-founded discovery the carnival of electrons proclaimed by a few enthusiasts in London the other day. It is a very unfortunate thing for science when half-baked theories are solemnly proclaimed as facts. The present case involves a striking and interesting hypothesis as to the structure if matter, no more sound or valuable than many other which has been propounded in the last two thousand years, until invested with the dignity of substantial evidence. This is not yet forthcoming, and however interesting and sensational the hypothesis may be, it should not just now be taken too seriously. Lodge and Crookes, the sponsors for the recent proclamations, are both men who have done notable work in science, principally experimental, but neither of them can fairly lay claim to being either cautious or conservative in hypothesis. Professor J. J. Thomson, on whose experiments the electron scheme of salvation is largely based, has our sincerest respect, and that because he has uniformly been somewhat more cautious in his judgments than many of his fervid disciples; but his work has been purely in the electrical side of the problem, and therefore, as we have several times intimated, stands in dire need of corroboration from independent lines of inquiry, before the conclusions can be accepted as fact, or even rise to the rank of a sound theory. Whatever may be their ultimate fate, they have led to a very interesting field of investigation for which all thanks, but this does not constitute by itself inherent probability of correctness.

There is nothing sacrosanct about the atom, using that word in its chemical signification, and in fact many chemists and most physicists have looked forward with some confidence to its resolution into structures more truly elementary. Evidence on this point has been steadily accumulating for many years. Attempts to split up the so-called atom have been not infrequently made, and more than once prior to the present excitement has there been apparent success. A score of years ago one brilliant investigator, fully the peer of those now concerned, communicated a discovery of this sort to the French Academy of Sciences, where it was, with a wisdom rare in scientific bodies to-day, held up in committee for a confirmation which never came, for the author soon found the source of his error. Occurrences of this sort should inspire caution in dealing with topics of this sensational description. For all this it may be quite true that a hydrogen atom, for example, is divisible into some hundreds of elementary ions, but true or false the evidence in the case is open to very grave doubts. The experimental data based on the hypothesis are numerous—*de bene esse*—as our legal friends pleasantly put it; but the interpretation of the basic facts is emphatically open to discussion. When one goes back and reinspects the foundations upon which a very improving structure has been somewhat hastily built, there appears to be a logical flaw in the very corner-stone. How serious it is remains to be seen, but it is undeniably there. The crucial point in the whole problem is the magnitude of the particles which take an important part—as principals or accessories—in certain electrical phenomena. The current estimate of this magnitude involves directly the hypothesis that the condition or thing which we call "electric charge" obeys identically the same laws in non-matter composed of infinitely subdivided atoms, that it does in the material bodies with which alone we can experiment. This is not susceptible of proof by any experiment in which the point at issue is already assumed among the data. If proved at all it must be by an independent line of investigation, and it is precisely this proof which is at present lacking.

It does not help the matter any to assume that the particles in question are in themselves "electric charge," for in the first place independent proof is necessary to justify such an assumption, and secondly the hypothesis leads to an unpleasant tangle in accounting for the properties of matter in its ordinary forms. We heartily wish that the experimental basis of the whole affair could be thoroughly reviewed by competent physicists and chemists before any further time is spent in elaborating the superstructure. As a matter of fact, the work on radium, which seems to have been responsible for this latest acute spasm, tends as a whole to weaken rather than strengthen the position taken by Lodge and other extremists. Assuming the correctness of M. Curie's thermal manifestations, they are by no means inexplicable on far less revolutionary suppositions than those here considered, and M. Curie has been disposed himself to the conservative rather than the radical view. In this connection it may not be amiss to call attention to the vigor with which certain physicists of good repute contended for the existence of hot ice not many years ago. It is certain that the recent active work in the line of radioactivity has brought to light many interesting and perhaps highly important facts; it is probable that such researches will add much to our knowledge of the fundamental properties of matter; it is possible that the old atom has been forever broken up and that we must hereafter discuss matter in terms of electrons; but if this last contention is established it must be by far stronger and more direct evidence than has yet appeared. To put a new theory of matter on a firm basis many conditions beside electrical ones must be fulfilled by the working hypotheses, and we regard it as very unfortunate that the electrical evidence, always looked at a little askance by scientific men in the wider field, should stand sole sponsor for doctrines which, true or false, have been exploited with more noise than discretion.

Niagara Falls Meeting of the Institute.

The twelfth annual convention of the American Institute of Electrical Engineers was held at the Cataract House, Niagara Falls, this week, and was in full swing when this journal went to press on Wednesday. The attendance was large and even beyond expectation, 320 being registered by Tuesday morning, while some 400 were present by Wednesday. The excellent programme prepared has already been published in these pages, and is being very closely carried out.

The annual convention was called to order at 10 o'clock on Monday morning, in the auditorium of the Natural Food Company, which had been placed at the disposal of the Institute for its meetings.

President Scott opened the meeting. In his opening address he referred in very complimentary terms to the work done during the past year by Dr. Sheldon, Prof. Sever and Mr. H. W. Buck in preparing the programme and arranging for the convention. Mayor Hancock, of Niagara Falls, welcomed the Institute to the city and told something of its progress during the past few years. The secretary then read invitations from the Niagara Falls Hydraulic Power & Manufacturing Company and from the Niagara Falls Power Company, to inspect their plants, offering the delegates to the convention and their friends, every facility for seeing them at their own time and pleasure.

The Niagara Club also extended the courtesies of the club to the Institute. The president then read his address, the parts which were most enthusiastically received being those in which he referred to the fact that the membership has increased 60 per cent. during the past year, and the reference made to Mr. Carnegie's gift in connection with the Union Engineering Building. In the course of this admirable address, Mr. Scott said: "Our membership on September 15, 1902, included 1,630 names. Since that time nearly 1,000 applicants have been elected associates. The new men range in age from 19 to 65. The ages of those who have been elected are given in the following table: Over 50 years, 2 per cent.; 45 to 50 years, 2 per cent.; 40 to 45 years, 6 per cent.: 35 to 40 years, 10 per cent.; 30 to 35 years, 24 per cent.; 25 to 30 years, 34 per cent.; 20 to 25 years, 21 per cent.; under 20 years, 1 per cent. Approximately 60 per cent. are between 25 and 35 years of age, and are presumably young men who are getting under substantial headway in life and are in their accelerating period."

Mr. Scott also made the further interesting analysis:

"Forty-four per cent. of these men are graduates of schools of recognized standing. Of the graduates 45 per cent. graduated within the past 5 years (not including 1903) and 77 per cent. within the past 10 years. Cornell University leads the list with 12 per cent. of the graduates; the Massachusetts Institute of Technology is second with 8 per cent.; Columbia, Purdue, Ohio State, Princeton, Worcester Polytechnic Institute, Lehigh, University of Michigan and the University of Wisconsin follow next and there are substantial numbers from McGill, Stevens Institute, University of Pennsylvania, University of Illinois, University of Minnesota, Pennsylvania State College, University of Nebraska, University of California, Harvard, Yale and Rose Polytechnic Institute. In addition there are representatives from as many other institutions.

"The position and occupation of the new members is difficult to classify definitely and satisfactorily, but a general summary shows the following:

Electrical Engineers with manufacturing companies	30%
Electrical Engineers with operating companies	25%
Managers and superintendents, duties presumably executive rather than technical	16%
Consulting engineers	10%
Electrical engineers with mills, mining plants and the like	6%
Students	6%
Professors and instructors	4%
Mechanical and electrical draftsmen	3%

"I think we may congratulate ourselves that our additions are truly representative of the electrical engineers of America."

The reference to the Union Engineering Building was very interesting, as it embodied a narrative of Mr. Scott's personal dealings with Mr. Carnegie in securing the great gift of $1,000,000, and closed as follows: "Four of the organizations (the fifth has not yet taken final action) which were designated in the letter have without hesitation formally accepted the administering of this generous gift to engineering, and their representatives are now actively developing plans. These plans look forward to the realization of an ideal long cherished by some of the foremost and far-seeing engineers of the country, an ideal which brings within its scope the advancement of the engineer and of his profession, both within itself and in its outward relations. In short an ideal the realization of which will strengthen modern engineering, which is the very basis of prosperity and of progress and will exert far-reaching influences beyond our powers to discern."

One of the interesting features of the meeting was an exhibit of the Hewitt converter and mercury vapor lamp, by Mr. P. H. Thomas accompanied by an able exposition by him and by Dr. Von Recklinghausen on Monday night, when an account was given for the first time of a single-phase mercury converter.

Engineering Educational Project in England.

On June 28, according to a special cable dispatch, Lord Rosebery, as Chancellor of the University of London, announced that Wernher, Beit & Co., Sir Ernest Cassel, Lord Strathcona and other public-spirited citizens have offered to contribute £300,000 to erect a scientific university in London if the London County Council will undertake to keep it up at a cost of £20,000 annually. The government has promised a site for the institution in South Kensington.

Another dispatch of June 29 said: Following this morning's announcement by Lord Rosebery that Wernher, Beit & Co., Sir Ernest Cassel, Lord Strathcona and other public-spirited citizens have offered to contribute £300,000 for the erection of a scientific university in London, under certain conditions, comes the statement this afternoon that a scheme has been launched for the erection of completely equipped metallurgical teaching and research works as a memorial to Bessemer, the discoverer of the process named after him.

It was stated at a meeting held at the Mansion House to-day to discuss the matter that the scheme would form an integral part of the wider plan initiated by Wernher, Beit & Co. and others.

Several speeches in support of the plan were made at the meeting. The Duke of Norfolk, in his address to the meeting, paid a warm tribute to the work of Bessemer. Prof. Henry Marion Howe, the metallurgist of Columbia University, New York, warmly seconded the remarks of the Duke of Norfolk.

Gas Engine Tests.

Two papers were read before the recent Saratoga meeting of the American Society of Mechanical Engineers on gas engine tests. One of these was presented by Mr. C. Oliver, and gave the results of a test on a 10-hp Otto engine using gasolene. The thermal efficiency was found to be 32.8 per cent. and the brake horse-power efficiency 19.1 per cent. Of the total heat supplied, 32.7 per cent. passed off in the exhaust, 30.5 per cent. in the jacket water and 6 per cent. in radiation. Messrs. H. F. Holloway and G. O. Hodge communicated the results of a test of an engine using kerosene and gasolene as fuel, the engine being rated at 15 hp at 260 r.p.m. In this case the highest indicated thermal efficiency was 24.89 per cent. using kerosene, and 20.19 per cent. brake efficiency. When using gasolene the highest indicated efficiency was 20.07 per cent., corresponding to a brake efficiency of 15.08 per cent.

Municipalism in Leipzig.

U. S. Consul B. H. Warner writes from Saxony: "The Leipzig City Council has passed an ordinance compelling employees in the various departments of the city government to take up their residence in the city limits on or before the 1st of January, 1905. As the waterworks, lighting plants, storage warehouses, markets, pawn shops, hospitals, etc., in addition to the departments under city control in the United States, are municipal institutions, a large number of people will be affected by this ordinance. It is said that this action was taken in order to foster Leipzig's growth, to increase the city's income, and to concentrate the conservative vote."

The Marconi System in Australia

A special dispatch from London says: "The Australian telegraph authorities have pronounced against the adoption of the Marconi wireless system. Mr. Scott, head of the telegraph department, personally experimented with the system and was unfavorably impressed with it for practical use, as the currents were uncontrollable and the messages liable to interception."

Combination Lighting, Heating and Pumping Plant at Dresden, Saxony.

ONE of the most interesting and beautiful electric lighting plants recently installed on the Continent of Europe is that at Dresden, the capital of Saxony, the object of the plant being to heat and light the royal and municipal buildings of that famous city. The plant includes a central station generating steam at high pressure, about 1,000 hp for electric lighting alone, an extensive tunnel or subway system, and provision for pumping on account of proximity to the River Elbe. The buildings to be supplied extend along the River for nearly a mile, and the most available site for the plant was in the rear of the Royal Theatre and near the river. While it was desirable to remain near the river for the purposes of obtaining condensing water, receiving coal and disposing of ashes, this location carried with it serious obligations. As all visitors to Dresden will remember, there are a number of famous and beautiful buildings in the vicinity mentioned, and it was imperative that the new plant should harmonize with them. As will be seen from the view presented herewith of the exterior of the station, a stately and beautiful building has been erected, which is probably the most ornate central station in existence, the smokestack being artistically and effectively concealed within the stone work of the central tower.

Aside from the central station itself, the tunnel or subway system is a most interesting and admirable feature of the work. It was built in open trench, which was subsequently refilled, the side walls and floor being of brick facing earth or rock excavation with brick arches for the roof. It is about 8 ft. high by 9 ft. wide inside, ordinary cross-section, and as it is below the level of the Elbe, which has frequent floods, it has been thoroughly water-proofed, and except through one shaft has no opening whatever except those into the buildings which it serves. An electric motor mounted on small wheels is drawn by an attendant from one stationary pump to another for the purpose of pumping off the seepage water into the proper drains. As he goes through the tunnel, the workman connects up his motor at the proper points and switches the lights on before him as he switches off those behind.

An essential feature of this interesting tunnel is that it affords excellent accommodation for the electric wires and cables, which, as will be seen, are supported along one side, the steam pipes passing along the other side. As a matter of fact, considerable economy is effected by dispensing with insulation, but at the same time a coarse protective netting of heavy iron wire is placed as a shield to the circuits in the manner indicated by several of the engravings.

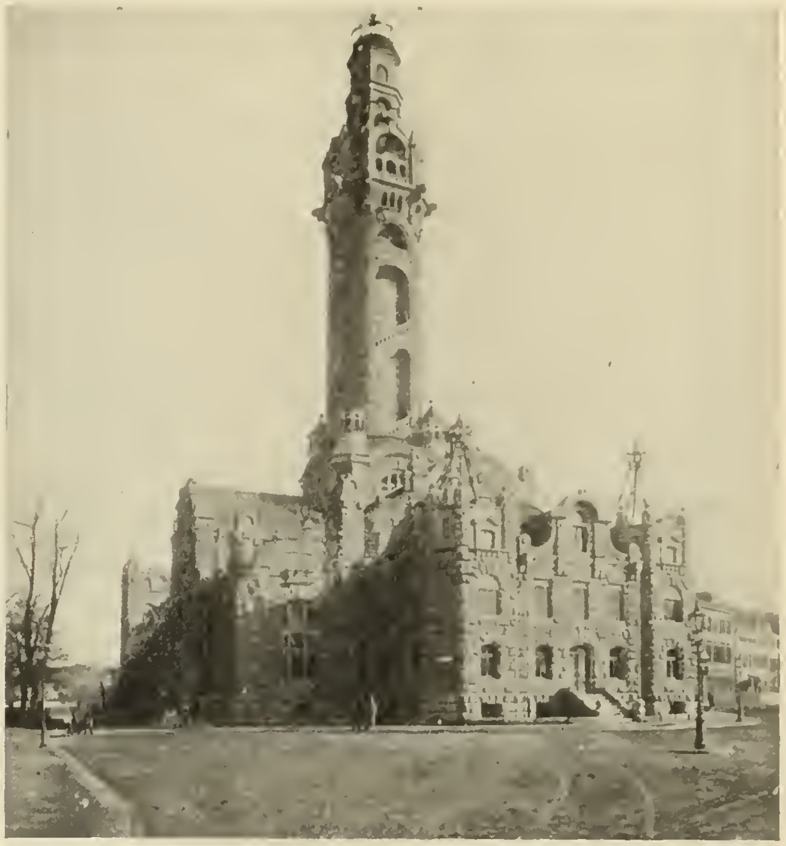

FIG. 1.—EXTERIOR VIEW OF DRESDEN STATION.

As a matter of fact, the low-potential current used hardly necessitates such elaborate protection, but a farther degree of security is obtained by placing the cables of each circuit some feet apart, the adjacent cables in each case affording no short circuit in the event of accident. The cables are painted different colors. The lighting circuit has five cables, two positive, two negative and one neutral,

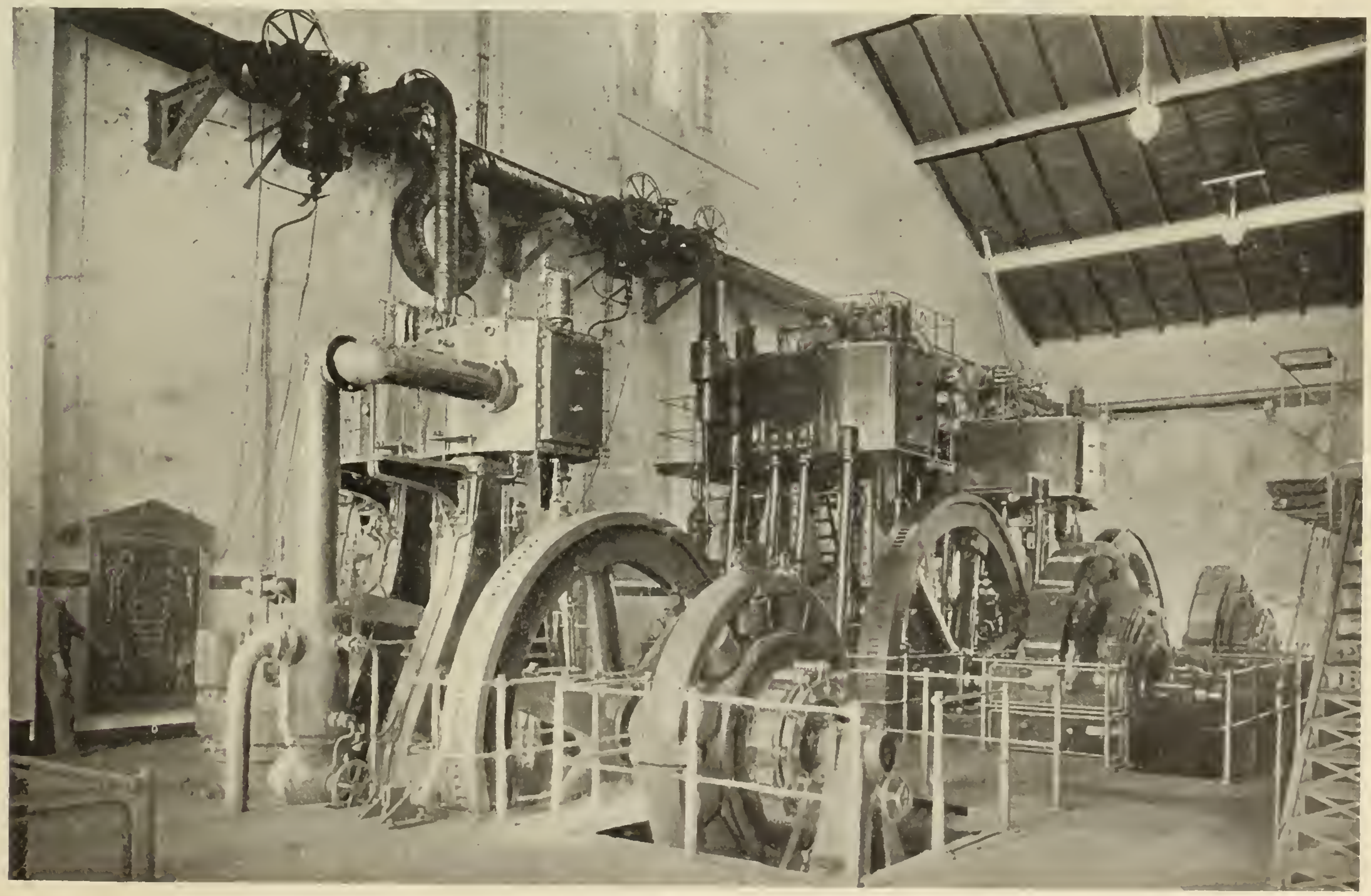

FIG. 2.—VIEW OF INTERIOR OF DRESDEN STATION.

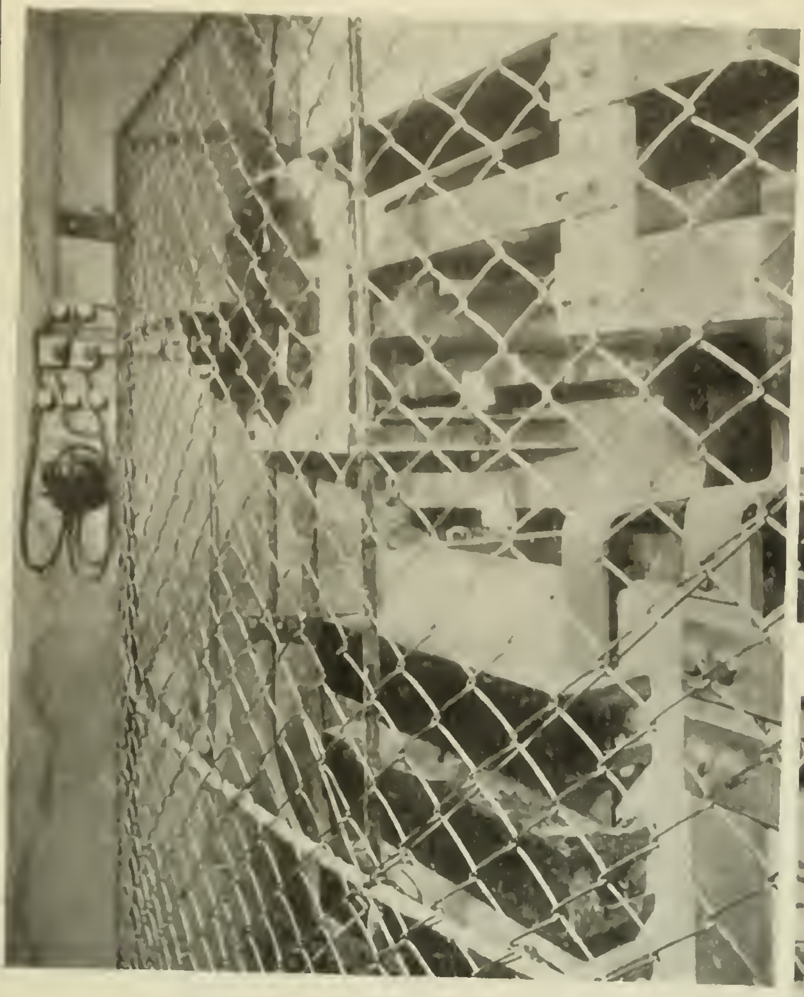

FIG. 3.—DISTRIBUTING BARS AT ROYAL CASTLE.

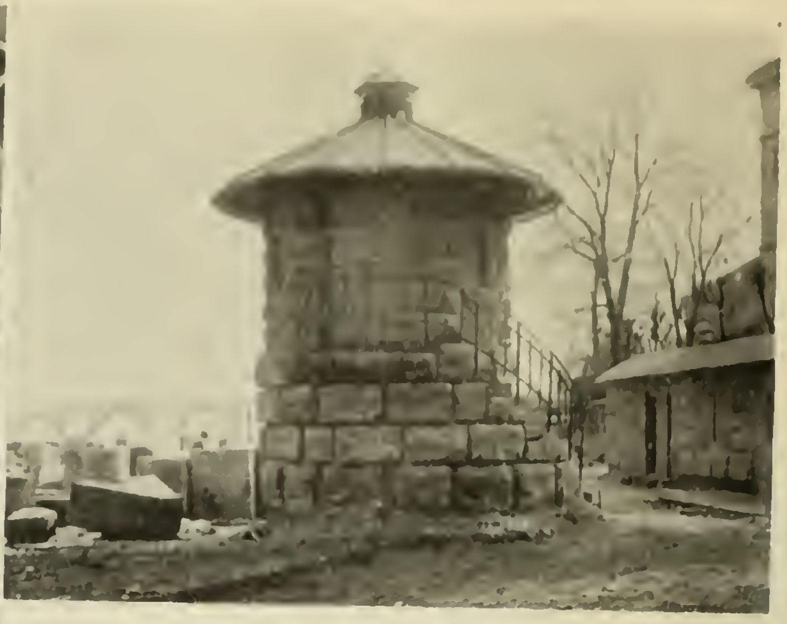

FIG. 5.—PUMP HOUSE.

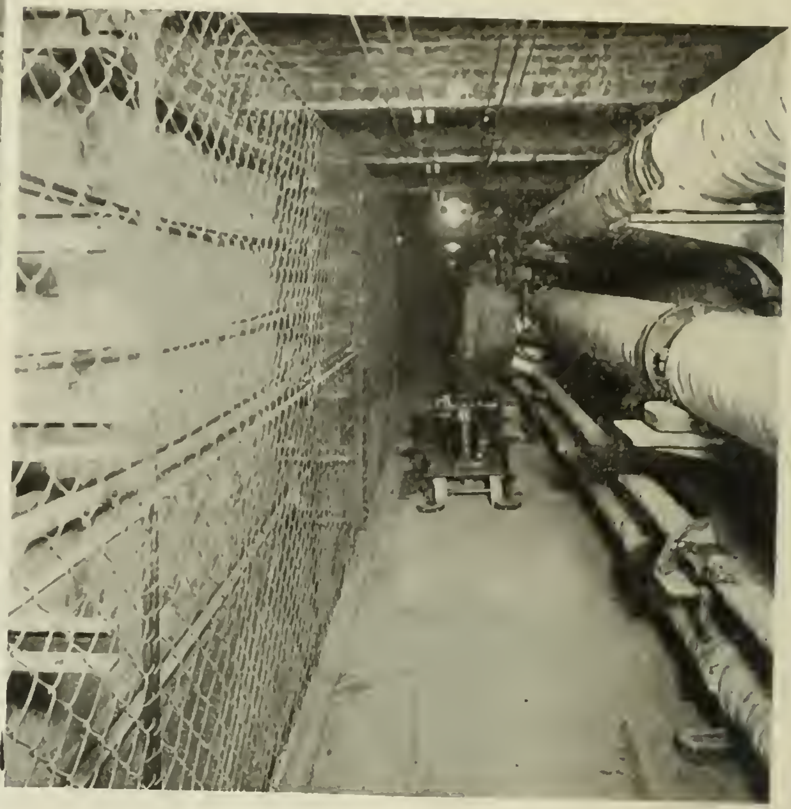

FIG. 6.—CABLE AND PIPE PASSAGEWAY.

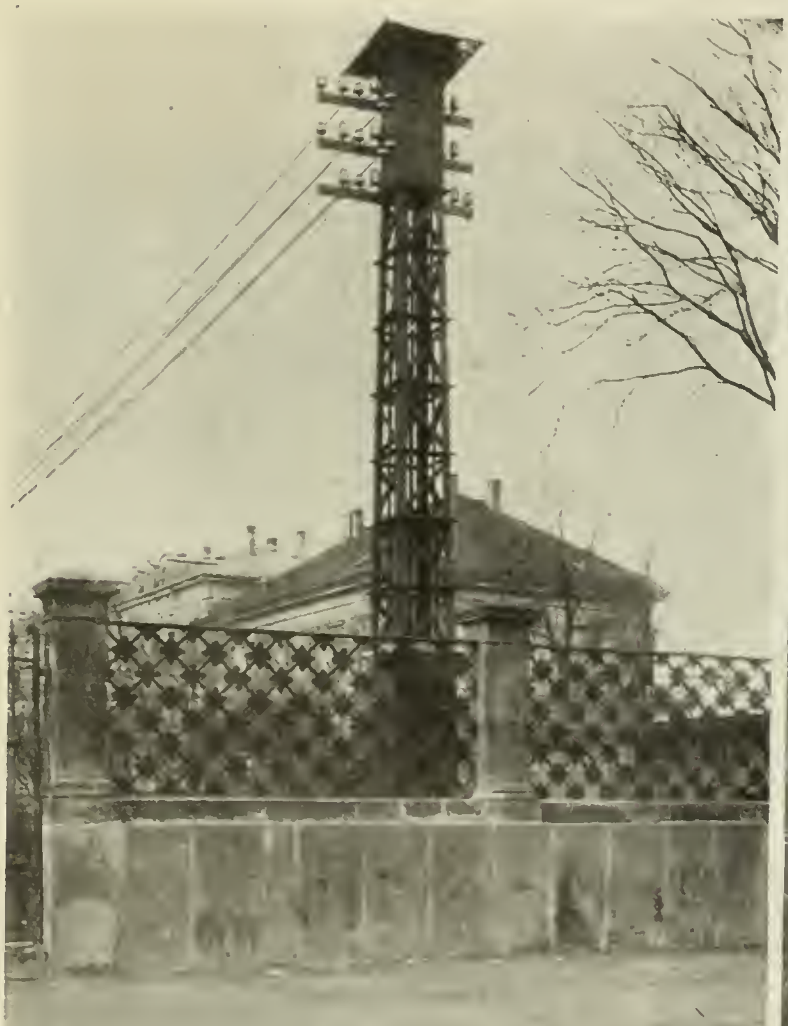

FIG. 4.—POLE AT FEEDING-IN POINT.

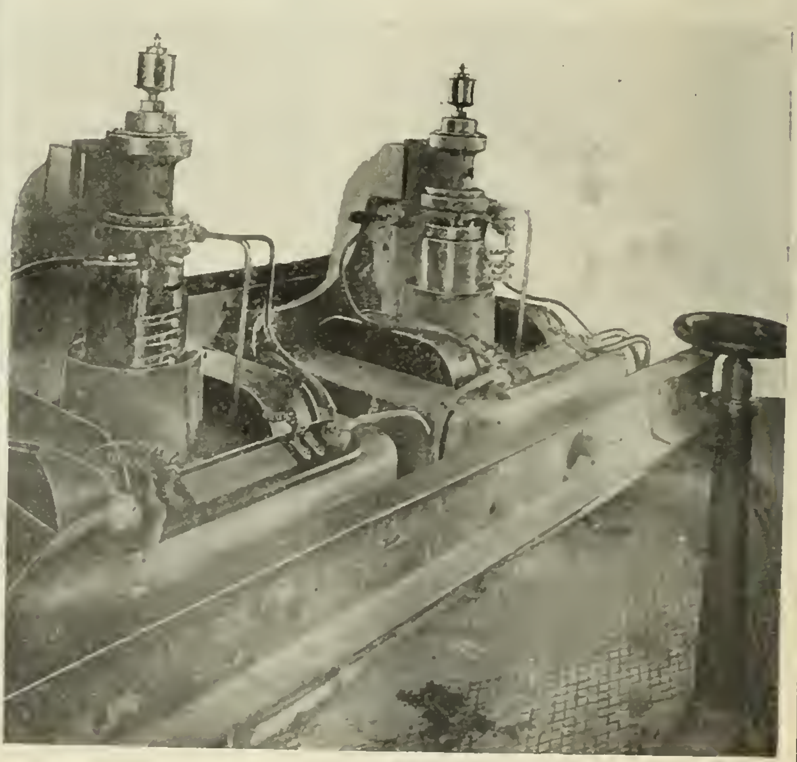

FIG. 7.—PUMP ROOM.

COMBINATION LIGHTING, HEATING AND PUMPING PLANT, DRESDEN, SAXONY.

the latter being grounded twice at each feeding point. The cables are round except at the branching and feeding points, where the current passes through flat bars. In the whole tunnel there are six such feeding points, and from each two pressure wires lead back to the switchboard in the central. The cables, wherever they are at the side of the tunnel, rest on porcelain insulators bolted to channel irons, built into the masonry; overhead the insulators are supported by double-hook hangers.

There are two separate auxiliary circuits, to the royal castle and to the royal theatre. Both are lead-covered cables of 625 square millimetres cross-section and go underground to these buildings. The one for the castle is connected with an automatic cut-out switch at a point in the tunnel. The cable to the theatre has no such cut-out at its connection, because during the performances an attendant is at the switchboard.

Coming back to the power plant, it may be noted that the boiler room contains ten boilers, each of 2,500 square feet of water heating surface. They are of a two-furnace double-cylinder, vertical communicating type. The lower cylinder contains longitudinally two furnace tubes with grates and ash pits. The gases passing out of the ends of these tubes pass to the upper cylinder and through its tubes, coming out at the end above the furnace doors. The gases then enter the compartment in which the two cylinders are contained, entirely enveloping the lower boiler and the vertical connecting pipes, and finally escaping to the flue at the bottom, opposite the furnace door. The smoke is, of course, consumed at the furnace, and arrangement is made for superheating the steam. These boilers furnish steam for both the heating apparatus and the engines.

There are three vertical , compound high-speed engines, made by the Sächsische Maschinenfabrik, formerly Richard Hartmann, of Chemnitz; two of 384 to 517 hp, with cylinders of 17 and 25 inches bore, stroke 24½ inches, speed 120 r.p.m. and pressure 110 pounds; and one with cylinders 13 and 20 inches bore, 19 inches stroke, developing at 160 revolutions and 110 pounds pressure 186 to 264 hp.

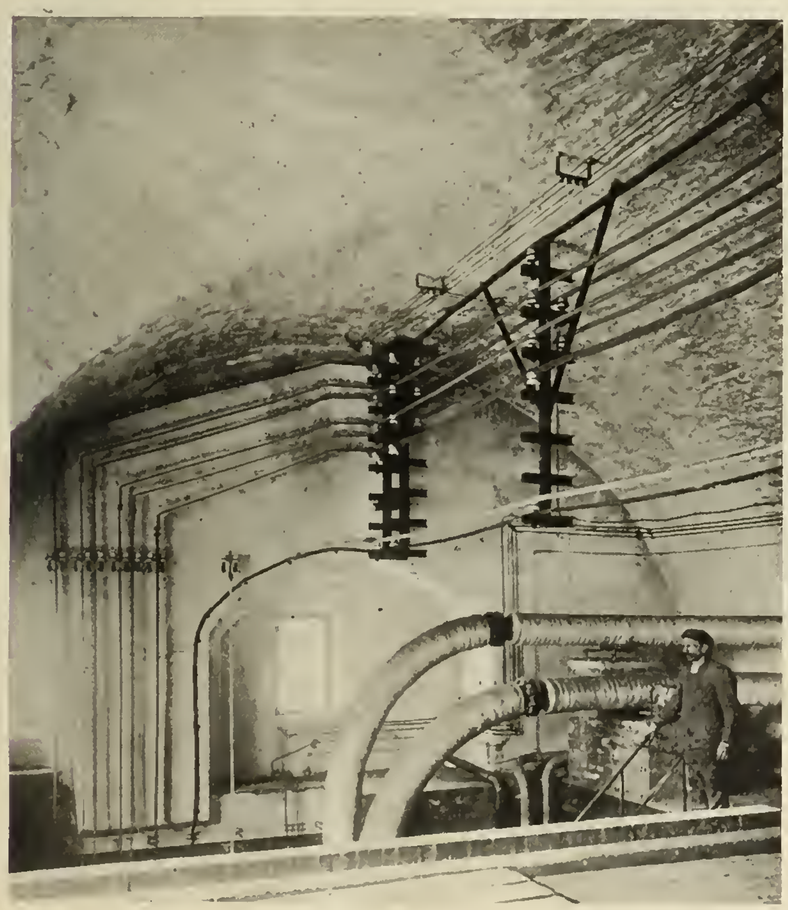

FIG. 8.—ENTRANCE TO THE CASEMATE UNDER THE TERRACE.

The engines are supplied with condensers, it having been determined that to use the exhaust steam for heating purposes would not be economical; at times this would be in too great volume and at other times insufficient. The water is furnished to the condensers from an isolated pumping station on the bank of the Elbe. There are two pumps, of 17 hp each, of the centrifugal type, with vertical shafts and direct-coupled motors.

The engines in the power house are direct-connected to three generators. The dynamos of the first two engines furnish from 260 to 360 kw each at 220 volts; the third, 130 to 175 kw at 220 volts. They were manufactured by the Allgemeine Elektricitäts Gesellschaft, of Berlin. There are two parallel-connected banks of storage batteries, each of 2 x 132 cells. The capacity of each bank is 1,080 amp-hours. The charging current rate is 360 amp. and the discharging rate is the same. The whole plant is arranged with a view to the greatest economy, and waste is eliminated in every possible way. The cost of the installation complete was about $750,000.

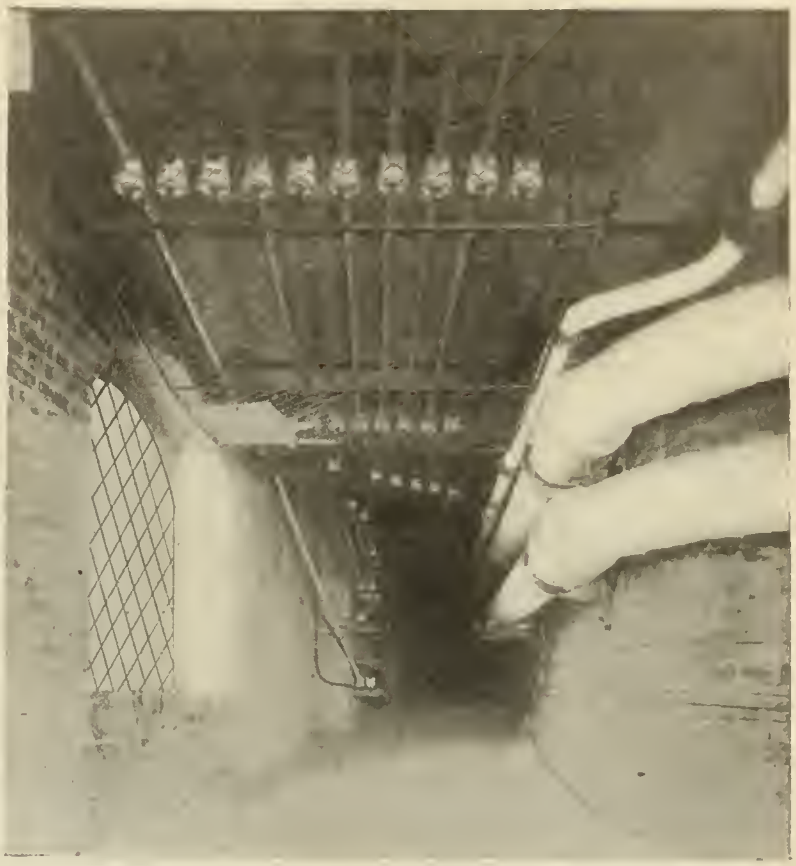

FIG. 9.—CABLEWAY FOR CROSSING THE MUNZGASSE.

Wireless Telegraphy in Japan.

The necessary plant is now being erected for communication by wireless telegraphy between Miesaki, in Nagasaki prefecture, and Hassekimon, on Sharyo Island, off Kelung, Formosa, a distance of about 850 miles. The installation was commenced in January last, and the expenditure on the enterprise is estimated at about $10,000. Mr. Saiki, an engineer in the Department of Communications, is in charge of the work at Miesaki. The station at Hassekimon was commenced in March last, and is in charge of Mr. Ichimura, an engineer in the same department. It is expected that everything will be completed by the end of July, and that communication will be established immediately. Experiments in wireless telegraphy, it seems, have been continually made by the Department of Communications and by the Navy since 1896. The experiments were first made, with satisfactory results, between Yawata, Kazusa and Funabashi, Shimosa, a distance of 11 miles, and afterwards between the shore and ships in Tokyo Bay, a distance of over 20 miles. Wireless telegraphy in Japan, it is asserted, materially differs from Marconi's system. An application of Signor Marconi to patent his invention in Japan was refused, and the system now being established between Formosa and Kyushu has been developed by a Japanese inventor.

The Kaiser on the Kearsarge.

A visit to the *Kearsarge*, the new United States battleship, was made at Kiel last week by the Emperor William, who spent some time on board. Part of a long cable dispatch on the subject says: "With the telephonic and signal apparatus in every part of the ship the Emperor showed familiarity, and he pointed out one or two good new things. The German constructors have been having trouble with electric connections, and the Emperor was especially interested in them. At present the Kearsarge's general electrical system is invisible, as it is enclosed in semi-permanent constructions."

An Automatic Telephone Exchange for Chicago.

By R. E. Sack.

A TELEPHONE exchange in Chicago, which has been attracting much attention, and was of especial interest to all attending the convention of the Independent Telephone Association, is that of the Illinois Telephone & Telegraph Company, of Chicago. This is an automatic exchange, and presents features not embodied in manually-operated exchanges. It may be considered as marking an epoch in the art. The main feature which distinguishes the automatic from the manual system of telephony, is the elimination of the operator. This system, as tried on a smaller scale at Fall River, New Bedford and other places, has already been described in these pages.

An introduction to the system can as well be made through the subscribers' apparatus as any other part. This does not differ materially from the ordinary telephone instrument, except for the calling dial underneath the transmitter. This is of metal, and along the edge are ten finger holes numbered consecutively from 1 to 0. A stop is provided at the lower of the holes to limit the distance that the dial may be revolved. It might be urged that any except the usual method of calling would involve educational work on the part of the company, but from the following it will be seen that any person of even less than average intelligence can readily grasp the necessary routine movements immediately. To call a number, say 654, the subscriber first takes the receiver from the hook, then placing his finger in the hole No. 6, turns it around to the stop above-mentioned. Releasing it, the dial is instantaneously restored to its original position by a spring. The subscriber is now connected with central. In the same manner he then calls 5 and 4. Having turned the number desired, he presses a button, which rings the bell of the unit of 1,000 subscribers, the second-selector and connector switches differing but slightly in their construction from the first selector or subscriber switch.

In manually-operated exchanges it has been found that the number of cords required for operation at times of the heaviest traffic, varies from 10 to 12 per cent. of the total number of subscribers connected to the exchange. In this case, however, enough switches have been installed to allow 32 per cent. of the total possible number of connections to be made at once. As seen from Fig. 1, further provision has been made by installing on the racks parts of switches, so that the percentage can be increased to 50 with ease. In fact, to permit all subscribers to talk to each other at one and the same time it is but necessary to install the additional required switches without the prohibitive complication which such a course would cause in a manual exchange. This possibly may be considered one of the most important features of such an installation. Although the capacity of the station is 10,000, provision is made for 10,000 subscribers, and by adding third selector switches the system can be increased to 100,000.

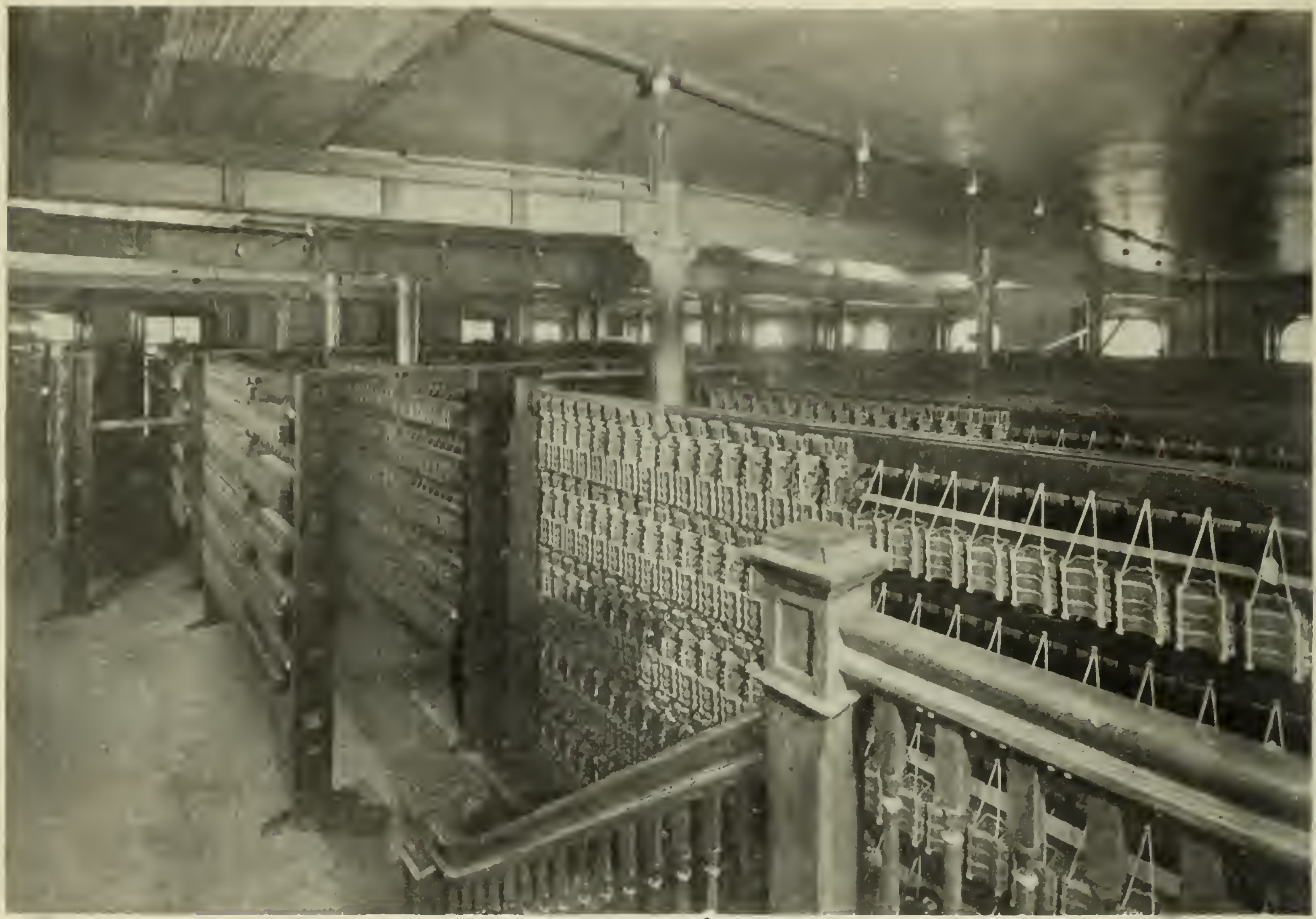

Fig. 1.—General View of Automatic Switchboard

As will be seen from the various photographs, the unit idea predominates in the entire board, a certain number of first and second selector and connector switches being installed for each subscriber. These can to a certain extent be arranged to suit conditions. In the present installation each unit of 1,000 subscribers consists of eleven racks, six of which have 150 first selector switches each, arranged on six shelves, 25 switches to a shelf. The seventh rack contains 100 first-selector and 40 second-selector switches, the balance being installed on the eighth and ninth racks, 20 to a shelf. The connector switches are mounted on the tenth and eleventh, each having five shelves with 16 switches on each. A feature of the installation is the small space occupied by each rack, which is eleven ft. 6 in. long, 10 in. wide, and set 3 ft. centers. Although the skeleton of each rack on which the switches are mounted consists of oak in this case, any suitable material can be used. The wires from the switches are carried to a terminal head at the end of each shelf, whence they are carried in cables to troughs running along the top of all boards. These carry all the cables from the distributing board and those between the connector, the first and the second selector switches.

There being three banks of contacts, each consisting of 10 rows and 10 contacts in each row, 300 wires are required for making connection with each switch. Nine wires lead to the magnets and relays, two of which are the line wires that go to the particular group on which that subscriber has his number, and four wires for the person wanted, and the connection is completed. When the conversation is finished, the hanging up of the receiver sends current over the wires to the switchboard and instantly clears the lines which were engaged. One second or less for each figure is all the time required. In the event that the desired subscriber is busy, a buzzing sound in the receiver notifies the caller that such is the case. A selector calling apparatus is placed in the instrument, but of course the calling party is no more concerned as to this than he is about any other constructive feature of the telephone.

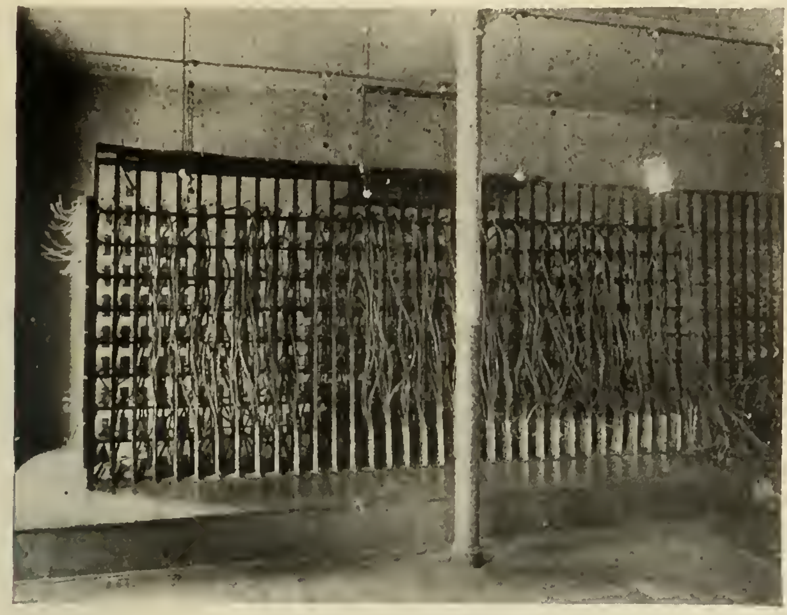

FIG. 2.—DISTRIBUTING BOARD DURING CONSTRUCTION.

The exchange building is located at 177 to 181 Fifth Avenue, between Adams and Monroe Streets. It is a four-story and basement brick structure, and was completely remodeled to meet the requirements of the company. From the cross-section of the building shown in Fig. 8, it will be seen that the different floors will be used for the following purposes: Basement, cabling and storage battery; first floor, offices and supplies; second floor, cable distribution and automatic switches; third floor, automatic switches; fourth floor, automatic switches and power plant. In Figs. 6 and 7 are shown respectively floor plans of the second and fourth floors. Each of the floors of the building is about 48 x 58 ft. in size, with an average height of 13 ft. One feature which impresses itself on a person accustomed to manual exchanges is the comparatively small size of the building for the number of lines which enter it. This is due to a great extent to the absence of switchboard operators, who in turn require toilet and lounging rooms, although it is true that an automatic exchange, aside from the operators, requires about the same number of attendants as a manually-operated one.

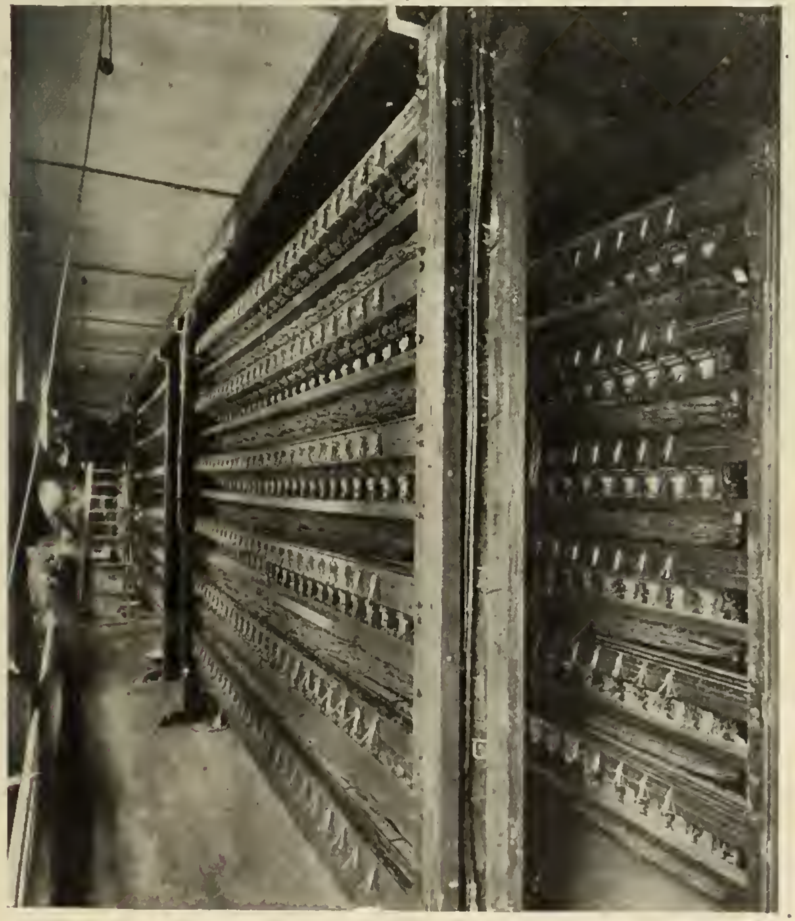

FIG. 3.—REAR VIEW OF SWITCHBOARD.

The overhead and underground system of such an exchange does not present any novel features, the usual circuits and apparatus being employed. The underground system of the Illinois Telephone & Telegraph Company, however, is of unusual interest because of a complete system of underground tunnels in the business district of the city. Anyone acquainted with the congestion of pipes, ducts and cables in the streets of a city the size of Chicago will at once realize the great importance of such a system. Every dollar expended is invested in permanent improvements, which in the future will not require a rearrangement, an increase, or even an abandonment of parts of the system. These tunnels are of horseshoe shape, 8 ft. high and 6 ft. wide at the widest part. These extend from the Chicago River on the north to the Illinois Central depot on the south, and from the south branch to the lake. They cross under the river at two points, at Van Buren Street and at Fifth Avenue, and will be extended to meet the growth of the business. For a detailed description of these the reader is referred to the Electrical World and Engineer of March 8, 1902.

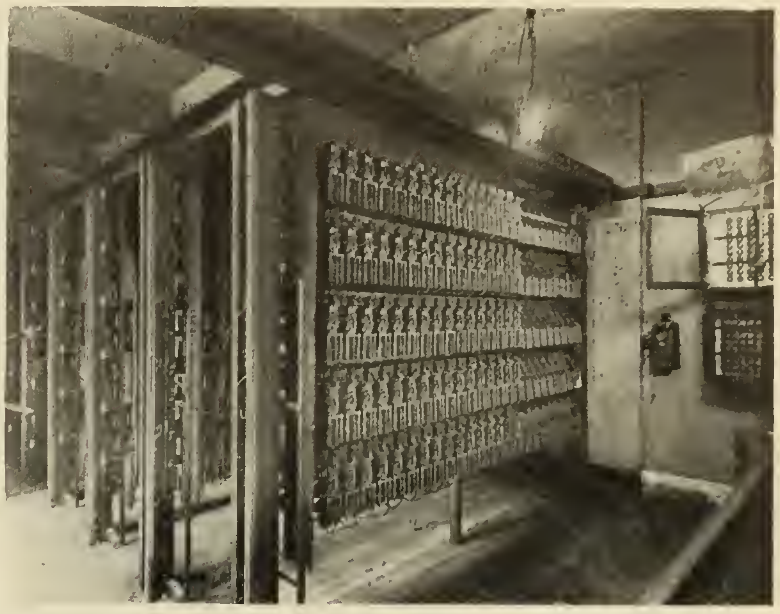

FIG. 4.—FRONT OF SWITCHBOARD AND TELL-TALE BOARD.

The method pursued of bringing the telephone cables into a building is quite flexible, and obviates the objectionable features of running service connections from ordinary conduits. This does away with the building of street manholes, which at times it is almost impossible to construct, and furthermore does not require work subsequently in these for making connections. As will be seen from Fig. 10, small laterals are taken off from the tunnels at different

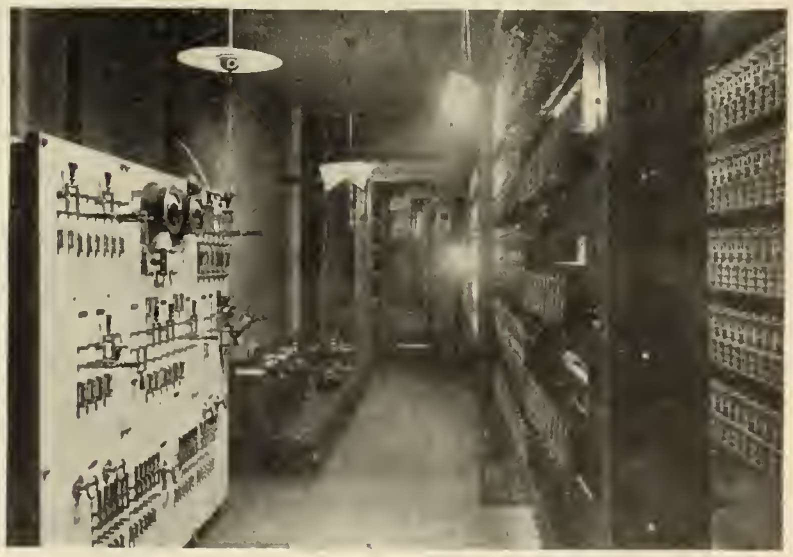

FIG. 5.—SWITCHBOARD AND POWER PLANT.

points for serving individual buildings. The lateral is three feet in diameter, and is run horizontally to the building, and then four-inch wrought iron pipes are driven to meet the lateral, this pipe being placed under the sidewalk or within the building walls, as desired. The pipes, of course, can be readily changed to meet new conditions, whereas the laterals are at such depth as not likely to interfere with any probable future improvements in the nature of street railway tunnels which have been proposed from time to time.

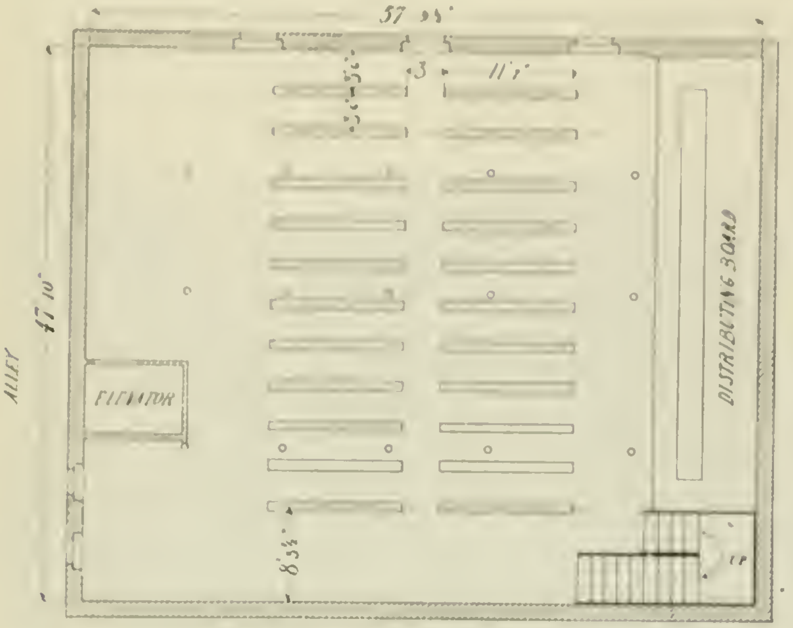

FIG. 6.—PLAN OF SECOND FLOOR.

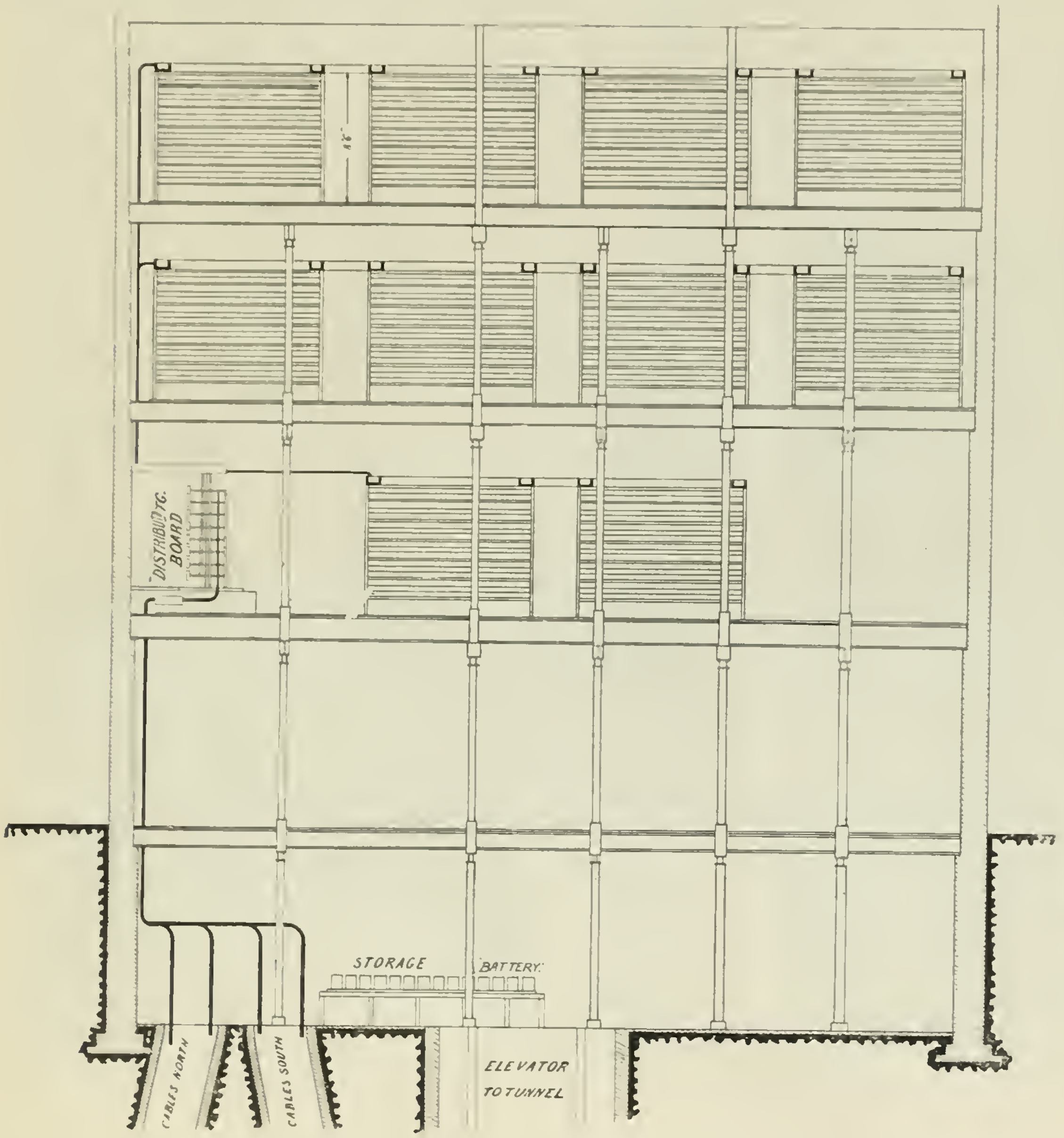

FIG. 8.—CROSS-SECTION THROUGH EXCHANGE BUILDING.

Reverting to the exchange building, the course of the cables from the basement to the tunnels is through two vertical shafts, each about three feet in diameter, connecting with the latter by two laterals, one for the north and the other for the south cables. The cables will be supported from the roof of the tunnel by means of special iron brackets. A specially constructed car will permit the unreeling of the cables directly from the reels to the racks. Provision has been made for the lowering of the car with reel mounted thereon on an elevator from the basement of the building to the tunnels through a large shaft. Sixty 200-pair lead-covered underground cables are carried on the north wall to the distributing board located on the second floor. These cables are pot-headed underneath the platform sup-

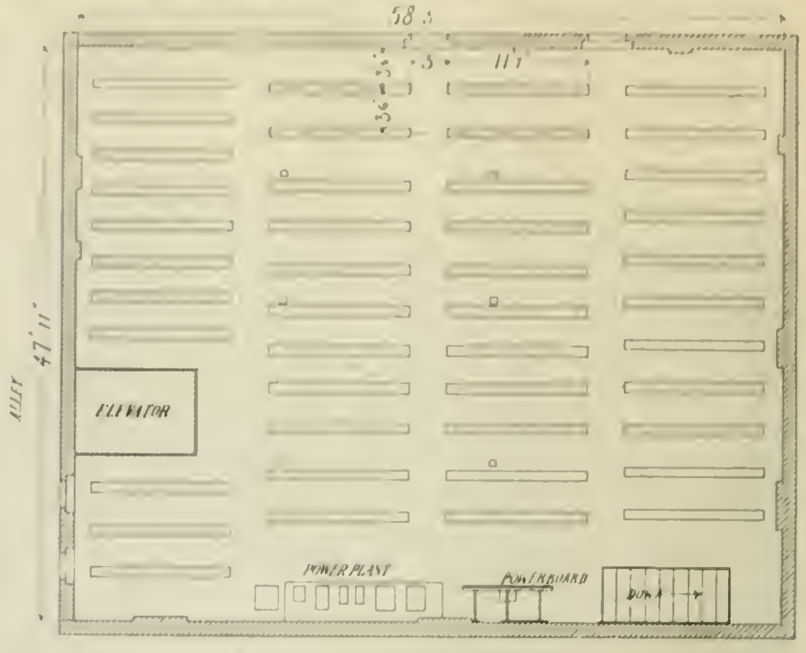

FIG. 7.—PLAN OF FOURTH FLOOR.

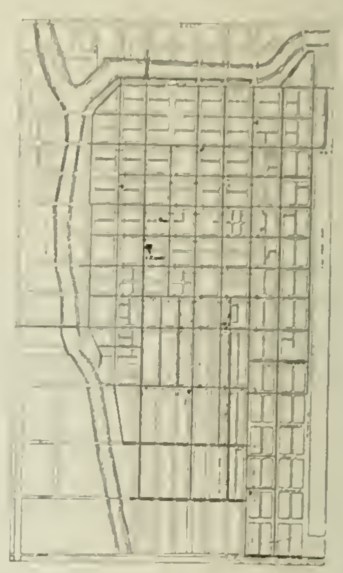

FIG. 9.—MAP OF TUNNELS AND EXCHANGE.

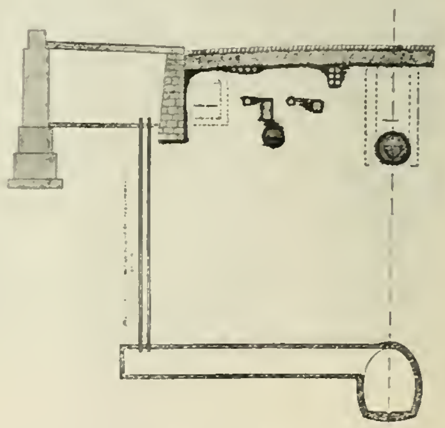

FIG. 10.—STREET CONNECTION WITH TUNNEL.

porting the board, and from each one of the former, eight 25-pair cables are taken to the line terminal blocks located on the distributing side of the board. The automatic switches on the several floors are permanently connected to springs on the protector or switchboard side, heat coils and carbon lightning arresters being provided in each circuit. All subscribers' connections are made at this point with jumpers, as is the case in manual exchanges. The capacity of the board is 12,500 lines on the distributing side, whereas that of the exchange is 10,000.

On the upper floor is installed the power plant, which is seen in Fig. 5. From the same it will be noticed that a three-panel marble switchboard of substantial construction has been installed. On the same are provided the necessary switches to permit of various combinations being made, also a Weston voltmeter and an ammeter and fuses of the cartridge type. The primary sources of current for both power and lighting purposes are the mains of the Chicago Edison Company, although a battery located in the basement is used as a reserve and for the operation of some of the machines. Two 2.8-kw Sprague motor-generators are provided for charging the batteries from the Edison circuit. By means of switches on the switchboard, either one of the motor-generators can be used for charging either one of the batteries, one of which is always in use. One rheostat is provided for the two machines, which is arranged to remain in circuit in any position, thus changing the speed of the motors and as a consequence varying the voltage of the current delivered by the generators for charging the battery. Two Holtzer-Cabot motor-generators are provided for ringing the subscribers' bells. One of these is operated from the 220-volt Edison circuit, whereas the other is for use with the storage batteries, thus insuring an unfailing supply of alternating current for ringing. Two interrupters which supply current to the rotary magnets of the second-selector switches and are also provided with howler and busy current attachments, are operated from the storage batteries exclusively, as this gives a most uniform current. It will be noticed that these machines are provided in duplicate to insure against any interruption in service. A small air compressor located on the third floor is also operated from this switchboard by a motor and will be used for supplying compressed air for cleaning the switches, this operation being necessary once or twice a month. Taps will be located at different points on the various floors so that a hose can be readily attached to these and used wherever required.

The storage battery consists of two series of 26 cells, each series having a capacity of 350 amp. at the one-hour rate of discharge. The cells are of glass and contain eleven plates each. The battery is installed in a room in the basement, especially built for that purpose, and provided with a positive air circulation. The glass jars are insulated by porcelain insulators and supported on a wood framework. All exposed surfaces are thoroughly covered with P. & B. paint. The battery was made and installed by the American Battery Company, of Chicago.

The most novel and interesting feature about the exchange, and in fact the entire system, is of course the automatic switchboard. As a detailed description of the switches has appeared in these columns, the operating features alone will be considered. The present equipment of the exchange will be that required by 10,000 subscribers, although one can be readily installed and operated for ten times as many. The complexity of the exchange does not increase with the size, an increase in apparatus being proportionate to the increase in the number of subscribers only. As is well known, the paradox of increased complexity of installation and of a corresponding increased cost of operation holds good for manually-operated exchanges, and prevents an exchange of more than some 9,000 subscribers being readily installed. With an automatic exchange, economic considerations alone in regard to the wire plant lead to one of the size considered. It should further be borne in mind that the same number of switches are always at work in an automatic exchange, whether the hour be night or day. In manual practice the number of operators is increased during the so-called busy hours and decreased when the night comes on and the volume of business is supposed to be lax. Oftentimes this decrease of force is greater than the decrease of business will warrant, some special event sending in a number of hurry calls which the depleted force cannot handle. This can never happen with the automatic exchange, which always has as many operators or switches as callers.

The switchboard in reality consists of units, each composed of eleven boards for every 1,000 subscribers. Each board consists of six racks, on which the various switches are mounted. In each unit supplying service to 1,000 subscribers, the equipment consists of 1,000 subscriber or first-selector switches, which select the first figure on the thousand of the number called; 280 second-selector switches, which select the particular hundred in that thousand, and 160 connector switches, which select the last two digits in the number, and are really the switches that connect the calling to the called subscriber. There are, accordingly, 1,440 switches in each battery connections. Of the 300 wires, 100 pairs are connected to the "vertical" and "rotary," or talking banks of contacts, and lead to the ten different groups of second-selector switches. The other 50 pairs connect with the "busy," or uppermost bank of contacts,

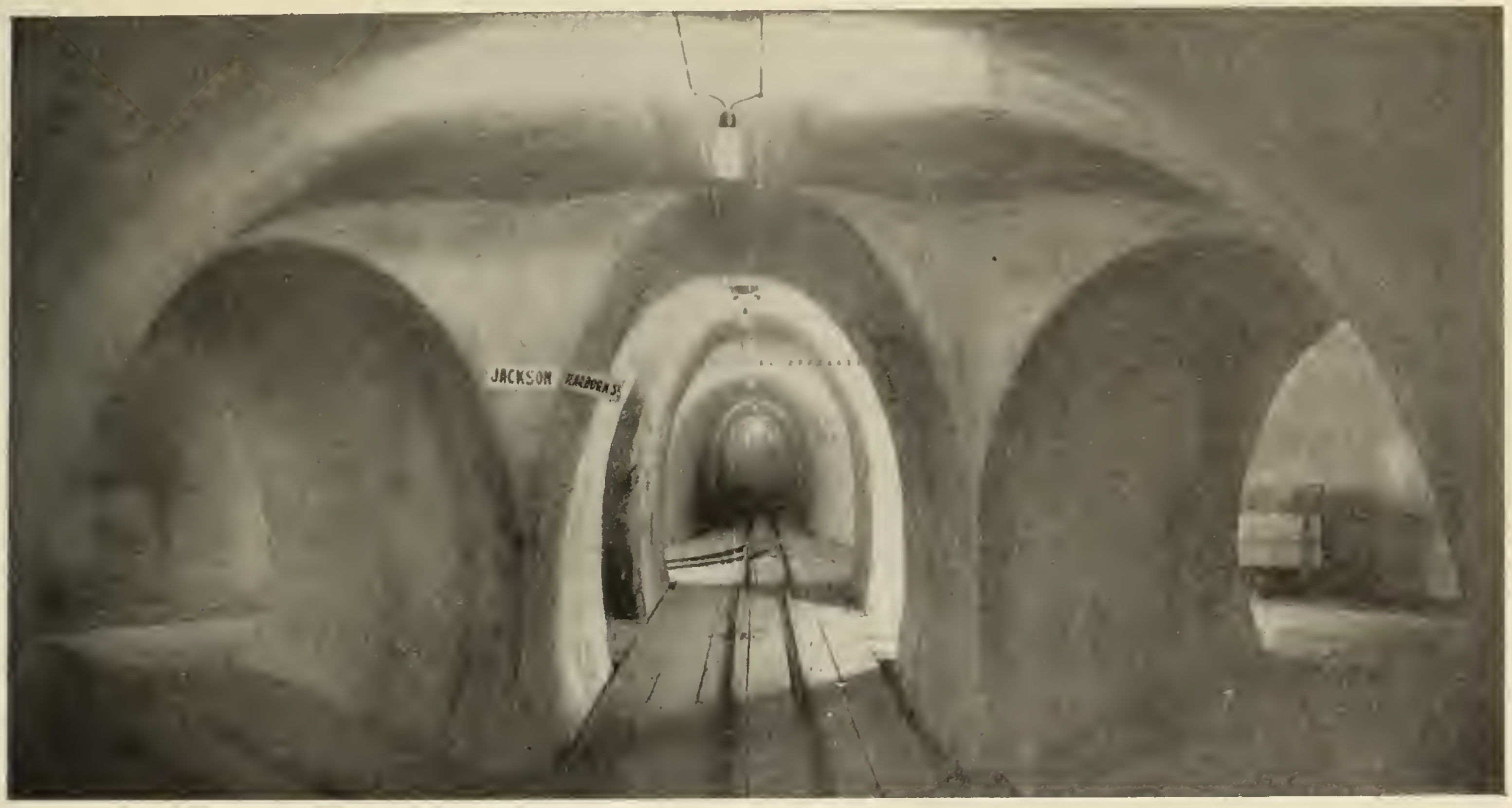

FIG. 11.—VIEW OF TUNNELS.

and lead along the group of 75 switches so as to prevent any two calls from coming in on the same trunk line. The wires from the bank of the second selector switches lead to the connector switches, and from there to the first selector switches, tapping them on to the lines leading to the subscribers' instruments.

In Fig. 4 will be seen a row of connector switches, part of which, as can be readily noticed, being only partly installed. This also shows the tell-tale board. Fig. 2 shows the distributing and protective board in process of construction. Fig. 3 shows a rear view of the racks, whereas Fig. 1 gives a general view of the switchboard on the third floor.

As shown in Fig. 4, a tell-tale board is installed on the fourth floor. This is provided with 8-cp bunghole incandescent lamps, arranged in ten rows of eleven each, each row corresponding to one of the boards forming the switchboard. The lighting of a lamp on the tell-tale board in connection with a smaller one on a particular shelf of the rack indicated, at once localizes the fault and indicates the blowing of a heat coil, which is mounted behind each automatic switch. This consists of small wire coiled around a hard rubber tube. When a ground on the line or a short circuit in the telephone or switch occurs, the wire is heated and the tube expanding releases a spring which breaks the circuit to the automatic switch. The spring when released makes another contact which lights the signal lamp on that shelf, and also the corresponding one on the tell-tale board.

Below the tell-tale board another lamp board is seen, which consists of 200 lamps, two for each of the 100 groups of connector switches. The alternating current which operates the bells at the subscribers' instruments, is completed through these lamps. In the case of a short circuit in any one group, the resistance of the lamps prevents the short-circuiting and the cutting out of the other groups, and the lighting up of the former at once locates the trouble.

It is expected that one switchboard attendant will be required for each thousand switches. In case of a ground, the heat coil is blown and trouble located, as already explained. A short circuit on the line is known the instant the subscriber attempts to make a call, as the switch, by not operating properly, makes a noise unlike the regular sound, but one with which the attendant is familiar, so that he can locate the trouble immediately. When a subscriber leaves his receiver off the hook, no busy signal is made should a call for that telephone be made. By means of a "howler" current the diaphragm of the hanging receiver is vibrated rapidly to attract the subscriber's attention.

A measured service will be given by the company, the maximum being $85 for business houses and $50 for residences. Each actual connection will be made at the rate of five cents up to the maximum, all beyond that amount being free. All calls will be registered by means of a small meter, similar to a cyclometer, which will be attached to each first-selector switch at the exchange, busy calls not being recorded.

Although several automatic exchanges have been in operation for a number of years and others are being constantly added, none has been made which equals in size the present installation. As soon as this exchange has been completed and is in successful operation, the financial and physical facts relative to the largest automatic exchange in the world, which exceeds in size any manually-operated exchange ever constructed, will be made available. What this will mean to the telephone indnstry, it is hard to predict, but it is claimed that it will revolutionize present apparatus and methods, if successful.

The magnitude of the work undertaken has been such that to carry on the same expeditiously and efficiently, several subsidiary companies have been formed. The Illinois Telephone & Telegraph Company is the parent and operating company which secured a charter from the city of Chicago, four years ago. A. G. Wheeler is the president of this. The Illinois Telephone Construction Company is a subsidiary company organized to construct the system of tunnels under the streets for the purpose of carrying the cables. The Automatic Electric Company, of Chicago, was organized to purchase the factory of the Strowger Automatic Telephone Exchange. This manufactures automatic telephone apparatus under the Strowger patents, and has constructed the boards and telephones for the automatic exchange, which has been described above in considerable and careful detail, and which is now rapidly nearing completion. It is needless to say that during the last week, the exchange was a center of attraction for those in attendance at the annual convention of the National Independent Telephone Association, to many of whom the automatic method was almost an entire novelty.

Convention of the Independent Telephone Association of the United States.

THE Independent Telephone Association of the United States held its annual convention at the Auditorium Hotel, Chicago, June 24 and 25. The first session opened at 2 P. M., June 24. Judge James M. Thomas, president of the association since its inauguration, gave his annual address, which he prefaced by a few remarks to the effect that at one time it was thought necessary by ministers to preach "hell fire and damnation," but that there had been a change in this respect, and modern sermons were milder in their tone. He thought that the kind of president's address that was expected by the Independent Telephone Association in past years, when the strenuous battle of the Bell interests was on, might be likened to the "hell fire and damnation" sermon of former years, but he did not think that kind was necessary this year.

In his address he opened by stating that as president and active participant in the affairs of the association for six years, he had had no opportunity to take the general view of its affairs from a distance that would enable him to act as critic. He now felt that the association having accomplished the original objects for which it was formed, he should turn his work over to other hands. He thanked the association for the honor it had conferred upon him in retaining him six years as its head. In some quarters the association had been criticised as being an organization with but one idea. He was glad it was that kind of an organization, especially since that one idea involved the very existence of the independent telephone industry. Before men can do business they must first establish the "right" to do business. This the independent telephone interests of the United States had done. At the present time there were more telephones in use connected with independent exchanges than connected with Bell exchanges. The Independent Telephone Association, he thought, had reached a stage of its existence where a reorganization upon a different plan was necessary, since the old objects for which it was formed no longer existed. He thought that the future of the association should be placed in the hands of the technical telephone men. Telephone problems of to-day were those which called for the engineer of the highest practical order of business ability, in order that the stability of investment in independent telephone enterprises might be improved.

Hon. Hugh Dougherty, of Bluffton, Ind., presented a lengthy report on "Patent Litigation." This report was a review of the work of the association in patent litigation for the past six years, and practically constituted a final report in that respect. A meeting of the independent telephone men was called in May, 1897, at Fort Wayne, Ind. This meeting adjourned to meet in June of the same year at Chicago, at which time the present Independent Telephone Association of the United States was organized. The following convention, held at Detroit, began the work of patent litigation. In connection with securing funds to carry on patent litigation, some of the best legal talent of the country advised that it would not be best to allow contributors to the patent litigation funds to be known. If this were done, these contributors would become virtually parties to the suit, and in case of a decision adverse to independent interests, all the independent exchange and manufacturing companies which had been contributors, if their names were known, might be brought under an injunction which would prevent them from doing business at once. It was, therefore, thought best, as long as this litigation was going on, or there was a possibility that the Berliner case could be appealed to keep entirely secret the names of contributors to this fund. This put the gentlemen in charge of the patent litigation in a somewhat delicate position, as they were obliged to ask for large sums of money all over the country without rendering any kind of public accounting of what was received. Nevertheless, it was gratifying to know that the confidence in the officers of the association was kept up for six years, until the work was accomplished. The efforts of Judge Thomas in behalf of the association without compensation were eulogized. It was stated that Judge Thomas refused to take any compensation for the immensely valuable services he had rendered, until all the money needed for the litigation fund was contributed, and as a result he had received nothing at all commensurate with the value of his services. It was urged that before the convention adjourned it should take some action which would secure to Judge Thomas some of the financial return which was his due as compensation for the services he had rendered. A history of the patent litigation of the association was then given, together with a complete statement of the contributors and amounts received from each for the patent litigation fund. The amount contributed amounted to a total of $50,127, all of which had been expended except a balance of $62 now in the treasury. The report of Mr. Dougherty was received, and a vote of thanks given to the committee on patent litigation.

Prof. J. C. Kelsey, professor of telephony at Purdue University, read a paper on "The Telephone and the Technical School." It was noticeable that the first demands for special technical education in telephone engineering came from the industrial world rather than from the college authorities; in fact, when the matter was first broached to college authorities, they did not favor it. Perhaps this was no wonder, considering the meagre amounts of telephone information and apparatus to be found in the engineering departments of most of the technical schools, and the careful manner in which in years past information on telephone engineering had been bottled up. Even at the present time, in the American Institute of Electrical Engineers, a body whose discussions usually included the best of everything in electrical engineering, the telephone papers were usually evasions of the subject or a statement of generalities. The questions asked of those who were conducting the course in telephone engineering were amusing and varied, and showed a lack of appreciation of the importance of this branch by the questioners. The foundation for this course in telephone engineering at Purdue was similar to that for any other branch of engineering. Toward the latter part of the course the student was taught the principles of operation of telephone exchanges, the construction and performance of appliances and circuits, and lastly the mathematics of the various circuits. It was hoped that the telephone engineering course would accomplish its object of being a benefit to the industry to which it is supplying men.

Mr. S. P. Sheerin, of Indianapolis, presented amendments to the constitution which amounted practically to an entirely new constitution, with the exception of Article I, which specified the name of the association. By way of introduction to these amendments he stated that as at present organized, almost the sole purpose of the association was to fight patent cases. With the battle now completely won, the fighting army could be disbanded and reorganized into an association of great strength for other purposes. The principal change accomplished by the new constitution which he proposed was to make the membership consist of individuals instead of companies. The object of this change was to make it possible for every man of good standing in the independent telephone field to become a member of the association. It would place the association in the hands of a great number of young men now coming to the front on whom the future of the association would depend. The admission fees were placed at $2 and the annual dues at $1. The principal object of the association, as stated in the new constitution, is the dissemination and exchange of knowledge. The amendments were unanimously carried, without further discussion.

Judge Thomas read to the association a letter from T. C. Martin regarding the work of the United States Census Office in compiling information from independent telephone companies. Mr. Martin expressed regret at being unable to be present at the convention to explain this matter in person. Judge Thomas strongly endorsed the effort of the government to get together figures regarding the extent of the independent telephone business, because it was to the interest of the companies to have the magnitude of the business known. Secretary Ware followed up Judge Thomas's remarks with more along the same line, except that what Mr. Ware had to say was more especially regarding the giving of information by independent telephone men in various localities to the officers of the various telephone associations. He had found it very difficult to get full information regarding the extent of the telephone business in various localities. He said they would be agreeably surprised if accurate statistics were available, as usually the number of independent telephones in any country or state were much greater than commonly estimated.

An invitation was read from President Francis, of the Louisiana Purchase Exposition, to hold the convention at St. Louis in 1904. It was suggested that the second week in September had been set aside for electrical congresses, and would be a good date for the convention. Prof. Goldsborough, chief of electrical exhibits, was present in the convention, and seconded President Francis's invitation. It was voted to hold the next convention at St. Louis the second week in September, 1904, the exact date to be determined by the Executive Committee.

The session on Thursday morning was opened by the reading of a paper by C. E. Tarte, of the Citizens' Telephone Company, of Grand Rapids, on the Economy of Good Construction. He said that while most of the modern construction work was good, there were certain companies whose construction work looked as though they had been asleep for several years past. As an example of the difference in maintenance cost with good as against bad construction work, he cited the experience of the Citizens' Telephone Company, of Grand Rapids. The construction of this company, which began in July, 1896, at first included but little cable. The pole lines carried eight, nine and ten arms and were very heavily loaded. Inside of the buildings cotton-covered wire was used. Both wires were put under one staple, and there was a general lack of protective devices. After being in operation a short time the heavily-loaded pole lines began to yield to the great strain put upon them, and the wires became slack, causing frequent crosses. Because of the great number of lines on a pole it was a matter of half a day to find a cross. After a storm, there were so many crosses that every available employee had to be pressed into the service to help clear the lines. At such times there was no attempt to look for individual troubles. Each pole line was gone over and every cross cleared as the repair men went along. It was only after several days that the general chaos was sufficiently restored to order so that individual troubles could be looked up separately. The company finally turned over a leaf as regards construction work, and began a gradual reconstruction of its lines in a more substantial manner. In the new work, fewer wires were put on a pole line, and more cables were used. Wires were kept out of tree tops, which had heretofore been a source of great trouble, and roof fixtures were taken down. The result can be best shown by the following figures, giving the number of troubles per year per subscriber for several years. In 1899, before the reconstruction began, there were three line troubles per year per subscriber. In 1900 this was reduced to 2½ per year, in 1901 to 1½ per year, in 1902 to one every eleven months. In 1903 the line troubles so far have been at the rate of only one every two years per subscriber. The cost of wages for the repair men necessary to keep the lines in operating condition was $2.63 per subscriber less in 1903 than in 1899. The depreciation of lines is about one-third what it was formerly. The number of men employed in maintaining the lines is less than it was three years ago, although there is now double the circuit mileage. At the close of the paper President Thomas spoke of the Grand Rapids exchange as being somewhat unique, in that all the money for building the exchange had been raised by sale of stock in Grand Rapids and vicinity. There had been no going outside for capital and no bond issue.

"Eastern Telephone Development," was the subject of a paper read by F. A. Demarest, general superintendent of the Interstate Telephone & Telegraph Company of New Jersey. He said that it was little realized how extensive independent telephone development was in the East at present. The first and most extensive independent telephone development had been in the West, and it was commonly considered that the East was backward in this respect. While this was true once, it could not be truthfully said at the present time. At the beginning of the independent movement in the East it was extremely difficult to raise capital and to secure franchises. Following on this came the difficulty of securing apparatus equal in efficiency to Bell apparatus. The builders of the first independent exchanges had almost invariably been to conservative in estimating the possibilities of growth, and had installed exchanges of insufficient capacity to take care of the business which was offered. This was because the original estimates were based upon the number of subscribers on the Bell exchanges. He gave several examples of this, which he said could be multiplied indefinitely. The rest of the paper was a detailed statement as to the names, locations and business of the principal independent telephone companies in the East.

Mr. L. W. Stanton gave a short talk on "Economics in Telephone Service." The first point he brought up was in regard to economy in the distribution of work among the various operators in an exchange, so that each operator will be performing as much as she can do efficiently, and at the same time there will be no operators overloaded and none with insufficient work. He said that the number of lines in front of an operator was no criterion whatever of the amount of work that operators had to do. In some cases, ten lines in front of an operator might keep that operator more fully employed than 150 or 200 lines of another kind. This point should be remembered in the design and operation of telephone exchanges.

The true measure of work is the number of calls answered per day by each operator. For measured service, 500 calls per day to an operator's position was considered about the proper figure, and for unlimited service, 1,800 calls per day per operator's position. In making counts of the number of calls answered per day, it is well to beware of efforts on the part of the operators to swell the actual amount by recording too many calls, so making their work appear larger than it really is. As an example of the importance of distributing work properly among operators, he cited two exchanges of about the same size operating under similar conditions, in one of which operators' wages amounted to 57 cents per month per subscriber, and the average time of responding to a call was over five seconds. In the other exchange, the operators' wages amounted to 19 cents per month per subscriber, and the average time of responding to a call was 2⅓ seconds. Some exchanges were operated with an expense as low as 13 cents per month per subscriber for operators' wages. As illustrating the importance of good engineering in a telephone exchange, he cited the case of two telephone exchanges, both built for 5,000 subscribers, one of which cost $150,000 more than the other, and was a more expensive exchange to operate and to maintain. The next point brought up was a warning to look out for idle investment in cables brought about by the inability to use a number of pairs of wire in each cable. He knew of many exchanges where a large number of pairs of wire in each cable were lying idle and could not be used because they did not terminate at a box where they were needed. For instance, a cable might have 25 pairs of wires terminating in one box, 25 more in the next box, and so on. There might be call for only 15 pairs at the first box and 40 at the next. The practical result was usually that more cable would be purchased to supply the excessive demand at one point, while wires terminating at another point would be lying idle. The remedy for this is to have multiple terminals for each pair of wires, so that it could serve subscribers at two or more points and the investment in wires would not lie idle if there were not enough subscribers at any particular terminal box to employ all the pairs. Further than this, it was important to have multiple taps on each pair of wires, because it might be desirable to operate party lines, in which case one subscriber could be taken from one tap and another from another. Some independent companies did not favor party lines; but such lines offered a cheap service for those who could not afford to pay more, and there were many who would not have telephones at all if they could not get the cheap party line service. He thought that independent telephone companies would have to come to party line business, if they had not already done so. Some independent companies, whose exchanges were not originally laid out for party lines, had been operating party lines by connecting together two subscribers' lines at the switchboard, so that the party line arrangement extended no further than the central office. The investment outside of the central office in lines was just as large as it would have been with individual subscribers' lines. This practice had been engaged in principally because with cables terminating only at one point it was not always feasible to get two subscribers on one line at one terminal box. As the cables terminated at only one box, the company could not connect two parties on one line, except at the central office. Of course, the investment was almost as large in such a case as it would be for individual lines. Such an arrangement could not be financially profitable to a company.

Judge Holmes, of Sherman, Texas, introduced a resolution expressing the association's disapproval of the recent purchase of the Kellogg Switchboard & Supply Company by Bell interests, and making it the sense of the association that none of its members should patronize that company. The motion was tabled without discussion. There was evidently a feeling that in view of the various complications connected with the Kellogg Company's affairs, it would be unwise to take any action at this convention.

Mr. J. G. Ihmsen, representing Judge Thomas's many Chicago friends in the independent telephone field, requested the privilege of the floor in order to perform the very pleasant duty of presenting Judge Thomas with a handsome gold watch.

Judge Thomas responded courteously, referring to the criticisms of his administration which had arisen some time in the past and which he now believed were entirely buried. He was grateful to receive this token, because he believed that those who had contributed towards it had done so in the same spirit that he had contributed his services to the independent telephone business in times past, namely, because it was what they wanted to do.

Mr. H. D Critchfield urged that now that independent telephone companies were becoming strong, they should not forget that, after all, they were very much interdependent upon each other. No company could be so strong that it was not dependent upon others. Independent interests must stand together in the future as they had in the past. The election of officers being in order, he nominated, at the request of over a hundred independent telephone men, Hon. Hugh Dougherty for president, in recognition of the services he had rendered the association. Mr. Dougherty was unanimously elected. Senator C. W. Kline, of Hazelton, Pa., was elected vice-president. There were two nominees for secretary and treasurer, H. B. McMeal and Frank G. Jones. The ballot resulted in 24 for Mr. Jones and 18 for Mr. McMeal. An Executive Committee, consisting of the president, secretary and the following gentlemen, was elected: Prof. W. E. Goldsborough, of Lafayette, Ind.; H. D. Critchfield, of Chicago; J. G. Ihmsen, of Chicago; Thomas Finucane, of Rochester, N. Y.; W. E. Doolittle, of Lafayette, Ind.; C. E. Tarte, of Grand Rapids; A. L. Tetu, of Louisville, Ky.; E. E. Clement, of Washington, D. C., and Capt. E. A. Moulton. Secretary-elect Jones being called upon, said a few words to the effect that he believed the present convention and reorganization meant the beginning of a new and greater association.

Mr. H. D. Critchfield said that with the report on patent litigation made yesterday, all the doubts of the past regarding the policy of the management of the association had been dispelled. It was now seen why the officers were obliged to proceed with their work without letting members of the association know what was going on. Most of the criticisms of the officers, to be sure, had come from those who had never contributed a cent to the litigation fund. The fact that the contributors had kept it up until the fight was won showed that the officers had retained their confidence until the last. He thought it was in order at this time to move a vote of thanks to the president and retiring officers. The motion was unanimously carried, and the convention adjourned. Over seventy telephone operating men were in attendance. Notes of the exhibit features appear elsewhere in this issue.

Notes on Japanese and Chinese Developements.

After a hard and bitter fight between the promoters of the Taipeh Water Power Company, of Formosa, China, and the Governor-General, the establishment of that company has been sanctioned. The company has placed orders for electric machinery and other appliances. The present capital of the company is 20,000 yen (about $10.000). The company's plant is intended to supply 3,000 16-cp incandescent lamps.

The government of Formosa, China, has proposed to use wireless telegraphy between the mainland and Formosa. Receiving stations will be at Keelung, Miyeseki and Hizen.

It is reported that the laying of the submarine telephone cable between Hiroshima and Moji is now under way and would be completed by this time.

The City of Macao, China, is to have an electric light plant and the local government will advertise for tenders. The exclusive privilege is to last for a term of 30 years to the firm securing the contract. Tenders must stipulate the amount for which they are prepared to supply the power.

All necessary papers have been drawn up and signed allowing the introduction of foreign capital for the Tokyo Electric Railway Company, of Tokyo, Japan. The same methods will be employed as those adopted by the Tokyo Electric Car Company, which has introduced foreign capital, not in cash, but in the shape of motors, rails, wires, cars, etc., the price of which is to be paid in installments at long intervals. According to the estimate of Sir Malcolm MacEacharn, representing the British syndicate, and the directors of the railway company, the capital account will be 7,000,000 yen ($3,500,000), of which 4,000,000 yen, or about $2,000,000, is the price of the railway materials, and 3,000,000 yen ($1,500,000) is the expense of the construction, so that the amount of the foreign capital will be 4,000,000 yen ($2,000,000). The terms of the loan are still kept secret, though it is alleged that the Industrial Bank of Japan will guarantee its payment. The following is the gist of the contract:

The British capitalists shall purchase the shares of the railway, at their discretion, from the market, and the amount of their subscriptions shall not be fixed beforehand.

The Tokyo Electric Railway Company shall use the plan of the works drawn up by Sir Malcolm MacEacharn, and shall attend to the business of purchasing land and constructing the line for the railway, while the British syndicate shall supply all the materials necessary for the construction and carry out all the other work of construction. The work shall be guaranteed for one year, and in case of any defect therein, the plant shall be reconstructed.

The Tokyo Electric Railway Company shall be authorized to appoint an engineering inspector, under whose direction the construction will be carried out by the syndicate.

The construction shall be finished in two years.

The board of directors of the Kei-hen Electric Railway Company has been authorized by the decision of the general meeting to construct an electric railway between Omori and Shinagawa, and between Haneda and Kawasaki, and to issue debentures or to raise a loan at their discretion to the amount of 500,000 yen.

Negotiations between the Hanshin Electric Railway Company and American capitalists on the introduction of foreign capital are reported to have proved a failure. As a result the board of directors of the company have decided to issue debentures at home within the limit of $1,500,000 whenever financial conditions become favorable for such a step. The company is, it is said, thinking of issuing 8 per cent. debentures to the value of 500,000 yen.

The promoters of the Tamagawa Electric Company, whose share capital is now being subscribed, believe that they can pay a dividend of over 20 per cent., when the railway is brought into working order. The transportation of pebbles from the Tama River to the city and the supplying of electric light constitute the principal features of the business of the company. It is already reported that the company has received applications for lighting to an extent that will bring in an income of up to 7,000 yen a year. The company will first construct a railway between Shibuya and the Futako ferry of the Tama River, the length being over 6 miles. Later on, the railway will be brought to the moat in the city.

The report of the directors of the Shanghai Mutual Telephone Company for the year ended March 31, 1903, shows that the switchboard in the exchange at that date had a capacity of 2,100 metallic lines. Two hundred and ninety-seven telephones were added to the service during the year, making the total connections 916.

It is reported that the Tokyo (Japan) Street Railway Company's line running from Tanachi, Shiba, to the Ryogoku-bashi, via the Maru-No-Uchi, Kanda-Bashi & Megane, will be constructed and opened to traffic by the beginning of August next. The company has also obtained permission to construct a large number of bridges on its line. All the material required for the railway construction is on the ground.

The Shibaura Engineering Works will establish electric light plants at Peking and Tien-Tsin. The necessary arrangements have been made in China by Mr. Shoychi Shimizu, engineer for the works, who will go for a second time to North China at once, taking with him the machinery for the construction of the plant. There is already an electric plant at Peking, but it is inadequate for the needs of that city.

Steam Turbine Test.

In a paper read before the recent meeting of the American Society of Mechanical Engineers, Mr Frederick A. Waldron gave a very complete account of tests of a Westinghouse-Parsons 400-kw turbo-generator plant, installed in the works of the Yale & Towne Manufacturing Company, of Stamford, Conn., the generating outfit consisting of a two-phase, 240-volt alternator having a capacity of 400 kw when the turbine is running condensing. Current is generated at 60 cycles, the speed of the machine being 3,600 r.p.m.

Reference was made to an incident which occurred when the plant was first started, wherein the field structure flew into a large number of pieces, entirely demolishing the electrical end and badly damaging the steam end, the accident being due to invisible flaws in the field forging. No damage was done to the building aside from breaking a few panes of glass, nor was anyone injured, although eight men were in the room at the time. Owing to the manner in which the revolving parts are encased, Mr. Waldron pointed out that the field of devastation is not so great in case of a turbine accident, notwithstanding its high speed, as in the case of a reciprocating engine fly-wheel.

The author kept a memoranda of questions that had been asked him in regard to the installation and of his answers, some of which were as follows: In reply to a query as to whether the windage is excessive, he said that it is more than in the case of the slow-speed generator, yet as a whole it has not a disagreeable effect since noise in the engine room is a comparative quantity. In answer to a question as to whether he was satisfied with the continuity of operation, he replied that aside from the break-down above noted, which was due to defects in material or to causes entirely foreign to the machine, it has been entirely satisfactory. As to what condensing outfit is necessary, he replied that the best is none too good, and for continuous running and high vacuums the dry system with a two-stage air pump will probably maintain higher average vacuums than any other system. Replying to a query as to the use of exhaust steam for heating, he said that the turbine exhaust has supplied 25,000 square feet of direct radiating surface and 7,500 square feet of blower stack surface; a temperature of from 60 to 70° F., was maintained in all buildings when generating 520 kw, and with a temperature of 220° F. in the exhaust chamber of the turbine. A 50 per cent. overload has been maintained at full speed for five hours without apparent injury to the machine. The turbine can be changed from condensing to non-condensing when running, this having been done daily during the heating period and without difficulty or shut-down. The exciter should be driven by an independent engine. The turbine costs from 10 to 15 per cent. less than the same size of reciprocating engine outfit, while the cost of the power house is 65 per cent. less. Finally, in reply to a query as to whether confidence has been shaken owing to the accident above referred to, his reply was that a second outfit has been ordered.

Test of 400-K.W. TURBINE.

Average Load.	Duration of Test. Hours.	Steam pressure.	Vacuum inches.	Superheat. Degrees.	Pounds water per kw-hour.	
					Maximum, lbs.	Minimum, lbs.
152	3	144.85	27.34	...	28.27	27.91
323	3	153.3	27.64	3.44	22.70	22.03
375	4	152	27.43	6.46	23.11	21.46
397	3	150.92	26.95	19.66	22.45	22.18
490	5	152.7	27.55	18.2	22.33	21.22

The above table gives the results of tests made on the turbo-generator unit. The analysis of the tests indicated that with a turbo-generator driving induction motors and with an evaporation of 8,707 pounds of water per pound of coal, a brake horse-power can be delivered from the pulley of a motor for about 2½ pounds of coal per hour. Under the same evaporative conditions, the average non-condensing engines distributed through the different rooms in the plant would require 7.05 pounds of coal for brake horse-power at the fly-wheel, or three times that of the quantity required for the electrical drive.

Fleming Lecture on Wireless Telegraphy.

Prof. J. A. Fleming, of University College, London, lectured on wireless telegraphy in the Royal Institution in London the other evening and illustrated his address by means of wireless messages flashed to the lecture table from Poldhu. Naturally these demonstrations excited great enthusiasm. The next day Prof. Fleming wrote to the newspapers to say "that a deliberate attempt was made by some person outside to wreck the exhibition. I have evidence that it was the work of a skilled telegraphist. I feel certain that if the audience present at my lecture had known that in addition to the ordinary chances of failure in difficult lecture experiments, the display was carried through in the teeth of a cowardly and concealed attempt to spoil the demonstration, there would have been a strong feeling of indignation." The next morning brought a sharp reply from Nevil Maskelyne, the well-known exposer of the notorious Davenport brothers and the author of "Modern Spiritualism," etc., who frankly admits his complicity in the interference complained of. He denies that any attempt was made to wreck the demonstration. On the contrary, he says, it was permitted to proceed when it would have been easy to defeat it. He then adds: "We have been led to believe that Marconi messages are proof against interference. Prof. Fleming himself has vouched for the reliability and efficacy of the Marconi syntony. No one can complain if we proceeded to put those statements to the test. The very object of the interference was to elicit some such evidence as that which Prof. Fleming had obligingly supplied. If all we had heard were true, he would never have known what was going on. Efforts at interference would have been efforts wasted. But when we come to actual fact, we find that a simple untuned radiator upsets the 'tuned' Marconi receivers—and Prof. Fleming's letter proves it."

A well-known London correspondent of ours writes us in regard to this matter: "You may have seen the correspondence in the *Times* about an alleged attempt to 'wreck' a lecture by Fleming on wireless telegraphy, at the Royal Institution. I was not behind the scenes, but it is absolutely false to say there was any such attempt. Maskelyne amused himself with overhearing the messages sent from Poldhu (via Chelmsford), and before the lecture he himself sent some unasked-for messages to the lecture theatre—including the word 'Rats'! He carefully abstained from sending anything till the end of the lecture, when the message from Chelmsford had been duly sent and received in presence of the audience. After that he chipped in with an amusing message chaffing Marconi. To call that 'wrecking' a lecture is the sheerest nonsense. There is down to the present moment no guarantee of secrecy of freedom from interference in wireless work; and Fleming's petulant accusations of attempts to wreck, show that this is so. Fleming used an ordinary coherer. In fact, the much-advertised magnetic detector appears not to be used anywhere. The Marconi Company's operators say they have never used one." According to later advices yet, Prof. Fleming did not use for his lecture the Marconi syntonic system, but untuned apparatus.

The Engineering Conference in London.

Under the auspices of the Institution of Civil Engineers an engineering conference has just been held in London, it being four years since the last, and the series having begun in 1897. The electrical section had Mr. Alex Siemens as its chairman and Messrs. R. E. B. Crompton, R. K. Gray, E. Hopkinson and James Swinburne as vice-chairmen. Three days were set apart for the meetings of the seven sections, which embraced subjects grouped under the head of (1) railways; (2) harbors, docks and canals; (3) machinery; (4) mining and metallurgy; (5) shipbuilding; (6) waterworks, sewerage and gas works, and (7) applications of electricity. Two of these meetings took place simultaneously in rooms at the Surveyors' Institute in Great George Street; two others at the Guildhall, Westminster; and a fifth at the Institution of Mechanical Engineers, Storrey's Gate.

WIRELESS TELEGRAPHY.

An interesting discussion on wireless telegraphy was opened by Mr. E. A. N. Pochin, who said in his introductory paper, that up to considerable ranges earth curvature is not a fatal obstacle, but hills, he said, may exercise a serious influence. He declared that the ether exhibits what might be called a variable transparency to Hertzian waves, sunlight being an important factor. As to the syntonic method of isolation, the conditions for sharp tuning were well understood, and theoretically a high degree of privacy seemed possible; but the most exaggerated ideas were, however, current regarding what had hitherto been attainable in practice. Whatever views were taken regarding the merits of any existing system, they all hoped, and probably believed, that developments would be forthcoming to render wireless telegraphy a reliable means of communication, fitted for regular commercial work in those special departments to which it is so eminently adapted.

Sir William Preece said he had been working on wireless telegraphy for fifty years, and his first experiment was conducted not far from Westminster Guildhall in the trial of Lindsay's system. Since that period not very much had been done. The only real novelty was that alternators had been built with a very high frequency. These had been applied by De Forest in America and by Mr. Tesla with apparently very great success. If we had advanced in the seven years towards the practical development of the system that advance had been small. We knew little about disturbances above, and still less of what took place through the earth. According to Fessenden, taking the sea as the standard and unit, it is thirty times better to send wireless messages over it than over fresh water, while over land practical communication had not been established for any distance whatever. It might be that they could work for ten or twenty miles, but sooner or later they were disturbed. Then, as to speed, the signalling for long distance was from five to ten and over short distances fifteen words a minute; while they had heard that in America, with the De Forest system, they were able to get thirty-five to forty words a minute. If that were true, a great advance had been recorded. Progress made in different countries was similar to that in our own. Not a single wireless commercial telegraph was in existence, and the only wireless circuits regularly at work were those which he established in 1896.

Mr. Neville Maskelyne agreed that it was difficult to obtain accurate information upon the subject, as wireless telegraphy was passing beyond the purview of the inventor and electrician into that of the skilled novelist and sensational editor. Wireless telegraphy was a misnomer; it certainly was not wireless and very often it was not telegraphy. The whole matter depended upon electrical disturbances in the atmosphere, which at a big station like Poldhu amounted to an insurrection. Wireless telegraphy was simply the means of electrically signalling, very useful in its way where employed when other means could not be utilized. It was only a stand-by, and its natural field was between ship and shore or shore or outlying lighthouse or station. It could in no sense compete with electric telegraphy where there was a metallic connection between stations.

Mr. J. Gavey, electrical engineer to the post office, held that most exhaustive experiments were required as to the possibility of syntony, admitting simultaneous communication within definite ranges. Such experimenting would involve an amount of plant at the command of few. It would require two land stations and a couple of well-equipped vessels to bring our information up-to-date. In other directions he had personally arrived at these conclusions: (1) That a syntonized installation having from 60 to 100 miles length could be established with certainty and regularity; (2) with reference to long-distance installations, we had very little practical knowledge, and it could only be inferred that communication over long distances was of a very uncertain character, and that failures were due to particular causes still requiring elucidation; and (3) that, although sharp tuning was certainly possible, and it aided materially in maintaining regular communication, it was not very effective in maintaining freedom from interruption by neighboring installations beyond a certain definite range, and that range required to be determined. Mr. Gavey described a new and very simple type of receiver. It consisted, he said, of a sharpened pencil, adjusted and resting lightly on a steel spring, with a little spot of oil at the point of contact. It would take up almost any class of signal, assuming that there was the right periodicity in the circuit, and with it they had taken up signals of all sorts of length from stations both in England and France.

Mr. Alexander Siemens stated that wireless telegraphy had been applied to communication with moving trains. The proper way to develop it was to apply the system to what it was best fitted for first, and proceed slowly. Mr. Marconi had made the great mistake of attempting the most difficult feat at once; he should learn to walk before he ran.

ELECTRIC RAILWAY WORK.

A number of papers were presented on electric railway work, but did not embody much that was novel. As to the third rail, Mr. W. E. Langdon said: "All the conditions suggest the propriety of confining the conductor rails to the "six-foot" and dissociating them entirely from the sleepers which carry the wheel rails. This would, inasmuch as structures would at points narrow the space, and for other reasons, necessitate the use of a flexible collector, which ought not, however, to prove an insurmountable obstacle. It would also entail, where a fourth rail is employed, the provision, in the 6-ft. space, of a structure which would accommodate both the potential rail and the return rail, either vertically, one above the other, or on practically the same level, side by side. . . . It would also claim consideration in dealing with crossings.

Mr. S. B. Cottrell, C. E., of the Liverpool Overhead Road, doubted the extension of such roads, in his paper comparing the various advantages of overhead, surface and sub-surface. Deep-level railways have the advantage that they can be constructed without interfering with the sewers, gas pipes, etc., with which all busy streets in important towns are necessarily so full, and there are many instances of such railways in London doing useful work, such as the Central London and the City & South London Railways, which, although the cost of construction was very high, are yet able to pay a dividend; but it must be remembered that at the present time neither of the railways referred to has efficient surface competition.

The disadvantage of these deep-level railways is the time occupied in descending by means of lifts to the platform level. For short distances, if there be taken into account the time of descending in lifts, traversing a foot-subway and waiting for a train, even if only 1 minute or 2 minutes—this operation being reversed at the point of arrival—the time so occupied does away with the advantages of the rapid transit between the points selected, and therefore any keen surface competition, such as by electric tramways, would seriously decrease the earning powers of these deep-level subways. Another drawback of deep-level subways is due to the question of ventilation, which in existing tube railways leaves much to be desired.

The special advantage of shallow railway subways is that passengers can reach the trains without the necessity for using lifts and foot-subways; therefore, they enjoy the advantages of rapid transit from point to point without the waste of time required in descending to a deep level. Cottrell spent considerable time in making himself acquainted with the shallow subway at Buda-Pest, and although this subway has surface competition, the fact that passengers can reach the trains by descending a few steps only, and the advantages of rapid transit, enable this electric railway to be a financial success. The Paris Metropolitan Railway, which is also a shallow subway, has had the effect of relieving the streets of a large number of omnibuses, and has rendered them available for other purposes. This railway also is a commercial success. In his opinion the fact that the Metropolitan and Metropolitan District Railways are what may be almost described as shallow subways is one of their "assets," and when these railways are electrified, they will enter upon a new era of prosperity in spite of other competition. Their ventilation is also an easy task.

Mr. E. W. Monkhouse, C. E., in a paper on transmission and distribution by single-phase alternating currents, said that the advantages of this method were so apparent, it only remained for a good motor to be produced to insure the system being used for long-distance power transmission in the future.

STEAM TURBINES.

Prof. Rateau, of Paris, read a paper on steam turbines in the course of which he said:

The prototype of the simple action turbine is that of De Laval. He conceived himself that the multiple-action turbine offers greater advantages. It is, therefore, a motor of this type that he has developed latterly. His turbine, known as the "multicellular," is composed of sheet-iron wheels in greater or less number, fixed on the same shaft and separated one from another by flat diaphragms. Many of these machines are already at work. Wheels of single sheet iron suffice up to a diameter of about 1 metre (39 inches); above this diameter it has been found advisable, in order to avoid deformation, to make the wheels of two conical disks of that metal. These multicellular "action" turbines can be disposed so as to run with very little loss from friction or from leakage, and as a result the consumption of steam is proportionately small at any load.

It is not necessary to insist on the well-known advantage possessed by turbines in general of their smooth and continuous movement of rotation, but the excessive speed for which they are obliged to be designed in order to meet the speed of flow of the steam constitutes in many cases a serious inconvenience, e. g., in its application to ship propulsion. For a long time this hampered their use for electric installation, but latterly dynamos of very high speed have been constructed, worked by steam turbines, constituting an outfit of light weight, requiring small space, and, although of ample power, of low cost, and, as a consequence of working and upkeep, as simple as can be desired. It follows that for this purpose the steam turbine may be expected rapidly to supplant the piston engine.

Direct-coupled to ventilators and centrifugal pumps, steam turbines, owing to their capability of producing great power at high speed, exhibit surprising results. Prof. Rateau has installed turbo-ventilators giving a pressure of half an atmosphere, and turbo-pumps with a lift of several hundred metres. He is prepared to install plants of several thousand horse-power compressing air to more than 6 atmospheres, or raising water to more than 600 metres (say 2,000 feet). This shows that the steam-turbine possesses vast possibilities.

German Electrical Goods for Russia.

Consul B. H. Warner, at Leipzig, reports: "German electrical interests are petitioning the government officials to arrange in making a new commercial treaty with Russia for lower duties upon German electrical supplies. At the present time about 20,000,000 marks' ($4,760,000) worth of electrical goods are exported to Russia from Germany annually, and the amount is increasing from year to year."

Composite System of Electrical Transmission and Distribution.*

By Frederick Bedell.

Electrical energy after generation must be delivered economically and in suitable form to the consumer. This delivery is commonly divided into two parts, namely, transmission and distribution, each of which must be efficient and simple.

Distribution should be by such a system that the customers' apparatus—motors or lamps—are connected directly to the distributing wires without the intervention of special contrivances. Again, inasmuch as low voltage receivers are required, it should be possible to gain the advantage of distributing at a higher voltage than that of the receivers. The three-wire system is widely used, being very efficient in this respect, and should be retained so that new economies will be in addition rather than alternative thereto. Furthermore, should a change of system be contemplated, it should be possible to convert an existing system into the proposed one without great expense or annoyance. The distribution system should be one that can be supplied from any approved generating plant and transmission system; for example, the distribution system should not call for the abandoning of an existing three-phase or two-phase primary line.

Transmission should involve the use of only standard apparatus, including transformers and generators. Provision should be made for supplying electricity in a satisfactory form for light and for power; the motor load should not interfere with the lighting service. Copper economy must not be inferior to the three-phase system.

In a word, to be desirable a transmission and a distribution system must not be inferior in economy, simplicity, flexibility or quality of service to existing systems, while it should be superior in as many of these particulars as possible, and at the same time make use of the same apparatus. Let us see in what way the composite system meets these conditions.

In the days of direct current, 10 amp. plus 10 amp. always made just 20 amp.; 10 volts and 10 volts made 20 volts; all quantities added arithmetically. This was substanially so with single-phase current. But with polyphase current we get the *advantage* of geometrical addition; quantities add in *two dimensions* instead of in one. Take the three line conductors of a three-phase system. Between each pair of wires the voltage is, say, 1,000 volts; we have practically three single-phase transmissions at this voltage connected together in delta, and yet nowhere does any voltage exceed the 1,000 volts. The three points forming the triangle of voltages are in a *plane* and not in a straight *line*.

A similar advantage arises in transmitting jointly a direct and an alternating current, or alternating currents of two frequencies; *differing currents add as though at right angles*. Thus 10 amp. of direct and 10 amp. of alternating current combine to make 14.14 amp. of composite current. Hence it comes about that a saving in conducting material is effected. *A composite current requires only that amount of copper required by either current separately.*

In the case cited, let the resistance of the conductor be unity. The line loss is then 100 watts for either current alone and 200 watts for the composite current, whereas if we had superposed two like currents of 10 amp. each the loss would be 400 watts.

Another fundamental characteristic is that differing currents ignore each other; each is ignorant of the presence of the other. *Each has its own independent line drop unaffected by the other.* The regulation of lamp and motor service may thus be made independent; the severest overload on the motors will not cause the lamps to wink.

These properties point to certain important advantages to be gained by double-current transmission.

For primary transmission it is commonly desirable that both of the composite currents be alternating; when desired, however, a direct current may be transmitted over single-phase, two-phase or three-phase lines for special purposes, as arc lighting, starting rotaries, etc.

In two-frequency transmission a variety of composite arrangements are possible, of which I will now describe but one—which we will call the tetrahedral system—on account of interesting and peculiar properties which it possesses and the fact that on account of simplicity and economy it fits the requirements of present practice.

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* A paper read before the Cleveland Electric Club, June 3, 1903.

We have seen that the advance from single-phase to polyphase transmission is represented, so to speak, by the advance from a line to a plane. Why not proceed further and gain any advantage there may be in using a third dimension in our pictorial representation? This we may do by combining a two-phase current of one frequency (the e.m.fs of which are represented by two lines, *A* and *B*, at right angles) with a single-phase current of different frequency, the e.m.f. of which is represented by a line, *C*, at right angles to both *A* and *B*. The model illustrates this. Two sticks, *A* and *B*, each 20 inches long, represent phase *A* and phase *B* of the two-phase e.m.f., each 20,000 volts. The stick *C*, about 14 inches long, to represent a single-phase voltage of 14,140, connects the middle points of *A* and *B*. Each stick is at right angles to the other two. The ends of *A* and *B* represent the potentials of the four line wires, and it will be seen that the difference of potential between any two wires is 20,000 volts; that is, from one end of *A* or *B* to another end of *A* or *B* is just 20 inches. This is a four-wire analogy of the three-wire, three-phase system. Systems with more than four wires with equal potential difference between wires can be employed extending the same principle, but no models can be made to illustrate them, for more than three dimensions would be required. The tetrahedral system,* with two frequencies (two-phase current for power and single-phase for light) meets well present practical requirements. I will show by means of lantern slides some of the ways of obtaining and utilizing the tetrahedral system. Composite transmission with asynchronous currents, as illustrated in the tetrahedral system, possesses the characteristics which we have noted of copper saving and independence of lamp and motor regulation. I will now call your attention to the unicyclic system which has been developed and operated by the writer for obtaining independence of regulation by means of synchronous currents. Although the use of polyphase low-frequency current for power, and single-phase high-frequency current for light is generally looked upon as desirable, there are instances in which the installation of only a single frequency is preferred. Suppose that between the two neutral points of a four-wire, two-phase system of say 2,000 volts a single-phase e.m.f. of half value; that is, 1,000 volts of the same frequency, be interposed. At the receiving end the single-phase load is similarly connected; in amount the single-phase load should be one-fourth of the polyphase load to give the same regulation, the voltage of the two being 1,000 and 2,000, respectively. We now get, however, a voltage of 2,236 between certain wires. With the same line copper, the load has been increased from 1.00 (two-phase) to 1.25, which exactly corresponds to the increase of line voltage. The generator and transformer voltages are the same as before and the single-phase and polyphase load are independent as to regulation. With one frequency we are, however, always limited to one plane in our graphical representation of potential difference and must forego the luxury of the third dimension with its accompanying advantages. The unicyclic system may be used advantageously when a station has outgrown the capacity of its primary lines.

The system is particularly suited to transmission lines for both light and power. Take the case of long-distance trolley lines supplied through rotaries from polyphase feeders. Intermediate towns through which the line passes may be lighted by single-phase current from the same feeders with independent regulation. For secondary distribution, the problem usually is to combine a direct-current, three-wire system with an alternating single-phase or polyphase system. This means that the Edison district of a city may be invaded with alternating apparatus—Nernst lamps and induction motors—and that the Edison district itself may be profitably extended into the outskirts of the city hitherto exclusively alternating. This suggests a happy solution of the municipal distribution question.

There are various ways of applying the composite system to such service, and when the use of the system is contemplated a careful study of local conditions will show the best way of adapting the system to each particular case. It is so flexible that I can scarcely give a brief and general description, but from the lantern slides of typical applications of this system, some of which are actual wiring schemes, you will see the practical working of the system. Some of the arrangements shown have only been tried experimentally. For combining direct and single-phase either generators or receivers, I will show you the square, the interneutral and the plain differential connection. The square connection is convenient for receivers, but not for generators; the reverse is true with the differential connection. The combined square and interneutral connection gives a good working system. With two-phase alternating current, the square connection cannot be used; either the differential or the interneutral connection may be used to advantage. This gives a very flexible distribution system, supplying incandescent and Nernst lamps, and also direct-current and polyphase motors. The copper economy is high. For isolated plants all the current can be supplied by a single double current generator.

I have shown you some of the ways in which the composite system is used for transmission and distribution. The simplicity of the circuits, the saving in copper, the improved regulation and great flexibility of the system are important characteristics, which make it desirable not only for new work but also as a means for development and improvement in the case of transmission and distribution systems now in operation.

Alternating-Current Motors for Variable Speed.

At the recent Saratoga meeting of the American Society of Mechanical Engineers, Mr. W. I. Slichter read a paper with the above title, directed at the erroneous impression that a variable speed cannot be obtained with an alternating current motor, and that if an alternating current plant is to be installed, the idea of obtaining a variable speed drive of any of the tools must be abandoned. In starting out it was, however, admitted that the alternating current motor cannot compete with the direct-current type where continual variations of speed, throughout a wide range, are required, as the latter motor is usually superior in efficiency under these con- as the latter motor is usually superior in efficiency under these conditions. A case was assumed where an alternating current plant is desirable for general reasons, such as distance of transmission or availability of power, and a considerable amount of the power is used in constant speed work, but a certain portion of the work requires a variable speed. What is the most appropriate and most efficient method of obtaining the variable speed?

The speed of an alternating current motor may be controlled in a number of ways:

(*a*) By varying the potential applied to the primary of a motor having a suitable resistance in the secondary. (*b*) By varying the resistance in the secondary circuit. (*c*) By changing the connections of the primary in a manner to change the number of poles. (*d*) By varying the frequency of the applied voltage.

The characteristics of the polyphase induction motor are very similar to those of the continuous-current shunt motor—that is, at a constant impressed voltage and frequency the speed tends to be constant, and a considerable change in load will not cause an appreciable change in speed. As the load increases, the speed drops gradually to a critical point, usually about 15 to 20 per cent. below the normal value, and then the motor breaks down completely if the load is any further increased. The same action occurs exactly if the load is kept constant and the voltage is decreased. But if the frequency of alternation of the impressed voltage is decreased, the speed will decrease in exactly the same proportion. That is, for a given frequency and a given number of poles in the motor, the speed is practically fixed and independent of all other effects. The one exception to this last rule is the effect of the resistance (or losses) in the secondary (usually the rotating) member.

The drop in speed from the synchronous value is directly proportional to these losses. Thus, by increasing the resistance of this circuit, any desired speed may be obtained at the expense of these losses. With the increased resistance, the speed at which the motor breaks down may be reduced to a very low value, even to zero speed. Thus, by reducing the voltage applied to the motor for a given torque, the effect is produced of over-loading it, and the speed drops. These characteristics are equally true for the two-phase or three-phase motor, of course, as the two motors are practically identical in their construction.

In this connection it should be remembered that a variation of an alternating voltage may be obtained by means of a reactance or compensator with a very small loss of energy, whereas with a continuous voltage the loss of energy is usually proportional to the variation in voltage. These methods were then taken up in the order enumerated, and their characteristics analyzed.

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* The copper economy and some of the engineering features of the tetrahedral system are discussed in ELECTRICAL WORLD AND ENGINEER, Feb. 28, 1903. For further articles on the subject, see *Electrical Review*, March 14, 1903. *Electrical Age*, March, 1903. *American Electrician*, April, 1903. *Mill Owners Magazine*, April, 1903.

Potential Control.—In this a suitable reactance or "compensator" reduces the line voltage to the fractional value desired. In this reduction the energy lost is only about 5 per cent. of the amount transformed. The induction motor should have a very large resistance in the secondary, which is preferably of the squirrel cage type. This resistance gives the motor a speed characteristic such that its full load speed is some 10 per cent. less than that of a normal motor, and as the load is increased, the speed will fall to about 30 per cent. of this value without the motor "breaking down" or falling out of step, which in the normal motor usually takes place at about 80 per cent. of the full load speed.

Such a motor would have the following characteristics, assuming its synchronous speed as 1.00, and the voltage applied as 100. (This is based on a 50 horse-power, 40 cycle motor, at 800 revolutions per minute, as an instance.) For constant full load (50 horse-power) torque at various speeds:

	Speed.	Volts.	Efficiency.	Losses, Motor.	K.W. Comp.
Full load speed	.89	100	81	8.8 K.W.	0.0 K.W.
Three-quarter load speed	.67	66	59	18.5 K.W.	1.0 K.W.
One-half load speed	.45	57	37	32.0 K.W.	2.0 K.W.
One-quarter load speed	.22	56	17	45.7 K.W.	3.5 K.W.
Normal motor (full speed)..	.98	100	88	5.0 K.W.	0.0 K.W.

From this it will be seen that the principal and worst characteristic of this scheme—the losses increased in the motor (thus increased heating) with the decreased speed. This means that the motor must be larger than normal.

Rheostat Control.—In this scheme the secondary or rotor must have a definite winding (as opposed to the squirrel cage, which is cheaper) with slip rings and brushes to lead out the current. The friction and resistance losses due to these brushes decrease the efficiency of the motor somewhat. The secondary is usually wound for a higher voltage and less current than in the standard or normal motor, to minimize these losses. The action of this method is based on the principle that, in an induction motor, the drop in speed for any given torque is proportional to the resistance of the secondary circuit.

This scheme would show the following characteristics for the same motor as before at 50 horse-power torque, constant:

	Speed.	Volts.	Eff.	Losses, Motor.	Rheo.
Full load speed	.96	100	86	5 K.W.	0.0 K.W.
Three-quarter load speed	.72	100	65	5 K.W.	9.0 K.W.
One-half load speed	.48	100	43	5 K.W.	18.5 K.W.
One-quarter load speed	.24	100	22	5 K.W.	28.0 K.W.
Normal motor (full)	.98	100	88	5 K.W.	0.0 K.W.

As will be seen, this method gives a higher efficiency throughout, but particularly excels the preivous method in having so much smaller losses in the motor itself, thus permitting of a smaller design and less danger of damage. The losses are concentrated in a rheostat, which is a cheaper piece of apparatus and less liable to damage, being of iron and asbestos usually, instead of high grade insulating materials, as in the motor proper.

Changeable Poles.—By using a pitch of winding which is commensurable with two numbers of poles, we may build a motor which will operate with either 4 or 8, 6 or 12, etc., poles, by a slight change of the connections. Or by a more intricate arrangement of windings a change from 4 to 6, 6 to 8, etc., may be made.

In this arrangement it is necessary to use a squirrel cage armature, since it is suitable for any number of poles, and the pitch of the primary coils has to be made some compromise value between the normal pitch of the two combinations, so it is usually not the best or most effective pitch for either number of poles. Therefore the constants of this motor should not be expected to be as good as those of the standard motor.

Of course such a motor operates advantageously only at two speeds corresponding to the synchronous speeds of the two arrangements. Thus, a 12 and 6 pole motor at 40 cycles would operate at either 400 or 800 revolutions respectively. If a wider range is desired, the potential control scheme first mentioned may be combined with it.

For a motor operating at full and half speeds, say with 6 and 12 poles for 800 and 400 revolutions, we would have:

	Volts.	Eff.	Losses.
Full speed, 50 horse-power	100	86	5.8
Half speed, 25 horse power	100	74	6.6

Thus, for full load torque at half speed we get an efficiency almost double that obtained with the other methods, but what losses there are are in the motor itself, as in the first case. The losses are about the same in the two cases, the speed thus the ventilation being half in one case, the heating is greater at the lower speed.

Variable Frequency.—Every induction motor tends to run at synchronous speed—that is, at a speed equal to

$$\frac{60 \times \text{frequency.}}{\frac{\text{Poles}}{2}}$$

Thus, if a different frequency is impressed on the motor, it will run at a different speed. Some installations have been made where two or three alternating-current generators are used to obtain different frequencies, and these circuits are carried around the shops by various sets of lines (usually three in each set) and the motor connected to the lines giving the frequency and speed desired. For normal losses in the iron the voltage must vary with the frequency. Thus for full and half speed we have:

	Volts.	Eff.	Losses.
Full speed, 50 horse power	100	88	5
Half speed, 25 horse power	50	87	2.8

Generators have been built having stationary armatures in the same frame and two revolving fields, with a different number of poles on the same shaft to give the multiple frequency desired. An application of this principle, which is very pretty theoretically, is that of a very small variable speed induction motor (whose losses are negligible) which drives a commutator feeding the primary of the load machine; by a suitable control of the little motor any desired frequency may be supplied to the load machine from zero to full value, thus it may be started and run at any desired speed. A variation of this is to attach the commutator to the shaft of the load machine and the brushes to the shaft of the controlling motor, thus when the load machine is standing still the brushes revolve at almost full speed on the commutator, and a very low frequency is obtained in the commutated circuit. As the load machine speeds up, the difference in the speeds of the commutator and the brushes decreases, and hence the frequency increases until that time when the commutator and brushes are revolving together at the same speed when there is no commutation and the load machine receives full frequency.

From the above it will be seen that the changeable pole and variable frequency methods are the most efficient, but do not permit of a variation through a wide range of speed. The rheostatic control is the simplest and easiest of control, giving a range from standstill to full speed, but is not as efficient as the first two, although more efficient than potential control. The last mentioned has the disadvantages of low efficiency and considerably increased heating in the motor itself, and is also unstable at low speeds, say below one-third speed. That is a small variation in torque or a smaller variation in voltage will cause a considerable variation in speed.

The potential control is used where moderate variations in speed are wanted, not reaching to less than half speed for instance, and where the load is intermittent, not giving the motor a chance to get too hot. Its great disadvantage is the amount of current it takes at starting, which causes considerable disturbance in the supply circuit, flickering of lights, etc., due to the drop in voltage. The motor used is a cheaper one to build (for the same size) than the others, but if anything like continuous running is desired, the motor must be larger, thus much of this advantage is lost.

One advantage of this motor is that it may be totally enclosed for use in powder mills, oil refineries or where much dust or corrosive vapor is encountered, as it may be controlled from a distance without increasing the number of wires.

The rheostatic method is particularly adapted where frequent starting and low speeds are required, as it causes no unusual drain on the supply system when starting. Thus it is used for hoists, elevators, etc.

The changeable pole system has the same disadvantages in starting as the potential control. For long-continued running at only two different speeds it is excellent, and has constants comparable with those of a continuous current motor.

To vary the frequency of alteration for the motor requires an increased investment in generating station or auxiliary apparatus and line copper, and the greater the number of speeds desired, the greater this complication, but in its action and economy it is equal to any.

One point which is important to bring out is that with the changeable pole and changeable frequency systems the motor will not vary appreciably from the set speed for changes of load, while with either potential or rheostatic control, a change of load will cause an appreciable variation from the desired speed, requiring a readjustment of the potential or resistance to bring the speed to the desired value again.

Preparing for Wireless Telegraphy on the Pacific.

Mr. W. G. Clark, of Seattle, Wash., who is prominent in electrical affairs on the Pacific coast, and who has been in charge of the engineering and construction of the wireless telegraph stations for the De Forest Wireless Telegraph Company between Seattle, Nome, Siberia, Japan and Manila, sends us some interesting details of the work. He writes: "I am just putting in the first station at Cape Flattery, which is to be 100 hp, with towers 220 ft. high, located on cliffs 170 ft. above the water. It has been quite a problem to design the towers, as the wind pressure at that point at times reaches 135 miles per hour. There are no harbors anywhere near the point, and it is necessary to haul the material up the side of the cliff to the rocks at the top. The ocean comes right up to the base of the cliffs, so it has been difficult to devise means of handling the necessary supplies. I recently installed a wire tramway on the top of the cliffs out to the rock standing some distance out in the Pacific Ocean, and now run barge or scow under the tramway and lift the material from the tram to the top of the cliffs by means of an engine located on the cliff. It was troublesome to get the rope over the rock, as it was a perfectly straight rock 90 ft. high and impossible to climb, but we succeeded, and now have the tramway installed ready for operation.

Difficulties Encountered in Establishing Wireless Telegraphy on the Pacific Coast.

"The question of removing timber is also one of considerable importance. I enclose you herewith a photograph giving you something of an idea of the forest tangle which we have to remove before starting the towers. We have some trees 9 ft. in diameter which have to be removed. The trees are standing so close together it is almost impossible for a man to get through between them. I enclose you another photograph showing the point at which we have to unload supplies. The place shown in the picture is entirely covered by water at high tide, but when the wind blows the waves fill the pockets even at low tide. Material has to be hoisted up the face of the cliff back of where the men are standing, to a height of 170 ft.

"I also send you a picture showing how the weather can mix things up on the Cape. The rock in the foreground is the one on which we have our tramway fastened, and is something over 90 ft. in height, and storms often bury this rock completely under water. The wave in the picture which you see dashing against the rock is thrown up 60 ft. above the rock, and the rock upon which it is dashed is something over 60 ft. in height, so you see it can get real stormy and dangerous when it tries.

"We have a great many Indians employed on the station, and in fact the station is being constructed on one corner of an Indian reservation. Just think of it! Aborigines constructing a wireless telegraph station on their own hunting ground for trasmitting messages over two thousand miles of the Pacific Ocean into Dutch Harbor, Alaska. What would Volta, Ampere, Ohm and Faraday think of such as this? Is it not a place where the Past and Present shake hands and travel on together?"

Recent Electrochemical Developments.

CARBON ELECTRODES.

A patent was granted on June 23 to James Hargreaves, John William Stubbs and John Kearsley, of Middlewich, England. Mr. Hargreaves is well known as one of the inventors of the Hargreaves-Bird cell for the electrolysis of sodium chloride. The subject of the present patent is the construction of carbon electrodes for electrolytic cells, so as to have a small electrical resistance and to allow a ready renewal of parts of the electrodes when worn or broken. For this purpose the inventors pass rods of carbon through the openings of a metallic conductor bar and fasten blocks of carbon to the ends of these rods; a casting of lead is used to make electric contact between the metallic conductor bar and the carbon rods; the conductor bar and lead castings are covered with cement.

ZINC CUP FOR PRIMARY BATTERIES.

For a great many portable primary batteries, particularly for dry cells, the containing cup is made of zinc and constitutes the anode. Such cups are commonly made by rolling the zinc into sheets, bending the sheet into cylindrical form, soldering the edges together and soldering to one end of the cylinder a bottom and to the other end a binding post. In a patent granted to Vincent G. Apple, of Dayton, Ohio, on June 23, the following construction of a seamless cup of zinc is described. Zinc is heated to its melting point, 420° C., and forced under a pneumatic pressure of about 125 pounds per square inch into a mold. The zinc then forms a compact, homogeneous structure of uniform density, without flaws or blow-holes, so that the walls of the cup may be made very thin. The cylindrical wall is corrugated or undulated in order to obtain a large active electrode surface and to strengthen the mechanical structure.

STORAGE BATTERY CONSTRUCTION.

Two patents were granted on June 23 for new constructions of storage battery plates. Mr. George H. Gale, of Detroit, Mich., forms a series of holes through a sheet of metallic lead, and reams out or cuts away the walls of these holes between the two surfaces of the plate, so that the holes communicate between the surfaces of the plate and form an interior chamber. This internal chamber is filled with a solid mass of active material. The plate will thus be able to hold a great amount of active material without danger of dropping out, but it seems doubtful whether the active mass is best located to enable the electrochemical action between the active mass and the ions of the electrolyte, to go on.

Mr. Carlo Bruno, of Rome, Italy, constructs plates for automobile batteries as follows: He rolls a conducting plate of lead out to less than one-tenth of a millimeter in thickness and stamps out of the plate upon one or both sides projections at right angles to the plate. The active mass which has previously been formed into sheets is then applied upon the plate, an endless strip of the mass being pressed upon an endless strip of the lead plate, and the latter is then cut into suitable lengths. As such a plate is liable to bend easily, it is supported by being enclosed in a receptacle of celluloid perforated in the usual manner. These receptacles are laterally stiffened by corrugated vertical strips of celluloid.

In this connection we may also mention a patent granted on June 23 to Mr. Hiram Percy Maxim, the well-known engineer of the Westinghouse Company, for a charge indicator for storage batteries. On automobiles it is important to know exactly how far the battery is discharged. An ordinary voltmeter would indicate this sufficiently, if the battery would be discharged at constant normal discharge rate, but this is not the case in automobile service. Mr. Maxim has, therefore, devised a voltage-indicating instrument with means of compensation for such voltage variations as are incident to variations in the discharge rate; that is, he provides compensation both for the drop in voltage, due to discharge rates above the normal rate, and for the rise in voltage due to discharges below the normal rate. His instrument, therefore, indicates the voltage corresponding to normal discharge rate and thus shows the condition of the battery charge.

New Telephone Patents.

TELEPHONE FIRE ALARM APPARATUS.

An automatic burglar or fire alarm attachment for telephone systems is the subject of a patent issued to S. Schwarzschild, of Rochester, N. Y. This, like many preceding similar devices, is adapted to connect to the subscriber's telephone circuit, and to interconnect, through a switch, an induction coil and interrupter, with thermostats or window switches, etc. The operating of the auxiliary circuit by the momentary closing of one of these emergency contacts permanently closes the controlling switch, signals the central office and through the interrupter greets the operator, upon her response, with a howling buzz. This notifies her of the urgent nature of the call. There are two unfortunate circumstances which affect the adoption of such a system. First, probably few telephone companies would care to take the responsibility of "protection," and secondly, in those places where central energy systems are in use (and these the very kind of places where protection would be most frequently desired), the awkward habit occasional relays have of buzzing on their own account would undoubtedly cause considerable trouble from false alarms.

LOCAL REPEATER.

Under the title, "Apparatus for Telephoning," J. R. Troland, of New York, has obtained a patent for details of construction pertaining to the original scheme for telephone repeaters. With this scheme it was contemplated to allow the receiver of the first stage of the circuit to talk into the transmitter of the second stage and *vice-versa.* Such apparatus did not operate satisfactorily for long-distance work, but Mr. Troland thinks he has a use for it as a means of talking connection between private and central office telephone systems. Thus, in order to extend a call received via the central office line, the transmitter and receiver of an extension line of the private system are to be brought into proximity to the instruments of the central office line, and by means of the private system switchboard are to be extended to any desired location.

To such an application of private instruments the operating telephone company would probably object very strongly, but even though this obstacle were removed, it seems doubtful that any very practical use can be made of this device, for two reasons: In the first place, if the excitation of the diaphragms is kept small, very poor transmission will result. On the other hand, if this excitation be made great, then the repeating apparatus from the two directions being interconnected will cause a mutual repetition irrespective of external excitation. This will be a hum depending upon the natural acoustic properties of the various diaphragms and similar to that ordinarily produced by bringing one's transmitter and receiver into proximity.

Boiler Tests.

Tests of eight Manning upright boilers, as reported at the recent meeting of the American Society of Mechanical Engineers by Mr. F. A. Waldron, showed 8.707 pounds of water evaporated per hour per pound of coal with a steam pressure of 151 pounds, equivalent to 10.240 pounds from and at 212° F. The equivalent evaporation from and at 212° F. per pound of dry coal was 11,130 pounds, and 12,370 pounds per pound of combustible. At the same meeting Mr. E. A. Hitchcock communicated the results of tests on a 107-hp Babcock & Wilcox boiler at the Ohio State University. With an economizer and air heater in use and a steam pressure of 136 pounds, the evaporation was 9 pounds per water per pound of coal, equivalent to 9,879 pounds from and at 212° F. The equivalent evaporation from and at 212° F. per pound of dry coal was 9.988 pounds, and 10,980 pounds per pound of combustible. In another trial with Pocohontas coal these figures became 10.482, 11.640, 12,507 and 12.327 pounds respectively. In this latter test the efficiency of boiler and grate was 75.50 per cent., and the efficiency of the system 80.28 per cent.

CURRENT NEWS AND NOTES.

ELECTRIC ROADS IN SPAIN.—United States Consul-General Lay, of Barcelona, Spain, informs us that two electric roads are being built in Spain. One runs from Porrino to Mondaris, in the Province of Pontevedra, and is being equipped by the Westinghouse interests. The other is from Linares to the mines, in charge of the Société Française d'Electricité et Traction en Espagne.

THE BUCKET SHOP EVIL.—Mortimer H. Wagar, vice-president of the Consolidated Stock Exchange, and George W. Baily, representing the New York Cotton Exchange, left this city last week for Chicago, where they will represent their respective institutions at an anti-bucket shop conference which has been called by the Chicago Board of Trade. The result of the meeting may be the formation of an anti-bucket shop association made up of representatives of the institutions participating.

STEEL CORPORATION IN CANADA.—It is stated that the United States Steel Corporation is about to establish works at Port Colborne, Ont., on the Welland Canal. This branch will employ at least 3,000 men and the object is to secure absolute control of the Canadian market. The trust, it is said, has obtained the government's permission to form a basin on the Welland Canal, near Port Colborne, to be used for its ships. It is claimed that iron and steel can be manufactured cheaper there than at Pittsburg. Niagara power is close at hand, and the corporation has already secured an option on 6,000 hp from one of the Niagara power companies.

BUFFALO AND TROLLEY.—At Pottsville, Pa., a buffalo bull which escaped from a circus had an exciting battle with a trolley car and died of his injuries. The animal was dazzled by the light of the reflector on one of the cars. He was being driven at night from the show grounds to the station. He bellowed in fury and butted the car again and again. After the light went out he seemed satisfied that he had conquered and submitted to being driven off. The animal was frightfully injured about the head. He died next day. The passengers of the car, it is said, were thrown into great excitement by the incident. It would have been strange if they sat quietly through the performance.

TEST OF A COMPOUND STEAM ENGINE.—In a paper read at the recent Saratoga meeting of the American Society of Mechanical Engineers, Prof. D. S. Jacobus gave the result of tests at various powers on a horizontal cross-compound condensing steam engine provided with a Corliss valve gear. The engine was provided with a reheater coil in the receiver, which was supplied with steam at boiler pressure. The cylinder heads of both high and low-pressure cylinders were jacketed with high-pressure steam. The engine ran at about 120 r.p.m., and was directly connected to an electrical generator. The steam pressure averaged about 150 pounds per square inch above the atmosphere, and there was an exceptionally good vacuum. The water consumption of the engine per indicated horsepower per hour varied from 12.10 pounds at 627.4 h-p to 12.75 pounds at 1,004.3 hp. At 401.4 hp the water consumption was 13.92 pounds, and at 339.7 hp it was 14.58 pounds.

NEGRO DISTRICT MESSENGERS.—At Atlanta, Ga., on June 27, two hundred white messenger boys were thrown out of employment by the Western Union and Postal Telegraph companies and their places filled with negro men. As a result of the change, rows have been the order around the headquarters of the telegraph companies. It was feared to use negro boys, as it was well known that the white boys would not be long in running them off the streets. The grown men employed by the telegraph companies have fared little better, as the boys have banded together and a mob of them has attacked the messengers every time they leave the office. Six boys jumped on one negro at Western Union headquarters and bruised him badly before the office force could rescue the negro. The management then had to call on the police to clear the office of boys. As both companies have made the change the boys will hardly have a chance to institute a boycott, but they say they will continue to make it lively for the negro messengers and force the companies to take them back.

AMERICAN PACIFIC CABLE.—The new commercial cable from San Francisco to Manila, by way of the Hawaiian and Midway Islands, will be formally opened by President Roosevelt on July 4 from his summer home, at Oyster Bay. The President's message will be the first over the new line and will be addressed to Governor Taft, conveying greetings and congratulations on the opening of direct communication by an American cable between the United States and the Philippines.

HOBOKEN WIRES UNDERGROUND.—An ordinance has been introduced in the Hoboken (N. J.) Common Council to compel all electric and telegraph companies to put their wires underground. The passage of the ordinance will affect the Western Union Telegraph Company, the Postal Telegraph Company, the New York & New Jersey Telephone Company, and the United Electric Company. It is estimated that it will cost each of these corporations $30,000 a mile to take down poles and wires and construct conduits.

CONTROLLING INDUCTION MOTORS.—A patent granted June 23d to Mr. P. J. M. Girault, of Paris, France, describes a method for controlling induction motors. The general principle is the well-known method of introducing resistances of known value into the armature circuits and cutting them out gradually as the speed of the motor increases. For this purpose, the inventor uses what he calls "transformers with single windings," i. e., a single winding on an iron core, which forms a closed magnetic circuit. Such a winding is connected to each phase of the armature, and each single turn of the winding is connected to a segment of a commutator. By moving a handle, it is possible to short-circuit any number of turns of these windings with resistances of a predetermined value.

MAGNETIC TESTS OF IRON AND STEEL.—A committee of the American Society for Testing Materials, recently appointed to study the subject of "The Magnetic Properties of Iron and Steel," met at the National Arts Club, New York, Friday, June 26, to formulate a line of investigation for the ensuing year. The following members comprise the committee which will report its findings at the annual meeting of the American Society for Testing Materials, in 1904: Prof. J. Walter Esterline, Purdue University, La Fayette, Ind., chairman; Dr. R. G. G. Moldenke, Watchung, N. J., consulting metallurgist; Mr. J. A. Capp, chief of testing laboratory, General Electric Company, Schenectady, N. Y.; Mr. J. A. Mathews, metallurgist, Sanderson Bros. Works, Crucible Steel Company of America; Mr. H. E. Diller, chief chemist, Western Electric Company, Chicago; Mr. Robert B. Treat, engineer, Crocker-Wheeler Electric Company, Ampere, N. J.; Mr. W. A. Layman, general manager Wagner Electric Company, St. Louis, Mo.

GILBERT'S DE MAGNETE.—With regard to the magnificent translation of Gilbert's "De Magnete," made by Prof. S. P. Thompson and a corps of able associates, under the auspices of the Gilbert Club, we are glad to learn that the club has just exactly cleared the bare costs of printing and binding. This, of course, leaves nothing for those who contributed their work for the purpose of bringing out a worthy edition of the great English electrical pioneer. In response to a recent inquiry on the subject, Prof. Thompson informs us that there are a few copies on hand which could be bound up and which the club would be glad to dispose of, as it desires to have a few pounds available to spend next November on the tercentenary celebration at Colchester, England. If any of our readers would desire to secure a copy of this splendid piece of translation and of book-making, we shall be glad to receive their subscription, or they can address Prof. Thompson directly. The cost delivered in this country in Holland binding would approximate about $10 per copy, a price which a few years hence is likely to be found doubled or tripled.

RECEIVING DEVICE FOR WIRELESS TELEGRAPHY.—A patent was granted on June 16 to Prof. Reginald A. Fessenden for a "method of utilizing the energy of waves." The general principle of the receiving apparatus for use in his wireless telegraphy system is that the electromagnetic waves on their arrival so change a condition of a body of coherent matter as to effect an indication of the arrival of the wave. The "metallic barretter," or current-actuated wave-responsive device, patented before by him, was based on the same principle. Now he has found that a liquid barretter works even better. He observed that if the loop of a metal barretter such as used by him previously, be broken while it is immersed in a liquid, as nitric acid, it will, nevertheless, act and even more efficiently than before. Liquid barretters may, of course, be constructed in widely different forms. The action of the electromagnetic waves on the liquid barretter is to cause a greater current to pass in the local receiver circuit, owing to the fact that the conductivity of electrolytes increases with heat. With a liquid barretter having a resistance of between 600 and 2,000 ohms the increase of conductivity when the liquid is heated is so marked as to permit of the operation of a siphon recorder or relay, though a telephone may be used.

LOW FREQUENCY INCANDESCENT LIGHTING.—A new method for utilizing low frequency currents for incandescent lighting is the subject of a patent granted June 23 to B. G. Lamme. The method is intended particularly for use in connection with the inventor's single-phase alternating-current traction system, which when first described in an Institute paper last year, aroused considerable attention. In this system alternating currents of very low frequency—about 15 cycles—are used. If currents of such a low frequency were supplied directly to the lamps, there would result very objectionable fluctuations of light. In order to produce a steady non-fluctuating illumination, the traction current is transformed into a plurality of displaced phases and the different phases are supplied to different filaments in a single lamp or in different lamps located in proximity to each other, so that the maximum illumination of one filement will occur at the same time as the minimum illumination from an adjacent filament; or if there are more than two filaments and more than two phases of current, the phases will overlap so as to make the resultant illumination substantially constant. For this purpose a phase-displacing device of any kind (of the type of a polyphase induction motor or synchronous motor of motor-generator) may be used, one phase being connected to the traction circuit. Of the various lamp filaments one is also connected to this circuit, while the other ones are connected to the other phases of the phase-displacing device.

ALTERNATING-CURRENT TRACTION.—A patent on a "method of and means for driving electric motors" was granted on June 23 to Mr. George Westinghouse, Jr., on an application filed more than nine years ago, on April 23, 1894. In the Lamme system of single-phase alternating-current traction, which is soon to be tried on a large scale, a series-wound motor is used. On the other hand, in the present patent Mr. Westinghouse suggests the use of an ordinary shunt-wound, direct-current motor, which is provided with the usual commutator. The alternating current is supplied to the armature of this motor through two collector rings. When the motor moves in synchronism with the alternating current supplied, it gives direct current at the commutator, and this direct current, taken off at the brushes, is used for exciting the field magnets. In shunt across the field magnets, a storage battery is provided, which is thus supplied with current from the brushes on the commutator, so long as the potential across the alternating-current mains is high enough. The storage battery is thus charged by means of energy derived from the alternating-current mains. Should the voltage on the alternating-current mains fall, the storage battery is discharged and furnishes the current for energizing the armature and field magnets of the motor. This same function is performed by the storage battery whenever it is desirable to discontinue the connections between the motor on the car and the alternating-current mains. The storage battery, which is charged during the running of the car, becomes especially useful in starting, as it then may be used to supply the current for bringing the motor up to synchronism, before the alternating current is thrown into the motor. In this way a type of motor which is not capable of starting by itself under a load when fed by alternating current, is started under load by means of the battery. Another way is to use the motor always running at synchronism and to drive the axle of the car from the motor by means of any gear capable of engagement or disengagement. The car is then stopped and started and its speed is varied by proper manipulation of the transmitting gear. In this case the secondary battery is required for running the car when it is disconnected from the line and for aiding the motor when the potential diminishes for any reason. It is also useful through counteracting any tendency of the motor to diminish its speed and fall out of synchronism at starting.

TELEGRAPHIC SPEED.—A special cable dispatch from London of June 19 says: "A train on the London & Northwestern Railway, conveying the members of the International Telegraph Conference from London to Glasgow, ran from London to Carlisle, a distance of 299¼ miles, in 5 hours and 58 minutes without stopping. It is said that this is the world's record."

TYPEWRITER TELEGRAPHIC ACCESSORY.—A telegram from Utica, N. Y., of June 22 says: "August Schneider, of Ilion, has closed a deal with the Remington Typewriter Company by which the company adopts his invention of a telegraphic transmitter attachment to a typewriter used to send telegraphic numerals by machinery. The company will at once begin manufacturing the transmitters. Mr. Schneider has been for several years working on various kinds of telegraphic transmitters, but not until a few months ago was he successful. He claims to have discovered a force for propelling his machine which will wholly revolutionize mechanical power. He is very guarded with his secret, but has demonstrated it so acceptably to the expert mechanics of the Remington company that they were satisfied that it was all right and made him a handsome offer for his invention. The transmitter is composed of a small nickel-plated box about five inches long and three inches square. This holds the mechanism and mysterious force which operates the typewriter. Six drops of a secret liquid operates the machine for four weeks." This may be all right, but the "drops of secret liquid" rather discredit the thing.

TELEPHONY IN ENGLAND.—In the discussion of Mr. Aitkens's English Institution paper on his plan for divided multiple telephone switchboards, Mr. J. Gavey, of the English Post Office Telegraphs, said it was only a few years ago that the multiple board was supposed to meet the requirements of a given locality with a capacity of 6,000. Now a multiple board of 15,000 was actually in existence, and a 20,000 board had been designed, but this still was very far from meeting the requirements of the public. The divided multiple boards used in America could hardly be said to bear very seriously upon the problem, because they did not have automatic signalling, and when he said that this involved ringing up and ringing off, it would be seen that there was very little in common between these boards and that proposed by Mr. Aitken. The author, however, had made certain definite statements as to number of subscribers, number of operators to work junctions, the time in getting through, and so on, but in order to prevent any misunderstanding he would like to point out that it was impossible to determine those factors directly without first postulating the number of talks per subscriber and the type of apparatus being used. With regard to the apparatus, no definite comparison could be made between the old type of ringing up and off again and the modern types of automatic signalling. He himself had a very firm hope in the introduction of automatic signalling, in which the subscriber merely removed the telephone to call and placed it back again to ring off; in which the signalling on the junctions was wholly automatic; in which the talking was reduced to a minimum, the operator simply being called upon to ask for the number, and, seeing by the signal what was going on without intervening. With such a system, which he believed would be in universal use before many years, the capacity of the operation and the carrying power of the lines would be absolutely doubled.

LETTERS TO THE EDITORS.

The Measuring of Lighting Schedules.

To the Editors of Electrical World and Engineer:

SIRS:—In the N. E. L. A. printed report of Municipal Lighting Statistics is given a standard to 1 a. m. every night, 2,190 hours, which means an average run of 6 hours per night. Are we correct in this? Perhaps your readers can answer.

We have followed this matter up very closely for a number of years and find that on a start one-half hour after sunset, in this locality, which the contract of the Marlboro Electric Company requires, we average approximately six and one-half hours per night, or 2,428 hours per year, as shown in the report. We find that a start one-half hour after sunset is none too early, and many nights the lights should be running earlier on account of the darkness, particularly on cloudy evenings.

Will you kindly secure us what information you can regarding experience of companies on a standard of 2,190 hours on the 1 a. m. schedule or give us the names of some companies that run on that schedule and show only 2,190 hours or less. The point is one of interest and importance.

MARLBORO, MASS. C. B. RUSSELL.

The Metric System.

To the Editors of Electrical World and Engineer:

SIRS:—I note your explanation of the greater length of the anti-metric as compared with the pro-metric portion of the report of the committee of the American Society of Mechanical Engineers. The metric opponents carry "the laboring oar." The facts, however, are susceptible of a different explanation—the pro-metric argument is short and soon exhausted, while the anti-metric case is endless.

Referring to your "hideous trinity" of ounces, no one but a metric advocate can see any conflict between the avoirdupois and the fluid ounces—one a measure of weight and the other of capacity. As for the troy ounce, it is used for weighing gold and silver and for nothing else. As a special unit for this purpose, it is strictly comparable to the carat for weighing gems, which unit is universally used in France and Germany just as it is here.

You tell us that there are two different pounds—the avoirdupois and the troy. The troy pound is practically non-existent—gold and silver for which only the troy weight is used, being weighed in ounces and pennyweights exclusively—never in pounds. I venture the assertion that you never saw, as I never saw, a troy pound weight in your life.

Similarly you speak of our different kinds of gallons, quarts, pints and tons. Did you ever in your life suffer the loss of a cent of money or of a second of time, or were you ever in the slightest degree confused because the quart by which peanuts are sold differs from that by which milk is sold? If some of these units are superfluous, let us drop them—a course that, while not easy, is, nevertheless, far easier than adopting the metric system.

While some of these units are superfluous, except for the two tons they lead to no confusion because they are used for distinct and perfectly well understood purposes. Regarding the confusion which undoubtedly exists between our two tons, will it be any less among three? Will it be any easier to get rid of our long ton after the addition of the metric ton than now? The long ton is the most familiar example we have of the difficulty of getting rid of an old unit of measure even when as in its case, it is inconvenient and acknowledged by all to be a nuisance. It is an object lesson of the difficulty of changing even one unit of measurement.

I note of course your statement that we have 64 units in actual use. Who first made this count I do not know, but as a matter of fact, two-thirds of these units are obsolete, obsolescent or used for such special purposes (for example the troy and apothecary's weights) as not to enter into the life of the average citizen. Counting the units which are in common use, those of our system number 19, while those of the metric system (again counting those in common use) number 30.

Had you read my paper on this subject you would, moreover, have found a table of nearly 500 non-metric units now used in metric countries, of which Germany claims over 100. You would also have found a condition in metric countries to which we are strangers, namely units of the same name and used for the same purposes, but having different values in different districts and even towns. Thus, in Spain and the countries of Spanish America—"metric" every one of them—there are known to be in use to-day 10 pies, 17 varas, 17 fanegas, 25 quintals and 27 arrobas.* This conditions may be fairly described as confusion, and it was this which originally lead to the conception of the metric system, as well as to its adoption wherever it has been adopted. The adoption of the system has, however, been powerless to cope with the situation.

The supposed simplicity of the weights and measures of metric countries is an absolute fiction. Nowhere—France included—has the metric system done away with the old units. In France to-day they are calling for more law to compel the use of the system by whole industries which do not, and, by the testimony of the metric advocates who call for more drastic laws, will not use it unless compelled to do so. If the system is so much better than others, why, after a hundred years' experience with it, should the French people still be so obtuse as to fail to see its advantages and adopt it voluntarily? If existing compulsory laws in France are insufficient to bring about its general use, what prospect is there that its adoption in the government department will bring about its general adoption here?

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* See *Foreign Trade Requirements*, published by Louis Scribner & Co. This book has a table of foreign units of about twice the length of that from which my own was drawn.

It is easy to direct the shafts of ridicule against almost any target, but in this case they return to prick the sender. Perhaps you would have been less inclined to ridicule the difference between our liquid and dry measures had you known that the French people still use their old dry measures—the boisseaux (bushel), the setier and the minot, and their old liquid measures—the pipe, the piece, the feuillette, and the mesure, etc.

The metric advocates should come down from the clouds of speculation, and examine the facts. When they do this, they will find that, measured by the units in actual use and their ratios with one another, our system of weights and measures is more simple and more uniform than that of any country in the world; that no set of old units has ever been displaced by the metric system; that the uniformity which they seek to establish is the very thing they will in fact destroy, and that the confusion which they seek to destroy, they will in fact establish.

New York City. F. A. Halsey.

To the Editors of Electrical World and Engineer:

Sirs:—Why is every electrical engineer a born metric crank? For the palpable reason that applied electricity is a laboratory fledgling, and you can see pieces of the eggshell sticking to its back yet, among which this metric fancy is one. This answer may be divided into three sub-heads, viz.: First, that electrical engineers are themselves a laboratory product; indeed, the personnel of the members of any electrical society shows this, for looking down the list of members we see that about one-half of them are college professors. Second, electrical work begins and to a large part ends in the laboratory with the measurement of quantities, rather than the construction of machines. Thirdly, the technical literature of electricity comes largely from Europe and European laboratories.

But I do not cite this as any disparagement of electricity as a science or art, but merely as a satisfactory explanation of the general predisposition of the electrical fraternity in favor of the metric system. Electrical engineers, like other classes of men, look through the tinted panes of their own house and see everything outside with the colors of those panes.

It is said that people who live in glass houses should not throw stones, and it seems to the writer that if electricians are so anxious to have the metric system generally adopted, they should set a good example by adopting it themselves. It is a common tradition among them that they are using, in part, at least, the metric system, but it is time this notion was exploded.

When in the early development of electricity scientific men looked about for measuring units, although they were born and bred in the metric system, did they take this for their base? Not at all; they took what they called the *C. G. S. system*, which is based not on the metre but on the centimetre, and not on the metric $\frac{1}{100,000}$ part of a day, but on the second, viz.: the $\frac{1}{86,400}$ part of a day. Now, when they had established a set of units on this system, they found they were all too big or too small for practical use, so they thereupon prepared a still different set of units based neither on the metre nor the centimetre. The ampere, for instance, is only 1/10 of the C. G. S. unit for current, and is still ten times as big as it ought to be. Likewise, the volt is one hundred million times, and the ohm a billion times bigger than the C. G. S. unit. The farad, which is only one-millionth of the C. G. S. unit, is still several million times too big for ordinary use. And yet these so-called "practical units" are called "metric."

What is a volt? A potential sufficient to generate a current equal to one ampere through a resistance of one ohm. What is an ampere? A current produced by one volt potential through a resistance of one ohm. What is an ohm? The resistance through which one volt will send a current of one ampere. These definitions embody all that 90/100 of the electricians of this country know about the electrical units, except that they mean certain marks on the scales of certain instruments. Whatever relation the electrical units may possibly bear to the metric system, it is certainly of no practical use in ordinary life.

You complain of different tons, gallons and quarts; but will any one tell me how many different kinds of ohms there are? There is, first, the "legal ohm," which is defined as the resistance of 106 centimetres of a mercury column of one square millimetre section. Then there is the "British Association ohm," which is only .9887 of the legal ohm, the "practical ohm," which is the resistance of a column of mercury one metre long, and one square millimetre in cross-section, and is only .9415 of the "B. A. ohm"; and, finally, there is the "*true ohm*," whose value nobody has and nobody will ever precisely determine, but which is *supposed* to be something larger than the "B. A. ohm," and is given by Lord Rayleigh as 106.21 cm of the mercury column. A prominent electrical professor once remarked in my hearing that he had lived through three ohms, and hoped he had now reached the last, but who can tell whether he has or not? One may say that all these ohms are not in use, but who knows how many instruments graduated in "B. A. ohms," "practical ohms," and other ohms, are in existence and in use?

Probably it will be answered that my objections are ridiculous, as one ohm has now been settled on for everybody. They are not more ridiculous, however, than the old set of units which you again parade before us, of troy ounces and the like; nor are the latter more an argument against the English system than the former are against the electrical. The fact that such things exist does not prove anything for or against a system. The thing for you to prove is that you can put them out of existence. Nowhere have you shown that the use of the metre, litre and gramme in this country would lead to the abolition of the old measures. It has been proved over and over again that it never has this effect. To what end then, introduce a new jargon into what is already alleged by you to be confusion?

As regards the remaining units used by electricians, what about the electrical horse-power, which equals 746 (in the metric system 736) watts? and what about the "circular mill," which equals .0000007854 of an inch? Then there is the mil-foot of copper, which has a resistance of 10.74 ohms. Are these relations any more convenient than what you are pleased to term the "quaintly complex" and "incongruously inexpedient" ratios of the weights and measures in common use among us?

For thirty years or so the metric propagandists have treated all who ventured to dispute their gospel as "back numbers," worthy only of a pitying condescension, but it is now time for them to assume a more impressive rôle if they wish to prevail. They are on the defence. It is incumbent upon them to do more than merely repeat their old platitudes and jesting stories. This may have done till now, but as Lincoln said, "You cannot fool all the people all the time," and the public is waiting now, and vainly waiting, for answers to the questions put to the metric advocates as to their programme. The report of the A. S. M. E. Committee is a signal example of this, as any one can see at a glance. The reason why the antimetric argument was more than twice as long as the metric was, simply because there were volumes to be said against the metric system, and scarcely anything to be said for it. Again and again are the pointed inquiries and statements of the anti-metric side passed over in silence by their opponents.

In reply to some of the arguments presented last fall before the American Society of Mechanical Engineers, the French Society of Civil Engineers undertook to state the metric position. A list of thirty questions was prepared for them to answer, but no committee was appointed to answer them, and nobody seems to have been willing to undertake the task. Instead, a number of the members made speeches extolling the perfection of the metric system, and incidentally referring to some of the questions which had been asked. After a fine-tooth combing of all the replies, I found that only ten, the least important of the thirty questions, had been even referred to directly or indirectly, and of these three were dodged. All the rest were passed over in silence.

Instead of repeating the time-worn and thread-bare glittering generalities with regard to the metric system which we have heard so many times, why do you not, if you wish the metric system to progress, answer the objections that are raised to it? If you do not, it must be presumed that you cannot.

You say that "only about twenty years ago" the mechanical engineers and mechanics of this country would not even have deigned to consider the question of the national adoption of the metric system. This question was considered by the National Academy of Sciences more than thirty-five years ago and decided in the negative. It was also before the American Society of Mechanical Engineers at one of their earliest meetings in 1881, more than twenty years ago.

The one point, which is really the only point of importance, we appear to agree on, is that there shall be no compulsory legislation. That point waived, the whole argument might as well be abandoned, for it is certain that the metric system has made no progress in this country, and without compulsory legislation never will. As to its becoming anything like universal, this claim has repeatedly been exploded as absurd, for it has not even begun to be universal yet, whereas English measures for a number of purposes, as for instance screw threads, are substantially universal.

The ancient story about the numerous ounces, tons, drams, etc., in common use, is pure nonsense, even if it had anything to do with the question. There is only one ounce, one pound, one foot and one inch, from Edinburgh to Sydney, and from Alaska to Florida, and, we may add, Mexico. There are but two gallons, the Imperial British gallon and the United States standard. If there are two tons in use, cannot one be abolished by act of Congress and leave the other? If one ton cannot be thrust out, it is certain that the 64 measures constituting, according to the ELECTRICAL WORLD AND ENGINEER, the English system, cannot be displaced by a job lot of foreigners.

MONTREAL, CANADA. GEORGE W. COLLES.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Determination of the Friction Losses in Continuous-Current Machines.—KINZBRUNNER.—An article illustrated by diagrams, in which the author describes a modification of Dittmar's method for the determination of these losses, for the purpose of simplifying it and doing away with the long calculations. It depends upon the following idea: If a continuous-current machine, the exciting-current circuit of which is interrupted, is connected either directly to a source of exciting current of small voltage, about ⅕ to 1/15 of the normal machine voltage, or in series with a suitable rheostat to a source of higher voltage, the machine will begin to run at a certain position of the brushes. It is then possible to obtain any desired number of revolutions of the armature either by changing the position of the brushes, or better, by changing the voltage of the armature. The quantity of the current taken up hereby by the armature will depend on the work done by the machine, or expended in its armature resistance respectively, and on the position of the brushes. With a favorable position of the brushes an increase of the number of revolutions up to 1½ times can be gotten in most cases, without sensible sparking at the commutator. It might appear as though the armature in such a case was only rotating in the field generated by remanent magnetism, and if also the number of revolutions of the armature depended only on the magnitude of that field. This is not the case, however; the armature traversed by the current generates a field, the position of which is dependent upon the position of the brushes, and it is mostly this field, which effects the rotation of the armature. In that position of the brushes which was most favorable for an experiment, it was shown that the armature field largely surpasses that of the remanent magnetism. This phenomenon, the rotation of the continuous-current armature in the field generated by itself, can be used advantageously for the determination of the friction losses and for their separation from each other for determining the other losses, such as hysteresis and eddy currents. The energy taken up by the armature is used for making up for the mechanical losses, the ohmic loss and the hysteresis and eddy current losses. The ohmic loss can easily be calculated from the resistance of the armature. The hysteresis and eddy current losses are so small that they can be neglected. If, therefore, the ohmic watt loss is subtracted from the total energy taken up by the armature, the total friction losses of the armature at a certain number of revolutions, are obtained. The voltage necessary to reach the maximum velocity is about 30 per cent. of the normal machine voltage with small machines, 20 to 10 per cent. with medium (5 to 10-kw), and 10 to 5 per cent. with larger machines. The best position of the brushes can be found by moving the brush-holder until the number of revolutions reaches its maximum, with the least consumption of current in the armature. The determination of the best position of the brushes is important and the accuracy of the experimental results depends considerably on it. The voltage of the armature and the current strength are observed for some velocities, say 5/4, normal, ½, ⅓, ⅕ and perhaps somewhat less. The article concludes with the results of practical tests of the method on several motors.—*Elek. Zeit.*, June 11.

REFERENCE.

Repulsion Motor.—MARIUS LATOUR.—An illustrated mathematical article, in which the theory of the motor is treated. A 15-hp motor was constructed and was found to confirm the theories. Such a motor is found to have a comparatively large starting torque.—*Elek. Zeit.*, June 11.

LIGHTS AND LIGHTING.

Intense Arc Light.—VOGEL.—A study of the phenomena taking place in the burning of the new arc light carbons, which are impregnated with various substances for the purpose of increasing the luminosity of the light. The author proceeds from a carbon rod composed half of carbon and half of a mass of sodium fluoride, potassium fluoride and calcium fluoride, in equal parts, and calculates for a current of 10 amp. and 45 volts the volume and velocity of the gases passing through the arc. He comes to the conclusion that carbon, being the material which can stand the highest temperature without melting, will not only remain the fundamental material for all electrodes for arc lamps, and electric smelting furnaces, but will also furnish the proper mantle material for all other light-emitting substances and the conductor which can be depended upon even at the highest temperatures. It follows, therefore, that only as many per cent of the flame-coloring or light-emitting substances should be incorporated into the carbon for gasification, as can be utilized in the arc. Accurate examinations have shown that there is a lower limit of 3 to 5 per cent. and an upper one of 15 to 20 per cent., according to the nature of the substance used. Therefore, electrodes with 50 and more per cent. of salts will necessitate an unnecessary amount of current or heat to be spent on the work of melting and gasifying substances with a lower melting temperature than the carbon, which will result in a lower temperature of the arc and an increased condensation of the superfluous gases. Thus these large admixtures are neither of advantage for the economical use of current, nor for the intensity of the light, but just the reverse. —*Zeitsch. f. Beleucht.*, May 30, June 10.

REFERENCE.

Mechanical Details of Enclosed Arc Lamps.—SLEIGH.—An abstract of a paper read before the Newcastle Section of the Institution of Electrical Engineers, with discussion.—Lond. *Elec.*, June 12.

POWER.

Vizzola Electric Power Plant.—An illustrated description of the power station of the Societa Lombarda, at Vizzola, Italy, supplying light and power current for a large area. The River Ticino is the source of supply of water, through a canal 4¼ miles long, the fall available at the power house being 100 ft. The equipment consists of 10 machines and three sets of exciters, each of 200 hp. Each unit is of 2,000 hp, and driven directly by a turbine, which are all constructed for a variable fall of 75 ft. to 87 ft. and revolve at 187 r.p.m. The three-phase alternators, generating at 11,000 volts, with a periodicity of 50, have a revolving field fitted with 32 poles on to which a flat copper strip is wound, the whole being pressed up together after winding on the former before shipping on to the cores. On January 1st last 15,000 incandescent lamps and 750 motors were connected to the system, supplied from 98 sub-stations. The total length of the primary lines is 87 miles, and of secondary lines about 15 miles are connected to the system.—Lond. *Elec. Eng.*, June 12.

REFERENCE.

Power Plant.—Kenny.—A long illustrated article on the plant of the Pueblo & Suburban Traction & Lighting Company, at Pueblo, Colo. The water power development is described at length.—*Elec. Rev.* June 13.

TRACTION.

New Motor Cars for the Central London Railway.—An article containing an illustrated description of the new cars adopted by the above railway. The new trains consist of five ordinary and two motor cars, one at each end of the train. The motor cars have the underframe bent over the top of the motors instead of having the truck swinging between the sole bars, as in the old cars. The motor truck carries two motors rated at 130 hp on the basis of one hour's run with a temperature rise of 75° C. at the hottest part. The motors are of the solid frame type, the field magnet being a single casting, supported by two bearings on the truck axle and a lug resting on a bracket riveted to the transom. The magnet frame is provided with openings at each end, by which the armature can be removed. These openings are closed by circular castings, which carry the armature shaft bearings. The framework of the motor has ventilating covers at the end farthest from the commutator. The armature has ventilating ducts, possesses 39 slots with 10 conductors per slot, and is "series-wave" wound. The commutator has 195 commutator bars. On account of the limited space available, an interesting design has been adopted for the framework of the motor, the commutator at one end and the armature end plate at the other, overhanging the bearing. The armature shaft is hollow, allowing a stream of cold air to pass through it and through the ventilation ducts in the armature. The complete motor weighs 4,375 lbs., including gear, of which 2,040 lbs. is spring-borne. With 200 amp. at 500 volts, each motor gives a tractive effort of 3,150 lbs. at the tread of the wheel, which is 34 in. in diameter. The truck carries a collector shoe of chilled iron.—Lond. *Elec.*, June 12.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

New Aberdeen Electricity Works.—An illustrated description. Power is furnished by 6 water tube boilers, fitted with superheaters and chain grate stokers. The generating sets comprise 3 sets of 200 kw each, and 2 of 420 kw. The machines are compound-wound and fitted with throw-over switches to put in the compound winding when connected to the traction board, or they can be run as shunt machines on the lighting circuits. There are also one 60-kw balancing set and one boosting set consisting of a 110-hp, 440-volt motor, directly coupled to two 42-kw dynamos for charging the batteries. The battery room contains two batteries of a capacity of 2,200 amp.-hours at 220 volts.—Lond. *Elec.*, June 12.

REFERENCES.

Electricity Supply for Small Towns and Villages.—Mountain.—An abstract of a paper read before the Leeds Section of the Institution of Electrical Engineers, in which the author considers the question for the conditions obtaining in England. He gives a detailed estimate of the total cost of generation per unit sold, based on the use of oil, town gas, producer gas, and steam.—Lond. *Elec.*, June 12.

Electric Light Stations, Their Design and Arrangement.—Matthews.—An abstract of a paper read before the English Society of Engineers, with abstract of the discussion.—Lond. *Elec.*, June 12.

Toronto Electric Light Company.—An illustrated description of the works.—*Can. Elec. News*, June.

Electric Lighting by Incandescent Lamps.—A. H. M.—A short article in which the author discusses some causes of trouble arising in their operation and points out the remedies.—Lond. *Elec. Eng.*, June 12.

WIRES, WIRING AND CONDUITS.

Prevention of Electrically-Deposited Dust.—Munroe.—The author states that in lighting installations with continuous-current supply, when one wire is earthed and the voltage is above 200, dust gathers in quantity in the vicinity of all flexible conductors, and also on the outside surface of the bulbs of the lamps. He conducted a test with differently covered conductors and found that standard flexible wire is the most troublesome. He states that the trouble could be overcome if the flexible wire were made concentric with the earth-connected wire outside, there being no dust gathering on the latter wire. He thinks that if such wires were adopted, it would do much to delay the ruin of many a valuable wall decoration, be it paint, paper or tapestry.—Lond. *Elec. Rev.*, June 5.

REFERENCE.

Insulation and Mechanical Protection of Electric Wiring.—A. H. M.—The author gives his opinions, based on a practical experience with the various systems, as to the most suitable arrangement for given requirements. He discusses wood casings, plain iron gas barrels, lead sheathed conductors and enamelled steel tube systems and gives precautions which are to be observed to protect the wiring from injury.—Lond. *Elec. Rev.*, June 5.

ELECTRO-PHYSICS AND MAGNETISM.

The Mighty Atom.—Rutherford.—An unofficial report under this title, of the lecture recently delivered by Prof. Rutherford before the English Physical Society, with remarks by Sir Oliver Lodge, in which he gave a condensed statement of the work done by him on the subject, which has been noted repeatedly in the Digest. Rutherford dwelled upon the condensation, which he effected, of the emanations from radium and thorium and states that the emanations appear to have the properties of a gas corresponding to a molecular weight of about 100. The emanation apparently cannot be affected by any chemical treatment, however drastic. The excited activity, on the other hand, is able to be affected by certain chemical means. The amount of matter involved in these emanations is inconceivably small. It would probably take many hundreds of years, or thousands of years, to collect enough to measure by a balance. But the methods of electrical and magnetic measurement are so extremely delicate that it becomes possible to detect and measure the quantities. Thorium and radium emanations and the excited activities they produce, are but examples of a very large number of similar phenomena which the radio-active bodies exhibit. He suggests that in some way the matter in radio-active bodies is undergoing change, by means of which new substances are being produced which are temporarily active, and that, on the average, these substances decay with time. Radiation implies change. The thorium X is a body, from which something has been expelled. There appears to be a close connection between radiations and chemical change. The thorium X is similarly radiant matter; it throws off positively-charged particles. The process continues, each change being determined as to its magnitude by the activity of the preceding stage. First, there are thrown off positive bodies; these are the most important in the energy problem; they are followed by negative electrons and cathode rays. The X-rays are very readily absorbed. They are projected forth, and bring about ionization of the gas surrounding the active substance by their collision with gas molecules. When these gas molecules have absorbed the rays, the radium is subjected to self-bombardment; consequently, it grows hot and maintains its temperature above that of its surroundings, as observed by Curie. It is calculated that a gramme of radium contains enough energy to raise 500 tons a mile high; that is, about 10 to the ninth power gramme calories (this is equal to about 1,200 kw-hours). Of matter in general, we have no evidence of the amount of heat in an atom; we know nothing about the energy of the atoms. There is no reason why there should not be an enormous store of energy in matter itself, of which we get evidence only in radio-active processes. Sir Oliver Lodge, in commenting upon the paper, called attention to the importance of the phenomena, and that there was the evolution of matter going on before our eyes. Every atom contained within itself some seeds of decay; we ought not to assume that any atom is eternally permanent. It seemed as if we should find a rise and decay in ordinary matter, as if we could write a kind of history of any given piece of matter, and find it ultimately dying down, perhaps into electrons, somewhat as a nebula contracts and collapses into planets, and into a central radio-active sun. By some such process it might be surmised that there have been generated the chemical elements that we know.—Lond. *Elec. Rev.*, June 12.

A Remarkable Phenomenon with Radium.—Dorn.—A note on a phenomenon which showed itself when Prof. Dorn wanted to open a glass tube into which about 30 milligrams of the strongest radium bromide had been introduced 6 months before, and which had then been closed by fusion. At the instant, when the three-cornered file had hardly scratched the surface of the glass, the glass was pierced by an electric spark with audible noise. The spark was distinctly visible, although the occurrence took place near the window on a bright afternoon. The author thinks that the negative electrons have passed through the glass wall and gone off, while the positive ones remained in the interior of the tube. On the outer wall of the tube there has then been positive electricity accumulated by surface conduction, or from the air, which was ionized through the radiation of the radium. As the tube was held in the left hand and the metal of the file in the right, a discharge was possible, but it remains remarkable that the difference of potential could reach a value sufficient to pierce at least 0.2 millimeter of glass.—*Phys. Zeit.*, June 15.

Conductivity of Solid Paraffine Under the Influence of Radium.—Becquerel.—A paper read before the French Academy of Sciences on May 18th, giving the results of experiments conducted by this well-known investigator on the conductivity and the residual ionization of solid praffine under the influence of radium rays. The experiments were carried out with a glass tube of 3 cm diameter, against the inner wall of which a sheet of copper had been placed. In the axis there was arranged a narrow cylinder of aluminum, supported by a block of sulphur. A very small glass tube was fixed in the aluminum cylinder, which tube served as a receptacle for the radium compound, a small amount of radium chloride. The space between the two cylinders was filled with molten paraffine, as pure as possible. The copper cylinder was connected with a battery of 100 or 200 elements, the aluminum cylinder was isolated and connected with a gold-leaf electrometer. Under these conditions the electrometer showed no current; but as soon as the radium was introduced into the central tube, the gold leaf of the electroscope diverged rapidly, indicating a current through the annular layer of paraffine. When the radium was removed, the current very gradually became weaker. This phenomenon can be interpreted by the persistence of the state of ionization into which the solid paraffine has been brought by the rays, which have traversed it. The results show that it will be necessary to take the conductivity, which is acquired by paraffine under the penetrating influence of the radium rays, into account in experiments where the paraffine is used as insulator and is exposed to the rays.—*Comptes Rend.;* abstracted in *L'Eclairage Elec.*, June 13.

ELECTRO-CHEMISTRY AND BATTERIES.

The Application of the Electric Furnace in Metallurgy.—Keller.—An illustrated abstract of a paper read before the Iron and Steel Institute during its recent session by the well-known French electrometallurgist. The author first mentions the use of the electric furnace for the production of special alloys, such as ferro-chromium, ferro-tungsten, ferro-titanium, ferro-vanadium, etc., all of which, owing to the high temperature at which they are produced, can be obtained only by electric smelting. The manufacture of ferro-silicon in the electric furnace is then taken up, the sale of which is stated to have now assumed very considerable proportions. The degree of purity attainable in the electric furnace in making high-grade ferro-silicon is particularly noteworthy. The author states that the results of working have shown that the energy required for the production of one ton of 30 per cent. ferro-silicon amounts to 3,500 kw-hours. A hydro-electric works developing 10,000 ehp upon the shaft of the turbines would, therefore, be capable of producing 16,000 tons of 30 per cent. ferro-silicon annually, or nearly 30 tons per day. The furnaces for the production of the alloy in the author's works at Livet, Isere, are of 150 hp each. The raw materials employed are preferably scrap iron, quartz and coke. Quartz is more suitable than sand, since the latter often produces obstructions in the furnace. Scrap iron and steel are to be preferred to iron ore, for the reason that, together with a pure quartz, the working proceeds without the formation of any appreciable quantity of slag. The furnaces employed are of the resistance type. The author thinks that the future of the electric furnace as applied to the metallurgical preparation of this alloy is, therefore, assured beyond question, and for the reasons above mentioned the development of the industry is likely to assume considerable proportions at no distant date. The electrometallurgy of iron and steel is next taken up by the author. He has determined experimentally that one kw-year utilized in an electric reducing furnace is capable of yielding about 4 tons of steel-making pig iron. In a general way, therefore, the reduction of iron ore by electricity in a country possessing metallurgical works and equally good conditions of transport throughout, is only theoretically practicable if the ore can be obtained on equal terms, and if the cost of the kw-year does not exceed $6.12. But the scale of production in an electric furnace is less than that of blast furnaces, and therefore establishments equipped for electric working would be of less capacity. As the working expenses are also considerably higher, it does not appear as if the reduction of iron ores, so far as the smelting of ordinary pig is concerned, will ever enter the sphere of practice in any European hydro-electric works. Other conditions, however, obtain in countries like Brazil, where coal is scarce, but an abundance of good ore and water power are available. The author states that an important electrometallurgical establishment for the production of iron and steel in that country is under consideration. A concession has been granted for a waterfall of 114 ft., which is capable of supplying a minimum of 25,000 hp. The work of confining the fall within channels has been contracted for under penalty for 2,500,000 francs. The cost of 1 hp is, therefore, 10 francs per year. Calculating 10 per cent. amortization for the complete plant, the cost of one kw-year will be less than 25 francs. The iron ore is of remarkable purity and averages 65 per cent. of metallic iron, the cost, delivered at the furnace, being reckoned at 12.50 francs per ton. The conditions are, therefore, favorable for such an enterprise. A detailed description of the author's furnaces for the reduction of iron ores and for the refining of metal, is given, and also a short sketch of the author's idea of the equipment of an electric steel works.—Lond. *Elec.*, June 5.

Metallic Diaphragms.—Brochet.—An article considering the theory of metallic diaphragms for use in electrolytic processes, and giving various experiments performed by the author. The influence of the current density at the electrodes, of the surface of the electrodes and of the form of the holes and perforations, which may be employed, is discussed. The resistance of the electrolyte and the voltage of decomposition also are shown to have an influence whether the metallic plate acts as diaphragm or as intermediary electrode. The author lays down the following conditions in order to obtain the best results: 1, small diameter of the perforations; 2, as large a number of perforations as possible; 3, small thickness of the plate; 4, good conductivity of the electrolyte.—*Zeit. f. El. Chem.*, May 28.

REFERENCES.

Electric Furnace Methods of Iron and Steel Production.—Kershaw.—An illustrated article describing some of the well-known types of electric furnaces.—*Elec. Rev.*, June 6, 13.

Water Purification by Ozone.—A note on a demonstration of the ozonizer constructed by Otto, of Paris, in the plant of the Atmospheric Products Company at Niagara Falls.—*West. Elec.*, June 20.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measurement of Magnetic Forces.—Searle.—He describes how the magnetizing force (which he calls the "magnetic force") can be read off directly in gausses on a Weston millivoltmeter, by adjusting a shunt and another resistance in series with the instrument, but also shunted by this same shunt: by properly adjusting these two resistances, the readings may be made to indicate the gausses directly, or some convenient multiple of ten times the actual number. He used this in connection with tests for measuring the quantities of the iron for transformers, and found it a great convenience to read off the results in gausses directly or to adjust for specific readings. Although not so stated, such an adjustment of a voltmeter can be correct only for the particular magnetizing coil of an apparatus, and would, of course, be quite different for any other coil. The connections used in this method are illustrated.—Lond. *Elec.*, June 12.

REFERENCES.

Development of the Current Interrupter.—Wright.—The first installment of an article dealing in the present issue with the older forms of interrupters.—Lond. *Elec. Rev.*, June 5.

Universal Registering Galvanometer.—Armagnat.—A description of a new galvanometer of the Deprez d'Arsonval type, constructed by Carpenter. The paper is arranged vertically and moves through slots at the top and the bottom of the apparatus.—*L'Eclairage Elec.*, June 13.

TELEGRAPHY, TELEPHONY AND SIGNALS.

The Equipping of Telephone Exchanges.—Clausen.—The author considers in detail the cases of a small exchange of not more than 300 subscribers' ultimate capacity, an exchange of an immediate installation of 500 lines, and a capacity of 1,200 lines, and a large exchange of 3,000 lines, with an immediate installation of 1,500 lines. He arrives at the following conclusions: For exchanges up to say 300 lines' capacity, the magneto board is the most economical. For exchanges expecting to reach 1,200 ultimate, the centralized calling trunking board is on an equally desirable basis with the common battery multiple. For a 3,000-line capacity exchange only the common battery multiple is to be considered, but special study must be given to the power proposition.—*West. Elec.*, June 20.

REFERENCES.

Space Telephony.—PERKINS.—An illustrated description of Ruhmer's photographophone and apparatus for space telephony, as described in Hammer's recent lectures.—*Electricity*, June 10.

Anglo-Belgian Telephone Cable.—LANCE.—An illustrated abstract of a paper read before the Societe Belge d'Electriciens on the construction and the laying of the above cable.—Lond. *Elec.*, June 12.

Seattle Independent Telephone Plant.—DIERINGER.—An illustrated article with a description of the power plant and the exchange equipment.—*West. Elec.*, June 20.

Telephone Engineering.—HANDY.—The first installment of an article on the design and construction of modern telephone plants in large cities. The general design of a plant is taken up and discussed for a city of 300,000, 500,000 and 1,500,000 inhabitants.—*Elec. Rev.*, June 20.

MISCELLANEOUS.

Shock of 55,000 Volts.—A brief record from the *Neue Wiener Tageblatt* of an extraordinary case in which a workman was subjected for 5 minutes to a discharge from a 5,500-volt, three-phase circuit and yet survived. He appears to have suffered no permanent injury except to his hands, which were so severely burnt that amputation may be necessary. The upper skin of the front and back of the hand and of the left forearm was entirely detached from the lower skin and was completely charred and dried up. The under skin looked as if it were cooked and had lost all sensation. The sole of the left shoe was perforated and torn away in places. Prof. Jellinek delivered a lecture on this case to an Austrian medical society.—Lond. *Elec. Rev.*, June 5.

Electro-Medical Installation.—A short article describing the new electro-medical installation at the Middlesex Hospital. It is supplied from the street mains with 200 or 100 volts continuous current, and high-frequency currents are generated either by a motor transformer or by the ordinary Tesla apparatus with condensers, spark-gaps and step-up transformers. For treatment with ultra-violet light there are two Finsen 1,000-cp arc lamps and a Leslie-Miller ultra-violet lamp. Experiments are also made with the Cooper Hewitt mercury vapor lamp for the generation of ultra-violet light. The equipment also includes x-ray instruments and the ordinary apparatus for galvanic and faradic treatment.—Lond. *Elec. Rev.*, June 12.

Protection for Electrical Industries in England.—BYNG.—An article in which the author voices the agitation at present going on in England for a protective tariff from the standpoint of the electrical manufacturer. He strongly advocates the introduction of such a tariff. He says: "As an English manufacturer, I say that there is not a single electrical article, which I will not produce as well, as cheaply and as quickly as any foreign manufacturer, if I receive the same help and protection as are enjoyed by the foreigner. But I cannot be expected to risk my money when I am heavily handicapped by not having a secure home market. . . . As a manufacturer, I emphatically endorse Mr. Chamberlain's promise of higher wages for working men in an era of protection; indeed, so convinced am I of the truth of this, that I am prepared to give an undertaking to pay higher wages as soon as this country protects me against the foreigner." The author appeals to his fellow electricians not to leave off working until the great consummation has been achieved, which shall put the English nation in the same position as that held by other countries.—Lond. *Elec. Rev.*, June 12.

REFERENCE.

Instruction.—Two articles describing the new laboratories of electrical engineering at the Massachusetts Institute of Technology and the plans for the new engineering building at the University of Pennsylvania.—*West. Elec.*, May 16.

Directory of Electrical Societies, Etc.

AMERICAN STREET RAILWAY ASSOCIATION, Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Annual convention, Detroit, Mich., July 14, 15 and 16.

Warren Rotary Engine.

Some time ago we referred to an interesting type of rotary engine invented by Mr. I. C. Warren, and are now enabled to give a description in detail of the mechanism. The engine is being placed on the market by the Rotary Engine Company, Keystone Telephone Building, Philadelphia.

The principal cause which has been responsible for the long delay in producing a feasible engine of the rotary type has been the apparently opposing requirements of maintaining steam-tight joints conjointly with a piston speed so high as to prohibit the use of any heretofore known means of packing or insuring the necessary perfect contact between the moving piston and the walls of the containing steam chamber or cylinder. With this difficulty to face, it is highly improbable that many of the numerous proposed designs of rotary engines have ever been developed far enough to warrant consideration of such details as the percentage of cylinder or port clearances relative to the piston displacement, the proper maximum rate of flow through steam and exhaust ports and passages, the ratio of cylinder and receiver volumes, etc. It is certain that in the vast majority of recorded cases of failure the engine has been built solely on the strength of a single accidental "idea"; the primary, and usually the only thought, apparently, being simply to make something that would "go round" quite regardless of whether the proposed construction could be made to embody the usual fundamental characteristics of a steam engine.

In the course of the several years of study and the long series of practical experiments that preceded and led up to the final production of the perfected Warren engine, the inventor worked over practically the entire field of previously proposed constructions, as recorded in the United States Patent Office files, with a view to determining the nature of the fundamental difficulties to be overcome. For the principal of these—the question of tight joints—there appeared to be no possible adequate remedy within the lines of accepted engine building practice since, in order to constitute any material improvement over the old forms the rotary engine must be capable of operating at a piston speed of some 3,000 feet per minute—a speed fully double that at which a "tight" piston can be lubricated or operated safely; and, since it appeared desirable to operate at even higher speeds than that mentioned, it became evident that some radically new principle of construction must be adopted if the exacting requirements of the case were to be met.

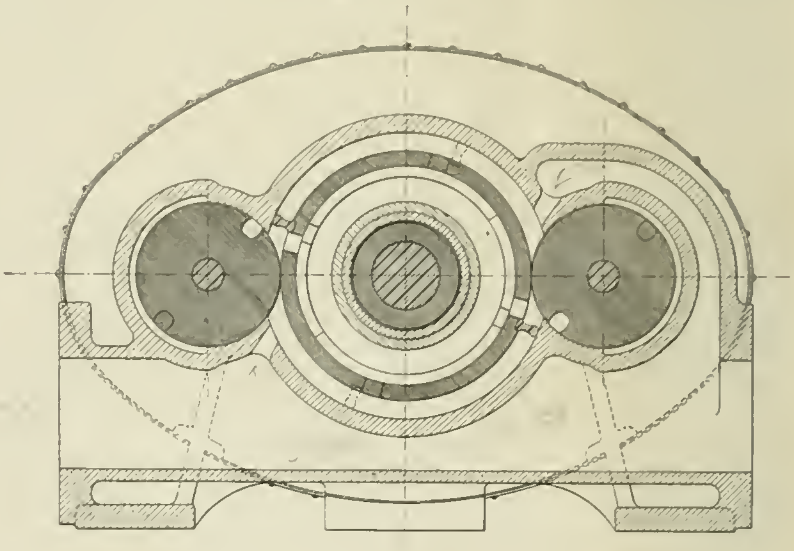


FIG. 1.—CROSS-SECTION OF ENGINE.

The new principle upon which the Warren engine is based was developed and demonstrated in the course of the experiments above referred to, and like the majority of important practical inventions, proves to be remarkably simple in its adaptation to the problem in hand. Considered broadly and in its effective essence, it consists in doing only just what is required in the specific case under discussion—the insuring a condition of perfect mechanical contact between two surfaces designed to form a steam joint, but without subjecting those surfaces to unnecessary and injurious pressure in order to hold them together against the action of the steam.

In a word, a condition of perfect contact, maintained absolutely without appreciable pressure between the contacting surfaces. The elements that contribute to the production of mechanical friction between moving surfaces in contact are, simply, surface area multiplied by the pressure under which said surfaces are forced together; and, consequently, if the pressure element be entirely eliminated, there cannot possibly be any friction between surfaces of any area moving upon or relative to each other at any conceivable speed. It is equally certain that two true and polished surfaces may be placed in intimate contact without the use of any measurable pressure whatever, and that such a contact will be quite as effective in forming a joint against the passage of steam as if the surfaces were being forced together under heavy pressure.

Referring to the cross-section indicated as Fig. 1, it will be observed that, in general arrangement, the engine consists of a concentric piston wheel and shaft mounted between oppositely placed rotary abutments. To this extent it cannot be said that the construction is altogether novel, as engines having rotary geared abutments have frequently been built in the past; it having been recognized, apparently, in these cases, that reciprocating parts were obviously very much out of place in a high-speed rotary engine. This more or less familiar general arrangement was adopted primarily because of its simplicity and manifest adaptability to the end in view; it will be conceded, however, upon reference to the drawings showing the longitudinal arrangement, that the similarity to familiar forms does not extend further than to warrant this first general classification.

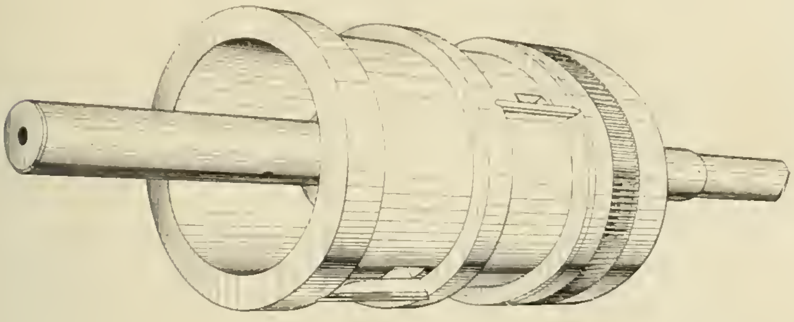


FIG. 2.—DRIVING WHEEL.

As shown in Fig. 2, the piston wheel carries a broad flange at either end, between which, across the face of the drum of the wheel, the vanes, or, as they may for convenience be termed, the "pistons," are mounted; the outer edge of the blade being turned off in line with the peripheral surface of the flanges, thus adapting these surfaces to run in close contact with the surrounding casing. It will be noticed that the main bore of the casing has a slight taper from end to end, and that the periphery of the flanges and "pistons" is similarly tapered to fit the bore, and it is by this expedient that the desired condition of continuously maintained "pressureless" contact is to be established between the moving flanges and pistons and the surrounding casing. Owing to the slight difference of diameter between the two ends of the tapered wheel, which are exposed to the pressure of steam introduced into the interior of the wheel—the web being perforated in order to establish uniformity of pressure throughout—a moderate end thrust upon the wheel and main shaft is created, the tendency of which is to force the tapered wheel further into the tapered bore, thus closing the joint between flanges, pistons and casing.

Now, in order to prevent the wheel from jamming forcibly into the tapered bore and sticking fast a small thrust bearing is mounted upon the shaft outside the casing, with provision for adjusting same along the axis of the shaft, thus making it possible to locate definitely the piston wheel in any desired plane relative to the casing. It is obvious that by this means the wheel may be set to run within an infinitesimal distance from the interior surface of the shell, and that through the normal wear on the thrust bearing any deviation from this original plane will be in the direction insuring increasingly intimate contact between the surfaces engaged. It is further evident that, owing to the high peripheral speed of the flanges and pistons which must, necessarily, give rise to rapid wear in case of any pressure existing between the surfaces, and to the fact that the wear upon the well-lubricated thrust bearing under its very moderate load will be exceedingly slow, the resulting end movement on the part of the wheel and shaft will never proceed at a rate sufficient to produce appreciable friction or wear between the involved moving and stationary surfaces. It has been most thoroughly and satisfactorily demonstrated by continuous operation of the engines under service conditions, that the wheel will rotate smoothly at the highest desired speeds, i. e., up to 5,000 feet per minute peripheral speed, while maintained in such intimate contact with the casing that a mirror-like polish is imparted to all the contacting surfaces.

The nicety of mechanical balance necessary in the maintenance of this ideal condition of contacts is easily secured in the essentially symmetrical piston wheel, since the speed at which it operates is not so high as to introduce those extreme difficulties encountered in the balancing of turbine wheels, which must operate at peripheral speeds from five to seven times that desirable or necessary for best results in the case of an engine operating upon a "static pressure" cycle. Likewise, by reference to Fig. 1, it will be noted that all lateral steam pressures upon the wheel and shaft are perfectly balanced, since equal areas at diammetrically opposite points are in all cases exposed to equal pressures. Thus it will be seen that the main driving element is absolutely free from all strains calculated to deflect it from its designed center and axis of rotation, save only the actual weight of the wheel and shaft, which the liberally designed and bath-lubricated main journals are amply capable of sustaining without greater ultimate deflection than would be compensated for by the gradual advance of the piston wheel into the tapered cylinder bore.

Referring now to the rotary abutments, it will be observed that these are provided with a peripheral notch or groove extending from end to end and adapted to admit of the passage of the wing pistons. These grooves have a sufficient cross-section to allow ample clearance for the passage of the pistons, and the abutments are connected for rotation with the main wheel through the medium of toothed rings or gears, giving a ratio of two turns of abutment to one of wheel; the single groove in the abutment being thus made to meet successively each piston. The abutments are mechanically balanced by drilling opposite the groove and are tested on a speed lathe for centrifugal balance. It will also be observed that the abutments are mounted upon shafts having bearings formed in the counterbored end plates of the abutment chamber or bore. Provision is made in these bearings for the application of elastic pressure inward or toward the center of the main shaft to offset the outward pressure of the steam which would tend to force the abutment away from the wheel and open up the joints. This pressure is applied upon small pistons or diaphragms taking steam from the interior of the engine; the pressure exerted by these pistons varies, of course, with the variations of the working steam pressure and is at all times sufficient to more than balance the outward pressure, leaving a moderate unbalanced force tending to seat the abutment in its bore and close the joint between the periphery of the abutment and the drum of the wheel.

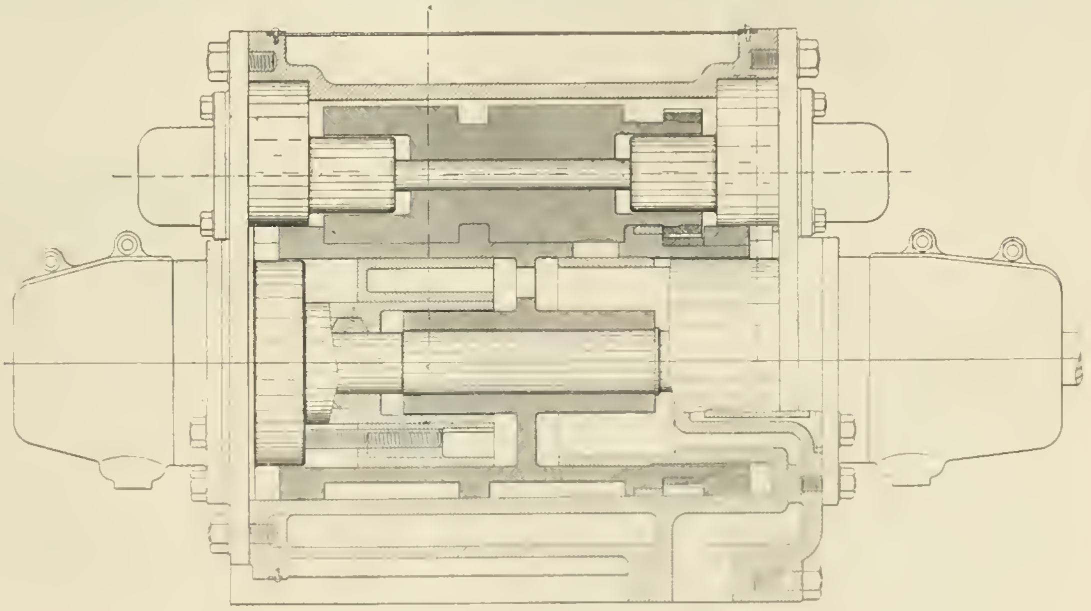


FIG. 3.—LONGITUDINAL SECTION.

It is important to note that the abutment does not merely roll upon the surface of the main wheel, but that, owing to the fact that the respective diameters of drum and abutment do not exactly coincide with the pitch diameters of the gears, a difference of surface speed is established amounting to about 600 feet per minute at normal speed. In this way a sliding contact is created which will cause the two rotating surfaces to wear each other away in harmony with the advance of the abutment due to the normal wear upon its journals. Similarly, the seat formed by the bore of the abutment is worn away at an exceedingly slow rate and thus is established between abutment and wheel and casing, the same condition of ideal "pressureless contact" described as existing between the main wheel and the casing.

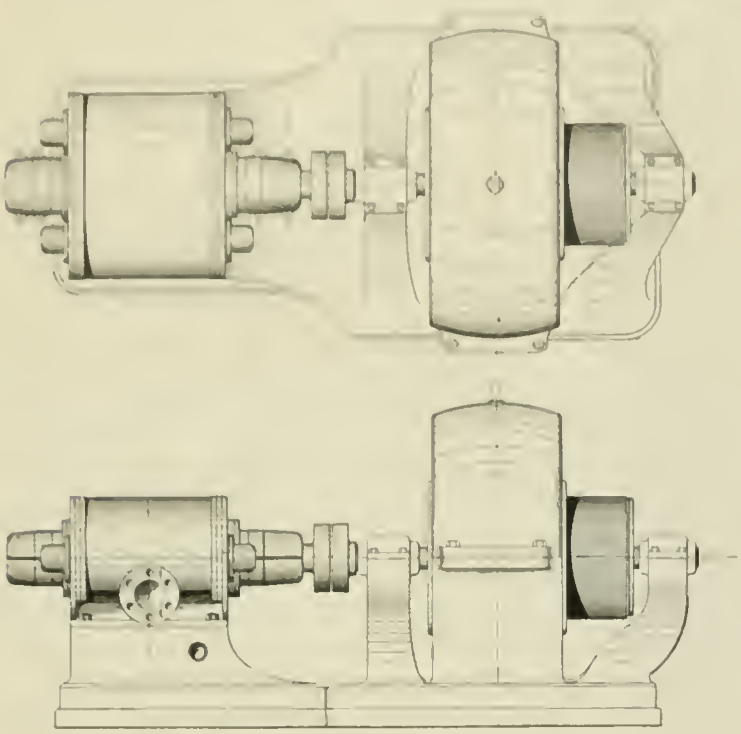


FIG. 4.—9-IN. SINGLE-EXPANSION ENGINE.

It may be pointed out that the abutments, being mounted between the flanges on the main wheel, and being free to move on their bearings and seats in a line parallel with the axis of the main shaft, are enabled to follow the longitudinal movement of the wheel in adjustment and normal wear; and also that since the abutments are symmetrical in construction and the steam pressures on the opposite ends equal, it follows that there is no tendency on the part of these members to crowd against either flange, and, since the relative movement on the line coinciding with the pitch line of the gears is practically nil, it is evident that there can be no wear at these points; and hence it is only necessary that the parts be closely fitted originally in order to insure a permanently satisfactory joint.

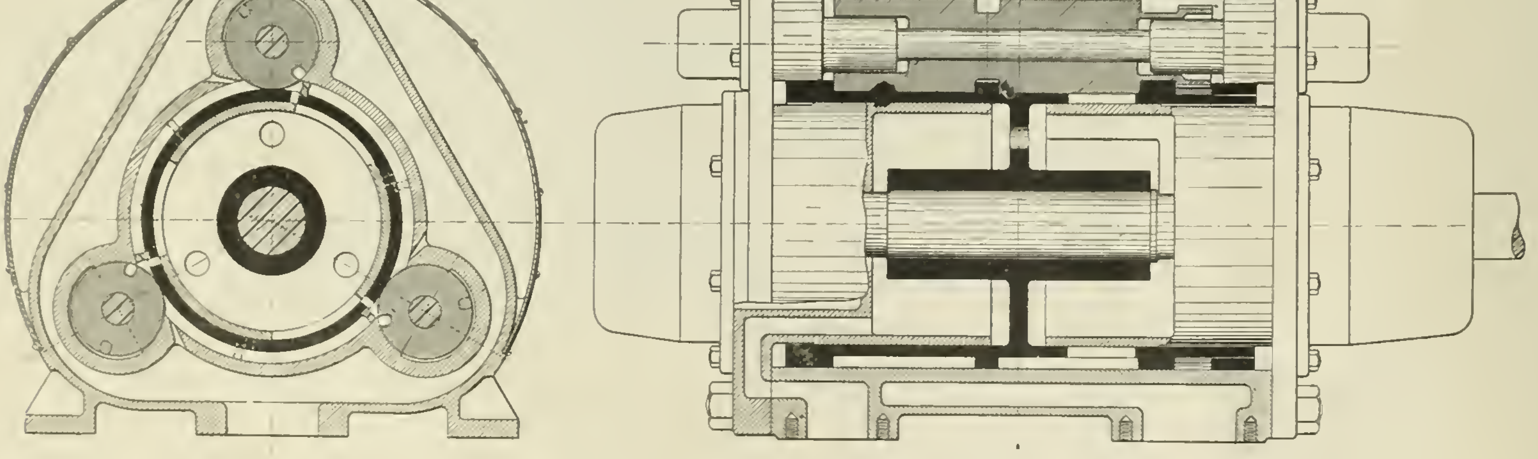


FIG. 5.—SECTIONAL VIEWS OF ROTARY ENGINE.

Having explained in detail the method by which the all-important problem of joints and "packing" has been attacked, we may now refer to the features of functional operation. The steam cycle in either the simple or the compound form is essentially similar to that of a Corliss engine, except for the fact that admission and cut-off are equally quick. Steam is admitted into the interior of the drum-shaped piston wheel, as shown in Fig. 3, and enters the working steam chambers through the ports shown in the drum of the wheel; the engine shown being of the type designated as "duplex simple"—that is, the single expansion chamber is divided by an intermediate flange into two equal compartments having pistons set 90° apart in order to insure uniform turning effort. The two drum valves are mounted upon inwardly projecting hubs cast as an extension of the casing heads, and, in the simple form of engine shown, are made fast to these hubs, giving a fixed cut-off; governing, when required, being accomplished by throttling. In the larger sizes and in compounds the drum valves are arranged to be shifted upon the hubs and are controlled by a special governor, which regulates the speed of the engine by varying the point of cut-off in the high-pressure cylinder.

It is not necessary to maintain a perfectly tight joint between the drum valve and the interior surface of the piston wheel, as any leakage past the valve merely results in raising the expansion line in the working chamber and adding a slight superheat during the latter stages of expansion. The valve is, therefore, fitted simply with a close "running fit"—a condition which will, of necessity, be maintained practically perfect indefinitely, since the valve, being mounted upon a stationary hub, will always maintain its original central position and any downward movement of the pistol wheel, due to wear upon the main journals, will tend to close the joint above and open the joint below the horizontal center line of the engine between valve and wheel, thereby creating a difference of mean pressure between the upper and lower steam chambers through the increase of leakage past the valve into the lower and a corresponding decrease of leakage into the upper chamber. This lowering of the main wheel center cannot proceed far before the increase of mean pressure, in the lower steam chamber will become sufficient, acting upon the full projected area of the wheel drum, to balance or support the weight of the wheel and shaft, and it is obvious that after this point is reached there can be no further downward wear of the main journals and consequently no further increase of leakage past the cut-off valve.

It is claimed that the frictional resistance of the Warren engine is hardly greater than that of a simple turbine wheel, while it possesses all the essential or desirable characteristics of the standard type of steam engine, and there is every reason to look forward to the realization of exceptionally high economy figures when tests of the engine in large powers are available.

Heretofore, and naturally in the course of development, only engines of small size have been built; yet, while the data secured in private tests of these machines are not available for publication, it is stated that a steam consumption ranging from 10 per cent. to 15 per cent. under the average in commercial reciprocating engine practice in equal powers has been repeatedly observed under service conditions.

The especial adaptability of the Warren engine to the purposes of marine propulsion is most obvious, as the engine is readily reversible, and steps are now being taken to introduce it generally in this field. In fact, its rapid and extensive adoption in every conceivable line of progressive power development is anticipated, as it is in all respects perfectly qualified to perform the full functions of a reliable prime-mover, possessing, apparently, every desirable feature of the reciprocating engine in addition to the manifest and special advantages associated with the ideal rotary prime-mover, such as a wide, practically unlimited range of speed with uniform angular velocity, freedom from vibration, greatly reduced bulk and weight, exceptionally low first cost as compared with either reciprocating engine or turbine, etc.—all contributing to adapt this form of engine to the widest possible field of application.

Fig. 4 shows a Warren engine direct-connected to a dynamo, and Fig. 5 illustrates a type which has been designed to meet the special requirements of traction and hoisting service and other lines of power application where great starting power, compactness and light weight are of primary importance. Except for the triplex arrangement of abutments and the attendant reduction of abutment diameter, relative to the wheel, the design is essentially similar to our standard two-abutment single-expansion engine. This type is recommended for all service requiring particularly powerful and uniform starting torque, quick acceleration and high power per unit of weight and bulk of engine.

The Special Telephone System of the Manhattan Elevated Railway, New York City.

One of the most interesting separate or specialized telephone systems recently put into service is that of the Manhattan Railway Division of the Interborough Rapid Transit Company, New York City. The use of the telephone on long-distance main trunk lines of steam railroads is already familiar, but the application of it to traffic like that of the Manhattan system is a novelty, as it partakes in addition of some features of the private branch exchange work. The exchange is located at Ninety-ninth Street and Third Avenue, in operating rooms built for the purpose above the car shops of the company. The main operating room contains the switchboard, the distributing frame, fuse rack, relay and coil racks and the wire chief's desk. The board is of the central energy type. The maximum distance from the central to the instruments is about 8½ miles, so that assuming the central to be midway in the system, the total length of a conversation circuit might be about 17 miles, which, of course, is considerably greater than is ordinarily utilized in central energy systems. In fact, there was at first some doubt as to whether the longer lines might not give trouble on account of their extra resistance and capacity, but the difficulties have been admirably met and the apparatus responds excellently to all the requirements made upon it.

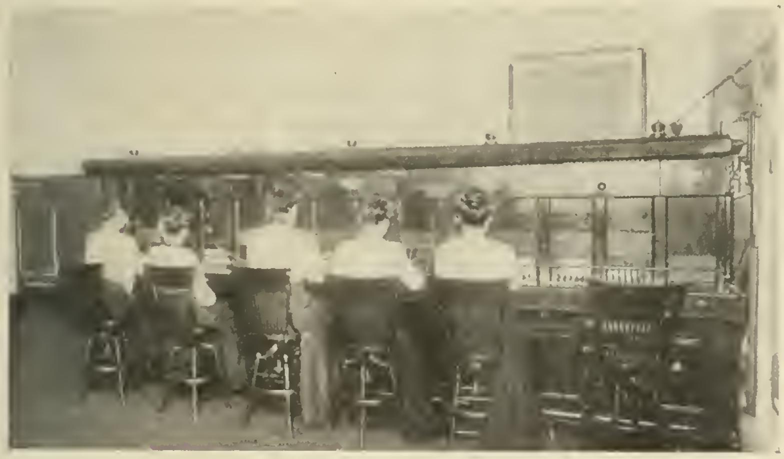


FIG. 1.—SWITCHBOARD.

The switchboard which is shown in Fig. 1, is of mahogany, the front and rear panels being readily removable and all parts being accessible. Positions have been laid out for six operators, each position being equipped with 15 pairs of intercommunicating plug circuits consisting of double supervisory signals and combination ringing and listening cams. The cords are white, brown or green, each cord being of a color different from that of the adjacent ones. There is also a testing section on the board, including a voltmeter and cord circuits for making ordinary line tests. At the present moment about 300 lines are in use, but the board as equipped would allow the operation of about 600 lines. The board is operated with lamp signals in the usual way with signal lamps, and for night service an extra relay is employed which causes a bell to ring in addition to the lighting up of the lamp signals. This lessens the strain upon the night operator and at the same time gives him instant warning of a call.

All the wiring work at the exchange is as thoroughly carried out as though it were a large central office system. The incoming lines run to one side of the distributing frame behind the switchboard and are jumped across to the other side, from which point they connect in the usual manner with the relays and the jacks. The battery is connected to the fuse panel where fuses are provided for each cord circuit and all the other principal leads. Carbon blocks with perforated strips of mica between them are used for lightning protection. The wire chief's desk, shown in Fig. 2, is placed well in front of the switchboard and is so arranged that the attendant in charge can act both as monitor and as wire chief. The work, is of course, quite different from that which would usually occur under the eye of such an official, as a telephone is located in each passenger station and switch tower along the line of the Manhattan Railway, as well as in all the offices, the power house, sub-stations and car shops.

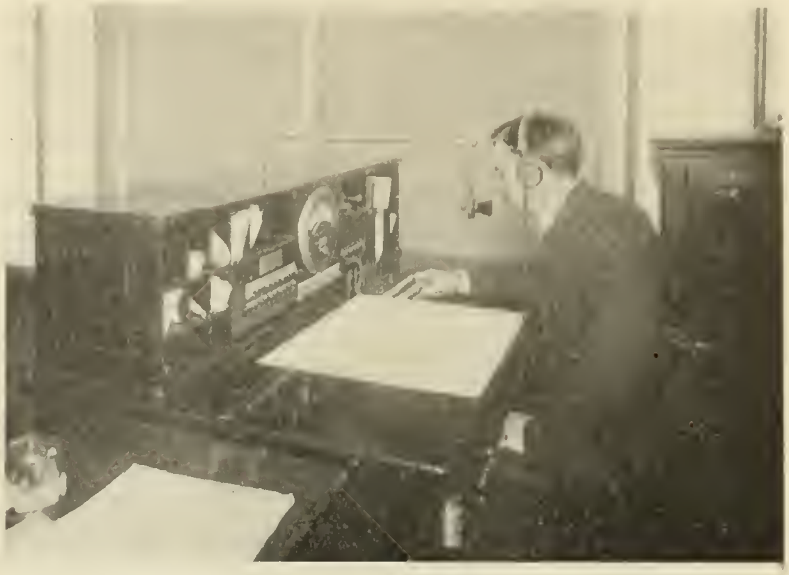


FIG. 2.—WIRE CHIEF'S DESK.

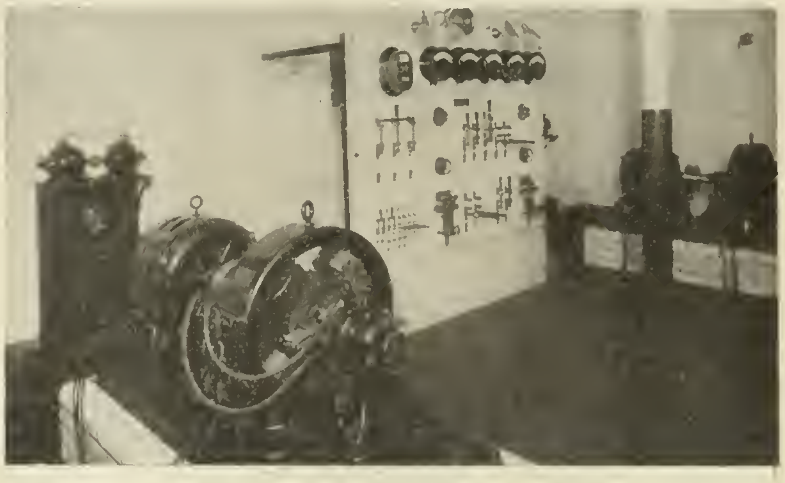


FIG. 3.—CHARGING AND RINGING SETS.

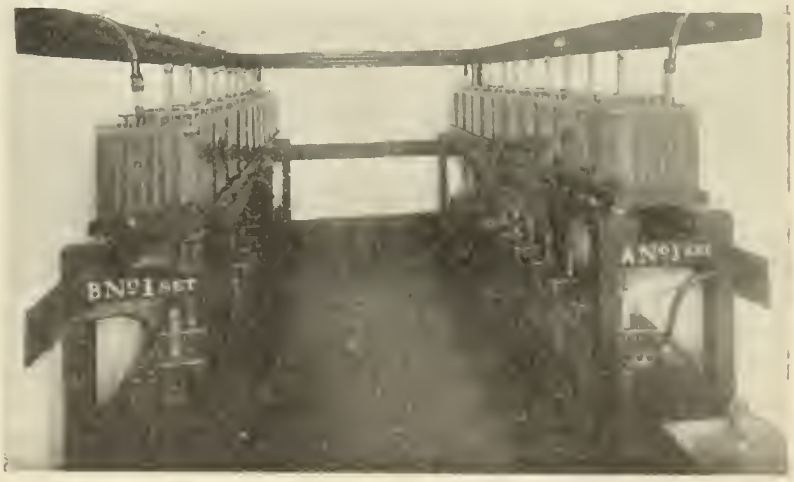


FIG. 4.—STORAGE BATTERY PLANT.

For the power equipment, two charging and ringing sets with batteries are furnished. These duplicate sets consist of a 5 hp, 300-volt, three phase, General Electric induction motor directly coupled to a 3 kw, 30 volt, Holtzer Cabot telephone generator running at 750 r.p.m.; the current for these motors coming from a sub-station through step-down transformers. Each charging set is mounted on an iron base supported by a white enamel brick foundation. Ringing current is supplied by Holtzer-Cabot generating sets, the motor taking about 24 volts from the storage battery and the generator end delivering alternating current at 75 volts. There are two sets of batteries of the chloride accumulator type furnished by the Electric Storage Battery Company. Each set consists of 11 cells in parallel and two in series. These sets are used one at a time, the other charging. The power board is of white marble and carries the necessary complement of measuring and indicating instruments, inclusive of Weston voltmeters and ammeters and a Westinghouse polyphase wattmeter. Two I. T. E. under-and-overload circuit-breakers protect the batteries when charging. These portions of the plant are shown in Figs. 3 and 4.

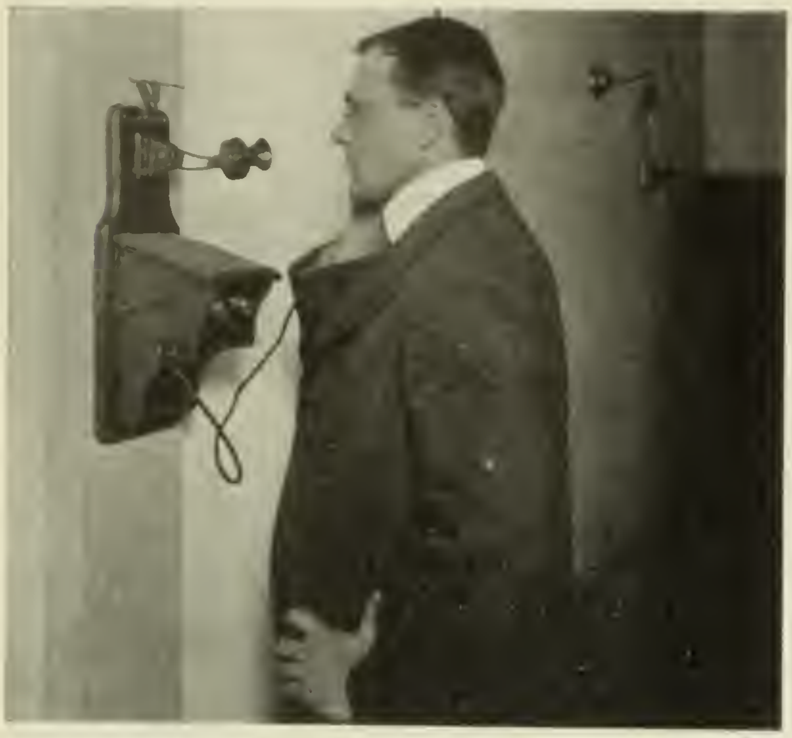


FIG. 5.—WALL TELEPHONE.

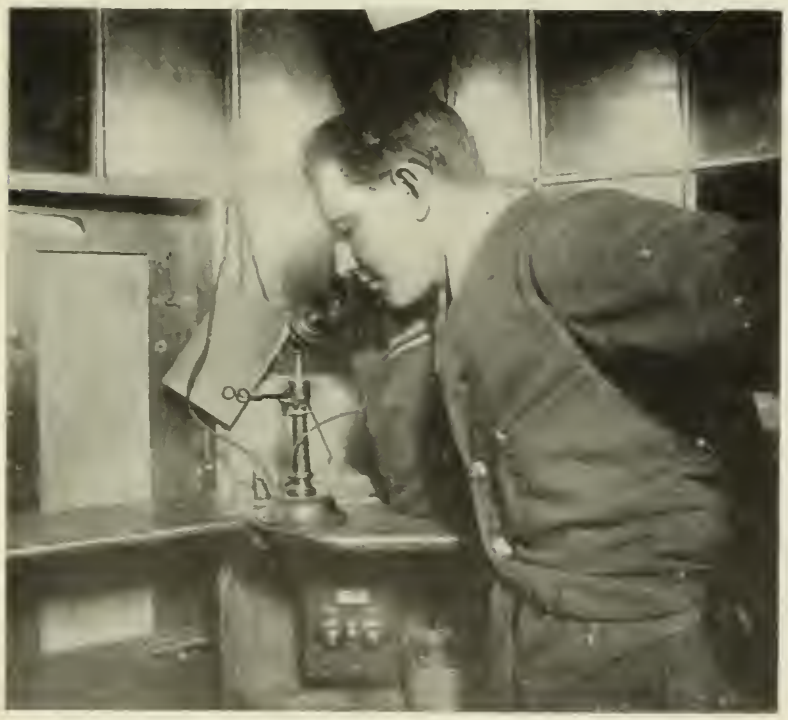


FIG. 6.—DESK TELEPHONE IN TICKET OFFICE.

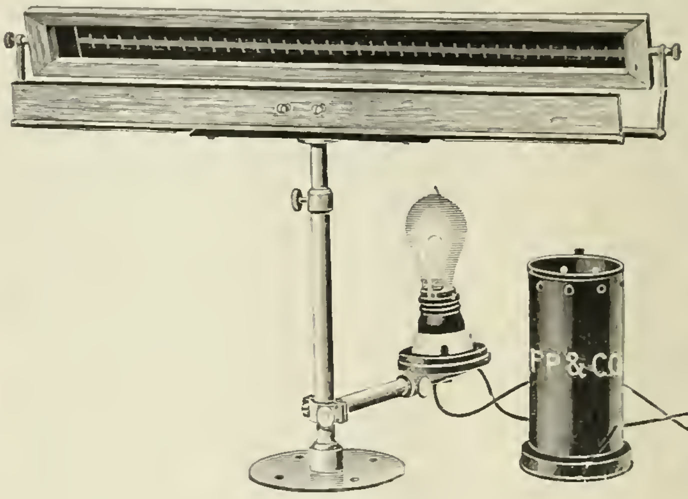
As indicated in Figs. 5 and 6, two styles of telephone are in use in the system. One of these is a wall type, which is employed in all the car shops, switch towers, inspection sheds, etc. The other style, Fig. 6, is a desk telephone, which is handily at the elbow of the ticket seller, and puts every station in direct touch with headquarters. All the outside wiring connecting the exchange with the instruments consists of lead-covered cable, with from 5 to 120 pairs. These cables are carried by a galvanized guy wire fastened to the elevated railroad structure with iron brackets or hangers, and are spun to this guy wire by marline. At each station the cables are pot headed and the wires are brought out to binding posts mounted on hard rubber strips in a junction box inside the station waiting room.

As will be seen from Fig. 1, women operators are employed in the day service, but the night service is taken care of exclusively by men operators. The force required for the system consists of the telephone engineer, Mr. W. H. Kinlock, eight operators and five repairmen. The operators work in three shifts, with five operators at the board in the busiest time of the day. As soon as the Interborough Rapid Transit Company's subway is completed, additional telephones will be installed and connected with this exchange, the board having been laid out expressly with this end in view. The entire equipment outside of the cable work was installed by the Lambert Schmidt Telephone Manufacturing Company, of New York City, under the direction and supervision of Mr. Hugh Hazelton, electrical engineer of the Manhattan Company, who was assisted in this work by Mr. Kinlock. The Lambert Schmidt Company was represented in the installation by Messrs. W. T. Booth and John C. Alberts.

Mirror and Scale Stand.

The mirror form of galvanometer lamp and scale stand or support, as shown in the illustration below, was designed and constructed by the firm of Foote, Pierson & Co., manufacturers of electrical measuring instruments, etc., 82-84 Fulton Street, New York City, according to the general plans furnished by the Lamp Testing Bureau. A number of these supports were constructed for the latter concern, and have shown themselves so well adapted to their purpose that Foote, Pierson & Co., are placing them on the market and call general attention to the model.

The support is so arranged that the scale can be raised in height to any desired position, and with a horizontal adjustment, so that the beam of light reflected from the galvanometer can be brought to the zero point. With the adjustable mirror the scale is seen with equal facility by the observer whether sitting or standing. With the opaque scale there is no question of parallax. When a ground glass scale is used, it is necessary in order to see the spot of light clearly, that the eye of the observer should lie in the direction of the beam. With this form of scale, the spot of light can be seen equally well from nearly every practicable position.



MIRROR AND SCALE STAND.

In addition, the stand has a lamp support which is arranged for an incandescent lamp. This support can be raised or lowered and turned through any angle in the horizontal position. The lamp is covered with a hood having an adjustable shutter so that the beam of light can vary in width. The holder can also be arranged so that a gas jet can be used instead of the incandescent lamp.

Lost and Unaccounted-For Current.

In view of the recent discussion by the National Electric Light Association of lost and unaccounted-for current, the following data furnished by the Westinghouse Electric & Manufacturing Company will be of interest: The central station referred to is operated by steam power furnishing current for lighting residences and business places, principally the former. During the year 1899 the plant was operated during the night hours only, and there were in service on its circuits 353 transformers and 406 meters, all of old types. The customers were metered.

Being satisfied that the distributing system was very inefficient, the superintendent decided to demonstrate this to the management. There being no primary wattmeters on the switchboard for measuring the total output of the station, no comparison could be made with the amount of current paid for, and he was compelled to arrive at this comparison by a different method. He purchased a 10-amp., 110-volt Westinghouse round pattern wattmeter, which was installed in a residence in series with a 5-amp. meter ot the type then commonly in use on the circuits. Before making the test the old type meter was completely overhauled and cleaned.

At the end of ten days the old meter indicated a consumption of 24 kw-hours and the Westinghouse wattmeter 29.1 kw-hours, a difference of 5.1 kw-hours, or 21.25 per cent. This, at the average rate charged for current at the time, resulted in a loss of 9.16 cents per night on this customer. The above test resulted in the purchase and installation of Westinghouse primary wattmeters. During the year 1899, when the old meters and transformers were in use, the station output was as follows:

	January.	July.	Year.
K.w. hours generated	36483	22376	379112
K.w. hours sold	13945	5888	118992
Per cent. sold	36.8	26.3	31.4
K.w. hours generated for 1 k.w. hour sold.	2.5	3.89	3.19

This indicates that for the year 1899 3.09 kw-hours were generated for every 1 kw-hour paid for, or, in other words, only 31.4 per cent. of the generated current was paid for, the remainder being lost. A revenue of $21,375 was received for the 118,992 kw-hours sold during this year, making an average price of 17.97 cents per kw-hour. The operating expenses of the generating station during the same year, including all labor and material, interest on bonds, taxes, cost of collections, insurance, free lamp renewals, advertising and general expenses were $14,406.25, making an average cost of approximately 3.8 cents per kw-hour generated, or 12.15 cents per kw-hour, leaving an average profit per kw-hour sold of 5.82 cents.

It was decided to substitute a few large transformers having the same aggregate capacity as the 353 smaller ones, and to use short secondary distributing systems. By this means current was furnished to a greater number of customers, and the core loss in the transformers was reduced by 22,500 watts. In other words, the capacity of the generating station was increased by an amount equal to the installation of a 22½-kw generator without any additional expense whatever for generating plant.

The old meters were replaced by Westinghouse round pattern wattmeters during the months of April, May and June, 1900. A test of the new meters and transformers was made in July, 1900, to compare with the test made on old meters and transformers in July, 1899. The following was the result:

	July, 1899.	July, 1900.
Kw-hours generated	22,376	19,015
Kw-hours sold	5,888	8,589

In July, 1900, a twenty-four-hour service was furnished in place of the twelve-hour service of the previous year, but notwithstanding this and the fact that additional customers had been secured during the year, the station output decreased for July by 3.361 hours. With the new meters and transformers the company gave twenty-four hours' service during July, 1900, with a generated amount of 3,361 kw-hours (15 per cent. less than under the old régime), and at the same time received payment on 2,701 kw-hours, or 46 per cent. more than with the old meters and transformers with a 12-hour service. This resulted in a decreased cost in coal for the month of $53.77, with an increased revenue of $465.19, or a net gain for the month of $518.96.

In next column is given a comparative statement of the results obtained for the years 1899 and 1901.

The increased cost per kilowatt-hour for generating current in 1901 was due to an increase in the cost of coal and supplies.

The changes in meters and transformers increased the per cent. in 1901 and reduced the cost of the current sold from 12.15 cents per kw-hour in 1899, to 6.49 cents in 1901. The average net profit per kilowatt-hour sold increased from 5.82 cents in 1899 to 7.2 cents in 1901, although the average price charged to customers had been reduced from 17.97 cents in 1899 to 13.69 cents per kw-hour in 1901.

	1899.	1901.
Total kw-hours generated	379112	650570
Total kw-hours sold	118992	427567
Kw-hours generated to 1-kw hour sold	3.19	1.52
Per cent. of generated current sold	31.6	65.7
Total cost of current generated	$14406	$27610
Cost per kw-hour generated	3.8 cts.	4.24 cts.
Cost per kw-hour sold	12.15 cts.	6.49 cts.
Received for current generated	$21375	$58534
Number of customers	406	803
Average price received per kw-hour	17.97 cts.	13.69 cts.
Average profit received per kw-hour	5.82 cts.	7.20 cts.

Customers were pleased with the reduced price and the accuracy of the meters, and their number increased from 406 in 1899 to 803 in 1901. This additional business necessitated an increase in generating capacity from 275 kw to 400 kw.

In 1902 (23 months after installation) fifty of the new wattmeters were tested to ascertain their accuracy. It was found that forty-nine had not deviated from the original calibration; that is, 2 per cent. plus or minus from 2 per cent. of full load to 50 per cent. overload. The other meter was found to run 4 per cent. fast. All meters were operated on the baby filament of a hylo lamp, and none of them crept.

Amalgamation of the Braun-Siemens and Halske and Slaby-Arco Systems of Wireless Telegraphy.

Mr. A. Frederick Collins states that his Berlin correspondent has advised him of the amalgamation of the Braun-Siemens & Halske and the Slaby-Arco systems of wireless telegraphy. The united companies under the name of the Wireless Telegraph Company (Gesellschaft für Drahtlose Telegraphy), began business June 15, 1903.

All the contracts signed by both the General Electric Company, of Berlin, for the Slaby-Arco apparatus as well as those agreements entered into by the Braun-Siemens & Halske Company, will be fulfilled by the new company. All the patents, inventions, etc., of Prof. Braun and Dr. Slaby have been taken over by the new company.

Contracts have been signed for a long term of years by and between the inventors and the recently formed company, which gives them the virtual monopoly of the wireless telegraph business in Germany. The Wireless Telegraph Company is now ready to undertake the construction, installation and operation of either of the systems now owned by them. It is quite likely that a combination of these German systems will be finally effected and a single standardized apparatus will take the place of the dual systems.

The Executive Committee of the new company are Count Georg Arco and Mr. Georg Wilhelm Bargmann. In view of the coming conference of wireless telegraphy to be held at Berlin on August 4, 1903, this combination of wireless interests is regarded by Mr. Collins as the first step tending toward a universal alliance between all the different wireless companies of the world.

Electric Truck Operating in Boston.

The first electric truck to be used in the streets of Boston was recently put in operation by the Edison Electric Illuminating Company. It is designed for heavy work in the handling of reels of cable, storage battery fittings, and other supplies, and for pulling cables through some of the street conduits. During its first tests it was run up Beacon Street hill from Tremont Street to the State House, laden with nearly 5 tons of lead cable, and it made 6 miles per hour on the level without trouble.

For hauling cable, the truck has a winch under the driver's seat, with a special 3-hp motor to run it. The truck is propelled by two motors through triple gearing on the rear wheels. The tires are of broad, flat rubber, 5 inches wide forward and 7 inches wide behind, and the vehicle runs quietly as a result. The truck weighs about 5 tons. It is designed to run 25 miles over city streets, with one battery charge. There are 44 cells in the battery, each having 17 plates. The average cost of current for running the truck is about $1.50 per day.

Wireless Telegraphy on the "Erin."

When Sir Thomas Lipton decided to equip his steam yacht *Erin* with wireless telegraphy, he selected the De Forest system. The complete apparatus was shipped from New York six weeks ago and installed on the yacht at Greenock, Scotland, just prior to her westward trip convoying the challenger *Shamrock III*, and her consorts, the *Shamrock II* and the ocean going tug *Cruiser*. Mr. H. M. Horton, of the De Forest Company, equipped the yacht with the wireless and operated the system on its trip across.

Sir Thomas had a handsome teakwood cabin (Fig. 2) built above the saloon of the *Erin* just abaft the mainmast, and Wm. Fife designer of the new challenger, raised a special topmast and yard arm (Fig. 3) giving the unusual height for such a craft of 120 ft. above the operating cabin. The antenna consists of five wires of No. 14 rubber-covered stranded wire, six inches apart, and strung very taut from the roof-insulator to the yard peak. Notwithstanding the unusually rough voyage across, this antenna and rigging stayed aloft, without damage, all the way over.

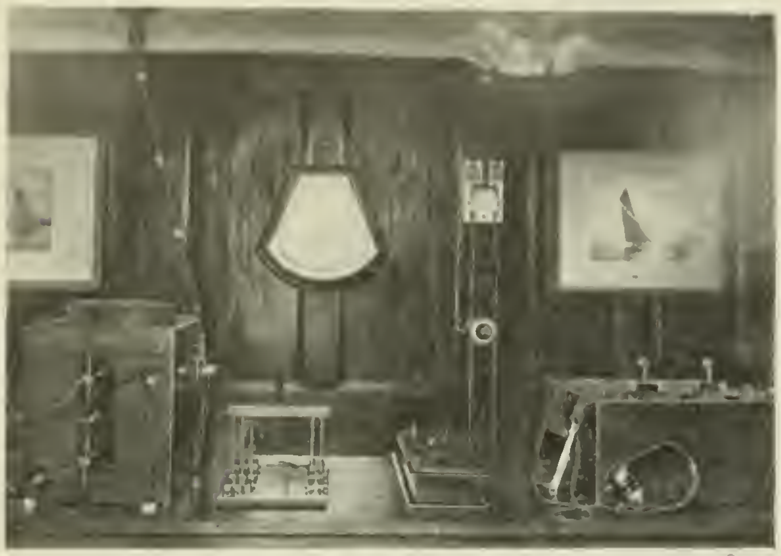


FIG. 1.—INTERIOR OF WIRELESS TELEGRAPH STATION ON THE "ERIN."

Inasmuch as the *Erin's* storage battery plant furnishes but 80 volts, the motor-generator set ordinarily furnished for the De Forest 1-kw outfits was not used. Instead a 1-kw alternating-current generator was belted direct from the fly-wheel of one of the two dynamo engines on board. The remainder of the apparatus, transformers, condenser, key and tuning circuit was located in the operator's cabin. One of the accompanying cuts shows the arrangement of the apparatus within this cabin, Fig. 1.

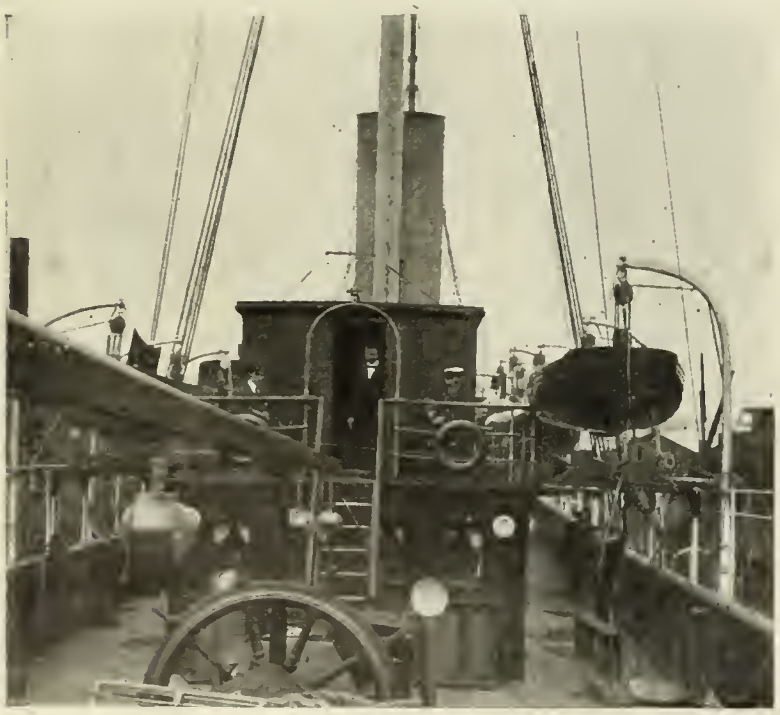


FIG. 2.—WIRELESS TELEGRAPH STATION ON THE "ERIN."

To the left on the table is located the spark-gap and condenser case and shutting switch, while the key and receiving apparatus are shown on the right. Transformers securely lashed to the framing are placed beneath the operating table out of possible danger from contact with the high tension lead.

Operators at the De Forest stations at Block Island, Point Judith and Coney Island were on the lookout for the first news from the little fleet from Thursday night, June 12 on, but on account of the rough seas encountered the *Erin* did not arrive within hailing distance until 10.50 Saturday night. Block Island and Coney Island picked the boat up almost simultaneously, she being at that time 120 miles from Sandy Hook Light. The De Forest station at Coney Island had recently been re-equipped with 6-kw apparatus, so that the operator aboard the *Erin* heard her call several hours before he was able to reply. Since then messages have been freely exchanged.

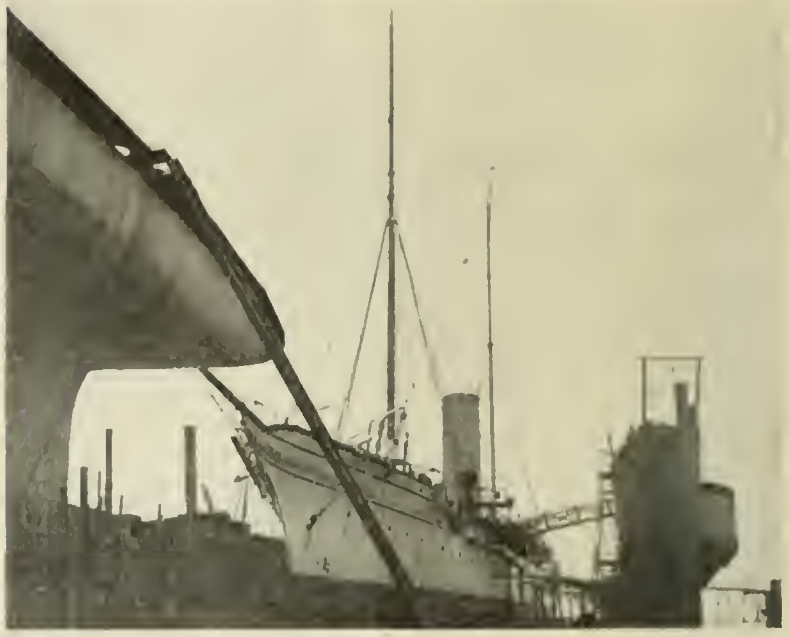


FIG. 3.—"ERIN" IN DRY DOCK, SHOWING ANTENNAE.

During the trial races of the two *Shamrocks* and throughout his stay in American waters Sir Thomas will be kept in touch with the De Forest stations around New York by the wireless system, an operator being kept on board continuously for this purpose.

Lighting Statistics.

The National Electric Light Association has issued a new edition of its report on municipal lighting statistics. The present brochure contains data from 830 cities and towns in the United States, as to the number of arc lights, candle-power, price per lamp, hours of burning, watts at lamp, candle-power-hours for one cent, nominal candle-power, price of coal, population, etc. One or two new columns are added, including the time of expiration of contract. The latter feature is interesting, but would be more so if the period or length of the contract were given instead, as that is the material point bearing on relative cost and nature of service given.

Heating and Ventilating Telephone Exchanges.

The New England Telephone & Telegraph Company, of Boston, Mass., possesses one of the most completely equipped exchanges in the country. Not only are the electrical and telephone appliances the products of the best engineering skill and attention, but the building itself has been especially designed with a view to both successful operation and the comfort and convenience of the employees. One of the first requisites of a telephone exchange building, because of the large number of employees and their constant and sedentary labor, is a proper system of heating and ventilating. The ventilation is especially important, and arrangements should be provided by which it can be maintained constant in volume independently of the amount of heat required or the state of the weather. Any natural means of ventilation is impracticable, since it is very difficult to maintain a proper circulation of air when the densities of the inside and outside air are nearly equal. With the fan system, however, all these points are easily taken care of.

In the present plant the fan, which is direct-connected to a vertical engine, forces the air through a steam heater composed of pipe coils, enclosed within a steel plate housing. The heater, however, is by-passed, so that a greater or less proportion of the air may be forced into the distributing pipes without passing through it, and this by-pass is fitted with a special hot-and-cold damper arrangement, which is automatically controlled by Johnson thermostats located in the several rooms of the building. The B. F. Sturtevant Co., by whom the fan and heater were installed, also supplied the galvanized iron piping, elbows, fittings, registers and screens, together with the direct steam-heating work, automatic control and the boiler and boiler setting. The steam is delivered to the engine at 25 lbs. pressure, and the exhaust passes into the heater.

A somewhat similar equipment was furnished by the above company to the Twin City Telephone Company, of St. Paul, Minn., sometime ago. In this case special precaution was taken to purify the air supply. It has been demonstrated that about 90 per cent. of the trouble caused by imperfect contact in the switchboard connections can be prevented by thoroughly cleansing the air as it enters the building. The action of the air-purifying and cooling apparatus adopted by the Twin City Telephone Company consists in thoroughly saturating the air with water by passing it through a fine spray and afterwards precipitating the moisture with the collected impurities and discharging it into the sewer. The water which is taken up at high velocity and held in mechanical suspension, is extracted by centrifugal force by passing it through a series of tubes in which spirals are so placed as to give the air a whirling motion, causing the suspended particles, which are heavier than the air, to be thrown outward and brought in contact with the tubes, from which they flow through perforations to a drip pan below.

The washing process imparts about 70 per cent. humidity at a temperature of 70° Fahr. in the operating room. This is considered the most desirable for health and comfort and avoids the excessive dryness resulting with other systems of heating and ventilating which often require a humidostat to correct the defect. Moreover, in the summer time, with the temperature outside of 80° Fahr., and with the normal temperature of the city water, the air delivered to the rooms can be readily reduced to 70°.

The air, after being tempered, washed and dried, is blown by the fan through the reheating coils into the tempered air chamber. A mixing damper is placed with connections to both, so arranged that the hot or tempered air, under the control of the Powers thermostat, in the operating room, is mixed automatically to the proper degree, maintaining throughout the year a constant temperature in the room with uniform air delivery and humidity.

High-Tension Switches.

The General Incandescent Arc Light Company for the past three years has been making a complete line of high-tension switching and controlling apparatus, in eight distinct types of oil switches for service, all the way from 2,500 volts to 25,000 volts, and ranging in ampere capacity up to any commercial requirement. The apparatus is designed to meet a great variety of requirements incident to equipping modern central stations of the largest size. The entire high-tension electrical controlling equipment of such plants as the St. Paul Gas Light Company, the Brooklyn Edison Company, the Chicago Edison Company and a large part of the equipment of the New York Edison Company, besides many other important large plants throughout the country, is of this type.

The General Illuminating Company has made a specialty of automatically-controlled oil switches. For example, any of the eight types of oil switches can be supplied with overload device, which causes the oil switch to open immediately in case of an overload of short circuit, or by the interpellation of a time limit relay, the opening of the switch can be delayed any desired amount up to 5 seconds. These switches can also be supplied with reverse current relays, the function of which is to cause the switch to open the circuit upon the reversal of the direction of the transmission of power. This is a very important feature, and one that is thoroughly taken care of in this type of apparatus.

A distinct feature of the oil switch overload attachment lies in the fact that the mechanism by which the switch is manually closed is so designed that if it is closed upon an overload condition such that an excessive amount of current would flow when closing the switch, the latter immediately flies open, through the instrumentality of the overload relays and device opening the switch, irrespective of the fact that the operator may still have his hand upon the closing mechanism at the time. In other words, it is impossible to hold the oil switch closed against a short circuit or overload condition.

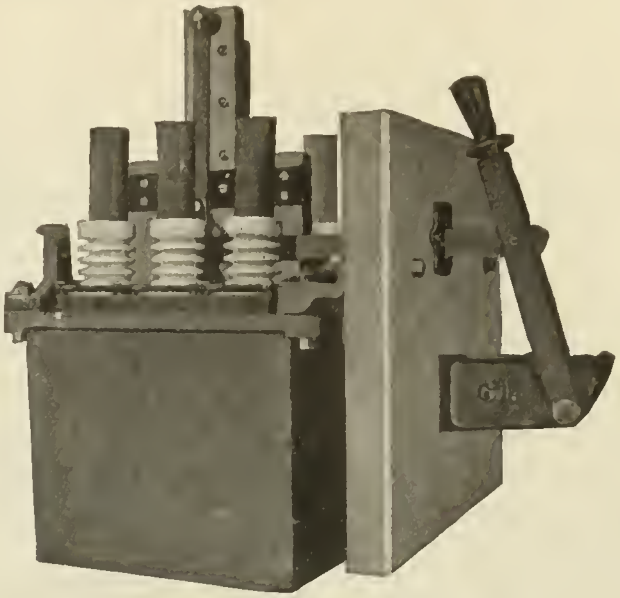


FIG. 1.—HIGH-TENSION SWITCH.

The present tendency to design all central station apparatus so that it can be controlled from a switch controlling board has led the same company to provide any of the oil switches with solenoid control, so that they can be installed at the most convenient places in the station, no matter how remote from the controlling switchboard. Heretofore this feature when used has been confined to the main switches of the station; it has been found, however, that great saving in the cost of installation, as well as greater facility

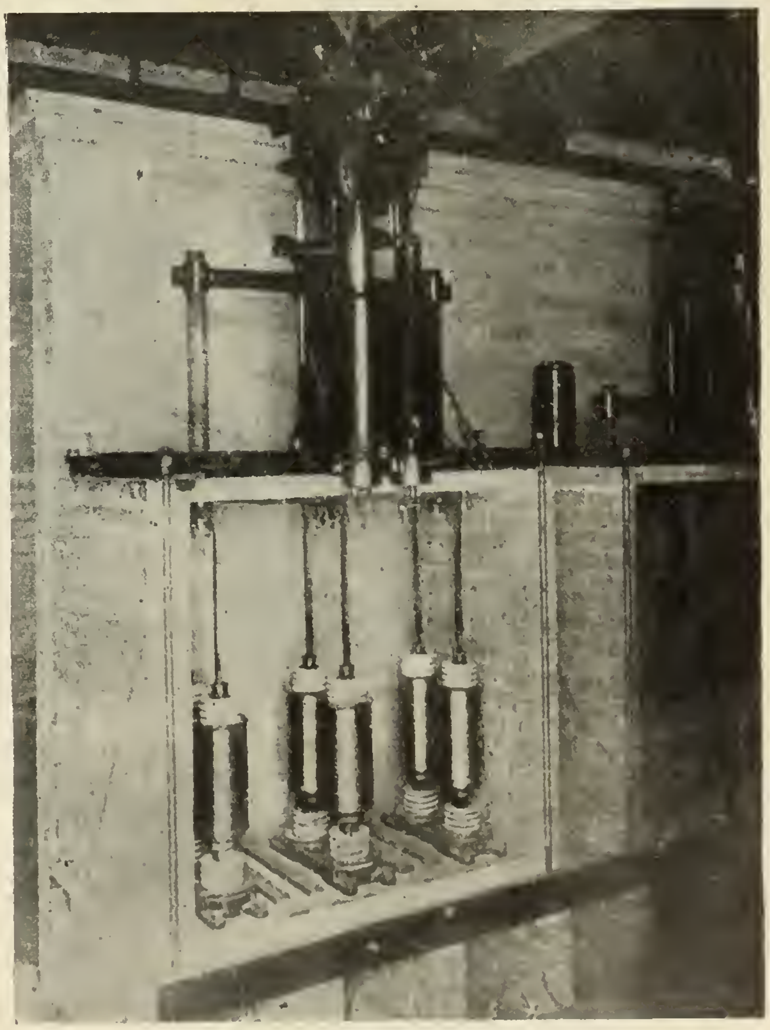


FIG. 2.—HIGH-TENSION SWITCH.

of operation is attained by making the smaller apparatus for remote control. This has been accomplished by the solenoid operating mechanism provided for this purpose, which operates in a similar manner to the solenoid control of the larger switches, but only of a smaller design.

Another distinct feature of these oil switches lies in the fact that certain types are designed as double throw switches in one and the same switch. It had formerly been customary for stations to use two single throw switches, arranged with an interlocking device, more or less crude, to prevent them from both being thrown in at the same time. One type of these switches is designed to operate up to 15,000 volts, with capacities up to 300 amp. in the double throw design.

Fig. 1 herewith shows a type of switch which has been designed to meet the most severe duty that could be placed upon the switch in a large central station where enormous generators are used, and where the largest factor of safety is necessary. Fig. 2 shows a switch which has been designed more especially for disconnecting bus-bar connections, or where smaller amounts of power are to be interrupted in small central stations or in sub-stations.

The Musso Duplex Typewriting Wireless Telegraph.

The Musso Duplex Typewriting Wireless Telegraph Company has recently been incorporated under the laws of Maine, with headquarters in New York City, Mr. Giuseppe Musso being president, Mr. James McCormack vice-president, and Mr. Robert E. Sylvester secretary and treasurer of the company.

The principal point of the Musso system of wireless telegraphy is in the substitution of the typewriter for the Morse instrument, telegrams it is said, being handled directly by the typewriter, the messages being printed in typographical characters on full page at the receiving station. As a single electrical impulse is sufficient to transmit each sign or character, the velocity obtainable is under the control of the operator, so that messages are transmitted as fast as the operator can manipulate the keyboard. The Musso apparatus is stated to operate according to the duplex system: two stations only transmit and receive messages simultaneously on the same instruments without interference. It is stated that with the Musso apparatus, the operator can isolate the station he desires to communicate with, without interference with, or overhearing by other stations provided with the same apparatus. It is claimed that all operations of the Musso apparatus being automatic except that of transmission, no skilled operator is required at the receiving end except when it is used as a transmitting station. The Musso system is also stated to be adaptable to telegraphy over wires as to wireless telegraphy.

The above are the claims made by the company for the Musso system. As some of the patents are still pending, the company declines to give at this moment exact details concerning the system with illustrations or diagrams. The experimental work conducted by Mr. Musso in Italy is stated to have been with the best results. At present a complete apparatus, of very simple design, is in course of construction in this country. The inventor has communicated the following information on the principles of his system:

The working of the apparatus is based on the synchronous revolving of a wheel in each communicating station, and for this purpose the Hughes clockwork was first used. This mechanism, however, being somewhat complicated, the inventor devised a small magneto-electric motor, and, by this means, he obtained two advantages: great reduction of the dimensions of the mechanism, and the elimination of a correcting device, the motor being self-correcting.

The sending circuit is controlled by a keyboard similar to that of a typewriter, and the receiving circuit acts on the levers of the printing device. The latter resembles an ordinary typewriter, operated by electromagnets inserted in a local circuit. The duplex working of the apparatus is one of the original features of the device, and the means of isolating any desired number of stations, during transmission, is another.

The inventor used, at first, the disposition of the Slaby-Arco system at the sending and receiving stations. He soon found, however, that the tapping coherer was almost useless for the working of his apparatus, because of its lack of sensibility both in cohering and decohering. He then constructed a coherer, consisting of a mixture of fragments of magnetite and pure silver. By introducing this coherer into a solenoid inserted in series with the antenna and the ground wire, he obtained a very satisfactory auto-decohering effect.

Another original feature of the system is a magneto-microphone relay, which gives an excellent mechanical effect. It consisted, in the inventor's experimental work, of a special microphone inserted in the aerial circuit and controlling a relay formed with a combination of an ordinary telephone receiver and a pencil microphone. The disposition is very simple and its sensibility is of the highest degree. From the standpoint of the acoustic effect, it is excellent when used as a sounder. In fact, the inventor obtained its excitation by simply breaking, at a distance of 30 ft., the circuit of six dry batteries, connected in series. It must be noted that he could not find any sensible difference in the result, by connecting or disconnecting the ground conductor.

From the study he made on this result obtained by so small a wasting of energy, he found that both inductive and static actions take place, the former by means of the two aerial wires, the latter by the feeble discharge between the terminals of the battery reophores. The above successful experiment also convinced him that the solution of the problem for long distance communication depends upon a proper receiving device rather than upon the indefinite increasing of power of the sending station.

Motor Driven Press Rooms.

A motor-driven printing press equipment installed by the Milwaukee Electric Company for Stearns Brothers & Co., of Chicago, presents points which possibly have not been covered in similar installations hitherto. A printer very much appreciates the advantages of speed regulation, while the fact that any press can be run on any quality of paper without shifting belts and the consequent loss of pressmen's time; and that he obtains so much better light and is able to keep his premises in so much better order without belts, makes it of greater value than can be readily seen by the printer unless he has already tried it. The saving in power is enough of an argument in a large city to convince him that it is time to change his methods of operation and put in electric drives. It has been found in the plant herewith described that the saving of power will come to fully 25 per cent. more than was estimated, due to their being able to shut down any number of the presses if necessary when "making them ready," and not having to run shafting while this is being done. It is a well-known fact that sometimes every press in the shop will be shut down while the forms are being got ready for work.

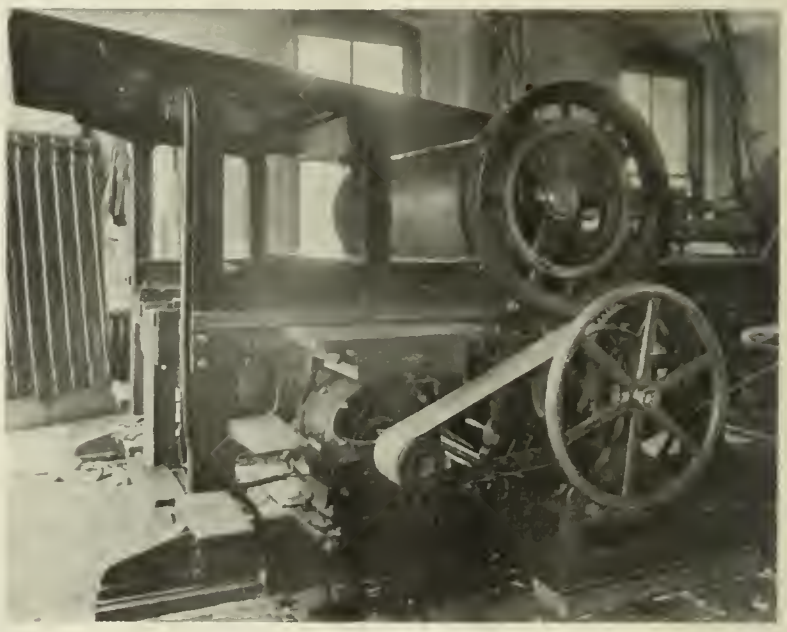


FIG. 1.—MOTOR-DRIVEN PRESS.

The speed regulation in this case has been obtained by using motors of slightly slower speed than that of the standard slow-speed motors. An example of the regulation on one large size Miehle press will illustrate the method. The motor used on this press, as shown in Fig. 1, is normally a 5-hp motor at 900 r.p.m., although for this work it is wound for 4 hp at 750 r.p.m. This speed can be increased 20 per cent. by means of field resistance, inasmuch as the power required by the press is slightly more at 20 per cent. increased speed than when running at 750 r.p.m.

The motors are located under the presses—the pulleys sticking out through the side frames—and belted with a short single rawhide belt to the largest pulley that is permitted by the frame of these. In this particular instance the motor pulley is 6½ in. in diameter, whereas that of the press is 15 in. The motor is fastened to the side frame of the press, and rests on an iron brace, which is fastened to the motor base, but is left free to slide on the floor with the former. As the large presses are not screwed down, it would not be policy to fasten the motor to the floor with the press moving.

The motors are controlled by Cutler-Hammer reversible printing press speed controllers, as shown in Fig. 2. The faces of these are mounted in the same position that the belt-shifting lever formerly occupied on the press. The resistances for the controller are screwed to the inner side of the side frame of the press near the floor and underneath the type bed. The field resistance, consisting of Cutler-Hammer iron-clad field rheostats, is mounted, together with a double-throw three-pole switch, on a piece of marbleized slate, the whole being fastened on the under side of the feedboard of the press.

The wiring from the cut-out cabinet on the side of the room is brought to the press in conduit concealed in the floor, which is run up from the end of the press to the switch located under the feedboard, and from there the wiring is done in iron conduits, protecting it from injury. Advantage is taken of the Chicago Edison Company's three-wire circuit, as either 110 or 220 volts can be used on the motor armature. With these two voltages and the field regulator, the speeds at which the press usually runs are obtained; that is, the higher speeds of the press for medium paper and the less difficult work and the lower speeds for extremely light paper and difficult color work. It is also possible to use the armature resistance, if necessary, to obtain the intermediate and the extremely slow speeds, the latter being used for adjusting the presses.

With 220 volts on the armature and the field resistance in, 20 per cent. increase in speed is obtained, which gives the maximum of the motor of 900 r.p.m. With 220 volts on the armature and no field resistance in, 750 r.p.m. is had as the normal speed of the motor, which can be decreased to 50 per cent. by armature resistance, giving the lowest speed with the armature on 220 volts of about 375 r.p.m. With 110 volts on the armature and all the field resistance in, the speed is 390 r.p.m., whereas that with no field resistance is 325 r.p.m. This can be reduced to 50 per cent. by armature resistance, giving as the lowest speed of the motor 163 r.p.m.

There are ten points on the armature controller (and two back-up speeds), so that in all 36 points of control are had, from the highest speed of 900 r.p.m. to the lowest of 163 r.p.m. In practice it is found that this is ample, and it will be noticed that between the lowest speed of 220 volts and the highest on 110, the speeds lap some 15 revolutions. In practice this does not really happen, as the lowest speed on 220 volts is not on full load. As a consequence, the speed is not lower than 390 r.p.m. On the lowest speed also the load is so light that this is not less than 175 r.p.m.

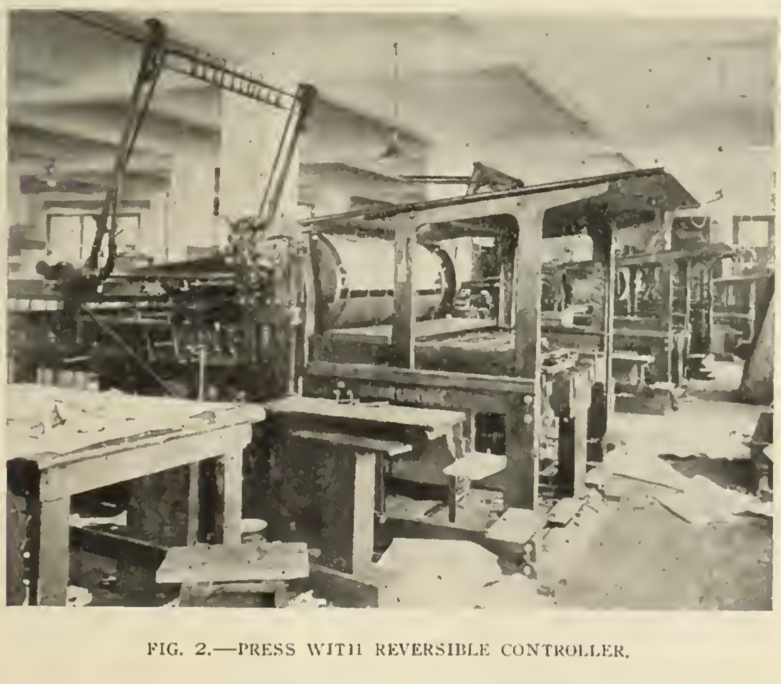


FIG. 2.—PRESS WITH REVERSIBLE CONTROLLER.

The speed regulation on the job presses is carried out in a similar manner to that on the cylinder presses, with the exception that no field resistances are used and the controllers are not reversible. These are equipped with ⅓-hp motors, 220 and 110 volts being used on the armature, together with a non-reversible armature and controller. The folding machine has simply a 50 per cent. regulation by the armature controller. The stitchers shown in Fig. 2, which are equipped with ⅛-hp motors mounted above the machine on brackets supported by the former, are equipped with speed regulators, which are found to be quite a saving in labor, inasmuch as different weights of stock can be advantageously worked with different speeds.

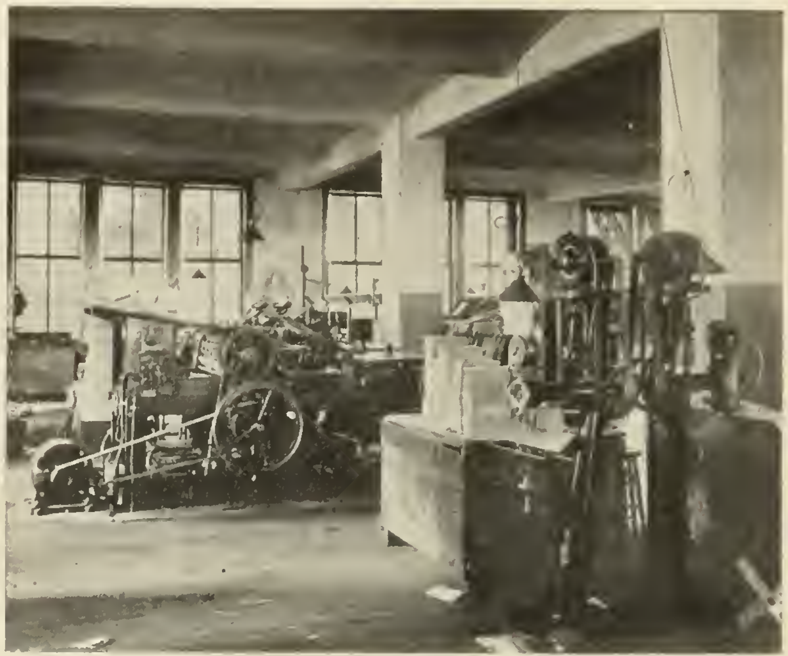


FIG. 3.—MOTOR-DRIVEN STITCHERS.

Every motor is equipped with paper pulleys and rawhide belts, it being found that much greater power can be transmitted with this form of drive and short centers than by any other method; gears not being advisable on account of the jerky motion of the machinery, the belts further acting as a cushion between the motor and the press.

Non-Arcing Fuses.

The McBride arcless fuse, illustrated herewith, is intended and adapted for use on every possible fuse-link connection. This brings it into use wherever an old-style link cut-out is in service, and applies to the Sawyer-Man style of cut-out, Edison link cut-out, panel board, switches, plug cut-outs, etc. The illustration shows a fuse in full size. The fuse consists of a cartridge, extending from each end of which is a copper wire sufficiently long to fit any link connection.

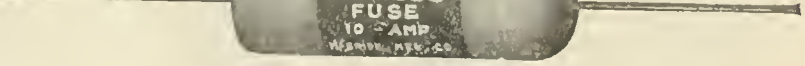


FIG. 1.—FUSE (FULL SIZE).

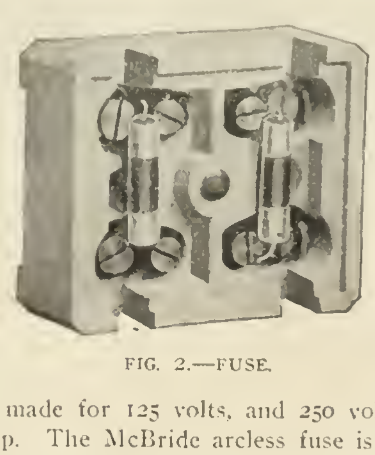


FIG. 2.—FUSE.

These fuses are made for 125 volts, and 250 volts, with capacities from 3 to 30 amp. The McBride arcless fuse is made to meet the requirements of the fire underwriters, and is handled exclusively by the Electric Appliance Company, Chicago.

Development of Electric Heating.

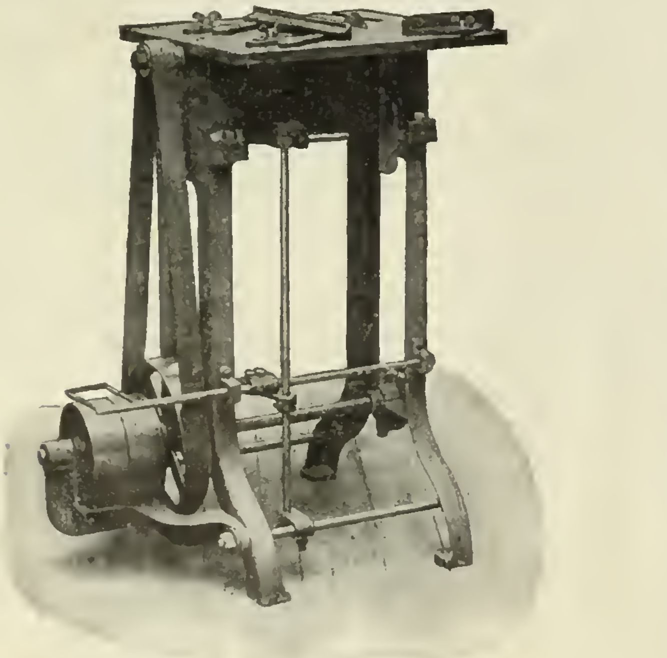
The activity in electric heating is testified to by the tremendous increase that has taken place in the electric heating branch of the Gold Car Heating & Lighting Company, of New York City. During the past three months, the number of cars and locomotives for which orders for steam and electric equipment has been received, has been very gratifying. A few of the orders recently taken by the Gold Co. for car, locomotive and electric car heating equipment, are as follows: Canadian Pacific, 200 equipments; Brooklyn Heights Railroad, 240; Missouri Pacific, 125; Wabash, 105; Erie, 102; New York, New Haven & Hartford, 101; Massachusetts Electric Companies, 100; Metropolitan Street Railway, 100; Southern, 79; Louisville Railway, 75; Central Railroad Company of New Jersey, 58; New York Central & Hudson River Railroad, 45; New Orleans & North Eastern, 40; Boston & Albany, 37; Cincinnati, Cleveland, Chicago & St. Louis, 36; Denver & Rio Grande, 35; Chicago & Eastern Illinois, 32; Western Maryland, 21; South Side Elevated, 20; Scranton Railway, 15; Nashville, Chattanooga & St. Louis, 21; Minneapolis, St. Paul & S. S. M., 22; Cincinnati, Hamilton & Dayton, 12; Texas & Pacific, 24; Georgia Railroad, 4; Lake Shore & Michigan Southern, 15; Boston & Maine, 28; New York, Ontario & Western, 14; Delaware, Lackawanna & Western, 25; Chesapeake & Ohio, 5; Atlanta & West Point, 6; Central of Georgia, 14; Alabama Great Southern, 4; Cincinnati, New Orleans & Texas Pacific, 14; Vicksburg, Shreveport & Pacific, 8; Alabama & Vicksburg, 6; Mobile & Ohio, 15; Louisville & Nashville, 3.

As a matter of fact, during the short period mentioned the company has sold nearly 4,000 sets of its heating equipment in the United States alone. During the past month an order has also been received for the shipment of several thousand sets of its specialties abroad.

The unfilled contracts on the books of the Gold Company at the present time are larger than ever before in its history. At the last meeting of directors, the regular quarterly dividend of 2 per cent., together with an extra dividend of 9 per cent., was declared.

A Metal Saw Table.

The Acme metal saw table, shown herewith, is the invention of F. D. Hazelton and is being put on the market by Hazelton & Donald, of Philadelphia. It is the result of the inventor's own needs while in the electrical business and is designed more especially for cutting sheet, rod and tube brass, fibre, hard rubber, printer's furniture and electrotype plates. It is almost indispensable to instrument makers and electrical manufacturers, being particularly handy for knife switchboard work. The machine occupies a floor space of but 18 x 24 inches, is constructed wholly of metal, and is self contained. One important feature is that the saw arbor is but one inch below the surface of the saw table, thus permitting the use of saws of small diameter and consequently obtaining the greatest power and accuracy. The table swings entirely open and may be set to saw to any desired depth, while the slitting gauge may be adjusted for slitting any width up to 12 inches. The cross cut gauge will swing either way to any practical angle. An improved device is provided for holding the arbor from turning while attaching or removing the saws. A removable throat plate allows the use of wood cutting saws up to 6 inches in diameter. The saw is now in use by such people as Warner & Swasey, Stanley Electric Manufacturing Company, St. Louis Transit Company and many others, although it has been only a short time on the market. The Garvin Machine Company handle New York business in connection with this specialty.

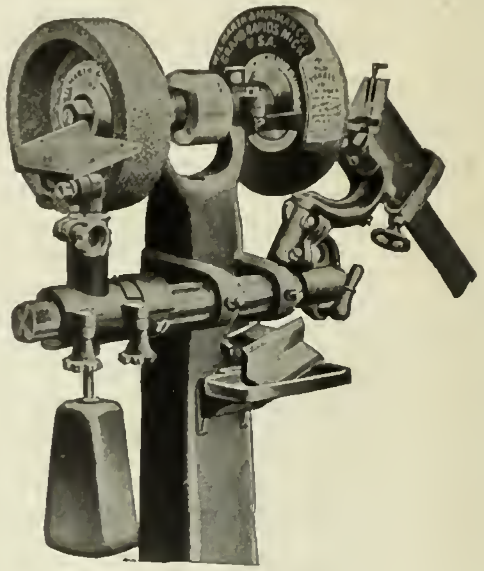


METAL SAW TABLE.

Attachment for Drill Grinders.

The apparatus herewith illustrated is a grinding attachment designed by the Wilmarth & Morman Company, of Grand Rapids, Mich., for their New Yankee drill grinders. The arrangement is similar to that used in the now familiar disc grinders, and consists of a table and its supports, capable of oscillating on a stud, and counterbalanced to keep it right side up. Two tables are furnished: a flat one with a ridge at one side to square work up against and a V-shaped table for round and similar work. These tables are quickly interchangeable without the use of a wrench and are adjustable for angle in all directions as well as up and down. Cutters, chasers, punches, dies, gibs, nuts, keys and a multitude of small parts that would otherwise be planed, milled or filed may readily be ground thereon.

A collar, adjustable on the stud, limits the movement of the table toward the wheel and a shield covering these parts keeps them free from grinder dust. A cupped wheel is used and as the work is moved clear across its face there is no tendency for it to wear out of true or groove, so that an emery paper-faced steel disc would have no advantages over an emery wheel in this respect, besides that the emery paper and the time required to cement it on would cost more than the same amount of abrasive in a cupped wheel. It should be noticed that when the wheel has been worked back to the web a plain wheel remains, which may then be used up elsewhere.



DRILL GRINDER ATTACHMENT.

A further factor in causing the adoption of a cupped wheel rather than a disc is that the presence of the drill grinder wheel (and these wheels run slower than regular wheels) would prevent a disc being run at the high rate of speed at which it is most efficient, unless it be made abnormally large.

The makers are prepared to furnish this attachment on a column without the drill grinder, but with a plain wheel and rest or surface grinder instead. This is intended for shops already equipped with drill grinders.

Index Head for Universal Milling Machines.

The illustrations herewith show a new universal indexing and dividing head for universal milling machines. It is arranged for making all divisions up to and including 360. Some of the details are entirely new, particularly the method of taking up wear between worm and worm wheel, and the arrangement for clamping the swivel block at an angle. Angular settings of the work spindle can be made 5° below the horizontal to 50° beyond the perpendicular when geared to universal machines. When fitted to plain machines, it may be swiveled through a complete circle if the front index plate is removed.

The worm and worm wheel may be thrown out of mesh for any position of the work spindle by turning the T-bolt through half a turn, and this is accomplished without removing any parts, slacking up any locknuts, or disturbing any adjustments whatever. The motion of the T-bolt is positive and it comes to a dead stop. The end of this T-bolt engages a slide attached to the worm casing, which slide is free to move endwise. The worm casing itself being confined between the walls of the swivel block, can only move in a vertical direction. The slide takes the horizontal motion of the eccentric end of the T-bolt. From this it will be seen that the worm moves away from, or toward the worm wheel in a plane perpendicular to the axis of the worm wheel. Compensation for wear between these members is obtained by adjusting the screws which attach the slide holder to the worm casing.

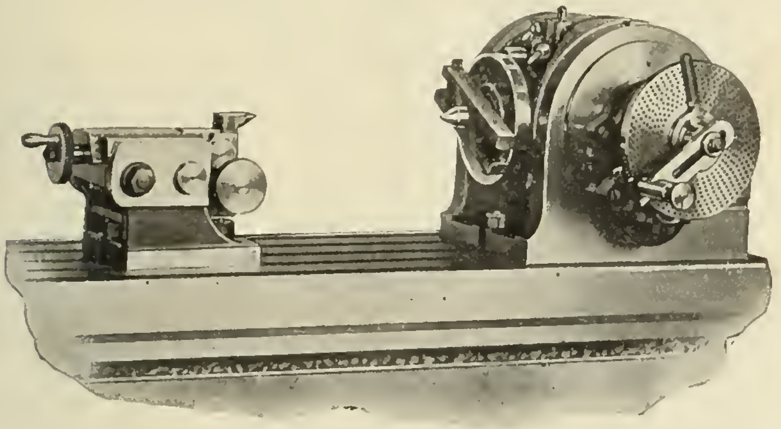


FIG. I.—INDEX HEAD FOR MILLING MACHINES.

The method of clamping the swivel block is rather novel, and deserves attention because of its extreme simplicity. The swivel block has large trunnions and is firmly secured in any position by means of the clamping straps shown, which are made to grip the trunnions by tightening two cap screws. These trunnion bearings have an arc of contact of 360°, are always fully protected, no part of them being exposed at any time, no matter at what angle the spindle is set. The entire mechanism is symmetrical in design and is very rigid in its construction. There are no openings to the inside and all gears on the outside are completely covered and protected from dirt, at the same time insuring safety to the operator.

The worm wheel is larger in diameter than is usual on mechanisms of this sort. Instead of the usual single notch on the index plate for locking, there is a series of small notches milled on the edge of the plate, which permit of moving the plate a very small amount, which is very often convenient when adjusting work to the cutter. The work spindle is provided for adjustment to compensate for wear, and it is provided with a clamping device, by means of which it can be firmly locked during cutting operations without disturbing the accuracy of the spacing. The tail stock shown has the usual elevating center. It may be set at any angle up to 10° above or below horizontal to bring the centers in line with the center of the work when milling taper reamers or similar work. This dividing head is made in three sizes—10, 12 and 14-in. swing. It is made by the Cincinnati Milling Machine Company, Cincinnati, Ohio.

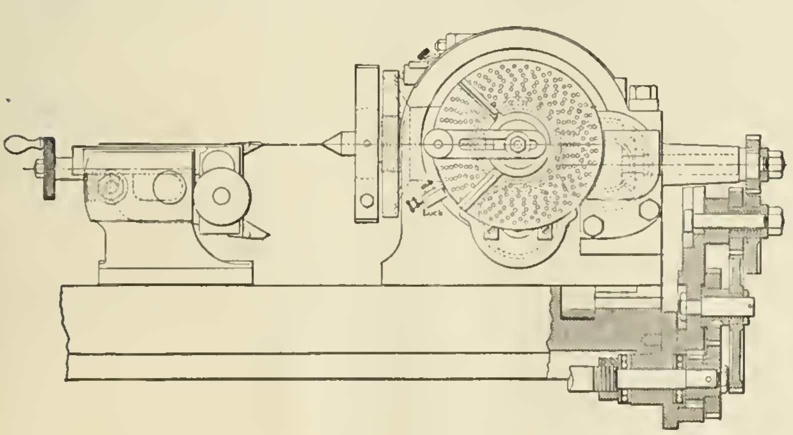


FIG. 2.—INDEX HEAD FOR MILLING MACHINES.

Exhibits at the Chicago Telephone Convention.

Below are given some notes on the exhibits at the Chicago convention of the National Independent Telephone Association last week:

THE VARLEY DUPLEX MAGNET COMPANY, of Chicago, was represented by C. L. Hibbard.

ERNEST A. PARADIS was present in the interests of the W. Y. Nagle Electric Company, of Toledo.

FRANK G. IONS, of Chicago, represented the American Electric Fuse Company.

BISSELL. The telephone products of the F. Bissell Company, of Toledo, were described by W. S. Bissell and C. M. Hamilton.

GEORGE W. CONOVER, 135 Adams Street, Chicago, who makes a business of purchasing and forwarding telephone and electric railway material, made favorable arrangements with a number of delegates.

E. J. NOBLETT, president of the E. J. Noblett Company, of Chicago, producer of cross arms, pins, brackets, cable, tool boxes and special cabinet work was present. It was hardly necessary for the company to have an exhibit, since its cabinet work is apparent in the output of many of the manufacturers of telephones in this country.

THE WILLIAMS ELECTRIC COMPANY, of Cleveland, was represented by Mr. R. Williams. He showed a new transmitter.

THE FRANK B. COOK COMPANY, of Chicago, showed several new devices recently brought out, including a subscriber's station protector, with and without a soldered heat coil; a new desk bracket, a new universal guy clamp, and a new tubular fuse and carbon arrester for pole terminals. The tubular fuse is snapped in position instead of being screwed in. A new distributing board and protectors with several new features was shown; also a new test connection for copper or galvanized wire. F. B. Cook, J. A. Cook, J. T. Thompkins and C. E. White were present.

ELLIOTT & HATCH BOOK TYPEWRITER COMPANY, of Cleveland, exhibited the Fisher and Elliott billing machines, which are being used by the New York Telephone Company and several other large telephone companies for preparing monthly statements of toll charges, installation order forms, pay rolls and other typewriter work. B. M. Loche was present.

THE NATIONAL TELEPHONE SUPPLY COMPANY, of Cleveland, which has recently entered the field with a metal hanger for telephone cables, was represented by Fred P. Auxer. The device is leverage tightening and is adjustable to any size of cable. It is made of zinc and wire, and is strong and inexpensive.

HUBBARD & COMPANY, of Pittsburg, manufacturers' agents for pole material and shovels, were represented by C. Seyler.

THE WILLIAMS-ABBOTT ELECTRIC COMPANY, of Cleveland, exhibited a comprehensive line of its telephone material. L. Sands was present.

THE AMERICAN ELECTRIC TELEPHONE COMPANY held open house at its immense factory and many of the delegates took advantage of the opportunity of thoroughly inspecting the company's complete line of standard apparatus. J. G. Ihmsen, P. C. Burns, John H. Reid and other representatives attended the convention. Mr. Ihmsen was chairman of the committee on local arrangements and was active in the proceedings of the convention.

THE VALENTINE-CLARK COMPANY, of Chicago, showed sections of cedar poles and a number of photographs of its lumber camps. The company is particularly strong on cedar poles. E. L. Clark, F. L. McGillen and E. H. Valentine were present.

THE GORDON BATTERY COMPANY, of New York, displayed a complete line of its well-known and reliable Gordon cells. W. C. Banks, electrician, and E. L. Deems, the Chicago representative, were in charge.

THE STERLING ELECTRIC COMPANY, of Lafayette, Ind., was too busy with a large number of contracts to arrange an exhibit. F. B. Rochtke, H. E. Doolittle and Evan Shelby were present. The Sterling company is now equipping an exchange at Springfield, Ohio, with 2,500 drops installed, and a board at Fremont, Ohio, with 1,400 drops, also a number of smaller exchanges ranging from 800 to 1,000. The Toledo exchange, having an initial capacity of 12,000, is now being enlarged by the installation of a section of 2,000 drops. This is the largest exchange built by this company, and it is giving unusual satisfaction. A number of photographs of the Toledo exchange were displayed.

The New Haven Novelty Machine Company, of New Haven, Conn., showed its well known splicing sleeves and pot heads. A new method of attaching the splicing sleeve to cable terminals was explained by H. C. Thompson.

The Chicago Telephone Supply Company, of Elkhart, Ind., showed a new Bell type express board. G. A. Briggs, president; H. C. Randall, secretary, and S. A. Duvall, engineer, were in attendance.

The Monarch Telephone Manufacturing Company, of Chicago, exhibited its line of telephone apparatus. S. Clinton, Walter H. Trimmer and E. E. Yaxley were present.

L. W. Stanton, of Cleveland, the well known engineering expert, was, as usual, an active figure in the convention proceedings.

J. L. Putnam represented the Clark Automatic Switchboard Company, of Providence, R. I.

H. H. Hipwell represented the Hipwell Manufacturing Company, of Allegheny, Pa. The company's line of telephones and switchboards were displayed at its Chicago sales office, 68 West Jackson Boulevard.

The Allen-Hussey Company, of Chicago, displayed a line of interior telephones, intercommunicating systems, hotel systems and the Duplex desk telephone bracket. A. R. Hussey, president and J. A. Boland, secretary-treasurer, were present.

R. D. McOuat, the Indianapolis jobber, was represented by Oscar M. Carman.

J. A. Mason represented the Central Electric Company, of Chicago, in the interests of its line of electrical supplies.

The Eureka Electric Company, of Chicago, had a very complete exhibit of telephone apparatus and featured a new ring-down Bell type board which showed very fine workmanship in all parts. Among other recent productions was a new express type lamp line monitor board, a new type of key, new self-restoring drop, and a new central energy target. A very handsome catalogue designated as No. 23, was distributed by Messrs. H. J. Kusel, D. L. Caumann, P. J. Dedrickson, Paul Gardner, V. H. Messenger, H. L. Mehrin, H. H. Hansen and P. J. Kusel.

Francis Biedler & Company, of Chicago, showed sections of cedar poles.

National Carbon Company.—The well-known standard line of batteries and carbon material of all kinds, produced by the National Carbon Company, of Cleveland, was explained by Mark Moffett, of Cleveland; F. H. Murrey, general representative, and Burt Ward, Chicago representative. A carbon pocket piece souvenir was much sought after.

The Central Telephone & Electric Company, of St. Louis, was represented by J. W. Cummings, president. The articles featured were the Central porcelain fuse box, Bicker's protectors, with central patent fuse, and the Bicker cable terminal head. This company is the only manufacturer of telephone material in the St. Louis district and its goods are attracting widespread attention among the independents.

The Maltby Lumber Company, of Bay City, Mich., whose poles are used by telephone people all over the country, was represented by I. A. Maltby. A large number of photographs of lumber camp scenes constituted the exhibit.

Lindsley Bros. Company.—George L. Lindsley and J. A. Navarre, of Chicago, and E. A. Lindsley, of Idaho, represented the Lindsley Bros. Company, of Chicago, and Spokane. The company is a very large producer of telephone poles.

The Illinois Electric Company, of Chicago, manufacturerers' agent for a number of leading lines, was represented by C. W. Bacon, C. J. Litscher, L. K. Cushing, F. E. Healy, T. A. Brooke and Carl Keith.

G. H. Miller, of the Miller Anchor Company, of Norwalk, Ohio, showed the Miller anchor and auger used in anchoring guy wires. The anchor is designed for use in both earth and rock, and appears to be a simple and reliable device for the work.

The W. J. Barr Company, of Cleveland, showed several new styles of telephone arms. Mr. Barr supplies arms to nearly all the leading telephone manufacturers of the country, and is working up quite an extensive foreign business.

The Standard Underground Cable Company, of Pittsburg, whose products are too well known to require detailing at this time, showed a number of sections of rubber and paper-insulated lead-covered cables. J. R. Wiley, western manager; W. M. Wiley and F. S. Viele, of Pittsburg, were present.

The Crawfordsville Wire & Nail Company, of Crawfordsville, Ind., had an exhibit of telegraph and telephone wire. Richard R. Schweitzer was present.

The Carney Brothers Company, of Chicago, presented the merits of their cedar poles.

The Stromberg Carlson Telephone Manufacturing Company, of Chicago, made no display, but many of the delegates were entertained at the company's factory. Androv Carlson, H. D. Eddy, L. H. Jackman, C. W. Steiger, Eugene L. Browne, F. L. Martin, E. C. Lewis and George H. Fister represented the company's interests at the convention. The gentleman last named has recently become Ohio representative, with headquarters at Columbus, taking the place of E. C. Lewis, who goes to the home office.

Automatic Electric Company.—Among the entertainments, one of the most attractive was that of the Automatic Electric Company, of Chicago, which took a large automobile party to inspect the tunnel and exchange being built for the Illinois Telephone & Telegraph Company. As is generally known, this will be the largest automatic exchange ever attempted in this country. The Automatic Company is meeting with marked success in introducing its new departure. Its first large exchange has just been installed at Dayton, and 2,000 lines are now in operation. The company made no display at the convention, but its representatives were much in evidence, among them being General Manager H. D. Critchfield, Sanford Harris, J. T. Crook, J. C. Caldwell, M. A. Edson, and F. H. Wheeler.

William J. Murdoch, Chelsea, Mass., displayed his line of telephone instruments. One of the most unique souvenirs, which was visible everywhere, was a section of telephone transmitter, which was distributed by Mr. Murdoch.

The North Electric Company, of Cleveland, occupied two parlors; and while the company displayed none of its larger apparatus, the exhibit was quite unique. It consisted largely of very large and fine photographs of various views of a number of exchanges which the company has recently installed. The views brought out in the best possible manner the features of this company's up-to-date line of apparatus. C. H. North, president; L. G. Bowman and F. F. Sapp, entertained. Arranged on tables were a line of small parts, in which a new transmitter of the solid-back type was featured.

The Swedish-American Telephone Company, of Chicago, operated automobiles at regular intervals to and from its factory, where its large line of telephones and materials was displayed to best advantage. The company had a parlor and a very handsome art souvenir catalogue was distributed. E. B. Overshimer, A. V. Overishimer, C. H. Macklin, J. A. Russell and A. E. Dobbs visited the convention hall.

Millard Hopkins, vice-president of the A. P. Hopkins Company, of Escanaba, Mich., presented its line of telephone poles.

The Jones Perpetual Ledger Company, represented by Oscar L. Gagg, presented its perpetual ledger, a practical device which is being used in the accounting departments of a number of telephone companies.

Baker & Company, New York, displayed a large assortment of platinum rivets for contact work on telephone and electrical apparatus. A new form of rivet was shown for the first time. J. J. Lowthian represented the company and distributed some useful souvenirs.

Turner Brass Works.—The parlor occupied by the Turner Brass Works, of Chicago, was a noted headquarters for attractive souvenirs. The company displayed a line of its hand torches, metal appliances and other brass goods used by telephone people. A feature was made of a new automatic alcohol blow lamp which uses alcohol vapor. It is capable of a high degree of adjustment, and gives a fine needle flame at all times. It is fitted with a universal swivel, that the flame may be turned in any position. F. C. Binkley, Thomas Ferris, Paul Henderson and A. W. Straight were present in the interests of the concern.

J. G. Warner, representing the Warner Electric Company, of Muncie, Ind., distributed literature explaining the features of the Warner Standard pole changer, the Warner generator and the Warner dry battery outfit, which are known to all telephone operators. It is claimed these devices are used by more than 4,000 telephone exchanges in the country.

The Crescent Company, of Chicago, showed samples of its soldering outfits with the exhibits of the Illinois Electric Company. J. H. McGill explained the good points of the product.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was offered with some liberality, and the demand was chiefly for the renewal of maturing obligations. The closing rates were 4 per cent. for 60 to 90 days, and 4¾@5½ per cent., for four, six and seven months. Speculation on the stock market was at a low ebb, all of the transactions, which were the result of professional operations, being about the smallest of the year. One of the developments of the week was a decline in the securities of the International Mercantile Marine Company. The troubles of the United States Shipbuilding Company, together with the friction and litigation which attended the effort to reorganize it, evidently had an adverse effect on sentiment. The general list, however, was rather dull, and apart from a few securities, there were no movements of any decided importance. Very little of interest occurred in connection with the traction and industrial stocks. The chief activity in the latter was in the 5 per cent bonds of the United States Steel Corporation, which slowed down to 81¾ on offerings supposed to have come from inside interests. Brooklyn Rapid Transit closed at 56, after touching 54⅝, the closing quotation representing a net loss of 1 point since last week. Metropolitan Street Railway closed at 122, ex-div., this being ½ point loss. General Electric made a net gain of 1½ points, closing at the highest figure of the week, namely, 179, the lowest being 176½. Western Union was a little stronger and made a net gain of ½ point, closing at 84½. American Telephone & Telegraph closed at 142, which was the ruling figure throughout the week, being a loss of ¼ point since last week's quotation. Following are the closing quotations of June 30.

NEW YORK.

	June 23.	June 30		June 23.	June 30
American Tel. & Cable......	80	80	General Electric.	177½	179
American Tel. & Tel........	141	134	Hudson River Tel...........	..	..
American Dist. Tel	27	30	Metropolitan St. Ry.........	124	123¼
Brooklyn Rapid Transit ..	55¾	57½	N. E. Elec. Veh. Trns........	..	..
Commercial Cable.	..	162	N. Y. & N. J. Tel............	..	112
Electric Boat	17	17	N. Y. E. V. T. Co......	5	5½
Electric Boat pfd............	40	40	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.. .	1¼	1	Western Union Tel...... ...	83½	85
Electric Vehicle............	7	6½	Westinghouse com....	188	190
Electric Vehicle pfd........	13½	13	Westinghouse pfd...........	188	190

BOSTON.

	June 23.	June 30		June 23.	June 30
American Tel. & Tel	141½	134¼	Western Tel. & Tel. pfd....	90	90
Cumberland Telephone....	..	..	Mexican Telephone.........	1¾	1¾
Edison Elec. Illum..........	..	..	New England Telephone...	128½	125½
General Electric.............	..	..	Westinghouse	..	93
Western Tel. & Tel..........	12	12	Westinghouse pfd...... . .	..	93

PHILADELPHIA.

	June 23.	June 30		June 23.	June 30
American Railways	..	45	Phila. Traction	96½	95¾
Elec. Storage Battery	63	60	Phila. Electric	6¼	6¼
Elec. Storage Battery pfd.	..	60	Pa. Electric Vehicle.........	..	..
Elec. Co. of America.	8¾	8¾	Pa. Electric Vehicle pfd ...	..	..

CHICAGO.

	June 23	June 30		June 23.	June 30
Central Union Tel.	..	..	National Carbon pfd........	94	93
Chicago Edison.........	150	150	Northwest Elev. com........	..	..
Chicago City Ry....	197½	190	Union Traction	3½	3⅛
Chicago Tel. Co	..	125	Union Traction pfd.........	30	30
National Carbon	23	22			

*Asked.

BELL TELEPHONE FINANCES.—It is stated from Boston that the issue of $21,943,200 new stock by the American Telephone & Telegraph Company will increase the amount of stock outstanding to $131,628,200, and the annual dividend requirements after July, 1904, when the new stock carries dividends, to $9,872,115. The present year's requirements amount to $8,226,375. In the year ending December 31, 1902, the net earnings reported by the company, consisting of dividends received from the sub-companies, rental of instruments, and earnings from long distance traffic, was $7,835,272. This was after the payment of interest and taxes. The amount is $400,000 less than the present year's dividend requirements, and $2,000,000 less than the requirements after July, 1904. The dividends received from the sub-companies are almost equal to the dividends the parent company pays on its own stock. The following table shows the record of dividends received from the sub-companies, and the dividends paid on the parent company's stock, for the past five years:

	Div. rec'd from sub-Co.'s.	Div. paid by parent Co.
1898	$3,239,406	$3,882,945
1899	3,809,504	3,882,945
1900	3,846,821	4,078,601
1901	4,988,207	5,050,023
1902	6,023,523	6,584,403

Thus, the dividends received from the sub-companies increase about as fast as the dividend requirement of the parent company. Judging from the current rate of increase in output of instruments—over half a million a year—there is every reason to believe that the earnings of the sub-companies, and consequently the dividends paid to the parent company, will continue to keep pace with the latter's dividend requirements.

CHICAGO TELEPHONE NEGOTIATIONS.—Ignoring arguments that it might be a boon to the Chicago Telephone Company, the Council committee on gas, oil and electric light has recommended for passage the ordinance asked for by the United Telegraph, Telephone and Electric Company. By the terms of the measure the company whose operations at present are confined to Hyde Park, has the right to invade all parts of the city. The company waives its right, claimed in perpetuity to Hyde Park, in return for a 30-year franchise. It has been claimed that the measure could easily be taken advantage of by the Chicago Telephone Company when its own franchise expires in 1909, and would give it an extention of nearly 30 years with little change of rates. The ordinance contains the following provision: Compensation to the city at the rate of 3 per cent of the gross receipts for the first ten years and 5 per cent thereafter. The rates to be on a measured scale, as recommended by the commission last year, based on calls actually made. The rates are to be subject to council regulation at all times, subject to limitations such as shall be reasonable. A bond in the sum of $100,000 is to be given to indemnify the city from possible loss. The rates allowed by the ordinance for business or residence service are as follows:

Calls.	Yearly Charge.	Excess.
600	$60	5 cents.
1,200	88	4 cents.
1,500	100	4 cents.
2,100	118	3 cents.

For two-party lines the charge allowed is, for 600 calls, $44, and 5 cents for excess calls; for 1,500 calls, $80, and 3 cents on excess calls; on four-party lines, 600 calls, $28, excess 5 cents; 1,500 calls, $68, excess 3 cents.

WESTCHESTER LIGHTING BONDS.—The Westchester Lighting Company, New York, bonds to the amount of $5,260,000, have been listed on exchange. It has franchises, nearly all of which are perpetual for the distribution of gas and electricity in the municipal divisions of Westchester County. These bonds, which are a part of an authorized issue of $10,000,000, have been used in the acquisition of the capital stock of about a dozen gas and electric companies. Westchester Lighting Company shows as follows for the year ended December 31:

	1902.	1901.	Changes.
Gross	$1,037,799	$849,153	Inc. $188,646
Expenses	662,461	598,112	Inc. 64,349
Net	$375,338	$251,041	Inc. $124,297
Interest	252,920	231,554	Inc. 21,366
Surplus	$122,418	$19,487	Inc. $102,931

CUMBERLAND TELEPHONE & TELEGRAPH.—The earnings and expenses of the Cumberland Telephone & Telegraph Company for the month of May compare with those of the same month last year as follows:

	1903.	1902.	Changes.
Total earnings	$282,669	$252,153	Inc. $30,516
Total expenses	166,368	159,137	Inc. 7,231
Net earnings	$116,301	$93,016	Inc. $23,285
Fixed charges	21,470	18,475	Inc. 2,995
Surplus	$94,830	$74,540	Inc. $20,290

The number of subscribers May 31, 1903, was 98,560, as compared with 85,150 on the same date in 1902; an increase of 13,410 for the year.

A LONG OHIO TROLLEY.—A contract for grading, covering the route between Napoleon and Defiance, has been awarded by the People's Rapid Transit Company, of Toledo, O., to Morrison, Fowler & Scott. Men and teams were already at work, but the efforts to complete the project have been redoubled, and President Morgan says that cars will be running between Toledo and Defiance next fall. The plan is to build north from Cincinnati and south from Toledo. Originally the southern terminus was Greenville, Darke County, 150 miles distant. Then the project was enlarged and the route extended to Cincinnati. The section now building, Toledo to Defiance, is 50 miles in length. Mr. Morgan says that much stock has been placed with people in the towns along the route. The directory of the People's Rapid Transit Railway Company was reorganized after the route was extended from Greenville south. The project contemplates a road 220 miles long, and will tap 54 cities and towns, among them being Monclova, Napoleon, Defiance, Paulding, Van Wert, Celina and Greenville on the northern end and Hamilton and Cincinnati on the southern end. When in operation the company will carry express goods, freight and passengers. The franchise privileges include freight cartage.

CONSOLIDATIONS AT ATLANTA.—Further deals are reported from Atlanta. The Georgia Railway & Electric Company, in which there is a large Boston interest, Mr. T. Jefferson Coolidge, Jr., being one of the directors, has acquired the Atlantic Gaslight Company, which has been owned by the United Gas Improvement Company. This acquirement places the street railway, electric light, power and gas business of the city of Atlanta, Ga., under the control of the Georgia Railway & Electric Company. The Atlanta Gaslight Company has outstanding $1,150,000 5 per cent bonds, $600,000 6 per cent preferred stock and $1,014,000 common stock, and has been showing earnings of about 2 per cent upon the common stock. It will receive in exchange for its stock $600,000 of Georgia Railway & Electric Company 5 per cent preferred stock, share for share, and $1,014,000 of Georgia Company common stock, share for share. Through this exchange the United Gas Improvement Company, of Philadelphia, becomes a large stockholder in the Georgia Company. The Georgia Company had outstanding previous to this merger $4,000,000 bonds, $1,800,000 5 per cent preferred stock, and $5,000,000 common stock. It controls 142 miles of electric railway, owns two power stations, steam heat mains, etc., and serves a population of about 125,000. The company has been showing earnings of about 2 per cent upon its $5,000,000 common stock, or just about the same proportion as the Atlanta Gaslight Company.

CHICAGO TROLLEY PLANS.—At a conference of officials of the Chicago City Railway Company and the City Council's franchise committee the following points have been agreed on tentatively: The company is to expend from $15,000,000 to $18,000,000 on improving its system, placing the underground trolley on its trunk lines downtown and as far south as Eighteenth Street. Grooved rails and similar changes that the city asks are conceded. Every effort will be made to determine on a universal transfer plan, to which the Union Traction Company is expected to give its approval when its financial troubles are straightened out. Efforts will be made to reduce congestion within the loop district by transfer stations. The company insists that consideration shall be given possible damage claims, cost of operation, the additional investment for rehabilitating the service and other outlay.

NIAGARA FALLS POWER.—At the annual meeting of the stockholders of the Niagara Falls Power Company and its allied companies the following board of directors for the power company were elected: Edward D. Adams, John Jacob Astor, George S. Bowdoin, Charles F. Clark, Charles Lanier, Joseph Larocque, Darius O. Mills, Victor Morawitz, Daniel O'Day, William B. Rankine, Francis Lynde Stetson, F. W. Whitridge, Edward A. Wickes. With the exception of Messrs. Morawitz and O'Day, the same list of directors was elected for the allied companies. The board of directors has organized by electing the following officers: President, Darius O. Mills; first vice-president, Edward A. Wickes; second vice-president and treasurer, William B. Rankine; secretary, Frederick L. Lovelace; assistant secretary and assistant treasurer, W. Paxton Little.

WORK IN THE PHILIPPINES.—Charles W. Gross and Arthur L. Shipman have filed with the Secretary of State of Connecticut a certificate of incorporation of the Manila Railway & Lighting Company, incorporated with $6,000,000 capital. Under the broad Connecticut laws, the company has the right to build any kind of railroad anywhere, to run steamship lines and to establish gas and electric plants outside of Connecticut. It is said that New York capitalists are starting these enterprises in the Philippines, but Mr. Gross will neither confirm nor deny this, nor will he give the names of the backers. He said he and Mr. Shipman were acting merely as attorneys.

MEXICAN LIGHT & POWER.—The syndicate managers of the Mexican Light & Power Company announce that they have purchased the Mexico Electric Light Company, owned by Siemens & Halske, of Berlin. The purchase is partly in cash and partly in stock in the new company. The deal was arranged by F. S. Pearson, of New York, vice-president of the Power Company, and the earnings of the electric company will be sufficient to pay the interest on all the bonds of the power company. Preliminary note of this has already been made in these columns.

SCHENECTADY RAILWAY BONDS.—The Schenectady Rail-

illustrated by the figures of the Treasury Bureau of Statistics showing the importations and exportations by great groups during the eleven months ending with May, 1903. These figures show that while way Company's application to the New York State Railroad Commission for permission to issue $7,500,000 mortgage bonds has been granted on the conditions that but $4,000,000 bonds be issued now, $2,000,000 of which shall be to retire an existing $2,000,000 mortgage on the road, and that before the issuance of the remaining $3,500,000, or any part of it, the company shall obtain the consent of the board. The $2,000,000 granted now is to be used in construction.

CONSOLIDATION IN PENSYLVANIA.—A New Jersey charter has been applied for by the Johnstown & Cumberland Railways, Light & Power Company, which is to take over a score or more of street and suburban railway and electric light plants in central and southern Pennsylvania, between Johnstown and Cumberland, Md. The capital stock of the company is $6,000,000.

DIVIDENDS.—The directors of Mexican Telegraph have declared the regular quarterly dividend of 2½ per cent, payable July 15. The directors of Central & South American Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable July 8.

Commercial Intelligence.

THE WEEK IN TRADE.—Some irregularities are still presented in the crop, trade and labor conditions, but, according to *Bradstreet's,* six months' trade returns point to actual business having been better than a year ago, and the situation as a whole shows favorable features predominating as to the future. The temporary renewal of trouble in the New York building trades is an unfavorable factor, while speculative advances in grain and cotton tend to cloud the real situation as regards the new crops generally. The iron and steel situation seems to have slightly improved. Large contracts have been made for rails by leading trunk lines and central western roads. The condition of other finished products is better and even in cruder forms the feeling is fairly firm, except for foundry pig iron. Railroad earnings are better than was earlier expected, notwithstanding flood interruptions in the first part of the month. The returns for the first week of June show a gain of 9 per cent. over a year ago, while those for the second and third weeks indicate increases of 10 to 12 per cent in excess of last year. The feature in the price situation was the upward rush of prices for cereals and cotton. The advance in the latter was most spectacular. Retail trade in drygoods and light summer wear generally notes a check administered by abnormally cool weather. Wholesale business is naturally smaller in this line, and cotton goods are affected by the very high prices for the raw material. Export business for cotton is heavily reduced, and the movement of cereals abroad is also light. The copper market continues dull, notwithstanding the reduction in prices, and very little business is reported. The official prices are 14½c. for Lake and electrolytic, and 14c. for casting stock. The business failures for the week ending June 25, as reported by *Bradstreet's,* numbered 171, against 165 the previous week and 153 the corresponding week of last year.

VIEWS ON COPPER.—In a recent bulletin the National Conduit & Cable Company remark about the copper market: The tone of the copper market has eased off lately and substantial declines for the different grades have been established. The basis price now quoted for electrolytic wire bars is 14½ to 14¾. The drop from 15⅜ to the present figures has occasioned some orders, but we cannot find that these purchases have been in sufficient quantity to stimulate the price. There is, therefore every indication of a further decline except purchases for spot copper, which has generally held firm at the price quoted. There is no doubt that the present market conditions are in the buyers' favor. We have it in mind, however, that the holding companies are very strong, and many find it to their advantage to increase their stock on hand rather than force a market already weak. London cables, reporting copper weak on the English Exchange, have come too often not to influence the American market. The sentiment in London is certainly in favor of a very much lower market, and some of the speculative interests there are talking of as low a market as was seen in the weakest conditions of last year; and in view of the statistical position, with regard to exports and imports, there would seem to be a very good basis for their belief. Certain it is that the consumption of copper in America is nothing like equivalent to that of last year, and from information we have obtained we should say that the average consumption had been at least one-third less than of 1902. These conditions have not inspired confidence on the part of consumers, and there has been great hesitancy in placing contracts. New mines are operating this year, and the production in the old mines is generally believed to be much greater than last year.

FIGURES OF FOREIGN TRADE.—The growth in the consuming power of the United States in this period of business activity is the exportation of manufactures has increased only two million dollars as compared with the corresponding months of last year, the importation of manufacturers' materials has increased sixty-six million dollars as compared with the same months of 1902, and one hundred and thirty-one millions as compared with the corresponding months of 1901. As it can scarcely be presumed that the manufacturers of the country are importing in excess of their present or immediately prospective requirements, it would seem that the increase in manufactures which this growing importation of materials indicates is being consumed at home, since exportations of manufactures for the year show no material increase. A rapid increase in the importation of manufacturers' materials has been the striking characteristic of the fiscal year about to end. For the eleven months the total value of manufacturers' materials imported amounted to $451,081,163, against $384,775,764 for the same months of last year, $319,524,957 for the corresponding months of 1901, and $363,455,072 for the same months of 1900. Prior to 1900 the imports of manufacturers' materials had never touched the 300 million dollar line, except in 1893, when they were $300,461,795.

WESTINGHOUSE CORLISS ENGINES.—Westinghouse, Church, Kerr & Co., have recently secured a number of orders for large Corliss engines, of both vertical and horizontal types. Among these may be noted the following: The Edison Electric Illuminating Co., at Brooklyn, N. Y., will install a new 4,500-hp, Westinghouse, vertical, cross-compound Corliss engine in their Bay Ridge station. The engine will be direct-connected to a Westinghouse polyphase generator, similar to those already installed, and the new unit will increase the capacity of the plant to 13,500 horse-power, with a maximum of 20,000 horse-power. The two 4,500-hp units now in operation were also furnished by Westinghouse, Church, Kerr & Co. The Coney Island and Brooklyn Railroad Company will install a 26" and 52" x 48" Westinghouse, horizontal, cross-compound Corliss engine, direct-connected to a Westinghouse 800-kw, 600-volt generator. The new unit will operate in the South Brooklyn plant, in connection with the present equipment. The engine has a capacity of 1,250 ihp, with a maximum of 2,100 ihp. Four 225-kw Westinghouse, compound, engine-generating units will also be simultaneously installed. The Boston Northern Railway Company will install in its power station at Lynn, Mass., a 30" and 60" x 48" Westinghouse, horizontal, cross-compound engines, of 1,620-ihp capacity, with a maximum of approximately 3,00 ihp. The engine will be direct-connected to a 1,050-kw Westinghouse generator, furnishing current at 600 volts to the railway system.

SOME RECENT BULLOCK CONTRACTS.—The Bullock Electric Manufacturing Company, St. Paul Building, New York, has lately secured some substantial contracts for generators to be installed in various plants throughout the country. The Pittsburg Reduction Company has ordered two direct-connected machines of 3,000-hp capacity each. Two 1,000-kw alternating-current generators have been requisitioned for by the Niagara Falls Hydraulic Power and Manufacturing Company. Two alternating generators have been ordered by the Mutual Electric Company, California. These machines will have a capacity of 1,500 kilowatts each. The Pacific Electric Railway Company, California, has also called for three generators of the same type and capacity. A 1,200-kw, alternating-current machine is to be installed in the Chicago plant of the Glucose Sugar Refining Company. The Bullock people have also obtained some large Canadian contracts recently. One calls for four alternating-current generators of 1,000 kilowatts each, for the Shawinigan Water and Power Company. Another order is for an alternating-current generator of similar size for the St. Francis Hydraulic Power Company, Province of Quebec. The Bullock machine shop No. 3, at East Norwood, is to be extended 1,000 feet, making its total length 1,200 feet.

THE UNION RAILWAY COMPANY OF NEW YORK is building three new sub-stations in the vicinity of New York, one at West Farms, one at Mount Vernon and the other at Yonkers, all of which are to be equipped with Westinghouse apparatus exclusively. They will be operated by the very large power station at Kingsbridge, which is owned by the Interurban Street Railway Company, having been built by Westinghouse, Church, Kerr & Company, and the Westinghouse Electric and Manufacturing Company. The substation at West Farms will contain nine 375-kw., oil-insulated, static transformers, divided into three groups, supplying current to three 1000-kw. rotary convertors. The switchboard consists of high tension, alternating-current, receiving panels with electrically-operated oil circuit-breakers, low tension, alternating-current, rotary panels and load panel, with direct-current rotary panels and load panel; also about twenty direct-current feeder panels. The other two substations, now in course of construction, will have similar equipments, excepting that the capacity in each case will be three 500-kw. units instead of three 1000-kw units.

A 28,000-HP MEXICAN PLANT.—The Mexican Light and Power Company, Limited, of which James Ross, of Toronto, is president, and F. S. Pearson, consulting engineer of the Metropolitan Street Railway, is vice-president, is about to award contracts for the equipment of its large water power plant to be constructed at Necaxa, in the vicinity of Huachinango, State of Pueblo, Mexico. The power is to be transmitted to Mexico City, some 90 miles, for lighting, traction and manufacturing purposes. The initial installation will have a capacity of 28,000 horse-power. There will be four alternating generators of 5,000-kw each, at 300 rpm, direct-connected to turbines of 7,000 horse-power each. The available head is 725 feet. The average volume of the Necaxa Falls throughout the year is about six cubic meters per second. At the present time, when the falls are at their greatest, nearly 100 cubic meters per second, it is estimated, are available. In the winter time or the dry season four cubic meters per second is the average. The contracts for equipment will be let through the New York offices of the company, 29 Broadway.

WORLD COPPER PRODUCTION.—Messrs. Henry R. Merton & Co., of London, estimate the copper production of the world during 1902, as follows, in long tons of 2,240 pounds, being compared with the preceding year:

	1901.	1902.
North America	318,640	349,870
South America	42,385	38,750
Europe	93,013	90,985
Japan	27,475	29,775
Cape of Good Hope	6,400	4,450
Australia	30,875	28,640
	518,788	542,470

The increase in the copper production of the world in 1902 was a very small one, the total being only 23,682 tons, or 4.6 per cent. That it was not larger was due to the decrease in some important countries, especially in Spain, Chile and Australia. North America is the only section showing a marked increase.

EQUIPMENT, ETC., FOR SOUTH AMERICA.—The export commission house of Kates & Bok, 79 Wall Street, is purchasing considerable electrical equipment, machine tools, etc., for the Argentine Republic and Chili. The Standard Company, of Chicago, has secured a contract for several electric elevator cars, and the Emerson Electric Manufacturing Company, of St. Louis, has obtained substantial orders for fans. The Kates & Bok people recently secured a contract for the complete equipment of a bolt and nut factory to be erected in Buenos Ayres. The Acme Machinery Company, of Cleveland, Ohio; the National Machinery Company, of Tiffin, Ohio; the Pawtucket (R. I.) Manufacturing Company, and the Howard Iron Works, of Buffalo, N. Y., will supply the machine tools. Considerable quantities of various supplies will also be purchased. The Allis-Chalmers Company has been alloted a fair-sized contract by the same firm, for mining machinery to be shipped to South Chili. The Rand Drill Company has also secured a good-sized order for its specialties.

GOULD STORAGE BATTERY ORDERS.—Among recent orders secured by the Gould Storage Battery Company, of New York City, the following may be noted: Berlin Street Railway Company, Berlin, N. H. (floating battery), 220 cells; San Jose Street Railway Company, San Jose, Cal., 255 cells, with 22-kw. regulating booster. This plant was ordered through the Western Electrical Supply Company, St. Louis, Mo. Newton & Boston Lines, Boston, Mass., removing a battery, which formerly floated at the station, out to Lexington, Mass., adding to the present plant cells 617 tanks, also adding an automatic regulating booster, with a capacity of 50 kw.; St. Louis Smelting & Refining Company, St. Louis, Mo., duplicating a plant which it had at its factory at Desloge, Mo., by installing 250 cells, and changing the plates so that there will be two batteries of 11 plates in 19 plate tanks. Each of these batteries will be equipped with a double Gould 15-kw. booster.

EQUIPMENT FOR NEW OFFICE BUILDING.—Mackenzie, Quarrier & Ferguson, on behalf of the Harrisburg (Pa.) Foundry and Machine Works, have just secured a contract for the engine equipment for the new Bailey, Banks & Biddle building in Philadelphia. The contract calls for two 120-hp standard engines, also a machine of same type of 75-hp capacity. The larger engines are to be direct-connected to 75-kw General Electric generators. The other engine will be direct-connected to a 50-kw General Electric generator. The Madison Square Building, New York, is to be installed with a 120-hp Ideal engine, also an 80-hp one, direct-connected to Westinghouse generators of 75-kw and 50-kw capacity. The new Oliver Building, Boston, is to be equipped for lighting purposes with two 125-hp, one 80-hp and one 40-hp Harrisburg engines, for direct-connection to generators of 75 kilowatts, 50 kilowatts and 25 kilowatts respectively.

SPARK GENERATOR ASSOCIATION.—A meeting was held lately at Indianapolis, Ind., when the Mechanical Spark Generator Association of America was organized by manufacturers representing all but two of the factories in the United States. The following officers were elected: President, V. G. Apple, Dayton, Ohio; secretary treasurer, B. E. Tritt, South Bend, Ind., Advisory Committee: E. R. Harding, Chicago; H. N. Motsinger, Pendleton, Ind., and Frank Remy, Anderson, Ind. The aims of the association are to bring the spark generator manufacturers in closer touch, to discuss the proper line of improvement and the best application of spark generators to gasoline automobiles, launches, stationary engines, etc., and to do what is possible for the general betterment of the industry.

GREENPORT, L. I., PLANT TO BE REMODELED.—The municipal plant of the village of Greenport, Long Island, is to be remodeled by W. M. Sheehan & Company, 136 Liberty Street, N. Y. The new equipment will have a capacity of about 400 horse-power. Two 72 ft. by 18 ft. McEwen boilers, of horizontal tubular type, will be installed. There will be one 16 in. by 36 in. engine, also a 12 in. by 30 in. one. They will be shafted, and of Fishkill Corliss build. A 15 in. by 15 in. Ball & Wood, direct-connected engine has also been ordered. The generators will be of two-phase type, and of 120-kw, 75-kw. and 50-kw. capacity. The Westinghouse Company took this contract. The order for the shafting has been given to the Dodge Manufacturing Company, 43 Dey Street.

THE AMERICAN CHINA DEVELOPMENT COMPANY, 320 Broadway, New York, in which J. P. Morgan, Cornelius Vanderbilt, August Belmont and other prominent New York capitalists are largely interested, will shortly let contracts for the electric lighting equipment, etc., of the machine shops, etc., of the Canton-Hankow railroad. The company is building this Chinese system, which will be nearly 1,000 miles in length. Many of the machine tools, etc., have already been let through W. Barclay Parsons, chief engineer. He will also award the contracts for electrical machinery. Manning, Maxwell & Moore and the Niles-Bement-Pond Company secured the principal orders for machine tools.

THE STROMBERG-CARLSON TELEPHONE MFG. CO., of Chicago, Ill., and Rochester, N. Y., recently sold a 100-drop switchboard to the Farmers' Telephone Company, of Perrysville, O. The Pixley-Dundas Telephone Company, of Wakefield, Ill., has recently purchased a supply of telephones, construction material and a drop switchboard from the Stromberg-Carlson Company. The Lynn Center Telephone Company, of Galva, Ill., has purchased a quantity of telephones and construction material from the company, and the Tri-County Telephone Company, of Creston, Ill., has purchased a switchboard, telephones and construction materials.

THE INTERNATIONAL TELEPHONE MFG. CO., Chicago, has recently completed the installation of a section of 2,400-line capacity central energy lamp signal multiple switchboard, with double-lamp supervisory clearing-out signals, increasing the system furnished by them a year ago for the independent plant at Saratoga Springs, N. Y. The original installation of two sections was the first order of exchange equipment furnished by the International Company, embodying all of its improved features and new patents on this line of apparatus, and it is said to be one of the most modern, convenient and durable systems now in use.

EXTENSIONS AT SOUTHAMPTON, L. I.—The Suffolk Light, Heat and Power Company, Southampton, Long Island, is to extend its operations. A new system of street lighting is to be installed in the village of Southampton, and an outdoor extension is to be made to Water Mill, about three and one-half miles distant. W. M. Sheehan & Company, 136 Liberty Street, is to carry out the work. The contract for the iron poles has gone to J. B. and J. M. Cornell. The National Conduit and Cable Company will supply the conduits and part of the cable. The remainder of the cable will be shipped by the General Electric Company.

LIGHTING ANNAPOLIS BARRACKS.—The new marine barracks at the Naval Academy, Annapolis, are to be lighted by electricity, generated by a motor-generator set consisting of a 100-hp direct-current motor, mounted on the same bed plate with and direct connected to a 60-kw. two-phase alternator. The current will be generated at 1,100 volts, and transmitted across the river and there transformed to 440 volts. These machines have recently been ordered from the Westinghouse Electric & Manufacturing Company, together with the usual switchboard and auxiliary apparatus.

PORCELAIN ELECTRIC LETTERS.—The Colonial Sign Company, of Akron, Ohio, is building a new factory in South Akron, which will soon be ready for occupancy. It is manufacturing a patented porcelain letter electric sign, and although it but recently placed its product on the market, it has secured some large contracts, and is building up a fine business. H. B. Camp, the veteran conduit manufacturer, is at the head of the company, as president. Mr. G. P. Good is vice-president; C. R. Quine, secretary; J. Edward Good, treasurer, and G. D. Chapman, general manager.

THE GREGORY ELECTRIC COMPANY, Chicago, reports a large amount of orders and business at high tide. This company is now at work upon its new plant at Sixteenth and Lincoln streets, making large additions to the buildings, and expects to have additions completed by December 1, 1903. The works at this location will be utilized to handle large generators and motors to the best advantage, the general offices, repair department and their warehouses for the smaller size machines being continued as heretofore, at 54-62 South Clinton Street.

SEMET SOLVAY WORKS.—The Semet-Solvay plant at Ensley has installed the first of four electric locomotives, the other three to follow soon. The locomotives carry coke from the Semet-Solvay plant to the furnaces of the Tennessee Coal and Iron Company adjacent. The Semet-Solvay Company is rebuilding its ammonia sulphate plant at Ensley, so that it can make its sulphate ammonia at first hands, rather than send the raw material to the parent plant at Syracuse, N. Y. It is also building a barrel factory of its own.

'PHONO-ELECTRIC WIRE FOR EUROPE.—The Bridgeport (Conn.) Brass Company has secured contracts through Maguire & Baucus, London, for several miles of "'Phono" wire, for shipment to the other side. Ten miles are to be forwarded for use on the Glasgow traction system. A good-sized shipment is also to be sent to the Dublin United Tramways. Recent domestic contracts have been received from the Coney Island and Brooklyn Railway and the Jersey City, Hoboken and Paterson Street Railway.

ARC LIGHTING AT ORE DOCKS.—For the purpose of furnishing current to the arc lamps at the Allouez Ore Docks on Lake Superior, which are the largest iron ore docks in the world, the Great Northern Railway Company has recently purchased from the Westinghouse Electric & Manufacturing Company two 75-kw. 2,200-volt two-phase generators, complete with two 5.62-kw. exciters, and a four-panel switchboard. The order also calls for seven 7½-kw. and one 2½-kw. transformers.

BALL ENGINE ORDERS.—Stewart & Co., department store, Baltimore, Md., will increase their electric plant by the addition of a 250-hp vertical engine direct connected to two 75-kw C & C electric generators. The Ball Engine Company, Erie, Pa., will furnish the engine. The Barberton Land & Hotel Company, of Barberton, O., will install a direct connected unit. The Ball Engine Company furnishes a 90-hp self-oiling engine.

POWER PLANT IN SAXONY.—Consul B. H. Warner, of Leipzig, under date of May 26, 1903, says: The Berliner Elektrizitatsgesellschaft proposes to erect a large central electric power plant at Crimmitzschau, Saxony, to furnish power to electric lighting companies, street railway companies and factories. Crimmitzschau and Werdau are but 6 miles apart, and the country between them is almost covered with manufacturing enterprises.

ORDER FOR WILLARD BATTERIES.—The Wilmington City Electric Company has placed an order with the Willard Storage Battery Company of Cleveland, Ohio, for elements to enlarge their battery from 2,000 ampere hours to 3,400. The original battery has been in use five years without renewals. During this time it has carried a load every day. On account of the good performance this order for enlargement was given.

EQUIPMENT OF SCIOTO VALLEY TRACTION COMPANY.—The Scioto Valley Traction Company, of Columbus, Ohio, has placed contracts with the Bullock Electric Manufacturing Company for two alternating-current generators of 1,000-kw capacity each. The Hooven-Owens-Rentschler Company secured the engine contract, which calls for two Hamilton Corliss engines of 1,600-hp capacity each.

STORAGE BATTERIES IN CANADA.—The Canadian General Electric Company, Ltd., Toronto, Canada, is now representing the Electric Storage Battery Company in the sale of the Chloride accumulator and the Exide accumulator, throughout Canada, and all inquiries from the Dominion in regard to storage batteries should be addressed to the Canadian General Electric Company, Ltd.

LINE MATERIAL FOR WEST AUSTRALIA.—The Albert and J. M. Anderson Manufacturing Company, of Boston, Mass., has been awarded a contract for line material to be shipped for use on the Kalgoorlie electric traction system, West Australia. The Anderson people have also some heavy orders on hand from Robert W. Blackwell & Company, Limited, London.

ORDERS FOR TRUMBLE SPECIALTIES.—The Trumble Electric Manufacturing Company, of Plainville, Conn., through its New York office, 36 Liberty Street, T. D. Watson manager, reports receipt within the past few days of some substantial orders for panel boards, new pendant push switches, flush receptacles, etc., especially from the Pittsburg district.

EQUIPMENT FOR N. Y. C. & H. R. SHOPS.—The New York Central and Hudson River Railroad shops at Weehawken, N. J., are to be equipped with considerable electrical machinery. The Westinghouse people have secured a contract for two engines of 1,250-hp capacity each, for direct-connection to 750-kw Bullock generators.

SEEKING EXPORT TRADE.—The Akron (Ohio) Electrical Manufacturing Company is making arrangements for the purpose of entering into the export trade on a somewhat extensive scale.

General News.

THE TELEPHONE.

LOS ANGELES, CAL.—The Home Telephone Company has decided to own all its buildings in the various southern California towns in which its system is or will be in operation, and with that end in view has already purchased lots for building purposes in Long Beach, Redlands, San Bernardino and Santa Ana.

CARTERS, CAL.—The Mountain Automatic Telephone Company has 20 subscribers and is now building toll lines. This is a new company and is making good progress in spite of many difficulties.

COLORADO SPRINGS, COLO.—The City Council has denied the application for a franchise of the Automatic Telephone Company.

PEARL, IDA.—The Rocky Mountain Bell Telephone Company has established a telephone exchange here and one at Myssa, across the river, in Oregon.

SALMON CITY, IDA.—It is stated that the Rocky Mountain Bell Telephone Company intends to extend its lines through Cassia County. The line will also connect with Malad in Oneida County.

O'FALLON, ILL.—Smiley Bros. operate a telephone line with a Kellogg 100-drop board and 55 subscribers.

BELLFLOWER, ILL.—This line is operated by J. A. Smith. It has a 50-drop board and 80 subscribers, with 10 miles of toll line at a 15c. rate.

SIDELL, ILL.—The Sidell Telephone Company has a 200-drop board, 100 at Fairmount and 100 at Alerton. There are 525 subscribers and 50 miles of toll line.

ST. ANNE, ILL.—The Local Telephone Exchange has a 50-drop board and 57 subscribers, with 5 miles of toll line. Subscribers pay $15; toll rates are 10c. and 15c.

SCIOLA, ILL.—The Sciola Switchboard Company operates a switchboard of 20 lines and 6 drop capacity and has nearly 300 subscribers, with 200 miles of farmers' lines.

SWANWICK, ILL.—There is a telephone line connecting this place with Cutler and Pinckneyville, giving service free to all the farmers along the line who helped to build it.

WENONA, ILL.—The Wenona Union Telephone Company is a mutual stock company. It operates a 300-drop board and has 15 miles of toll line. It has done well so far for a new concern and has a bright outlook.

PIPER CITY, ILL.—The Piper City Telephone and Telegraph Company has an American Bell 200-drop board, with 170 subscribers and more are expected. It has 30 miles of toll line. The rates are $1.10 and $1.50.

RANTOUL, ILL.—Coon Bros. operate a 200-drop board with 600 subscribers and 100 miles of toll line. They also have exchanges at Fisher, 100 drops; Armstrong, 100 drops; Potomac, 100 drops; Collison, 100 drops.

ROSSVILLE, ILL.—With switchboard capacity of 500, of which 244 are in use, the Rossville Telephone Company gives service to 433 subscribers. It has 125 miles of toll line, and there is a steady and satisfactory growth. Rates are $1, $1.50, $2, and $2.50.

FARMINGTON, ILL.—The Farmington Citizens Mutual Telephone Company has a switchboard at Leina of 100 line capacity, 20 installed, and one here, 32 capacity, 10 installed. Between 50 and 60 subscribers and 30 miles of toll line, besides party lines. This company has connection with all surrounding ones, giving all that is needed to take care of by this system.

PEKIN, ILL.—The Pekin Telephone Company has 150 miles of fine metallic toll line and exchanges at Delevan with 100 drops, 160 subscribers and 90 farmers; Havana with 200 drops, 175 subscribers and 55 farmers; Lacon with 200 drops, 155 subscribers and 80 farmers; Green Valley with 100 drops, 45 subscribers and 100 farmers; Manite with 100 drops, 60 subscribers and 75 farmers.

BREMEN, IND.—The Bremen Telephone Company has a Kellogg 300-drop board, 118 subscribers and 9 miles of toll line.

MELLOTT, IND.—The Mellott Telephone Company operates a 100-drop board and has 175 subscribers at $1 per month.

LADOGA, IND.—The Ladoga Telephone Company has a 300-drop American board, 250 subscribers and 12 miles of toll line.

HILLSBORO, IND.—The Hillsboro Telephone Company has 280 subscribers and operates a 200-drop board. Many farmers take the service.

LIGONIER, IND.—The Ligonier Telephone Company operates an "American," 300-drop board and has 270 subscribers. Rates are $1.25.

INDIANAPOLIS, IND.—A company of Indiana capitalists has purchased and is now operating a telephone system in Bowling Green, Ky.

LA PORTE, IND.—The La Porte Telephone Company has a 600-drop board, 500 subscribers and 56 miles of toll line. An extension is projected.

PENDLETON, IND.—The Pendleton Telephone Company is growing rapidly. It has a 300-drop board 265 subscribers and 16 miles of toll line.

HAGERSTOWN, IND.—The Hagerstown Telephone Company uses a 500-drop board, has 250 subscribers and 21 miles of toll line at 15c.

MONTMORENCI, IND.—The Montmorenci Telephone Company has a 12-drop board and 93 subscribers, mostly farmers, who depend on crops and prices.

PERRYSVILLE, IND.—The Perrysville Telephone Company serves 102 subscribers from a 50-drop board and has 31 miles of toll line. Its rates are $2 per month.

LEWIS CREEK, IND.—The C. M. Drake Lewis Creek Exchange operates an "American," 100-drop board, 65 in use. There are 85 subscribers and 25 miles of toll line.

KINGMAN, IND.—The Kingman Telephone Company operates a 100-drop board and has 130 subscribers. Rates are $1 and $1.25. Growth has been doubled in the last year.

NEW CASTLE, IND.—The New Castle Telephone Company has 400 switchboard capacity and an 80-drop board; 500 subscribers, 35 miles of toll line, all within one year.

OTTERBEIN, IND.—The Otterbein Telephone Company operates a Eureka 200-drop board and gives service to 230 subscribers at $15 per annum. There are 20 miles of toll line.

ROANOKE, IND.—The Roanoke Telephone Company uses Globe Automatic apparatus, has a 99-drop board and 60 subscribers. Residence rates are $1 and business houses, $1.50.

CORUNNA, IND.—The Corunna Telephone Exchange has connection with the Central Union Telephone Company. It operates a 100-drop Bell board and has 160 subscribers, and 80 on farmers' lines.

WARSAW, IND.—The Commercial Telephone Company has installed Eureka apparatus. It has a 500-drop board, 500 subscribers and 200 miles of toll line. Considerable increase is projected soon.

REMINGTON, IND.—The Remington Telephone Company has a 200-drop board with 100 subscribers and 70 miles of toll line. The plant has just been installed and already 100 more telephones are projected.

BATTLE GROUND, IND.—The Cairo Telephone Company operates a Sterling 100-drop board, has 67 subscribers and 16 miles of toll line. This company has disposed of one of its exchanges and expects to greatly improve the other.

DELPHI, IND.—The Carroll Telephone Company has a 320-drop board and over 300 subscribers. Farmers' lines are multiplying rapidly; seven co-operative companies have 405 telephones installed within a radius of ten or twelve miles.

MICHIGAN CITY, IND.—The Merchants' Mutual Telephone Company has a 1,000-drop board and will soon operate its full capacity as there are more orders now than can be supplied. There are 700 subscribers and 15 miles of toll line.

NASHVILLE, IND.—Thirty-five citizens of this place cut out the telephone wires from their residences and places of business recently, as a result of the fight which has been on for sixty days between the Morgan Telephone Company and the citizens.

ANDERSON, IND.—The Delaware & Madison County Telephone Company operates Kellogg apparatus, has 3,000 switchboard capacity and 900 subscribers. It has added 400 subscribers in ten months. Farm lines are being built in all directions and new cables put in.

HAZELRIGG, IND.—The Hazelrigg Co-operative Telephone Company has a 100-drop board, 50 drops in use, and 149 subscribers. There are 25 miles of toll line. Subscribers own their individual lines and telephones, and pay about $5 per year for service and expenses.

PLYMOUTH, IND.—The Plymouth Telephone Company has had such rapid growth that it has had to enlarge its system and yet finds it difficult to meet the demands for service. It operates a 300-drop board and has 325 subscribers with 125 miles of toll line. Its rates are $1 and $2.

UNION CITY, IND.—The Union City Telephone Company operates a 400-drop board, has 550 subscribers and 50 miles of toll line. Farmers' business promises to be a great feature. The company is now constructing an exchange at Lightsville with 40 subscribers to connect with this by toll line.

SOUTH BEND, IND.—The South Bend Home Telephone Company has a switchboard capacity of 3,000, with 1,850 lines installed. There are 2,500 subscribers and 150 miles of toll line. Business rates are $30; residences, $20. This company is branching out in many directions and is making good returns.

LAWRENCE, IND.—The Lawrence Telephone Company operates a 50-drop board and has 27 subscribers and 8 miles of toll line. The rates average $18. The outlook is very favorable, farmers and stock raisers about here finding a telephone a necessity. The company has more contracts than it can at present take care of.

CONNERSVILLE, IND.—The Connersville Telephone Company has a 600-line switchboard and 640 subscribers, with eight miles of toll line. The company is now putting up 20,000 feet of cable and preparing to make all lines metallic; it is also installing a Kellogg central energy system. The stock has been increased from $50,000 to $100,000.

FRANKFORT, IND.—The Central Energy Telephone Association has switchboard capacity of 600-drops and the same number of subscribers. The company has contracted for a lamp line signal full multiple switchboard of 3,200 lines capacity. Underground cables are to be put in, and everything necessary installed to make a perfect up-to-date system.

INDIANAPOLIS, IND.—The Big Raccoon Telephone Company has filed articles of incorporation with a capital stock of $4,000. The company will construct and operate a telephone system throughout Park and Vigo counties. The headquarters and principal exchange will be in Bridgeton. J. R. McMiller, James P. Jones, Robert M. Bell and John W. Seller are the incorporators.

MUNCIE, IND.—The Delaware & Madison Counties Telephone Company has just installed a new section to its switchboard, having filled the first of 1,120 drops in three months. The capacity is now 1,600, with 1,225 subscribers. There are 54 miles of toll line in both counties. Rates are $18 and $30. Farm lines are projected and the company now has over 100 signed contracts to take care of. The company has exchanges in Anderson, 900 subscribers; Elwood, 400; Alexandria, 200; and has toll stations at Eaton, Daleville, Yorktown and Albany.

WAGONER, IND. TERR.—The Wagoner Telephone Company gives good service to 220 subscribers, has a 400-drop board and 40 miles of toll line. Rates are $1.50 and $2.

PAULS VALLEY, IND. TERR.—The Pauls Valley Telephone Exchange was bought recently by the proprietors of the electric light system, Messrs. Thompson Bros. It has a 200-drop board and 150 subscribers at $1.50 to $2 per month and 25c. toll rate. There are 34 miles of toll line. All the lines were much deteriorated when Messrs. Thompson took possession and the next two months will be spent in putting everything in first class condition.

FOREST CITY, IA.—The Winnebago Telephone Company has a 300-drop board, 150 installed, and 150 subscribers.

CHURDAN, IA.—The Churdan Mutual Telephone Exchange operates a 200 drop board, has 100 subscribers and 7 rural lines.

WALL LAKE, IA.—The Wall Lake Farmers' Telephone Company operates a Eureka board of 52 drops and has 52 subscribers.

BEDFORD, IA.—The Bedford Telephone Company operates a 300-drop board and has 250 subscribers in town and 250 farmers. Rates are $1 per month.

ELDORA, IA.—The Eldora Mutual Telephone Company operates a 200-drop Eureka board and 175 subscribers. This is a mutual telephone company.

CONROY, IA.—The Iowa Hilton Telephone Company uses a 24-drop board and has 100 subscribers, and is constructing other lines. There is every prospect that business will be doubled within a year.

STORY CITY, IA.—The Story City Telephone Company is paying and prosperous. It gives service to 100 subscribers from a 200-drop board and has 25 miles of toll line. Rates are $1.50 and $2 per month.

OSKALOOSA, IA.—The Oskaloosa Home Telephone Company reports a fine outlook. It has now 1,100 switchboard capacity and 1,400 subscribers. Extensions and improvements are to be made in the near future.

GRAVITY, IA.—Mr. H. N. Anderson reports very favorably of his line here, which has a 100-drop board and 55 subscribers with 100 miles of toll line. The exchange gives connection with metallic toll lines to St. Joseph, Mo. Mr. Anderson also has an exchange of 30 telephones in Conway, Ia.

WEBSTER CITY, IA.—The E. H. Martin Telephone Company operates an 800-drop board, supplying 750 subscribers and 500 miles of toll line. The company owns a fine metallic toll line from Fort Dodge to Des Moines without intermediate station except at this place; also operates 15,000 feet of underground cable.

BLOOMFIELD, IA.—The Davis County Telephone Company operates a 400-drop board and has 290 subscribers with 75 miles of toll line. The company contemplates connecting 600 or 800 farmer telephones.

CARSON, IA.—The Carson Telephone Company, has a 200-drop board, 225 subscribers and 10 miles of toll line.

WASHINGTON, IA.—The Washington Telephone Company has filed articles of incorporation, the capital stock being $60,000. Mr. L. D. Robinson is president.

CORNING, IA.—The Corning Telephone Company has a switchboard capacity of 350 drops, 700 subscribers and 300 miles of toll line. Last year it paid 20 per cent. dividends, and now the company wishes to sell $10,000 first mortgage bonds to run ten years; optional payments at 6 per cent. interest. The line between Red Oak and Corning, is being improved, but good metallic lines to Omaha are needed.

OSBORNE, KAN.—The Osborne Telephone Company has a 300-drop board, 150 installed, and 120 subscribers.

GREAT BEND, KAN.—The Grimes Light, Telephone & Power Company operates a 380-drop board and has 180 subscribers.

NEODESHA, KAN.—The Hull Telephone Company has a 200-drop board and 179 subscribers, with 32 miles of toll line. Rates are $1 and $2; toll service 25c.

McPHERSON, KAN.—The McPherson Telephone Company has a 300-drop board and 440 subscribers, with 106 miles of toll line. Rates are from 75c. to $2.50 per month.

ATCHISON, KAN.—The Platte Purchase Telephone Company has a five-drop boards and 125 subscribers, with 50 miles of toll line. It has recently added three or four small exchanges.

FAIRVIEW, KAN.—The Fairview Telephone Company has a 100-drop board serving 200 subscribers. Rates are free to stockholders, as this company is run on the mutual plan and not for profit.

ATCHISON, KAN.—The Atchison Telephone Company operates a 1,200-drop board with the same number of subscribers. The company is erecting a new building, and putting in new construction throughout.

JUNCTION CITY, KAN.—The Wareham-Dewey Telephone Company operates a 500-drop board of Sterling make, has 450 subscribers and 55 miles of toll line. New cable and more toll work are projected.

SMITH CENTER, KAN.—The Exchange Telephone Company supplies service to 210 subscribers from a 300-drop board. There are also 102 miles of toll line. Rates are $1 and $2. Farmers' lines are to be added.

KINGMAN, KAN.—The Kingman Telephone Company operates a 300-drop board in Kingman with 252 subscribers, and a 100-drop board at Norwich with 32 subscribers. Rates are $2 for business, $1 for private houses.

EL DORADO, KAN.—The El Dorado Telephone Company reports business most satisfactory, both in service and profits. It operates a 300-drop board, has 225 subscribers and 200 miles of toll line. Many improvements are projected.

EMPORIA, KAN.—The Emporia Independent Telephone Company has just finished rebuilding and has put in 300 telephones in the last three months. It has switchboard capacity of 1,050 drops and 925 subscribers. There are 150 miles of toll line.

DOWNS, KAN.—The Downs Western Telephone Company has 300 subscribers and three exchanges of 300, 100 and 100 drops respectively. There are 260 miles of toll line and 100 miles of farmers' lines are to be built. The company has 27 toll line stations.

WILLIAMSBURG, KAN.—The Williamsburg Telephone Company operates a 400-drop board, has 225 subscribers and 150 miles of toll line, charging 25 cents per message. The company is connected with all the towns around and has 110 farmers connected to this switchboard.

BELOIT, KAN.—The Solomon Valley Telephone Company has 400-drop switchboard capacity and 400 subscribers. It also has exchanges at Cawker City, with 175 subscribers, and Glasco, 80 subscribers. The company will have 300 subscribers on its farmers' lines before the summer is far advanced.

JEWELL CITY, KAN.—The Jewell County Telephone Company reports marked improvement in toll line business. It owns an exchange at Mankato with a 100-drop Kellogg board installed. The board here has 100 drops and there are 110 subscribers with 100 miles of toll line. Two new exchanges are projected.

AXTELL, KAN.—The Axtell Telephone Company finds the telephone business yet in its infancy, but growing fast. Every farmer in the vicinity wants a telephone and is willing to pay a reasonable rate for it. This place has a 100-drop board and 125 subscribers. There are ten miles of toll line, the charge being 15c. per message.

ABILENE, KAN.—We are indebted to Mr. C. S. Brown, of the Brown Telephone Company for the following information. The company has increased its capital stock from $50,000 to $100,000 and will add 100 subscribers and 100 rural telephones as fast as the work can be done. It will also build 60 miles of copper metallic toll lines. It operates a 700-drop board, has 550 subscribers and 270 miles of toll line. The rates are $1.25 and $2. This company is also interested in the Union Tel. & Tel. Company, which is building 100 miles of toll line (copper) from Abilene to Topeka.

CLINTON, KY.—The Clinton Telegraph & Telephone Company operates a 200-drop board, has 90 subscribers and 150 miles of toll line.

RUSSELL, KY.—Russell and Danniton operate a 25-drop board, have 25 subscribers and 35 miles of toll line. An increase is projected.

WICKLIFFE, KY.—The Wickliffe Telephone Company operates a 100-drop board, has 85 subscribers and 16 miles of toll line. Rates are $12 to $30 per annum.

LOUISVILLE, KY.—The Louisville Home Telephone Company reports rapid growth. It has 6,100 subscribers supplied with service from a switchboard of 12,000-drop capacity.

HALEY'S MILL, KY.—The Haley's Mill Telephone Company belongs to H. C. Helsley, of Hopkinsville and D. Smith, of Fruit Hill. There are 30 miles of toll line which will probably be extended.

MORGANFIELD, KY.—The Morganfield Telephone & Telegraph Company operates a 300-drop board, has 300 subscribers and 50 miles of toll line. It has an exchange at Sturgis, Ky., with a 240-drop board and 230 subscribers.

LANCASTER, KY.—The Bastin Telephone Company operates a 200-drop board here and has one of 50 at Crab Orchard, 100 at Mt. Vernon, 100 at Livingston; with 320 subscribers in all and 210 miles of toll lines. Further extensions are projected. The lines extend into several counties.

MAYSVILLE, KY.—The Maysville Telephone Company operates a 400-drop board and has 415 subscribers; the number will shortly be increased as long distance lines are now being constructed. There are 200 miles of toll line. Rates are $24, $18 and $12. This company controls the situation, and its growth has been phenomenal.

NEW IBERIA, LA.—The People's Independent Telephone Company operates a 300-drop board with the same number of subscribers and 125 miles of toll line.

YARMOUTH, ME.—The Yarmouth Telephone Company has a 20-drop board and 35 subscribers, using Bell apparatus.

MADISON, ME.—The Somerset Telephone Company has a 100-drop board, 150 subscribers at $15, $18 and $24, and 20 miles of toll line.

MONMOUTH, ME.—The Lewiston & Greene Telephone Company has a 10-drop board, 38 subscribers at $12 per year and 35 miles of toll line.

BUXTON, ME.—The Saco River Tel. & Tel. Company supplies service to 24 subscribers from a six-drop board and has 50 miles of toll line. Its rates are $24.

FARMINGTON, ME.—The Eastern Telephone Company operates a 200-drop board, has 230 subscribers and 160 miles of toll line. Service is $15 per year.

NORRIDGEWOCK, ME.—The New Sharon & Norridgewock Telephone Company gives service to 200 subscribers from a 30-drop board. It has 30 miles of toll line.

NEW GLOUCESTER, ME.—The Pine Tree Telephone & Telegraph Company has a 20-drop board and 165 subscribers; also 15 miles of toll line. Rates are $12 per year.

SEWAGO, ME.—The Baldwin & Sewago Telephone Company has a 10-drop board, 28 subscribers and 23 miles of toll line. Rates are $15 per year. The toll line is to be extended.

ROCHESTER, ME.—The Rochester Telephone Company has a 400-drop board capacity and 550 subscribers; 25 miles of toll line and many country lines contemplated. At present it is hard work to keep up with the demand.

ARDWICK, MD.—The W. C. Lord Telephone Company has a 100-drop board and 36 subscribers. A number of toll lines will be built in the near future each having several stations.

HOYER, MD.—The Garrett County Telephone Company operates a 50-drop board here and seven others with from six to twelve drops. There are 400 subscribers and 250 to 300 miles of toll line, the rates for the latter service being $6 to $10 per year. A large increase is projected to give connection with long distance lines.

SPRINGFIELD, MASS.—The Hampden Automatic Telephone Company, using Strowger apparatus, is soon to be started here. This is one of the finest telephone centres in New England.

TEPEHUACAN, MEXICO.—A telephone line is being constructed between this city and Temala.

SAN JUAN BAUTISTA, MEXICO.—Dr. Nicanor L. Melo, of this place, has constructed a telephone line between San Juan Bautista and Teapa.

PUEBLA, MEXICO.—A system of telephone has been established between eight small towns situated in the Acajacate district, this state. It is to be extended to other towns.

CITY OF MEXICO, MEX.—The telephone company is preparing to vacate its present quarters in this city. The building will be torn down and the new National Opera House erected upon its site.

TOPOLOBAMPO, MEXICO.—Camilo A. Gonzalez, director general of telegraphs for the Mexican Government, has been making a personal investigation here with the view of establishing wireless telegraphic communication between this place and La Paz, situated across the Gulf of Lower California.

BELLEVUE, MICH.—The Citizens' Telephone Company has a 100-drop board and 62 subscribers, with 100 miles of toll line.

MAYVILLE, MICH.—The Moore Telephone Company operates a 50-drop board with 40 subscribers. The company is putting in farmers' lines.

PETERSBURG, MICH.—The Petersburg Telephone Exchange has a 100-drop board and 30 subscribers at $10 and $20. There are 7 miles of toll line.

WATERFORD, MICH.—The Michigan Telephone Company has a 12-drop board and nine subscribers. Rates are $15 per year; toll rate 10c. and upwards.

NEWAGO, MICH.—The Citizens' Telephone Company operates a local exchange and is part of the one at Grand Rapids. It has a 70-drop board and 48 subscribers.

CLIFFORD, MICH.—The New State Telephone Company has a 12-drop board and is operated by Dr. S. D. Keiller. It has, besides, a short toll line at $12 per year.

CASSOPOLIS, MICH.—Messrs. Jones & Reynolds operate the telephone line here very successfully. They have a 250-drop board, 206 subscribers and 100 miles of toll line.

BEAVERTON, MICH.—The Beaverton-Gladwin Telephone Company operates a 50-drop board, has five subscribers and four miles of toll line. Recent growth has been large.

METAMORA, MICH.—The Michigan Telephone Company operates a 50-drop board of Western Electric make, has 11 subscribers and $7 per year and is building farmers' lines.

HOMER, MICH.—The Homer Telephone Company operates a 150-drop board with 150 subscribers. Kellogg apparatus is used. There are 15 miles of toll line. Rates are $12 and $15.

DUNDEE, MICH.—The Monroe County Telephone Company has a switchboard capacity of 240, central energy. There are 180 subscribers and 11 miles of toll line, the rates being $12 and $24 for subscriptions.

THREE RIVERS, MICH.—The Three Rivers Telephone Company has added over 100 telephones to its service in three months. It now has 540, getting service from a 500-drop board. There are 75 miles of toll line.

ALMONT, MICH.—Mr. W. F. Hammond operates a 100-drop board of Western Electric apparatus. There are 30 subscribers and 70 miles of toll line. Rates are $15. A large increase in the number of subscribers is expected.

EARLETON, MICH.—The People's Telephone Company, of Wayne, operates four 10-drop boards, has 25 subscribers and 30 miles of toll line. The lines run through eight towns, and contracts with the Bell Company give other connections.

LANSING, MICH.—The Citizens' Telephone Company uses American apparatus, has 1,600-drop switchboard capacity and 1,718 subscribers. This is part of the Grand Rapids Company. The rates for business houses are $24, and for residences, $18.

MONROE, MICH.—The Michigan Telephone Company operates Western Electric apparatus, has 350-drop board capacity, 350 subscribers and several hundred miles of toll line. Farmers' lines are bringing large business and the company is installing great numbers of instruments.

GAYLORD, MICH. The Otsego County Telephone Company operates a 250-drop board with 132 subscribers. Also 32 miles of metallic toll line. In addition there is an exchange at Vanderbilt with a 150-drop board and 31 subscribers. Rates are all $12 and $15; party lines $3 less.

YPSILANTI, MICH.—The Washtenaw Telephone Company uses American Bell apparatus, has a 6-drop board and 20 miles of toll lines, the charge per message being 10c. An extension to West Sumpter is projected. This line is leased to the Michigan Bell Telephone Company on a sharing basis.

CHELSEA, MICH.—The Chelsea Telephone Company operates a 200-drop board and has 170 subscribers at $12 per year. Farmers' lines have just been completed, one of 18 miles, with 28 telephones, one of 8 miles, with 16 telephones, and a third, under construction, is 9 miles long and has 14 subscribers.

ADRIAN, MICH.—The Adrian Telephone Company operates a switchboard of 1,000-drop capacity, 700 lines being installed. It supplies 800 subscribers, and has 155 miles of toll line. Rates are $24 and $12. The country toll is 10 and 15 cents. Late demand has been so great that new subscribers have been refused. The company operates in addition, exchanges at Deerfield, 75 subscribers; Palmyra, 70; Jasper, 75, and Cadmus, 50. It has toll lines to every part of the surrounding country, with 65 stations, and connects or has contracts with 20 exchanges in the county.

WATERVILLE, MINN.—The Cameron Valley Telephone Company operates five exchanges, viz.: Waterville, 150 drops; Janesville, 150; Montgomery, 100; Le Seur Centre, 100, and Elysian, 50. There are 460 subscribers, 75 miles of toll lines and 150 miles of farmers' lines. Rates, $1 and $2 for town and $1.50 for farmers.

BRIDGER, MONT.—The telephone system from this place to Thermopolis, Wyo., taking in Cody, Basin, Meeteetse and other towns, will be completed some time in July by the Rocky Mountain Bell Telephone Company.

HOPKINS, MO.—The Hopkins Telephone Company operates a 200-drop board, has 460 subscribers and 30 miles of toll line. Rates are 25c. for each talk for 60 miles or less. The company has 150 telephones in town, the rest are farmers' lines, 8 to 10 on each line. The farmers pay $12 per annum.

PAPILLION, NEB. The Home Telephone Company operates exchanges at Papillion, Gretna and Springfield, with 100, 300 and 300-drop boards respectively, and 400 subscribers. There are 50 miles of metallic line and a large increase is projected. Rates are $1.50 for business or farm, $1 for residences.

NEW LISBON, N. J.—The Farmers' Telephone Company is making great progress in this vicinity. Its switchboard capacity is 250 with 65 subscribers. There are 35 miles of toll line at $20 annually. A large increase is in contemplation.

DEPOSIT, N. Y.—The exchange here has a 50-drop board and 130 subscribers at $10 per annum. There are 40 miles of toll line.

CHESTERTOWN, N. Y.—The Chestertown Telephone Company operates a 100-drop board and a 10-line toll board. It has 150 subscribers and 30 miles of toll line. Rates are $12, $15 and $20 per year. The company is now making all lines metallic.

CANASTOTA, N. Y.—The Farmers' Telephone Company has a 12-drop board with 39 subscribers, and 27 miles of toll line. An increase is projected. There is a fine metallic circuit, mostly built by farmers and excellent service for about 10c. per month.

MARSHVILLE, N. C.—The Marshville Telephone Company has been chartered with $10,000 capital. H. B. Marsh is among the stockholders.

CHARLOTTE, N. C.—The Caroline-Henrietta Telephone Company has been chartered to operate a telephone line in North Carolina. Thos P. Reynolds is interested. The capital stock is $600.

GREENSBORO, N. C.—The construction department of the Bell Telephone Company is making estimates for cables, underground wires, etc., to be used in rebuilding the recently absorbed local telephone company's plant in Greensboro.

ALBEMARLE, N. C.—The Albemarle Telephone Company operates a 100-drop board, has 80 subscribers and 60 miles of toll line. The company has recently bought the Stanley County system. It charges $1 for residences, $1.50 for business houses.

RALEIGH, N. C.—The Southern Bell Telephone Company is rushing a through line from Raleigh to Cheraw, S. C. A new exchange has just been completed at Selma, N. C., by the Bell Company. The company is working to connect every important town in North Carolina.

CHARLOTTE, N. C.—In connection with the erection of a new three-story exchange at Charlotte, the Southern Bell Telephone Company will install an entirely new system, placing its wires underground. New switchboards have been ordered. There are now 900 telephones in use.

MARIA ALENE, OHIO.—The Marion Telephone Company has a 50-drop board and 30 subscribers. The rate is $1 per month.

CLYDE, OHIO.—The Farmers' Telephone Company has 250 switchboard capacity, 25 drops installed and 100 subscribers. An increase is contemplated.

CAVETT, OHIO.—The Cavett Telephone Company has been incorporated with $5,000 capital stock by W. Brohnam, W. M. McQuown, J. H. Myers, O. H. Myers and Ernest Kahn.

CINCINNATI, OHIO.—The probate court has overruled the demurrer of the city to the petition of the Cincinnati Telephone Company, and the company will be granted a franchise to install its telephone system throughout the city. The wires will be placed underground.

CHATTANOOGA, TENN.—The Cumberland Telephone Company will erect an $8,000 addition to its Chattanooga plant and will put in a new $10,000 switchboard.

CHATTANOOGA, TENN.—The Hamilton Telephone Company, of Chattanooga, has received a charter, the capital being $5,000. The incorporators are Z. C. Patten, T. W. Fritts, L. J. Sharp and others.

TULLAHOMA, TENN.—A movement is on foot for the organization of a local telephone exchange at Tullahoma. A meeting will be held soon to discuss the situation. The Cumberland Company is already in the field.

BEAUMONT, TEX.—The Beaumont Telephone Company announces that it will build a toll line to Sour Lake Springs, a distance of about 25 miles. The work of constructing the line will commence as soon as the right-of-way can be secured.

FORT WORTH, TEX.—The Fort Worth Telephone Company, of which F. B. McElroy is vice-president, will construct a long distance line between this city and Hillsboro on the south and to Gainesville on the north. This company is building an exchange building here at a cost of $20,500. The same interests are establishing local telephone systems in Gainesville, Denton and Cleburne.

MOAB, UTAH.—The La Sal Mountain Telephone and Electric Company has been organized at this place for the purpose of operating telephone systems and an electric power plant.

MUSCODA, WIS.—The Basswood & Eagle Telephone Company is composed of 13 farmers who own the line between this place and Richland City, but has nothing to do with the switchboards at those places. There are 25 subscribers and 25 miles of toll line.

ELECTRIC LIGHT AND POWER.

HUNTSVILLE, ALA.—The Huntsville Railway, Light & Power Company has secured the contract for lighting the city for a period of five years at $75 per light per annum. The contract provides that a new lighting plant shall be erected by December 1.

BISBEE, ARIZ.—A new electric light plant is to be installed here. Phelps, Dodge & Co., can probably give information.

PARAGOULD, ARK.—The Crystal Ice Company has 1,800 16 and 32-cp incandescent lights for street lighting. The company is in the market for two direct-connected dynamos of 35 and 100-kw. It will also change its street lighting system.

GRIFFIN, GA.—The town of Griffin has voted $100,000 bonds for light, water and sewerage.

WASHINGTON, IA.—The Washington Illuminating Company operates 15 arc lights and 300 incandescents.

MT. VERNON, IA.—The Mount Vernon Electric Light Company has 2,000 16-cp and 60 50-cp incandescent lights.

FLEMINGSBURG, KY.—Henderson & O'Bannon operates one arc of 2,000 cp and 600 16-cp incandescents. A 30 to 40-kw 250-volt dynamo is required.

EVERETT, MASS.—A new contract has been placed by the city of Everett, Mass., with the Malden Electric Light Company for municipal lighting. Last year the arcs cost $90 each for 1,200-cp lamps, with free light for the police station and city hall. This year the lights will cost the same, but 2,000-cp lamps are to be used, the police station and city hall are to be lighted free, and light will be supplied to a new armory to the amount of $150 a year. The number of lights included is 87½, one lamp being on the dividing line between Malden and Everett. The population of Everett is now about 26,500, which makes the cost per arc lamp per capita practically 35 cents and the cost of arc lighting per capita 30 cents per annum on a moonlight schedule, all night burning.

QUINCY, MASS.—After three weeks of darkness due to the inability of the city of Quincy, Mass., and the officers of the local electric lighting company to come to terms an agreement has been reached and the streets once more are being lighted. The company has agreed to a new contract for street lighting at a reduction of six per cent. from the prices charged in the contract which terminated June 1. The company also agreed to increase the number of nights on which current is to be supplied by four per cent. For the next three years the city will pay $71 a year for each arc light, and $17.50 for each incandescent. The lights are to be on every night except two nights before and two nights after full moon, provided the moon is shining brightly. If it is obscured at this time the lights are to burn as on other nights. Heretofore the lights have been turned off whenever the almanac said there was a full moon, whether the moon was visible or not.

ZAMORA, MEXICO.—Brisbin & Davis have the contract for constructing the canal which is to run from the Rio Duerro to this place to furnish power for the Guanajuato electric generating plant. B. T. Davis is in charge of the work.

MERIDA, MEXICO.—The electric light and power company of this place, known as the Compania Yucateca de Luz y Fuerza Electricas, has gone into liquidation. The plant of the company is said to have cost more than $1,000,000, and it had a contract for furnishing the city with light for a period of years which has some time yet to run.

MONTEREY, MEXICO.—The Monterey Electric Light Company is preparing to erect a large addition to its present plant. When the necessary buildings are erected and the machinery installed the present capacity of the plant will have been doubled. Emil Dysterud, the manager of the plant says that about $150,000, Mexican money, will be expended in the contemplated improvements. The company is also negotiating with R. N. Oakman, who is establishing a large gas plant in Monterey, with the view of consolidating the two concerns.

PINE CITY, MINN.—The Pine City Milling & Electric Company operates 700 16-cp incandescent lights and contemplates putting in a 50 or 60-kw generator this season.

MONROE CITY, MO.—The Monroe City Electric Light plant has 32 arc lights, 2,000-cp enclosed and eight commercial arcs; also 1,000 16-cp incandescents.

ST. LOUIS, MO.—A contract has been made by the World's Fair corporation with the Union Electric Light & Power Company to furnish to the Exposition a minimum power of 6,000-kw and a maximum of 7,500-kw at a total minimum cost of $338.90. This, in conjunction with the Exposition's own plant, will supply all the power and light to be used on the grounds during the Exposition period.

JERSEY CITY, N. J.—The Jackson Electric Light Company has been incorporated with a capital of $25,000. Incorporators: Louis B. Dailey, Joseph will be expended in improvements. It is stated that the electric light company may also enter into a contract with one of the street railway companies here to furnish the electric motor for power for its cars.

SUMMIT, N. J.—The Essex-Union Water & Light Company, formerly the Mountain Electric Company has 10 General Electric arc lamps, enclosed multiple and 9,100 private incandescents, with 360 25-cp street lights. It also runs six motors on a commercial line and one 90-hp synchronous motor connected to a triple pump for pumping water in the water department.

SAYVILLE, N. Y.—The Sayville Electric Company has increased its capital stock from $15,000 to $30,000.

NIAGARA FALLS, N. Y.—The Council has granted the Niagara Falls Hydraulic Power & Mfg. Company permission to construct a transmission line to its new manufacturing district at the North End.

GREENE, N. Y.—The Board of Village Trustees has awarded the following contracts: for a 60-kw dynamo to Westinghouse Electric Co., $1,500; two 100-hp fire tube boilers, Watertown Engine Co., Watertown, $2,595.

MT. AIRY, N. C.—It is proposed to construct water works and an electric light plant, at a cost of $55,000. Contracts will probably be let about July 15.

TARBORO, N. C.—This is a municipal plant organized in 1900, using the General Electric system. It has 4¼ miles of circuit, 33 1,200-cp arc lights and 2,000 16-cp incandescents.

HAMLET, N. C.—The Freeman-Matthias Company, M. C. Freeman, president, J. I. Matthias, secretary and general manager, operates an alternating Westinghouse plant. There are 32 100-cp incandescent lights. An electric railway would be welcomed here.

MARYSVILLE, OHIO.—The Marysville Water & Light Company has increased its capital stock from $100,000 to $200,000.

WELLSVILLE, OHIO.—The citizens have defeated a proposition to issue $20,000 bonds to build a municipal lighting plant.

GREENVILLE, OHIO.—The Greenville Electric Light & Power Company has 120 7-amp. enclosed arcs and about 5,000 16-cp incandescent lights.

HIRAM, OHIO.—Hiram College operates an electric light plant to light the college buildings, homes of professors and the campus, besides a few streets.

HUBBARD, OHIO.—The electric light plant was destroyed by fire in 1901 and a recent vote to issue $10,000 to rebuild it has resulted in preparations for commencing work.

PORT CLINTON, OHIO.—The Port Clinton Light & Power Company furnishes 24 arc lights and 1,700 16-cp incandescents. There is an opening here for an electric railway.

SALINEVILLE, OHIO.—The Salineville Electric Light, Heat & Power Company was organized in 1901. F. Duncan is superintendent. It operates 49 2000-cp arcs and 900 mixed incandescents.

RAVENNA, OHIO.—The Council has made a lighting contract with the Ravenna Gas & Electric Light Company on a basis of $72.50 on the moonlight schedule. There is considerable talk of a municipal lighting plant.

XENIA, OHIO.—The Xenia Heat, Light & Power Company has been chartered, the incorporators being M. R. Snodgrass, H. N. Schlesinger, F. M. Hagan, A. H. Kunkle and Frank Torrence. The capital stock is $10,000.

PORTLAND, ORE.—Extensive improvements will be made in the near future in the electric plant of the Portland General Electric Company. Two 2,000-hp compound engines and a 1,000-kw alternator will be installed. The improvements will be made at an expense of about $250,000.

UNIONTOWN, PA.—The Marchand Electric Light, Heat & Power Company, of Uniontown, has been incorporated with a capital of $25,000.

PAWTUCKET, R. I.—It is reported that the J. & P. Coates Thread Company will build a conduit and bring its power from the electric light plant, and discard its present steam plant. This will mean a large addition to the present electric plant.

SISSETON, S. D.—The Fowler Electric Company, of Morris, Minn., is stated to have secured a franchise for an electric light plant.

SPRINGFIELD, TENN.—A recent election resulted in favor of $35,000 water and electric light bonds.

TULLAHOMA, TENN.—The municipal plant commenced operations August, 1902, with P. W. Lytle, superintendent. It operates 30 arcs and 1,200 16-cp incandescent lights; also two 50-hp motors for its own use.

SAN ANTONIO, TEX.—W. H. Weiss has made application to the City Council for a franchise to build and operate a competitive electric light plant here. The existing electric light company is making a strong fight against the proposed franchise which Mr. Weiss is seeking. Mr. Weiss states that if the franchise is granted he and his associates will expend several hundred thousand dollars in installing the new plant.

MOAB, UTAH.—The La Sal Mountain Telephone & Electric Company has been organized here and will install a power plant and operate an electric lighting and telephone system. J. M. Corbin is the secretary and manager of the new company.

ESSEX JUNCTION, VT.—The People's Electric Light & Power Company operates 125 32-cp street lights and 2,000 16-cp commercial and private lights.

BURLINGTON, VT.—At a city meeting, June 11, it was voted to bond the city for not exceeding $150,000, to establish a municipal electric lighting plant.

RUTLAND, VT.—The Rutland City Electric Company has 330 arc lamps and about 15,000 incandescents. It runs 56 motors aggregating 330-hp, many flat irons and some small stoves; also five cars.

MONTPELIER, VT.—The Consolidated Lighting Company has a water power at Bolton Falls and a fine new auxiliary station is now being constructed. There are 88 1,200-cp arc lights and 97 7½-amp. series alternating, also about 15,000 16-cp incandescents.

BIG STONE GAP, VA.—It was voted to issue $20,000 bonds for constructing an electric light plant, etc.

WAYNESBORO, VA.—The Waynesboro Electric Light Company, Rife & Schoppers, lessees, operates about 500 incandescent lights.

LEESBURG, VA.—The Leesburg Electric Company, organized this year with $23,000 capital, has 11 arc lights and 900 16-cp incandescents. It also operates eight motors.

BENTON, WIS.—The citizens have voted to issue $30,000 bonds for an electric light plant.

PLATTEVILLE, WIS.—The Platteville Electric Light Company is stated to have decided to remodel its plant and put in a new boiler for heating purposes.

RIVER FALLS, WIS.—This, a municipal plant, was built in 1900, and furnishes the city with 30 1,200-cp arc lights and about 1,500 16-cp incandescents. There is one 10-hp motor operated at a contract rate of $300 per annum.

THE ELECTRIC RAILWAY.

MONTGOMERY, ALA.—The Haynesville Railway Company has filed articles of incorporation, with a capital stock of $75,000.

HUNTSVILLE, ALA.—The Huntsville Railway, Light & Power Company is to install new 150-kw., direct-connected, three-phase, alternating units with about one hundred series alternating arc lamps.

BISBEE, ARIZ.—The construction of an electric street railway system here is contemplated. Phelphs, Dodge & Co. can probably give information.

WALLACE, IDA.—Herman J. Rossi has been granted a franchise to operate a street railway system in this city.

CHICAGO, ILL.—The South Side Suburban Railway Company has taken out incorporation papers. Charles C. Heisen, Cornelius J. Tom, Frederick C. Bendle, Clayton R. Taylor and Gustav Nelson constitute the first Board of Directors. The capital stock is $50,000.

CHICAGO, ILL.—Plans for extending the Lake Street "L" line through Maywood, Harlem and River Forest, and ultimately to the Fox Lake district, were outlined at a meeting of River Forest and Harlem business men. Clarence Knight represented the railway company. No agreement was reached, but both sides expect to come to an understanding soon. One of the offers made by Mr. Knight was to establish a noonday express service running from Fifty-second Avenue on a third rail track to Rockwell Street, the service from Maywood to Fifty-second Avenue to be local.

DUBUQUE, IA.—The resumption of street-car traffic on June 16, with non-union men, caused a demonstration. A mob surrounded the street-car company's power plant and broke every window in the building with bricks. From the power plant the mob marched to the car barns, where it broke into the building and wrecked the windows of all the cars, and partially wrecked the cars. The arrival of troops caused a cessation of the work of destruction.

ATLANTIC, IA.—At a meeting of the board of directors of the Western Iowa Interurban Railway Company, the following officers were elected: John A. Nash, of Audubon, president; Almer Stern, of Logan, vice-president; C. R. Benedict, of Shelby, secretary; Clyde Brenton, of Dallas Center, treasurer; H. H. Polk, of Des Moines, president of the Interurban Railway Company, of Des Moines, manager; John A. Nasb, of Audubon; G. W. Cullison, of Harlem, and E. W. Weeks, of Guthrie Center, executive committee. The executive committee was directed to secure a competent corps of engineers, and to commence the survey of the route at once.

TOPEKA, KAN.—The Arkansas Valley Interurban Railway Company, with headquarters at Wichita, has been granted a charter. Capital stock amounting to $1,000,000 has been subscribed. The directors of the company are: C. L. Davidson, J. M. Knapp, O. A. Boyle, James Allison, J. E. Howard, C. C. Cohn, C. H. Smythe, S. S. Noble, J. L. Johnson, John Heihl, R L. Holmes, of Wichita; W. W. Spencer, of Geuda Springs; W. E. Wilcox, of Arkansas City; George E. Hunter, of Wellington; A. L. Barner, Belleplaine; A. H. Barnes, of Oxford; S. C. Arnett, of Belleplaine.

LOUISVILLE, KY.—The Louisville & Southern Indiana Traction Company hás filed articles of incorporation. The capital stock is placed at $3,000,000. The lengtb of the electric lines to be constructed under the articles of incorporation is placed at 200 miles. The principal offices of the company are to be located in New Albany. The directors named for the first year are: Samuel Insull, of Chicago; James W. Dunbar, R. W. Wite, J. F. Stratton and J. O. English, of New Albany, Ind.

LYNN, MASS.—The project for the establishment of a new street railway from Lynn to Nahant has taken definite shape, and a company is in process of organization under the name of the Nahant & Lynn Railway Company, organized under the laws of Massachusetts and capitalized at $12,500.

WORCESTER, MASS.—The Worcester & Connecticut Eastern Railway Company has nearly completed a power plant with a capacity of 10,000 horse-power, at Wauregan, Conn., which is to furnish power for the system between Worcester and Norwich, Conn., and sell power to others. Sub-stations are to be built along the line.

ST. JOSEPH, MICH.—The Chicago, Michigan & Indiana Electric Railway Company, of Benton Harbor, has been incorporated, with $3,000,000 capital.

DETROIT, MICH.—The Owosso & Corunna Electric Company, of Owosso, Mich., intends to add a 10-mile extension to its present line and to install new lighting generators and arc lamps. Frank Van Tuyl & Co., of Detroit, Mich., are the general managers of the company.

ST. JOSEPH, MICH.—The Chicago, Michigan & Indiana Electric Railway Company, of Benton Harbor, has been incorporated with $3,000,000 capital, at Lansing. An electric railway is to extend from a point on the Indiana State line to Dowagiac, St. Joseph, Benton Harbor and Paw Paw, with an extension branch to Kalamazoo and Allegan, while the main line will extend along the lake shore to Chicago. The new railroad will carry passengers, mail, general freight, and fruit.

ANN ARBOR, MICH.—The Ohio & Michigan Traction Company has been incorporated in Michigan with a capital stock of $1,650,000, for the purpose of building an electric railway from Toledo, Ohio, to Ann Arbor, Mich., a distance of about 45 miles. United States Senator J. B. Foraker, of Cincinnati, is one of the first directors, the other members of the board being M. I. Wilcox, Toledo; H. C. Stahl, Bellevue, Ohio; John H. Clauss and T. H. Jungk, of Fremont; Myron C. Briggs, Fostoria, and William Ford, Toledo.

NEW YORK, N. Y.—The Interurban and Metropolitan Street Railway systems of New York City will add 40 or 50 new transfer stations by August 1. There are now 400 and 500,000 transfers a day are issued, making the average fare less than 3 cents. There has of late been considerable agitation and litigation on the subject.

BUFFALO, N. Y.—The International Railway Company has awarded contracts for the equipment for a new transformer house in this city.

BINGHAMTON, N. Y.—The Binghamton Railway Company has been granted a franchise in Owego. The company will extend its line now running between Binghamton and Union into Owego.

EAST LIVERPOOL, OHIO.—C. A. Smith, of this city, has secured a franchise for an electric road between Chester and Congo, W. Va.

CANTON, OHIO.—The Akron-Alliance Connecting Railway Company has filed a mortgage for $2,000,000 to the Eastern Trust Company of New York to secure an issue of 5 per cent. 20-year bonds. The road will be built at once from Akron to Alliance and later will be extended to East Liverpool. Officers of the company are R. D. Gibbey, president, and A. G. Spencer, secretary.

CANTON, OHIO.—Under a statute the Stark Electric Railway Company has had all its motormen and conductors sworn in as special police officers in Mahoning and Stark counties. They will have authority not only on the company's property but will have power to pursue and capture any one who attempts to escape. Failure to suppress lawlessness renders the employee liable to a fine of from $5 to $25.

MANSFIELD, OHIO.—The Mansfield Railway Light & Power Company has elected the following-named officers: H. M. Byllesby, president; C. F. Ackerman, vice-president; Reid Carpenter, treasurer; W. D. Breed, secretary. The company will spend $250,000 in improvements during the next few months. The power house will be enlarged to accommodate a new unit and a storage battery will be installed.

COLUMBUS, OHIO.—The stockholders of the Columbus Railway Company have voted to lease its property, franchises and privileges to the Columbus Railway & Light Company, which has been organized with a capital stock of $5,000,000 to take over the properties of the Columbus Railway Company and the Columbus Edison Company. The leasing company guarantees dividends on the stock of both the railway and light companies. The stockholders of the Columbus Edison are expected to ratify the lease of their property later.

TORONTO, ONT.—Finding it impossible to obtain its power from Niagara Falls for at least two years, the Toronto Railway Company has decided to increase its power plant from 6,000 horse-power to 10,000 horse-power to meet the growing traffic of the road.

WAYNE, PA.—The Radnor Belt Line Street Railway Company, capital $30,000, has been chartered. W. A. Obdyke, of Wayne, is president.

BEN AVON, PA.—The Ben Avon & Emsworth Street Railway Company has been chartered, with a capital of $4,000. S. L. Tone, of Pittsburg, is president; T. H. Clark, C. S. Hilman, A .M. Richmond and C. W. Gibbs are directors.

BETHLEHEM, PA.—The charter of the Hanover Central Electric Railway Company has been filed. The incorporators are: President, Clarence A. Wolle, of Bethlehem; Charles A. Walbert, Lemuel H. Woddrop, Edmund C. Cain and John T. Bacon, of Philadelphia. The capital stock is $48,000.

COATESVILLE, PA.—The Brandywine Electric Street Railway Company, of Coatesville, has been incorporated, with a preliminary capital of $6,000. The officers are Albert H. Swing, president, Coatesville; S. L. Hibbard, Jr., of Landsdowne; G. H. Walf, C. H. Johnson and R. S. Bair, of Philadelphia, directors.

MASONTOWN, PA.—The West Masontown Street Railway Company has organized by electing the following officers: President, Jesse V. Hoover; vice-president, F. A. Maddas; secretary, W. I. Crawford; treasurer, D. R. Anderson. The capital stock is now $20,000, and it is expected to increase it to $50,000 at once.

HARRISBURG, PA.—The following companies have been chartered, with the following directors: J. Hartwell Hillman, Jr., of Pittsburg, president; Arthur B. Sheets, Harry R. Weber, C. Percival Yocom, Richard H. Schorrer: Spruce Run Street Railway Company, capital $15,000; Kilbuck Street Railway Company, capital $30,000; Twin Creeks Street Railway Company, capital $18,000; East Bank Street Railway Company, capital $42,000.

EL PASO, TEX.—George Pence is promoting a project to build an electric railway between this city and San Elizario, a distance of 22 miles.

CHATTANOOGA, TENN.—It is said that the sum of $750,000 has been set aside for the improvement of the electric railways of Chattanooga and for the construction of an eight-mile road to Walden's Ridge pending the consolidation of the three local companies, the Rapid Transit Company, the Chattanooga Electric Railway Company and the Chattanooga Light & Power Company.

NASHVILLE, TENN.—The properties of the Nashville Railway were sold under foreclosure June 15 and bought in at the upset price of $500,000 by A. M. Shoont, representing Ladenburg, Thalman & Company, of New York; Isadore Newman & Son, of New Orleans; J. N. Williams & Son, of Richmond, and Percy Warner and others, of this city. The property was purchased by the Hambleton syndicate, of Baltimore, several years ago, and was bonded and stocked by $13,000,000, but defaulted on interest charges.

HOUSTON, TEX.—W. H. Chapman, general manager of the Houston Lighting & Power Company, announces that the company has decided to expend $180,000 in constructing important additions and improvements to its plant here. The capacity of the plant will be increased and the lighting area will be extended one-half mile around the whole city. An additional crossing of Buffalo Bayou by the company's cables will be necessary in order to supply the new territory with lights.

GRAFTON, W. VA.—The Grafton Street Railway Company has been incorporated, with a capital stock of $50,000.

WHEELING, W. VA.—The Buffalo Creek Railway Company, of Wellsburg, has been organized by W. W. Beall, J. C. Palmer, S. George, M. E. Boyd and others of Wheeling.

SHEBOYGAN, WIS.—The Sheboygan & Calumet Railway & Electric Company has been organized to build an electric railway to Chilton.

MADISON, WIS.—The Superior & Southeastern Railway Company, capital stock $50,000, has been incorporated. The incorporators are: John E. Glover, George C. Glover, Leslie E. Glover and L. A. Baker, New Richmond, and H. C. Baker, Hudson.

NEW INDUSTRIAL COMPANIES.

DR. PRATT'S X-RAY AND ELECTRO-THERAPEUTICAL LABORATORY COMPANY has been incorporated at Chicago, Ill., capital stock, $25,000. It is proposed to manufacture electrical apparatus. Incorporators: O. W. MacNelly, William E. Holland, R. S. Gregg.

THE CLAYPOOL ELECTRIC COMPANY has been incorporated at Columbus, Ohio, with $1[illegible],000 capital to manufacture and deal in electrical machinery and appliances. Incorporators: John Caswatt, R. W. McCoy, J. C. Burns, F. H. Shoedinger, E. Johns, all of Columbus.

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LEGAL.

TELEPHONE SUIT.—The Eureka Electric Company, of Chicago, informs us that Judge Shiras of the United States Circuit Court for the Northern District of Iowa, has dismissed all suits filed in the Meissner and Overshiner patent suits against the County Telephone & Telegraph Company, of Waterloo, Iowa. These suits were defended by the Eureka Electric Company.

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OBITUARY.

CAPT. J. M. BRINKER.—We regret to note that Capt. John M. Brinker died in Buffalo on the 9th inst., of paralysis. For many years Captain Brinker was a successful operator of coal mines in Pennsylvania. A few years ago he built the electric "Gorge" Railway through the gorge below Niagara Falls, spending about $1,000,000. The road has been a center of attractoin to many electric bodies and visiting electricians from abroad.

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PERSONAL.

MR. F. C. SMITH, manager of the Citizens Telephone Company, of Houston, Texas, is visiting New York.

MR. GEO. L. COLGATE has resigned his position as manager of the Consolidated Gas & Electric Co., of Batavia, N. Y.

MR. MAURICE CLERE, of Paris, arrived on the *Kronprinz Wilhelm* this week and has gone to San Jose, Sonora, Mexico.

PROF. FOREST R. JONES, of the Department of Machine Design, Worcester Polytechnic Institute, has resigned to accept a similar position at Cornell University.

MR. HENRY W. BROOKS, JR., has resigned as director and treasurer of the McCreary Electric Company and will hereafter devote his attention to his railway construction interests.

DR. BENJAMIN S. MERIGOLD, Professor of Industrial Chemistry at the Worcester Polytechnic Institute has been appointed Assistant Professor of Chemistry at Clark College, Worcester.

MR. J. M. ANDERSON, treasurer of the Albert & J. M. Anderson Manufacturing Company, Boston, Mass., where offices are at 135 Liberty Street, spent a few days in New York last week.

DR. C. F. WEBER.—We have an inquiry for the address of Dr. C. F. Weber, of Chicago, whose work on the manufacture of carborundum alumina was noted in an issue of May 30.

MR. E. W. RICE, JR., vice-president of the General Electric Company, was honored with a degree by Harvard University at the recent commencement, in addition to similar recognition already conferred by other seats of learning.

HON. CHANDOS S. STANHOPE, president of the Campania de Ferrocadriles del Distrito Federal (the Mexica Electric Tramways, Limited) which operates the extensive electric system in the Mexican capital arrived in New York last week en route for Europe.

MR. E. B. SCHATTNER.—It is understood that Mr. E. B. Schattner, of London, the inventor of the meter bearing his name, will shortly join the staff of the General Electric Company, at Schenectady. The company has the rights for his meter in this country.

MR. H. HINE, president of the Guanajuato Power & Electric Company, reference to which is made elsewhere, is now at Pittsfield, Mass. While in New York, he will be at the Waldorf-Astoria. According to present arrangements he will return about the middle of August.

MR. A. H. FORD.—It is generally believed that A. H. Ford, of New Orleans, will succeed David H. Belden as general manager of the Birmingham Railway, Light & Power Company. Mr. Ford is intimately associated to Isadore Newman, of New Orleans, one of the leading security holders of the company.

MR. IRA W. HENRY, the electrical engineer of Safety Insulated Wire & Cable Company, has just returned with his family from several weeks' trip abroad, during which time he visited England and the Continent and took part in various conventions, etc., besides inspecting a number of plants and places of technical interest.

MR. J. H. McCLEMENT has been made chairman of the board of directors of the Colorado Fuel & Iron Company, one of the large properties that has just passed under the Gould-Rockefeller management. Mr. McClement is very well known in the electrical field. He was formerly comptroller of the old Edison parent company, and was personally interested in electrical properties. Of late he has been a partner in the stock exchange firm of George P. Butler & Co., a Gould house. He is a man of excellent financial judgment.

MR. GEORGE F. LITTLE, sometime associated with the electrical supply houses of J. Jones & Son and Stanley & Paterson, and who more recently was with Sibley & Pitman, has formed a partnership with Mr. Charles S. Hughes, of Shanghai, China, for the purpose of handling American electrical supplies for the Far East. The new firm will be known as Hughes & Little. Its headquarters will be in Shanghai. Mr. T. D. Watson, 136 Liberty Street, will represent the concern at this end. Mr. Little expects to sail for China from San Francisco, August 8.

MR. A. S. FOOTE, of the telegraph departments of the Southern Pacific R. R. has contracted with the Stromberg-Carlson Telephone Manufacturing Company, of Chicago, for equipment to be used on the division from El Paso to New Orleans. Mr. Foote is stringing copper circuits between cities, and from stations to sections he uses grounded circuits. This places section, engine and work crews at the disposal of the dispatcher. It is also proposed to place at every blind siding some kind of a telephone apparatus that will enable wrecking crews to communicate with the dispatcher.

MR. E. R. KNOWLES, E. E. C. E., the well-known consulting engineer of this city, has been retained as consulting engineer for the heat, light and power installation to be made in the Publishers & Printers Building, to be erected on West Thirty-seventh and West Thirty-eighth Streets, New York City. This installation with be one of the largest of its kind in New York City and the projectors of this enterprise are to be congratulated on the selection of their engineer, who has already had a large experience in the elec-light and power equipment of modern factories, etc.

MR. J. K. ROBINSON, of Iquique, who represents the Westinghouse, Standard Underground Cable and other prominent American manufacturing interests in Peru, Chili, Bolivia and Ecuador, returned to New York last week from Europe, where he went in connection with some projects in which British capital is interested, for the erection of electrical and water power plants on the West Coast of South America. He will place contracts for equipment, etc., within the next few days. He is making his headquaretrs at the offices of the William E. Peck Company, 116 Broad Street.

MR. J. ORTON KERBEY, a war telegrapher, and manager at Pittsburg, as well as reporter in the Associated Press Senate gallery, at Washington, becoming later a consul for the United States under Secretary Blaine, is now located in Washington as vice-president of the Pittsburg and Amazon Rubber Trading Company, to look after relations with South American governments, etc., as well as to act as rubber expert. The new company has headquarters in Pittsburg, where a large amount of rubber is called for in tubing, insulation, betling, packing, etc., and will direct its efforts to rubber from the Amazon.

MR. ADOLPHO ASCHOFF, of Rio de Janeiro, Brazil, has bought out the old firm of James Mitchell & Co., of that city and San Paulo, representing the General Electric Company and other large American interests. He will continue the business on the same lines. The style of the new house will be Aschoff & Guinle. The new partner is Mr. Edwardo Guinle, a talented young Brazilian of wealthy connections, who has been during the last two years in the United States in the General Electric factory and New York offices. Mr. Aschoff is well known also in this country from his frequent visits, dating back to the Chicago World's Fair of 1893. He has a host of friends here, all of whom will welcome the opportunity to promote the interests of the new firm which comes to the front when electrical work is developing rapidly in the sister Republic of Brazil.

PROF. T. W. RICHARDS, of Harvard University, has deprecated lately the sensational talk about electrical corpuscles, and writing to the New York *Times*, says: "I wished only to state that in my opinion this corpuscular hypothesis was not an ultimate discovery, but only one of several possible hypothetical interpretations of the highly interesting facts discovered by Röntgen, Becquerel, M. and Mme. Curie, J. J. Thomson, and Rutherford. I am inclined to think that Sir William Crookes and Sir Oliver Lodge would agree with this statement. Popular reports often harm science by confounding hypotheses and facts. The difference between them cannot be emphasized too strongly, but each is useful in itself. Hypotheses are scientific dreams, often fruitful, leading to new paths of investigation which discover new truth, but they become dangerous when they are mistaken for realities."

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EDUCATIONAL.

WORCESTER POLYTECHNIC GRADUATES.—The following students have graduated in electrical engineering from the Worcester Polytechnic Institute and are reported in the positions noted: R. J. Rearborn, Westinnghouse Elec. Mfg. Co.; Carl D. Knight, General Electric Co.; Lewis E. Dickinson, General Electric Co.; Walter T. Goddard, Asst. Worcester electrical department; B. D. Foot, General Electric Co.; Lee C. Ilsley, Am. Tel. & Tel. Co., New York; E. W. Kimball, G. E. Munroe and J. A. Sandford, Jr., General Electric Co.; H. W. Morehouse and E. L. Stone, Jr., New York Telephone Co.; R. E. Truesdell, General Electric Co. Mr. M. M. Libby is not yet located, but has had several offers. Prof H. B. Smith states that the demand for men this year for recent and older graduates has been greater than the supply in electrical engineering work.

ELECTRICAL GRADUATES AT COLUMBIA.—Prof. G. F. Sever, of the electrical engineering department at Columbia University, New York City, sends us the following list of graduates in the class of 1903, with their occupations: A. B. Bradley, S. Brown, J. B. & J. M. Cornell; A. Coggeshall, E. L. de Forest, S. H. Everett, Jr., General Electric Co.; P. N. Golden, New York Edison Co.; F. F. Grevatt, General Electric Co.; P. L. Griffith, New York Telephone Co.; R. C. Hoguet, studying patent law; O. W. Lillard, General Electric Co.; M. Palmer, Westinghouse Electric & Mfg. Co.; H. Richards, Jr., Sec. Y. M. C. A., Columbia Univ.; T. O'Connor Sloane, Jr., Asst. in E. E. Dept., Columbia Univ.; R. Stover, located in New Mexico; W. T. Stromeyer, Western Electric Co., N. Y.; L. S. Thurston, General Electric Co.; A. B. Weil.

THE STEVENS INSTITUTE OF TECHNOLOGY.—Although the Stevens Institute maintains but one course leading to the degree of mechanical engineer the curriculum has been very much broadened of late and includes a thorough training in the elements of electrical engineering. Specializations are avoided, the entire available time being applied to a thorough drill in the fundamental principles and to their applications to modern engineering practice. The dynamo laboratory has just been thoroughly overhauled and a new system of wiring installed. The present graduating class has just presented the department with a five panel slate switchboard for the dynamo laboratory which will be installed during the summer. Prof. Albert F. Ganz, the professor of electrical engineering, has also been authorized to make a number of additions to the equipment and he expects to install much new and modern apparatus, especially for alternating currents, before the opening of the Fall term. The lecture and laboratory courses in electrical engineering now extend over both junior and senior years, the junior year being devoted to direct current work and the senior year to alternating current work. A preliminary course on general electricity is given during the sophomore year by Dr. Wm. E. Guyer, the Professor of Physics.

JOHNS HOPKINS UNIVERSITY.—The course in electrical engineering in the Johns Hopkins University is designed primarily for graduate students. Special facilities and opportunities are given for the prosecution of research work, and in the method followed in other departments of the University, the individual is encouraged in every way to follow his own ideas in original work. There are two courses of lectures, the first of which deals with such topics as electrical measurements, magnetic principles, distributing systems, direct current apparatus and alternating current principles and apparatus. This course is intended for students taking advancel work in physics who desire also to equip themselves witn a knowledge of applied electricity. A second more advanced course deals with dynamo design, alternating current dynamos, motors and transformers, rotary converters, polyphase transmission systems, etc. This course is intended for students who have already taken subordinate courses in applied electricity and who wish to further their knowledge along special lines. The course is flexible and aims to meet the needs of the individual student. A laboratory course is given in connection with each lecture course, the equipment being very complete. Electric power may be had in every form. Of the several students who have followed these courses during the past year the following have taken the appointments mentioned: J. H. Cloud, Assistant in Physics at the Johns Hopkins University; L. G. Hoxton, National Bureau of Standards, Washington, D. C.; C. A. Robinson and E. G. Schmeisser, both in General Electric Co., Schenectady, N. Y. Several other students are not yet located. We are indebted to Prof. John B. Whitehead, Jr., for these details.

Trade Notes.

THE SWEDISH-AMERICAN TELEPHONE COMPANY, Chicago, is upholding its reputation for high-class and up-to-date advertising, and has just issued an attractive pamphlet entitled "For they Themselves Have Said It." It can be had for the asking.

THE THOS. E. CLARK WIRELESS TELEGRAPH-TELEPHONE CO., of Detroit, Mich., states that any one desiring its Bulletins Nos. 6 and 7 with cuts and descriptions of its Junior Type, and Standard No. 1 apparatus can have same by writing to the company.

MAPS.—Thirty-seven maps and thirty-one illustrations are two of the features of the "Two to Fifteen Days' Pleasure Tours," on the New York Central. This is No. 8 of the Four-Track Series, contains eighty-four pages, with routes and rates. A copy will be sent on receipt of two two-cent stamps by G. H. Daniels, G. P. A., Grand Central Station, New York.

THE BRISTOL CO.—Waterbury, Conn., have just issued two new and handsome editions of its catalogues relative to its well-known, standard instruments. One of these pamphlets is No. 9 of May, devoted to Bristol recording pressure and vacuum gauges. The other is No. 10 of June, devoted to its recording voltmeters, ampere meters and wattmeters. Both are quarto size, profusely illustrated.

DOMESTIC AND FOREIGN PATENTS.—Goepel & Niles, 290 Broadway, New York City, have just prepared and issued a pamphlet which presents in a comprehensive manner the general recent practice relating to Unitd States patents. This manual should be of use to our readers in view of the large amount of pithy and valuable information that it contains, as it bears not only upon domestic, but foreign patents.

INSULATING PAPER.—We have received from the Antelope Lining Company Shelton, Conn., a sample of an insulating paper manufactured by that company for the insulation of underground electrical cables. The sample shows the material to be exceedingly tough, while being at the same time soft and pliable. It is difficult to tear the paper in any direction, and this mechanical strength would seem to render the material well suited for the purposes mentioned.

ELECTRIC CRANES.—During the month of June Pawling & Harmischfteger, of Milwaukee, Wis., received orders for eighteen traveling crane installations. The States represented are Montana, New York, Massachusetts, Kansas, Pennsylvania, Illinois, Ohio, Delaware, California, Wisconsin and Delaware. Among the firms to be supplied are the Allis-Chalmers Co., Chapman Valve Co., New York Edison Co., Kansas City Metropolitan Railway Co., Ingersoll-Sargeant Drill Co., Gesholt Machine Co. and A. & F. Brown Co.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 32 Cortlandt Street, New York, is manufacturing large quantities of telegraph instruments for domestic and export trade. The output of this department of its factory has increased over 300 per cent during the past year, and the company expects a more satisfactory report on its whole line during the next year. It is displaying considerable energy in the distribution of its trade literature. Its new catalogue, No. 16, is claimed to be the most unique in arrangement and the largest edition ever distributed by an electrical supply house in this country.

THE EUREKA ELECTRIC COMPANY, of Chicago, has just issued a catalogue (No. 23) in which is described and illustrated a complete line of telephone apparatus and switchboards, both for central energy and common battery systems. The extent of its line of products may be appreciated by an examination of its latest catalogue which contains 72 pages, and was gotten out in a very attractive manner by H. P. Didriksen, the sales manager of the company. Everyone concerned in telephone work will find much matter of interest in this catalogue.

THE WESTINGHOUSE ELECTRIC & MFG. COMPANY, of Pittsburg, Pa., has issued a very neat and interesting little pamphlet devoted to electricity in mining. It discusses the subject in considerable detail; and contains a large number of illustrations devoted not only to the apparatus, but to equipments and installations for which the company is responsible. These plants include work in coal mines, pumping electrical dredges, hoisting, fans and blowers, etc. Electricity has found no field of greater utility and profit than mining, and the Westinghouse Company has been enjoying a large share of the new business developed in this department.

THE ROBERT AITCHISON PERFORATED METAL CO., of Chicago, has for many years manufactured perforated sheet metal of all kinds for various uses. This company was established in 1868, and has become so well-known in the trade as to scarcely need any introduction. There are a number of uses in electrical manufacturing for perforated metal, and this company is prepared to handle orders from this class of trade with the same promptness that characterizes its dealings with other branches of industry. The company's catalogue, in addition to giving some of the sizes, contains some valuable tables on the weights of sheet metal of various materials.

AN INTERESTING SERIES.—"Little Masterpieces of Science," in six volumes, edited by George Iles, author of "Flame, Electricity, and the Camera," is in preaparation by Doubleday, Page & Co. The volumes are as follows: Volume I, The Skies and the Earth, R. A. Proctor, Newcomb, Charles Young, Iles, Lyell, Shaler, Huxley; Volume II, Invention and Discovery, Franklin, Faraday, Henry, Bell, Count Rumford, Stephenson; Volume III, The Naturalist as Interpreter and Seer, Charles Darwin, A. R. Wallace, Leland Howard; Volume IV, Explorers, Winsor, Lewis and Clarke, Pike, Wilkes, King, Powell; Volume V, Health and Healing, Sir James Paget, Sir J. R. Bennett, Geddes, Thomson, Prudden, Sternberg, Roose, Richardson, Colton, Billings; Volume VI, Mind, John Fiske, Sully, Galton, Hudson, Holmes, Maudsley, William B. Carpenter. The volumes will form a sort of key to the modern twentieth century world of scientific marvels. The series will be sold separately or bound in one volume.

ASBESTOS PAPER.—We have received from the Pittsburg Asbestos Reduction Company, manufacturers of Green's demagnetized asbestos paper and laminated insulation, some very interesting samples of the product of its work at Pittsburg, Pa. By demagnetized asbestos, it means an asbestos from which all the oxides have been removed, thus furnishing the basis for a fine insulation. Its method of making the paper is, it is said, the only one by which it can get a durable deposit of pure asbestos on wire or other parts of electrical apparatus. It takes this paper and laminates sheet upon sheet of any required thickness. This is vulcanized in molded or set pieces. It is also introducing a fine, purified asbestos into rubber, samples of which are forwarded to us, and which look remarkably serviceable. One can take the paper, ignite it with a match and let the flame and fire pass all over it, after which insulation will still remain. It would seem that for material of this character there should be a large opportunity in the electrical field. The company has offices at 404 Westinghouse Building, Pittsburg. Mr. John F. Green is the manager of the Company.

KELVIN INSTRUMENTS.—The well-known firm of Kelvin & James White, Ltd., Glasgow and London, have recently issued two new, handsome, quarto catalogues devoted to the standard electrical measuring apparatus devised for special purposes by Lord Kelvin. One of these pamphlets relates to the standard, direct-reading, electric balances, and gives careful descriptions, as well as elaborate illustrations of these, accompanied by price lists and code words. The larger pamphlet of the two, of slightly later date, deals with Lord Kelvin's electric instruments for high and low tension switchboards. These are illustrated in great variety and detail, including sector ampere gauges, round dial and edgwise patterns, and series transformers for use with these on circuits up to 6,500 volts, the gauges being made for use with or without such transformers. Other apparatus included are the amperemeter, voltmeter, with moving coil, in different sizes and styles; shunts, multicellular, electrostatic voltmeters, astatic voltmeters for alternating circuits, engine-room wattmeters, recording amperemeters, recording voltmeters, earth current recorders, paralleling voltmeters, portable instruments for direct and alternating circuits, etc. It is interesting and encouraging to notice the appreciation shown for apparatus of this high standard.

VARLEY DUPLEX MAGNET COMPANY.—It will doubtless be recalled by our readers that a few years ago the Varley Duplex Magnet Company, manufacturer of specialties in electromagnets, spark coils and coil windings, removed its works to Phillipsdale, R. I. We are now glad to understand from Mr. Richard Varley, president of the company, that a number of improvements have been introduced in order to facilitate the execution of orders and to ensure prompt deliveries. Ever since the Varley Company took up its location at Phillipsdale it has increased its floor space almost every six months, in the hope that it would be able to keep pace with the demand for its coil windings and magnets. In this respect it has, however, been agreeably disappointed, and it has now found it necessary to lease a large factory some 300 yards north of the American Electrical Works. This factory, which has been leased for a term of three years, is 130 ft. long 60 ft. wide and 3 stories in height, with an L, making 30,000 square feet in all. In addition to this the American Electrical Works have again increased the Varley manufacturing space on their premises by something more than 10,000 square feet. It is now believed that adequate preparation has been made for the large and rapid growth predicted by the experience of the past. The Varley Duplex Co. is spending a large amount of money on the proper equipment of this building with modern machinery for the manufacture of its automatic winding machines, and it is installing two gas engines of 50 horse-power to be used as an addition to the 75-h.p. steam engine already on the premises. As a matter of fact, the company, during the past six months has been able to execute only about half the orders offered to it, but this change will, it is believed, keep it fully abreast of all business as it arises.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 23, 1903.

[Conducted by Wm A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

731,422. ZINC CUP FOR PRIMARY BATTERIES; Vincent G. Apple, Dayton, Ohio. App. filed March 23, 1903. (See page 20.)

731,426. RING BUSHING FOR INTERIOR CONDUITS; William F. Bossert and Frederick F. Foxenberger, Utica, N. Y. App. filed Feb. 3, 1903. A spring ring clamped around the end of the conduit and having a flange secured to the wall of the outlet box.

731,428. AUTOMATIC ELECTRICAL CUT-OUT; David R. Bruce, Ponders End, England. App. filed Nov. 18, 1902. A latch which normally holds the circuit closed is released by the expansion of a rod under the heating effects of the current flowing through it.

731,429. STORAGE BATTERY; Carlo Bruno, Rome, Italy. App. filed Dec. 4, 1899. (See page 20.)

731,430. ALTERNATING CURRENT REGULATOR; Cummings C. Chesney and William J. Lloyd, Pittsfield, Mass. App. filed July 18, 1902. The current flowing to the translating circuit is controlled by varying the amount of inductance in the circuit, the apparatus consisting of a field magnet and an armature, the angular position of the latter being determined by a weight acting against the current flowing in the armature.

731,443. MAGNETIC ORE SEPARATOR; Knut V. A. Erisson, Falun, Sweden. App. filed Dec. 3, 1901. Details.

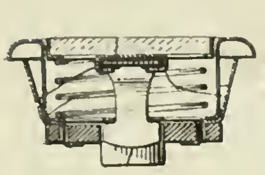
731,446. MAGNETIC SEPARATOR; Abraham E. Forsgren, Falun, Sweden, App. filed Jan. 13, 1902. An arrangement of primary and secondary poles between which a moving frame carrying the ore passes.

731,447. PROCESS OF CONSTRUCTING STORAGE-BATTERY PLATES; George H. Gale, Detroit, Mich. App. filed May 16, 1902. (See page 20.)

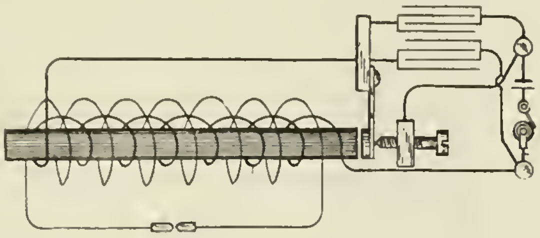
731,453. ELECTRODE; James Hargreaves, John William Stubbs and John Kearsley, Middlewich, England. App. filed Nov. 8, 1902. (See page 20.)

731,455. ELECTRIC BRAKE; Ernest R. Hill, Wilkinsburg, Pa. App. filed Dec. 29, 1899. Where the motor is used to generate a braking current, the field and armature are connected in separate circuits when the braking action is required, so that the reaction of the fields will not affect the armature current.

731,466. LIGHTING APPARATUS FOR RAILWAY VEHICLES; Benjamin G. Lamme, Pittsburg, Pa. App. filed Sept. 29, 1902. An incandescent lamp having a filiment of such large cross section that it may operate with a large current at low voltage and have such a degree of heat inertia that it will not cool sufficiently between slow alternations to make visible fluctuations in the light.



731,479.—Push Button.



732,014.—Induction Coil.

731,467. ELECTRIC-LIGHTING APPARATUS; Benjamin G. Lamme, Pittsburg, Pa. App. filed September 29, 1902. (See Current News and Notes.)

731,471. ELECTROMAGNETIC FRICTION CLUTCH; Leon J. Le Pontois, New York, N. Y. App. filed Sept. 18, 1902. A disk mounted to slide and rotate on its axis is interposed between two magnetic driven disks; thus the disk that is energized controls the direction of rotation of the shaft.

731,472. ELECTRICALLY CONTROLLED SPEED CHANGING MECHANISM; Leon J. Le Pontois, New York, N. Y. App. filed Sept. 19, 1902. Two electromagnetic clutches are arranged on two aligned shafts, which respectively carry friction disks and pinions. Each shaft is movable bodily when its clutch is energized, to lock the clutch and drive the gearing engaging with the particular pinion.

731,474. ELECTRICALLY CONTROLLED SPEED CHANGING APPARATUS; Leon J. Le Pontois, New York, N. Y. App. filed Dec. 20, 1902. A modification of the preceding patents to the same inventor.

731,479. PUSH BUTTON; Adam Lungen, New York, N. Y. App. filed Aug. 22, 1902. A flush push button in which the movable button is spring mounted in a cup and has attached to its back a circuit closing clip which projects through an opening in an insulating back plate to engage with two external contacts attached thereto. The invention also includes details of construction affording a cheap and reliable form of button.

731,484. CHARGE-INDICATOR FOR SECONDARY BATTERIES; Hiram Percy Maxim, Pittsburg, Pa. App. filed Aug. 4, 1902. (See page 20.)

731,501. DRIVING MECHANISM; Frank C. Rinsche, St. Louis, Mo. App. filed Nov. 10, 1902. A driving motor for a calculating machine arranged at each operation to make less than one complete rotation and to be returned by a spring.

731,581. DYNAMO ELECTRIC MACHINERY; Henry Leitner, Woking, and Richard N. Lucas, London, England. App. filed July 21, 1902. An electric system for lighting and other purposes of the kind wherein a secondary dynamo is employed to weaken the field of a main generator as the speed of said generator increases, characterized by a secondary dynamo having two armatures, one of which is employed to weaken the field of the main generator, while the other is closed through a suitable resistance so as to introduce armature reaction and vary the characteristic of the demagnetizing-dynamo.

731,606. TROLLEY POLE CONTROLLER; John J. O'Donnell, Aylmer, Canada. App. filed Sept 22, 1902. Details of a spring drum and ratchet arrangement.

731,621. ELECTRIC CLOCK; Otto Romanze, Enfield, England. App. filed Oct. 16, 1902. Details of a circuit closing device applied to the escapement wheel axle.

731,656. INDICATOR APPARATUS FOR CLOTHES DRYING MACHINES; William M. Barnes, Philadelphia, Pa. App. filed Feb. 19, 1901. The wet clothes are hung upon a carrier in batches and passed through a drying room. The indicator is an alarm circuit which shows when one complete batch has passed, so that the operator may not mix the dried and undried clothes.

731,711. ELECTRIC ARC LAMP; Joseph A. Rignon, Berlin, Germany. App. filed April 14, 1902. Inclined tubes carry the carbon pencils which are controlled by means of cords extending over guide pulleys at the ends of the tubes to a central pulley and thence downward to the armature of the magnet, which thus moves both pencils uniformly.

731,726. METHOD OF AND MEANS FOR DRIVING ELECTRIC MOTORS; George Westinghouse, Jr., Pittsburg, Pa. App. [illegible] 1894. (See Current Notes and Notes.)

731,740. COMMUTATOR BRUSH; Norman C. Bassett, Lynn, Mass. App. filed March 24, 1902. A carbon block curved on the arc of a circle and a brush holder having a surface to fit the brush.

731,741. ELECTROMAGNET; William Baxter, Jr., Jersey City, N. J. App. filed Nov. 21, 1902. An ironclad magnet having a number of switch arms pivoted to the central pole and radially arranged, so that when the magnet is energized a number of circuits will be simultaneously closed or opened.

731,750. MEANS FOR INDICATING THE RELATIVE POSITIONS OF MOVING PARTS; Harold W. Buck, Schenectady, N. Y. App. filed May 28, 1898. A synchronous indicator adapted to show when the cranks of two engines have assumed a certain relation to each other, so that the dynamos driven by the engines can be thrown into parallel at the proper moment.

731,767. SHIELD FOR X-RAY TUBES; Robert Friedlander, Chicago, Ill. App. filed March 9, 1903. A shield made of paper pulp and having sheets of lead embedded therein.

731,768. ELECTRIC HEATER; William A. Fuller, Rock Island, Ill. App. filed March 26, 1903. An open box-like structure around which a helical conductor is wound.

731,799. NON-INTERCHANGEABLE CONTACT PARTS; Rudolf Hundhausen, Wilmersdorf, Germany. App. filed Nov. 24, 1899. Plugs and sockets so constructed that only certain pairs can be joined together.

731,787. ELECTROSTATIC INSTRUMENT; Elton J. King, Fort Wayne, Ind. App. filed March 27, 1901. An electrostatic instrument comprising metallic surfaces having leads for different sides of a circuit, and metallic surfaces movable relatively thereto, the conducting surfaces of one set having a serrated edge with tapering teeth.

731,814. COMBINED POWER AND BRAKE SYSTEM; William B. Potter and Clarence D. Clark, Schenectady, N. Y. App. filed Oct. 31, 1900. In case the motorman fails to cut off the power before moving the brake handle, the operation of the latter first opens the power circuit.

731,822. APPARATUS FOR TELEPHONING; James Robert Troland, New York, N. Y. App. filed August 7, 1891. (See page 21.)

731,836. ELECTRIC MOTOR; Walter V. Ash, Perth Amboy, N. J. App. filed Jan. 2, 1903. The pole pieces of the field magnet are adjustable towards and away from the armature by means of lateral plugs having inclined faces which engage with similar faces in the movable core and by moving which the core is set inward or outward.

731,838. ELECTRIC SOLDERING IRON; James I. Ayer, Malden, Mass. App. filed March 5, 1902. The heating coil core to which the point of the iron is mechanically fastened, has a tapering axial chamber, so that the bulk of the metal of the core will be towards the point of the iron, and the heat developed in it more readily communicated to the working point.

731,857. ELECTRIC MOTOR; Penrose E. Chapman, St. Louis, Mo. App. filed Sept. 15, 1902. Details of the motor referred to in patent 731,501 preceding.

731,887. METHOD OF CONTROLLING ALTERNATING-CURRENT MOTORS; Paul Jacques Mathurin Girault, Paris, France. App. filed April 26, 1901. (See Current News and Notes.)

731,954. TROLLEY FINDER; Guy T. Roberts, San Diego, Cal. App. filed Feb. 24, 1903. Details.

731,966. ELECTRIC SWITCH; Charles F. Splitdorf, New York, N. Y. App. filed March 3, 1903. A switch adapted for gas engine circuits and having a single plug or handle by means of which either of two batteries can be readily thrown into service as desired.

731,992. METHOD OF INDICATING THE RELATIVE POSITIONS OF MOVING PARTS; Harold W. Buck, Niagara Falls, N. Y. App. filed May 28, 1898. The synchronous method referred to in patent 731,750.

731,996. METHOD OF OPERATING ALTERNATING CURRENT ELECTRIC MOTORS; Rudolf Eickmeyer, Jr., and Mary T. Eickmeyer, Yonkers, N. Y. App. filed July 6, 1894. The method of producing an initial starting torque in single phase alternating current induction motors, which consists in partially suppressing one of the two rotary components of the impressed alternating magnetomotive force and acting by means of the other rotary component to produce rotation of the induced member of the motor.

732,009. CIRCUIT BREAKER OPERATING SYSTEM; William B. Potter, Schenectady, N. Y. App. filed Oct. 31, 1900. Relates to the invention described in patent No. 731,814.

732,012. SWITCHBOARD; John F. Skirrow, East Orange, N. J. App. filed Oct. 24, 1901. Details.

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THE NIAGARA INSTITUTE MEETING.

The general meeting last week at Niagara of the American Institute of Electrical Engineers made a record of which the body as a whole may well be proud, and which reflects the highest credit upon President Scott and the members of the various committees who co-operated with him in organizing and conducting the meeting. The attendance reached the high-water mark, the number of guests and members registered falling but little short of 500. In the past the attendance at the general meetings of the Institute was largely made up of the same members from year to year, but at Niagara, while the "old guard" was well represented, the registry list and the new faces gave evidence of the recent great expansion of the membership which has been such a remarkable feature of the past year. It may here be remarked that one of the incidental though important benefits from the numerous local branches which have been instituted throughout the country, should be that of bringing this new element in direct touch with the active life of the Institute, thus not only enabling them to participate in its work through their local branches, but inciting their interest in the general meetings, which should give to the annual gathering a greatly increased value. A notable feature of the Niagara meeting was the admirable local arrangements made for the meeting and for the entertainment of visiting members and their families, the members of the local committee being particularly untiring throughout the meeting in their efforts to render the gathering an unqualified success from the social standpoint—in which they amply succeeded. We cannot refrain from paying a tribute to President Scott in his capacity as a presiding officer. Though with almost two score of papers on the programme, it was disposed of without a hitch, and yet with proper allowance made for discussion. It is needless to say that this implies upon the part of the presiding officer a firm grasp of the situation and an efficient exercise of parliamentary control, which in this case was unaccompanied by friction.

Owing to the large number of papers read and the length of some of the discussions, it would be impracticable to give a complete report of the proceedings in one issue. We are consequently obliged to divide our report in two portions, the second of which will appear next week. The average of the papers, notwithstanding their number and the slightness of a few, is extremely good. Two of the groups —those treating of electric railway and high-tension transmission subjects—form in fact extremely important contributions of permanent value to these respective subjects. The papers by Messrs. Armstrong, Carter and Renshaw, and the discussions which accompanied them, will go far toward placing in a definite and final state the problems of which they treat. Indeed, these, taken with papers on similar subjects presented at Great Barrington and Buffalo, present a mass of data and expressions of individual views of authorities that should place at the service of a competent author sufficient material for generalizations in, and a systematic exposition of, this branch of electrical engineering, which is badly in need of such a treatment. We hasten to add that this is not said in disparagement of the contributions to which we refer, as these represent the work of specialists on problems presented to them specifically in the successive stages of electric railway engineering development; and as collections of data and expressions of authoritative views they are of the greatest intrinsic value. It does appear, however, that the time is ripe to base upon this material and upon the investigations of others a systematic treatment for the student and for the electric railway engineer who has not had an opportunity to specialize in that particular field.

Of equal importance to the railway contributions and perhaps of more general interest, is the group of papers on high-tension power transmission and the accompanying discussion. In this connection we desire to point out the wisdom of placing in charge of a member who is a specialist in a subject, the preparation of a programme of papers on that subject. In this instance, such responsibility was placed with Mr. Ralph D. Mershon and with results so excellent that we hope the practice may become fixed in the conduct of the Institute. Two papers on alternating-current apparatus of diametrically opposite character were presented, those of Prof. W. S. Franklin on the synchronous converter and by Mr. W. L. Waters on commercial alternator design—the former being extremely theoretical and mathematical in character, and the latter a model of a paper written for an audience of engineers. The paper by Prof. J. Walter Esterline and Mr. C. E. Reid, giving investigations of the energy losses in armature cores, is an excellent example of the contributions being made to engineering from the college laboratory equipped for experimental work. Another example of the value of the college to engineering is illustrated in the several papers by Prof. Goldsborough and Mr. P. A. Fansler on electric railway and power station tests. Perhaps the two most striking technical incidents of the Niagara meeting were the description by Prof. H. J. Ryan of his cathode ray alternating-current wave tracer and the presentation by Mr. P. H. Thomas and Mr. M. von Recklinghausen of the several inventions of Mr. Peter Cooper Hewitt. A report of the latter will be found in this issue, and editorial reference to the former appears in another column. In following issues a number of the Niagara papers will be taken up for comment.

THE COMMERCIAL LIMITS OF POWER TRANSMISSION.

With all the valuable discussion of power transmission which the recent Institute meeting elicited, there is a broader phase of the commercial question which has as yet hardly received due consideration from engineers. It is comparatively easy, albeit somewhat risky like all prophecy before the fact, to figure out for any given set of conditions the maximum distance at which power transmission will pay, the maximum feasible voltage in the present state of the art, and even the most economical size of conductor to employ. But all these results, however useful in themselves, are confined to the present epoch, to the conditions true in the year of grace 1903, while the investments demanded must be, if commercial success is to be attained, sound and intact in 1925 or 1950. We are well aware that in the minds of many, commercial success begins and ends with the placing of certain securities with a proper bonus and profit to the underwriters, but the lessons of the past twenty years we have not yet quite forgotten, and we confess to belonging to that small band of fanatical ultra conservatives who hold that honesty is the best policy, and that exploiting as sound, a project that will infallibly be wrecked within ten years, is not an honest man's work. If electrical power transmission is to have the place in the world's future that we believe of right belongs to it, it must not be quite reckless of the future and of the effect of time in changing conditions. To be thoroughly sound a project must not only give a safe prospect of dividends in the immediate future, but of such continuance of them in spite of depreciation and change in the art, as will leave the securities of full value at maturity.

Just now we are in this country on the crest of a wave of financial prosperity such as never before in the country's history has been equalled. That this condition is permanent the most sanguine cannot maintain, and ere long we must be prepared for a recession. Therefore, in undertaking a work like power transmission, it is merely common caution to look forward and estimate the reasonable probabilities of the future. Once installed, a plant must at least earn its upkeep, running expense and fixed charges, even in times only moderately prosperous in order to score a moderate success. One of the first things, therefore, to be taken under consideration is the integrity of the market. A few miles more or less, a few thousand extra volts, or a few tons of copper are of inconceivably small significance compared with the solidity of the earning capacity. And strange to say, on no single point in the conduct of the transmission business do more good men go wrong. We have in mind, for instance, a hydraulic transmission plant which is doing a rapidly growing business. There is rather severe competition, prices are low and hard to increase. The plant has a large and increasing motor business from which a large amount of its revenue is derived. So urgent have calls for power become that a steam auxiliary plant of imposing dimensions was erected to meet the expansion, regardless of the fact that if prices are so low so that neither steam power nor hydraulic power can fairly meet them, no combination of these sources can help the matter. Now the peculiarity of the situation is that the small motor business is mostly among small manufactories engaged in the same line of work, and at the first pinch of hard times three-quarters of them will shut down, as they have done before, and leave the plant with a heavy investment to stagger under and a greatly diminished business.

This is but one type of the improvidence which too often leads to disaster. A plant which supplies such a community, or a booming town dependent for its prosperity on a few big enterprises, is a bad market. In some few cases, as in mining towns, a plant may be installed wittingly as a pure speculation, designed to clear enough profit before the end of the chapter to let out the investors even if the plant is scrapped. This is gambling, not investment, and in general it takes great judgment to tell how far a mining town is a sound market for anything except wild-cat stock. But mining camps are not at all in a class by themselves in this matter, and it must be borne in mind that a safe market is the only security which stands behind a transmission plant. Its physical assets are difficult to realize upon, and do not often in themselves afford what one would call gilt-edged security. One of the wildest schemes which we ever remember to have emanated from a supposedly sane person was a plan for developing the great Falls of the Zambesi in Africa, using the copper of the line as security to the creditors. Now the Falls of the Zambesi will some day be developed, and the dark continent may become the center of civilization when the failing fuel supply shall have driven men from the colder zones, but not upon that basis. Copper in ingots laid away in a convenient storehouse is pretty good security up to a reasonable percentage of its market value, but as a high voltage line strung through a tropical jungle with international complications to prevent its being taken down, it is about as valuable security as a second mortgage on the North Pole. When the day comes in which Rhodesia and the surrounding lands support a population that calls for a hundred thousand horse-power to use in its manifold industries, the mighty African cataract will have its turn at the game. Given a market and the investment will take care of itself.

CATHODE RAY ALTERNATING CURRENT WAVE INDICATOR.

Among the papers read last week at the A. I. E. E. convention was one by Professor Ryan, on a current-wave indicator operating by cathode rays. This describes a new and interesting application of the cathode rays. There are a variety of instruments which have been devised to leave a record of the outline of alternating-current waves. Some of these instruments are called oscillographs. An oscillograph, as ordinarily constructed, is a galvanometer with a very small natural period of vibration, so that it is able to follow every alternation of current without sensible inertia disturbance. When such a galvanometer is connected to an alternating-current circuit, its reflected spot of light is seen by persistence of vision to be drawn out into a long band, as the beam ranges cyclically from one end of the scale to the other. By watching this band of light in a rapidly revolving mirror, the band becomes optically analyzed into a series of waves of the outline corresponding to the current in the galvanometer coils. The image is often recorded by photographing the luminous trace.

In place of the oscillating beam from the galvanometer, Prof. Ryan employs a cathode beam impinging on a fluorescent screen, and caused to oscillate by the magnetic influence of coils supported close to the walls of the tube and traversed by the alternating current. The cathode beam is spread out into a band, similar to the galvanometer band. Similarly the cathode beam may be analyzed optically by a revolving mirror. Prof. Ryan prefers, however, to dispense with the revolving mirror, and employ a known perpendicular component of motion to obtain a cyclically re-entering closed curve of light, or, in fact, an indicator diagram. The engine indicator diagram combines a cyclically varying component of motion of excursion proportional to the instantaneous steam pressure in the cylinder, with a perpendicular motion obtained from the piston. In Prof. Ryan's apparatus the perpendicular component is not a uniform to-and-fro movement, but a simple harmonic movement, or pendulous movement. This is obtained by using another pair of coils magnetically acting upon the cathode beam perpendicularly to the first pair, and exciting these with an alternating current from which the harmonics have been practically all weeded out by the aid of resonance. It is the same sort of diagram as would be obtained from the steam engine cylinder if the horizontal component of motion were a simple harmonic motion, or were taken from an eccentric driven by the uniformly rotating engine shaft.

The cathode ray diagram may be photographed. It has then to be expanded horizontally to reduce the simple harmonic motion to corresponding uniform motion. This may be done either with the aid of specially prepared ruled paper, in which the spacing of abscissas follows the inverse of the simple harmonic law; or, the same result may be obtained by a method of projections described in the paper. It is curious to observe that no such reduction of the diagram to uniform motion would be needed if the base component of alternating current were adjusted to the simple triangular or saw-toothed form, instead of to the simple harmonic form. The instrument has the advantage that the cathode rays are practically inertialess, and thus respond fully and immediately to fluctuations in the current strength. On the other hand, it takes several seconds of exposure and cyclic repetition to secure a photographic record. The instrument is remarkable as requiring double excitation, namely first by high pressure or Winshurst machine, with a cathode ray-producing current of about half a milliampere; and second by the base component of simple harmonic current of about one ampere. While the oscillograph has the advantage over the apparatus of Prof. Ryan in giving a direct trace of a wave, which trace can be observed continuously, the latter admits of adjustment whereby a detail of a wave which it is desired to study may be exaggerated.

THE FORTHCOMING INTERNATIONAL ELECTRICAL CONGRESS AT ST. LOUIS.

At the Niagara Falls convention of the American Institute of Electrical Engineers last week, the Committee on Organization of the St. Louis Electrical Congress held a preliminary meeting. It was resolved that an International Electrical Congress should be held at St. Louis early in September, 1904, in connection with the St. Louis Universal Exposition. A resolution was also passed to the effect that, in the opinion of the committee, official delegates to this congress should be invited by the United States Government from the various foreign governments. We understand that a number of sub-committees have been already appointed to take up the various aspects of the proposition.

It is earnestly to be hoped that the plan thus formulated, and entered upon its initiatory stage, may be brought to a successful issue. It is of great importance to international sociology in general, and to international electrical interests in particular, that an official electrical congress should be held next year at St. Louis in conjunction with a general electrical congress. There are various questions of international technological importance, relating to electrical units and standards, that await determination at the hands of the next official electrical congress. Even although no decision should be reached upon most of these questions, great advantage would accrue to decision upon the remainder. The State Department at Washington will, no doubt, have proper representations made to it concerning the national importance of the matter. The various foreign governments should be invited to appoint and send a specified number of representatives to the chamber of delegates of the congress, the sessions of which would probably not occupy more than a week in all. The same course was followed in conjunction with the International Electrical Congress at the Chicago World's Fair in 1893. At that time Great Britain, France, Germany and Austria were all invited by the United States Government to send five delegates each. Belgium, Italy and Switzerland were invited to send three delegates each, and various other countries a yet smaller number. Most of the important countries responded to the appeal, and the congress which assembled was one of the most important in electrotechnical history. It established the international ohm, volt, ampere, coulomb, farad and henry. Only one official electrical congress has been held since the Chicago congress of 1893, and that was at Paris in 1900, in conjunction with the Universal Exposition there. Substantially the same course of official procedure was followed in that instance also.

As regards the electrical general congress at St. Louis, it is expected that this will be held in conjunction with simultaneous conventions of the electrical organizations of the country, such as the American Institute of Electrical Engineers, the American Electrochemical Society, the National Electric Light Association, the Association of Edison Illuminating Companies, and others. In this manner each of the various sections of the congress might be expected to co-operate, on a certain day or days, with the particular technical body to which that section is appropriate, so that the best papers and their fullest discussion might be obtained. The membership list of the Paris Electrical Congress contains about 900 names. There were no simultaneous conventions of prominent allied organizations held in conjunction with that congress. A greater membership roll might be expected with the aid of simultaneous conventions. It may be added that at the recent International Chemical Congress held in Berlin, more than 2,500 names were enrolled.

Street Railway Statistics of the United States.

In our issue of May 9 was given a brief abstract of the statistics of the street railways of the United States of America, as compiled by the Census Office from the returns collected last year. Director of the Census North has given out to the press this week the complete bulletin on the subject as prepared by Messrs. T. C. Martin and E. Dana Durand under the supervision of Chief Statistician Steuart. It is a voluminous and most interesting document, but is chiefly statistical, the detail text, discussing the various results, being intended to appear in the final report, which the Census Office aims to make a most complete and exhaustive treatment of the subject. As it is, the fullness of the work may be inferred from the statement that from all except 22 companies complete returns were obtained.

Having already given the gross figures, it is necessary only to recapitulate here; while some details and tables will be presented in our next issue. During the period covered by this inquiry there were in existence 817 operating street and electric railway companies and 170 companies leased to and operated by other companies, making a total of 987 companies. These companies owned 22,576.99 miles of single track. The par value of the capital stock and funded debt outstanding as reported amounted to $2,308,282,099. The average net capital liabilities per mile of single track owned for the companies reporting both factors were $96,287. The total income and expenses of the operating companies amounted to $250,504,627 and $219,907,650, respectively. The companies gave employment on the average during the year to 133,641 wage-earners and paid $80,770,449 in wages. There were 7,128 salaried officials and clerks employed, to whom $7,439,716 was paid as salaries. The roads carried 5,871,957,830 passengers of all kinds.

Unfortunately, a number of the street railway companies in existence at the census of 1890 failed to make reports to the Census Office, and, therefore, a comparison of the statistics of the two censuses will be, to that extent, defective, exaggerating somewhat the growth which actually took place. From the items as reported it appears that the single-track mileage increased from 8,123.02 miles in 1890 to 22,576.99 miles in 1902, or 177.94 per cent., and the number of fare passengers carried from 2,023,010,202 to 4,809,554,438, or 137.74 per cent.

The Electronic Theory of Matter.

On June 5 Prof. Crookes delivered an address before the Congress of Applied Chemistry at Berlin on "Modern Views on Matter," in which he discussed the ultimate nature of matter and energy. A quarter of a century ago Prof. Crookes, speaking before the Royal Society on the subject of rays emitted from exhausted tubes and the radiant property of matter at this low density, made the following observation: "We have actually touched the border land where matter and force seem to merge into one another—the shadowy realm between the known and unknown." He considers that the greatest scientific problems of the future will find their solution in this borderland, and even beyond: "here it seems to me, lie the ultimate realities, subtle, far-reaching, wonderful."

When president of the Chemical Society in 1888 Prof. Crookes pointed out the possibility of the genesis of the elements from "the formless mist" of ultimate matter. He strove to show that the elementary particles themselves might not be the same as when first generated; that the primary motions which constitute the existence of the atom might slowly be changing, and, in a word, the elementary particles, so far from being themselves eternal in existence, might share, with the rest of creation, the attributes of decay and death.

Now comes the electric theory of matter, and one of the earliest definite suggestions of this conception came from the pen of Dr. W. K. Clifford in the *Fortnightly Review*, for June, 1875. "There is," said Dr. Clifford, "great reason to believe that every material atom carries upon it a small electric current, if it does not wholly consist of this current."

Next came an army of experimenters, which, working upon the definite law of Faraday and the theories originally due to Weber, evolved the modern ultimate particle of electricity, the "electron," and which they found could exist separately. Then Prof. Crookes showed that the cathode rays consisted of a stream of negatively charged particles, the other contents of the tube being positively electrified. Then came the work of Lenard and Röntgen, who showed that the phenomena outside the tube surpassed in interest that which took place inside. Thus had been established the hurling power of electrically charged particles at a speed approaching that of light by electrically charged bodies themselves. But in 1896 Becquerel and later M. and Mme. Curie and M. Bémont, working upon the emanations of uranium and the other substances associated with it, were able to show that these emanations were of a nature very similar to Rontgen rays, being able to penetrate many substances in an almost exactly similar way. Then came the crowning point—radium.

Much light has lately been thrown upon the nature and habits of these tiny particles—electrons—their size and velocity, for instance, having been deduced from trustworthy data. The mass of such an electron may be taken as one seven-hundredth of that of the atom of hydrogen, until lately the lightest body known, or at about 3×10^{-28} grm. and its velocity at 2×10^{9} cms. per second, or two-thirds that of light. The kinetic energy per mgm. is thus 10^{17} ergs, or about three and a half million foot-tons. Becquerel has calculated that one square cm. of radioactive surface would radiate into space one grm. of matter in a billion years. The positively charged atoms or ions are the electrons, and according to Sir O. Lodge may be compared to the solar system, in which the electrons are represented by the planetoids. Thus the great penetrative power of these electrons is accounted for by their minuteness as compared with the space between them, but in their rush forward they must ultimately collide with something. The negative ones arrested by a barium platino cyanide screen will exhibit phosphorescence, the heavier positive ions will more effectively cause phosphorescence of a Sidot's zinc sulphide screen.

Although Röntgen rays and electrons penetrate various substances and act on a photographic plate, the former have much more penetrative and photographic action.

According to Sir Oliver Lodge's electronic theory of matter, an atom or ion has a few extra negative electrons in addition to the ordinary neutral atom, and if these negative electrons be removed it thereby becomes positively charged. The negative charge consists of superadded or unbalanced electrons—one, two, three—according to the valency of the body, whereas the main bulk of the atom consists of paired groups, equal positive and negative. As soon as the excess of electrons is removed, the rest of the atom, or ion acts a positively charged body hanging tightly together. In a high vacuum the spark tears the components of the rarified gas apart: the positively charged ions, having great comparative density, are soon slowed down by collisions, while the electrons are driven from the negative pole with an enormous velocity depending on the initial e.m.f. and the pressure of gas inside the tube, but approaching, at the highest exhaustions, half that of light.

Prof. J. J. Thomson, in his remarkable paper published in 1881, developed the idea of electric inertia, that is self-induction, and attributed to the electron, that most vital property. Thus, when an atom is regarded as merely a congeries of electrons, a non-material, so to speak, explanation of matter is at once forthcoming and an electrical theory of inertia, that is all intertia.

Prof. Crookes then went on to describe at length the scintillations observed on a zinc sulphide screen when a drop of a radium salt solution is placed upon it, or a piece of the solid salt allowed to remain in close proximity to the screen. The consequent phosphorescence is effected alike at the ordinary temperature or at that of liquid hydrogen, in the air or in vacuo, and to the naked eye appears as a sort of "milky way" and under the microscope as a bombardment of splashes, each forming momentarily a luminous halo with a dark center. These scintillations are probably only the splashing of the positive ions hurled off by radium with a velocity of the order of that of light and made apparent by the enormous extent of lateral disturbance produced by its impact on the sensitive surface.

In conclusion, Prof. Crookes asked: "Are we not incessantly learning the lesson that our researches have only a provisional value? A hundred years hence shall we acquiesce in the resolution of the material universe into a swarm of rushing electrons? This fatal quality of atomic dissociation appears to be universal, and operates whenever we brush a piece of glass with silk; it works in the sunshine and rain drops, and in the lightnings and flame; it prevails in the waterfall and the stormy sea. And, although the whole range of human experience is all too short to afford a parallax whereby the date of the extinction of matter can be calculated, protyle, the 'formless mist,' once again may reign supreme, and the hour hand of eternity will have completed one revolution."

Station Indicators for Subway, Elevated and Other Railway Systems.

By Ernest K. Adams, E. E.

INDICATORS for announcing the next station upon street car lines have been brought out from time to time, but, on account of their complicated construction, have not been successful. These indicators have been operated at different streets, either manually or automatically, and in the latter case by mechanical combinations which have been controlled by the revolution of the car wheels, projections from the track or other similar devices. The application, therefore, of indicators to street cars is of doubtful utility.

For subway, elevated and certain other railroad systems the case is different. Here the stations are comparatively far apart, and the presence of gatemen or guards upon the platforms of the cars makes it feasible to operate the indicators manually. There is no doubt but that a simple and practical station indicator car equipment, under suitable conditions, would be a convenience to and a desideratum by the public; for everyone, especially a stranger, is familiar with the difficulty in recognizing the approach of the station at which he desires to alight, either from the surroundings or the inaudible reminder that is given to the door-jamb by the platform attendant. It may almost be said that the thought: "What is the next station"? occurs somewhere every minute of the day.

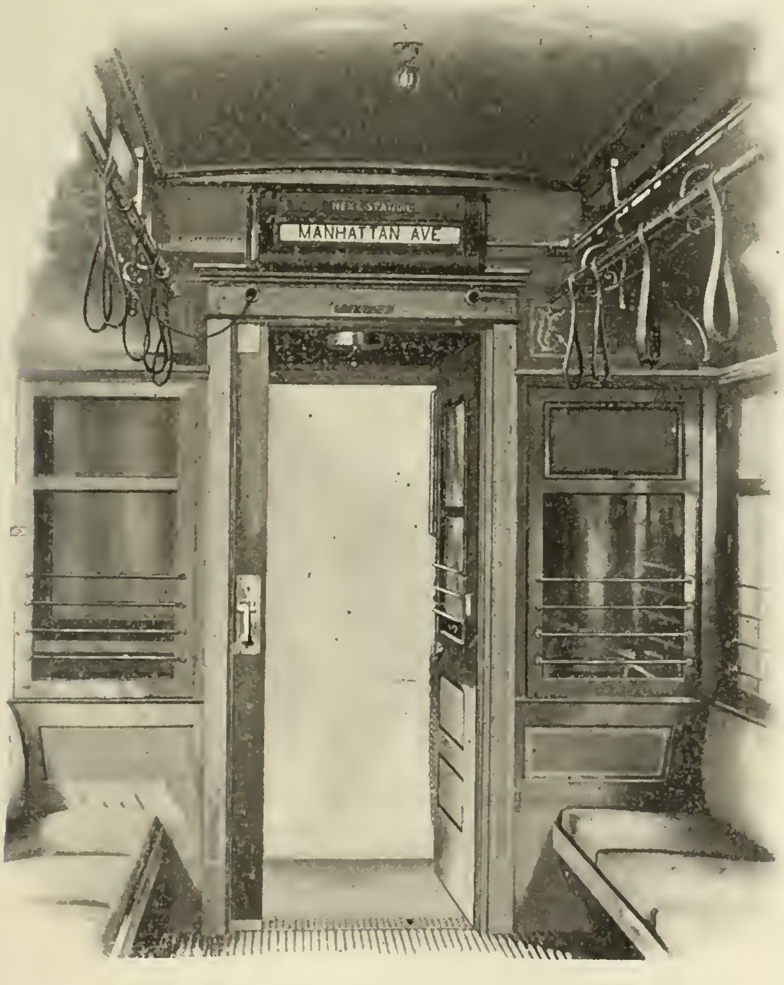


FIG. 1.—VIEW OF STATION INDICATOR AND CONTROLLER ON CAR.

The purpose herewith is to show a number of mechanical and electrical station indicators that are adapted, besides to certain railroads, to the elevated and subway transportation lines of New York and other cities. Both indicator systems, which are designed to be manually controlled from the platforms, with indicators mounted over the doors of the car where they may be easily read from any seat within, have an intermittent driving mechanism, enabling the rolls upon which the printed strips are wound to be both operated by a rotary motion and locked after the same. This rotary motion feature simplifies the indicator equipment, for, in the case of the mechanical indicators, in order to reverse the direction of the movement of the printed strips when the end of the route is reached, it is only requisite to reverse the direction of the motion at the controllers upon the platforms. Thus, going downtown, the guard turns the handle of one of the controllers of his car one revolution in a given direction as the train leaves a station, and in the opposite manner going uptown. The reversal of the direction of the movement of the strips in the electrical indicators is performed by a switch. Applications of similar indicators to other purposes than those above specified may be found upon certain boat lines and in general advertising.

By reference to Figs. 1 and 2, which give the general details of the mechanical indicator equipment that was installed in the New York Subway experimental car, "John B. McDonald," the arrangement of the system may be readily followed. The indicators, which are of substantial construction and provided with black station designations upon white strips, are mechanically connected by a hollow shaft, together with miter gearing, the said shaft extending throughout the length of the car and supported at intermediate points by brackets. These brackets may be incorporated in those which support one of the strap rails of the car, or the shaft may pass directly through the strap rail when desired. In this latter case the strap rail would be made of tubing.

Each controller, which is mounted at the extreme end of the car so that the gatemen need hardly move when operating the controllers of adjacent cars, is connected with the main shaft of the equipment by two sprockets and a heavy chain, this chain being capable of working through an angle of 90°. The ratios of the sprockets are such that one revolution of the handle of either controller will bring a new station name into view at the indicators. The intermittent gearing in each of the indicators is so arranged that the printed strips are advanced their given amount during the middle of the revolution of the controller handles. Thus it is not absolutely essential that a controller handle shall be left in a certain position, and furthermore the indicators within will not be disturbed by any vibration of the car.

The controllers are provided each with an indicating device, which enables the guard upon the platform to be informed of the condition of the indicators inside without actually looking at them, as would be sometimes necessary when the cars are unduly crowded. This indicating device consists of a planetary combination of gears, which permits any number of stations to be consecutively shown at an opening in the controller casting. This opening is designed to coincide with a similar opening in the controller lever, and in the daily operation of the equipment the guard will leave the controller handle in the position where the station name is observable through the opening in the aforesaid lever.

A stopping arrangement is also incorporated in one of the controllers of the car equipment for the purpose of preventing the gateman from running the printed strips off the rollers in the indicators. This device embodies a traveler, which is mounted upon a threaded portion of the controller spindle, and, while prevented from turning by the configuration of the adjacent support, it is allowed an up and down motion between certain limits, as determined by two adjustable stops fastened to the controller spindle.

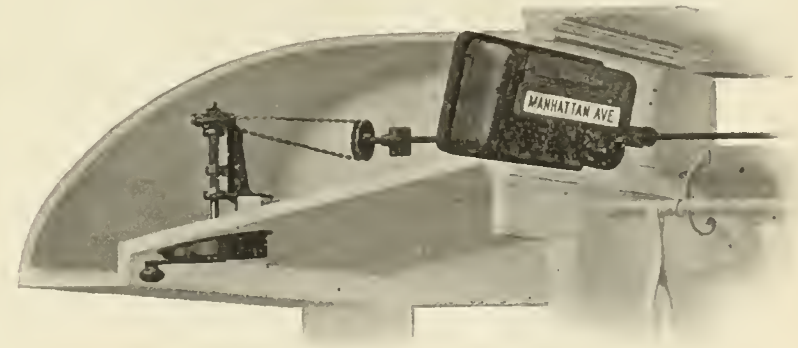


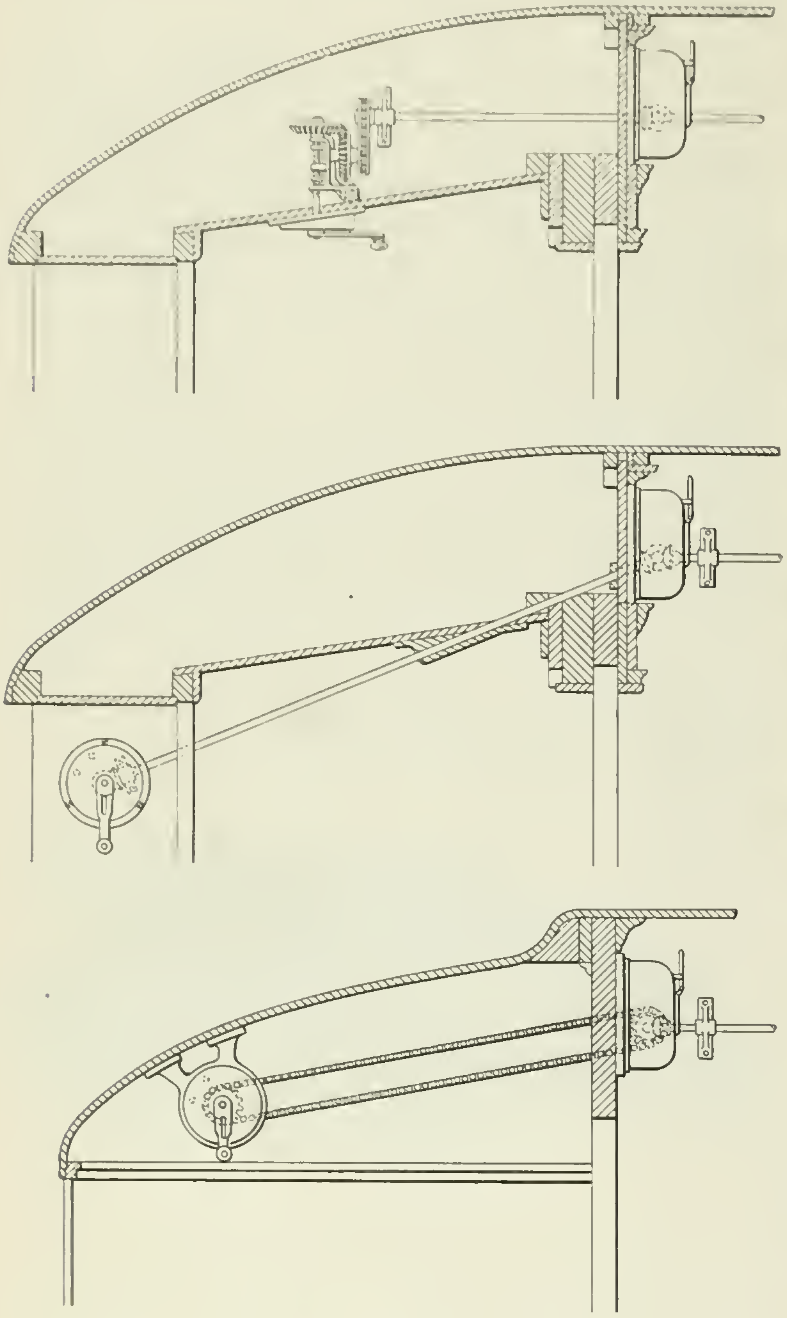
FIG. 2.—PERSPECTIVE VIEW OF STATION INDICATOR AND CONTROLLER.

A stamped metal flap, having the words "Next Station" embossed thereon, is hinged upon the front of each indicator, and normally held upward by two spring catches. When it is not desired to operate the indicators of a car, on account of a change of route, break-down or other reason, these flaps may be released and made to cover the openings in the indicators.

The number of stations that each of the above indicators is capable of accommodating, with two-inch letters for the station names, may be made, when required, approximately one hundred. The indicators may, therefore, be provided with station names of minor branches of the main road, upon which it is intended to operate the system, and when these additional names are required, the indicators may be quickly advanced or brought back to their proper positions. Attention has been given to the printed strips, both as regards their material, construction, feeding arrangement and means of preventing them from slipping off the rolls, upon which they are wound.

In this indicator system, where dependence upon manual control is observed, a considerable amount of complicated mechanism is avoided, and at the same time the equipment is placed in a different position from that of a fully automatic device. The extent and cost of the alterations required when installing the system in a car are moderate.

Several modifications in the controlling portion of the indicator equipment, which are adapted to cars of varying construction, are shown in Figs. 3, 4 and 5. Thus in Fig. 3 the necessity of employing a twist in the driving chain is obviated. The employment of a chain working through an angle of 90° has been found in continuous operation to work well; but it may be replaced when desired by a mitre gear, sprocket wheel and bicycle chain combination, the other parts of the controller being the same as before.



FIGS. 3, 4 AND 5.—SECTIONAL ELEVATIONS OF MODIFIED CONTROLLERS.

When it is advantageous to mount the controllers in vertical positions at the ends of the car, a construction, similar to that given in Fig. 4 may be taken advantage of. This construction includes a number of miter gears and a connecting shaft, suitably journaled at each end. The controller in this case is made up of the spindle and handle as before, together with a cylindrical case for holding the planetary indicating device. The stopping function for preventing the strips from being overwound is taken care of by two pins, which are mounted between the two gears of the planetary combination.

For a car having an open platform, such as are often found in elevated and railroad lines, a simple indicator controller is shown in Fig. 5. Here the controller is provided with two extensions, which are secured to the roof, the driving media embodying sprocket wheels, bicycle chain and mitre gears. The same stopping device is herein employed in the planetary combination of the controller as that shown in the preceding figure.

A testing machine, shown in Fig. 6, has been employed for determining in the laboratory the wearing qualities of mechanical station indicators. This device makes it possible in a few weeks to give an indicator equipment a test which is equal to several years of actual service. The arrangement is such that the handle of one of the controllers of the indicator system is given a quick turn, and allowed to rest for a short interval before being again revolved, as would be the case in daily employment. The device may be set for any given number of stations up to one hundred, and will automatically reverse at the first and last stations. An indicator equipment, similar to that installed in the already mentioned experimental car for the New York Subway, has been tested with the above machine many thousand times without perceptible wear.

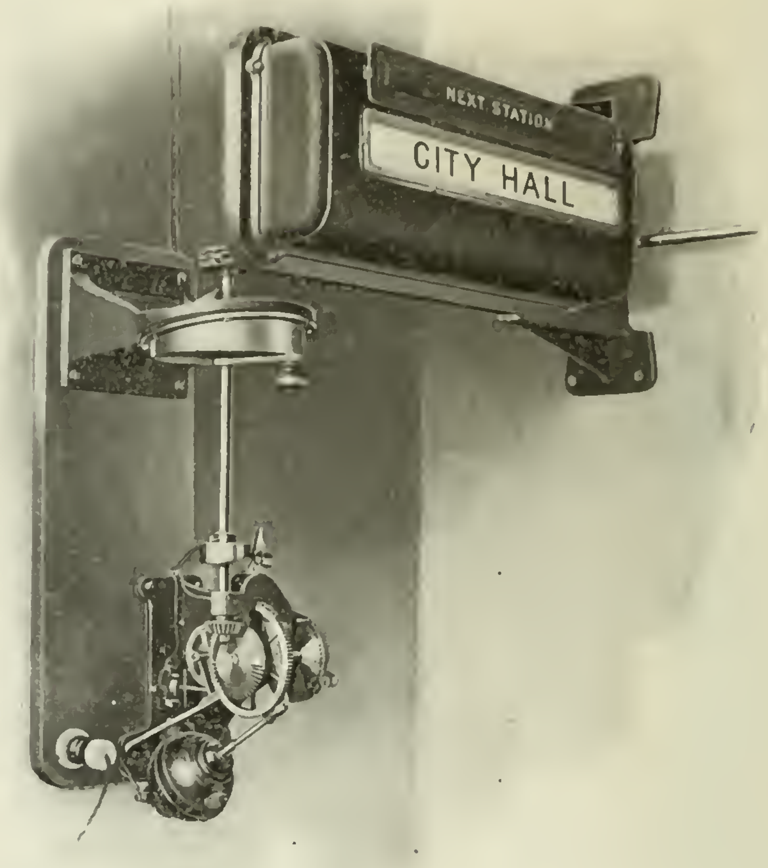
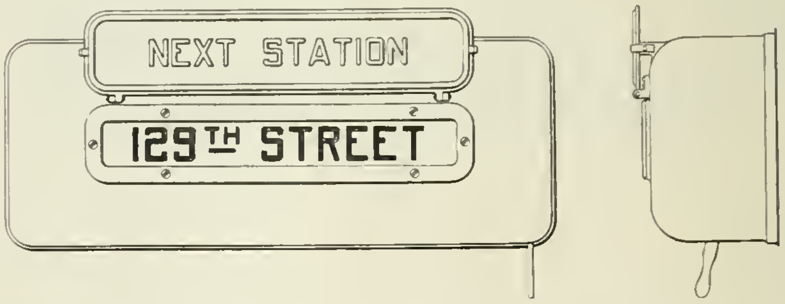


FIG. 6.—LABORATORY TESTING MACHINE FOR STATION INDICATORS.



FIGS. 7 AND 8.—FRONT AND SIDE ELEVATIONS OF INDICATOR.

By making the station indicators electrical in their operating function, several advantages are gained, with nearly the same first cost as in the mechanical types. These are the conveniences to be found in adapting the indicators and controlling switches to any form of car, together with the possibility of operating the indicators under a multiple unit system of control. In this case a switch is mounted upon each platform of a car, and by the closing of any one of the aforesaid switches upon a train of cars, the entire series of indicators will be simultaneously advanced one station. The control of the indicators may be given to the engineer in charge of the train or to a subordinate. For the wiring of the system only one extra flexible conductor is required to pass between adjacent cars. Obviously, the indicators of a car may be wired independently of the adjacent cars, in which event each indicator equipment would be controlled by the gateman or guard of that particular car.

The electrical indicator, shown in Figs. 7 and 8, is of substantially the same outward appearance and internal construction as the mechanical ones; but is provided with a comparatively heavy electric motor, magnetic brake, carbon contact, reversing switch and device for preventing the strip from being over wound. This combination gives a simple and positive indicator construction. The lever of the reversing switch is allowed to project through the case of the indicator, and when the end of the route is reached, in either direction, the guard is required to simply move over the aforesaid lever for the return trip.

A convenient form of switch for operating the electrical indicators is illustrated in Fig. 9. This device, embodying heavy carbon contacts and actuated by a cord, is adapted to be mounted upon the woodwork of a car in any desired location.

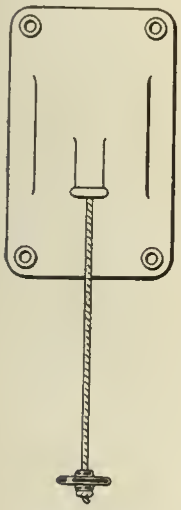


Fig. 9.—Elevation of Controlling Switch.

In the above electrical indicator equipment each indicator is operated by a separate electric motor. However, by employing one of the already described mechanical indicator systems, minus the controlling portions, an electrical equipment can be made with but one electric motor. This motor would be arranged to drive the connecting shaft of the indicators by worm or other suitable gearing, the motor perhaps being situated upon the roof outside of the ventilators in the center of the car. The reversing switch for the motor may be conveniently placed in the supporting element for the drive between the aforesaid motor and the indicator connecting shaft. A number of controlling switches, similar to the one shown in Fig. 9, would be employed for operating the system. This arrangement may be further extended and made to operate on the multiple unit plan. An electropneumatic system of station indicators may be also developed, but if electricity is to be employed, it is thought preferable not to complicate it by the addition of compressed air.

It would appear that, with the advent of subway and elevated railroads in different cities of the world, the time is opportune for the consideration by car manufacturers of the station indicator subject. It is believed that in many places the public needs station indicators.

The Sault Ste. Marie Power Canal.

A newspaper dispatch from Detroit last Saturday gave a somewhat alarming report of the condition of the new power plant at Sault Ste. Marie. According to the report of Lieut.-Col. N. A. Bartlett, who has just returned from the "Soo," when the water was let into the canal in order to test the plant informally, about five months ago, it was discovered that there was quicksand beneath the foundation of the power house. The action of the current of water upon this quicksand was such, it is alleged, that the whole foundation was threatened, and it was found necessary to shut off the water at once. On Sunday last a Philadelphia dispatch contained a statement made by two stockholders of the Consolidated Lake Superior Company, one of them a director, regarding the trouble. They admitted that a part of the foundation of the power house had been undermined, but declared that it was a trivial matter, and that repairs had already been effected. In a month or six weeks, they stated, the water will be again turned on. They think that the damage was principally due to an old water course which the pressure of the water in the canal had reopened. It was estimated that the necessary repairs would cost about $50,000. Piles have been sunk, the foundation has been replaced and the building is again in safe condition.

The Mechanical Cause of Gravitation

By Robert Stevenson.

As we have shown from the nozzle experiment, it is quite possible to make a ball describe an elliptical orbit in space by mechanical means, without the hypothesis of the mutual attraction of matter. It now behooves us to show that nature produces the elliptical orbits of the planets and satellites in a similar manner.

If we simply assumed the philosophical fact, "That what man can do, it is not impossible for God to do," we would have a logical right to conclude that the probable cause of orbital motion in nature is mechanical work or energy; because we saw from the experiment that it required power to produce the orbital motion of the balls, although it does not require power in free space to keep up that motion, no more than it requires force to keep up momentum.

But as natural philosophy does not accept logic for its data, nor does it accept philosophical reasons as a criterion for its facts, unless supported by experiment, or the mathematical reasoning which is based on experiment, we will not even accept Newton's dictum, given in the "Principia," Rule 1, Book III:

"We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances."

According to that, if mechanical power will produce gravity, it is not necessary to admit the necessity for the occult force of attraction. But it is equally open for the believer in attraction to use that rule, and say, "If attraction will produce gravity without power, it is unnecessary to admit that power is required."

Consequently, as attraction is in possession, it is my duty to establish the fact that natural gravity is produced by mechanical power, in a similar way to its production artificially by means of the nozzle. To do that we must first analyze the mechanical action in the nozzle experiment.

I will not attempt an explanation of that action by the Newtonian laws of motion, because they are inadequate for a true dynamical explanation, and it would be a waste of time to make the attempt. Some of the brightest mathematical geniuses have been trying during two centuries to reconcile the two, and they are still an immeasurable distance apart, as will be seen in the mathematical theory of the gyroscope, or spinning top, which can only be solved when spinning under constraint; but for perfectly free motion there can be no solution given by the present laws of motion, which is self-evident when the parallelogram of forces given a straight line resultant. But as I can prove that the true resultant in compounding momenta transversely is a curve, and that the parallelogram of forces under such conditions is a mistake, that will simplify the solution.

Consequently it is better for me to prove that Newton's laws of motion are inadequate, and by experiment show what the true laws of motion should be, than to keep circling in the old course, which is already strewn with the whitened bones of great philosophers who were immeasurably better qualified to find it (if it is possible to find it there), than I am. Therefore, I prefer to take a new departure, not for the sake of change, but for the sake of success. The fundamental principles on which Newton's second law is based are Galileo's principle of inertia, and the independent superposition of momenta.

I find that under certain conditions these principles are quite correct, but I also find that these conditions are entirely artificial; and, consequently, in applied mechanics, Newton's law is available; but it is not available under natural conditions. Newton himself knew that they could only be used in the explanation of natural phenomenon by the addition of the law of attraction—a law which entirely subverts his first law of motion, because it makes bodies move of themselves; or in the language of Karl Pearson, they have a "mutual regard for each other," and become dancing partners, with a selective capacity depending on quantity of mass, and distance apart. And it is that fallacy which has done so much to lead shallow minds into accepting the theory that matter is the God of the universe. As the great La Place told the great Bonaparte, it was all the Creator that was necessary.

Let us consider first Galileo's principle of inertia, to ascertain under what conditions it is true, and where it is false. Galileo's law of inertia: (See Kelvin & Tait's Nat. Phil., § 254.)

"When any forces whatever act on a body, then, whether the body be originally at rest or moving with any velocity and in any direction, each force produces in the body the exact change of motion which it would have produced if it had acted singly on the body originally at rest"

The same is expressed more tersely by Kelvin & Tait in § 253:

"Thus the same force will produce precisely the same change of motion in a body, whether the body be at rest or in motion with any velocity whatever."

For a still more detailed statement, see Price, Inf. Cal., Vol. III, §§ 246 7.

That law only applies when the force is acting in the direction of the bodies' previous motion, where change of direction does not take place. Now constant acceleration in a straight line never happens naturally, unless we suppose with Newton that matter has the innate power of attraction, or moving of itself. If a locomotive start a train and keep accelerating it at the rate of one foot per second for ten seconds, the acquired velocity will be ten feet per second. And the law says that during the eleventh second the same force will produce an increase of one foot per second, as was required to start the body from rest if the train has mass only, and is moving in free space. So far the law is correct.

But if the train was constantly moving in a circle, the law would not then hold, because the law of the force which changes the direction of motion is $M V^2/r$, which shows that resistance to change of direction increases with the velocity when the mass is constant; or more generally. *Resistance to change of direction in a circle is directly as the momentum, and inversely as the radius of the circle.* But according to Galileo's law it does not matter what the direction is, or what the velocity may be, the resistance to change does not vary so long as the rate of change does not vary.

Now that is a self-evident blunder, as any engineer who is responsible for the construction of a railway knows; and if he was to use that law in his practice, as natural philosophers and astronomers do, he would be either imprisoned for manslaughter or lynched by a mob on account of the terrible destruction to life and property at every curve in the railroad. He learns to cant his curves to meet increase of speed as well as curvature.

It is well for astronomers that they are not responsible for laying out a planet's orbit according to that law, or it would take more than all the hemp of Manilla to keep the world in ropes.

The crucial proof of the fallacy of that part of the law depends on experiment, and I will close this article by giving one of the simplest and most direct experiments of which I know.

EXPERIMENT II.

The following sketch will show my arrangement for proving that the resistance to change of direction of momentum increases with the momentum, so that those who are not satisfied with the physical reasoning based on the whirling table, where $F = M\ V^2/r$ is the law of force, instead of $F = M/r$, as Galileo's law calls for, may test the matter for themselves.

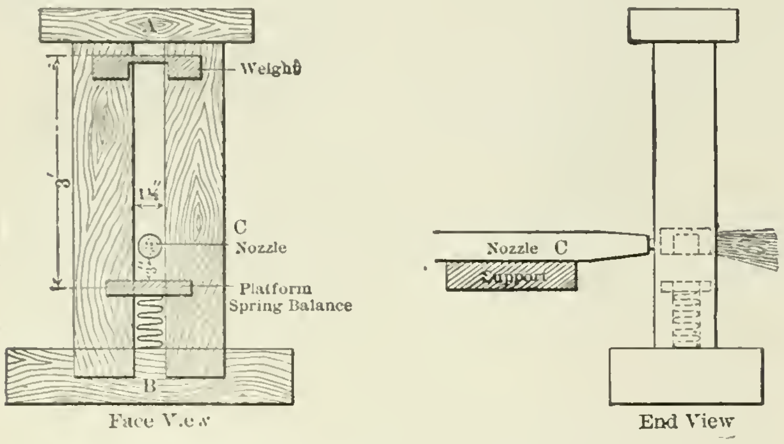


DIAGRAM OF EXPERIMENTAL APPARATUS.

Fix a straight water nozzle, *C*, one inch in diameter, in a horizontal position, and have an arrangement by which uniform jets of water can be forced through the nozzle at velocities from 5 ft. per second, to 10, 20, 40, 80 and 100 ft. per second. If an adjustable nozzle can be had that will keep the mass constant at these velocities, very well; but if not, then the increase of mass must be calculated in the experiment. Erect a small frame, *A B*, with slots for a weight to slide in similar to that used by pile drivers, but only large enough to give a clear fall for the weight of 3 ft. above the platform balance, which is placed about 3 in. below the nozzle. Have the frame fixed vertically so that the weight in falling will cut through the water jet at the point of the nozzle (without striking the nozzle) and then give an impact to the spring balance underneath the jet.

The balance should have an indicator, and be so arranged that the full amount of the impact will be registered, and can be recorded after every impact at the different velocities of jet above mentioned, the height of drop being constant. The most of the weight should be in the slots, so that the thin portion which cuts through the jet would not impede the jet when it was passing the point of the nozzle; but the portion of the weight which strikes the jet should be rigid enough not to yield to the water at the instant of impact.

The experiment proves that the registered impact is reduced in proportion to the momentum of water jet, whereas, if Galileo's law were correct, the momentum of the jet would have no effect in reducing the impact. Because it says that the same force will produce exactly the same effect whether the water be at rest or moving with any velocity whatever and in any direction.

That is the orthodox law in compounding momenta, and on that law Newton based his whole system. And if we acknowledge that the law is wrong in change of direction, then we must acknowledge that the law of the parallelogram of momenta is also wrong.

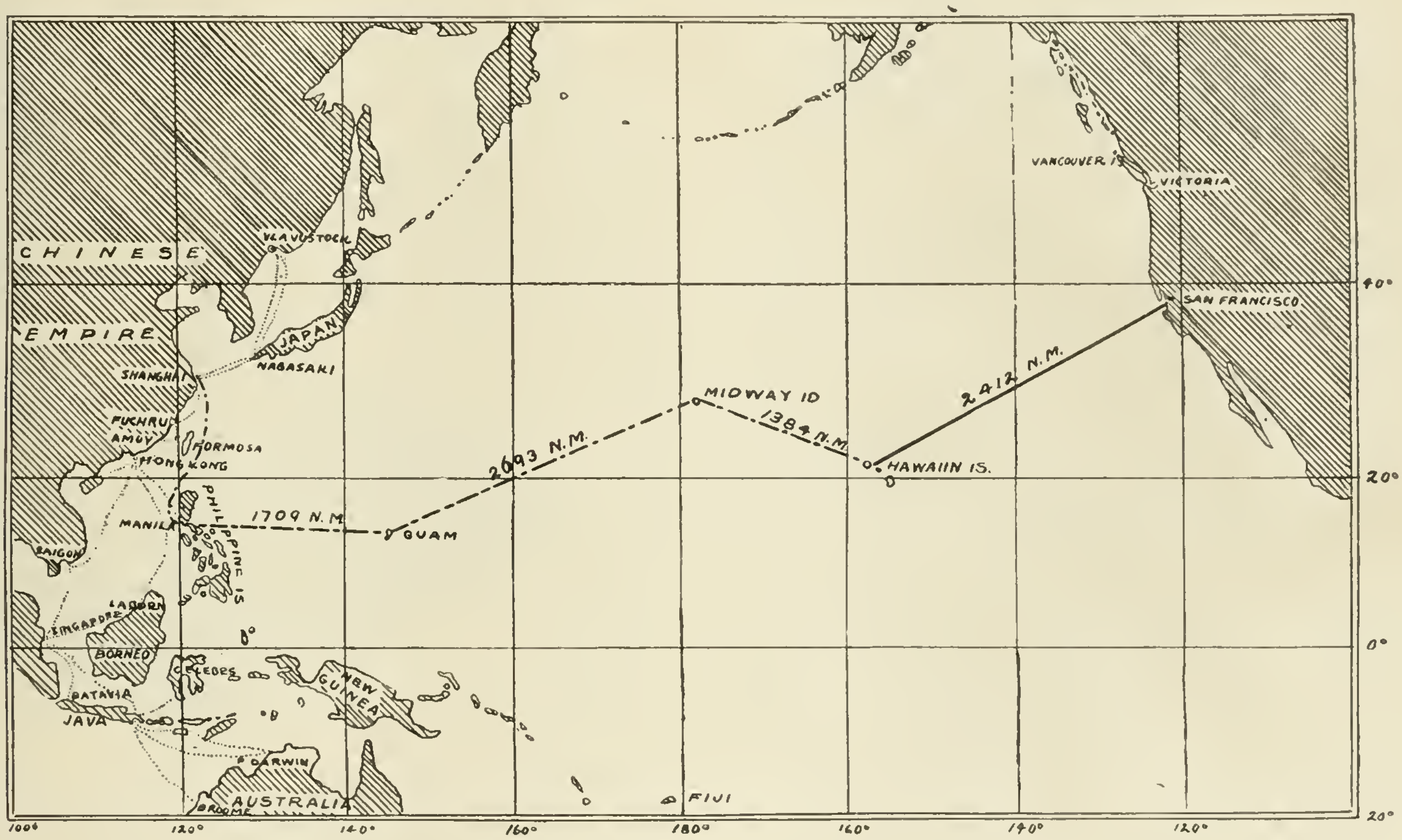
Completion of the First American Pacific Cable.

A great electrical project, long under discussion in various ways, has just been brought to a successful close by the completion of the Commercial Pacific Cable, when President Roosevelt sent a message to Governor Taft at Manila. The earlier stages in this great work have been duly noted by this journal, and a map is now presented with this article, prepared by the Commercial Pacific Cable Company, showing the route from San Francisco to the Far East, the distance in nautical miles from the Golden Gate to Manila being 8,198 miles. As a matter of fact, one more link remains to be laid down, namely the cable from Manila to Shanghai and Hong Kong, constituting an all-American cable from one Pacific continental shore to the other, and interlacing with the existing network that envelopes the coast of the Chinese Empire, Japan and the Strait Settlements, as well as the British colonies and possessions.

A great many interesting features have attended this work—political, financial, electrical, geographical and commercial. The extreme depth of the Pacific interposed many unusual difficulties. The route has four great ocean stretches of 2,270, 1,254, 2,593 and 1,490 miles. Between San Francisco and Hawaii, the mean depth is 2,500 fathoms, with a maximum of 3,073; between Hawaii and Midway Island, the mean depth is 2,000, the maximum 3,026; from Midway Island to Guam, the mean depth is 2,600, with a maximum of 4,900, and with sudden and great fluctuations; from Guam to Luzon, the average depth is 2,200, the maximum 3,400 fathoms. In 2,900 fathoms, with the ship steaming at 8 knots an hour, no less than 25 miles of cable are in suspension in the water. Two and a half hours are occupied in such case by any particular point in the cable from the time of leaving the ship to touching the bottom. Midway Island referred to above and noted on the map, is virtually a new American colony, created by the Commercial Company, and consists of two small islands surrounded by a coral reef eighteen miles in circumference. Buildings have been erected for the cable staff, the colony has been put under the care of the United States Navy Department, and Lieutenant-Commander Hugh Rodman has been appointed first governor.

The cable itself has been made and laid with great care, the contractors being the India Rubber & Gutta Percha Telegraph Works Company of England, and the work being begun by the cable steamer "Silvertown," which left the Thames with the first section, 2,413 nautical miles, on September 23, 1902. The cable proper, of copper, is sheathed in gutta percha. To protect these two, known technically as the core, brass sheathing is used. Next comes a cushion of jute yarn, and outside of all an armor of iron and steel wires. In the construction of the cable, which is 8,300 nautical, or nearly 9,600 land miles, in length, the following materials have been used: Nineteen million pounds of iron and steel wires, 2,010,000 pounds of jute yarn, 306,000,000 yards of preservative tape, weighing 5,090,000 pounds; 52,000 pounds of brass sheathing, 3,600,000, pounds of copper, 2,310,000 pounds of gutta percha, and 4,220,000 pounds of preservative compounds. The whole work has been completed in eighteen months from the date of the signing of the contract. A separate contract was awarded to the Telegraph Construction and Maintenance Company to lay the sections of the cable from Honolulu to Midway-Guam and the Philippines. On the 9th and 10th of April last the steamships Colonia and Anglia, belonging to the manufacturers, left London with more than 6,000 miles of cable in their tanks. The Colonia, which laid the longest section, that between Guam and Midway, 2,606 nautical miles, is the largest cable ship afloat.

The political and international fight over this cable has been long, and its close was hastened by the Spanish war and the acquisition of the Philippines, at which time the United States Government alone found itself to be paying out at least $400,000 for messages to and from the new possessions. Between September 20, 1895, and December 14, 1896, no fewer than twelve bills were introduced in the United States Senate and the House relating to the construction of a cable across the Pacific. Bills were reported and passed in one House, only to fail in the other. In the winter of 1901 Mr. John W. Mackay offered to lay the cable without subsidy or guarantee of any kind, as a private business enterprise. The bill favoring Government ownership finally came to a vote, and was rejected by 116 to 77. Meanwhile, the Commercial Pacific Cable Company was incorporated under the laws of the State of New York on September 23, 1901, with a charter authorizing it to lay and operate a submarine cable from California to the Philippine Islands, by way of the Hawaiian Islands. Prior to its incorporation the rate for messages from New York to the Philippine Islands was $2.35 a word; in November, 1901, this rate was reduced by the European cable companies to $1.66 a word. The mere announcement of the intention of the Commercial Company to lay a Pacific cable thus effected a saving of 69 cents a word. Before entering on the execution of its contract the Commercial Company bound itself to charge only $1 a word from San Francisco to China; $1 a word from San Francisco to Manila, and 50 cents from San Francisco to Honolulu, the last named rate to be reduced within two years to 35 cents a word. The company in its contract signed with President Roosevelt also agreed further to ask no exclusive concession, to operate independently of foreign companies, to be entirely at the service of the country in time of war, and to employ only Americans.



Map of Route of American Pacific Cable.

On July 4, as noted above, the circuits were completed and the first messages were flashed, the time occupied in the circle around the world being stated as 12 and 14 minutes for the 25,835 miles, with 20 transmitting and receiving stations. The President's message was as follows:

> Oyster Bay, N. Y., July 4.
>
> Governor Taft, Manila:
>
> I open the American-Pacific cable with greetings to you and the people of the Philippines.
>
> Theodore Roosevelt.

This was Governor Taft's reply, sent from Manila over the new cable:

> The Philippine people and the Americans resident in the islands are glad to present their respectful greetings and congratulations to the President of the United States, conveyed over the cable with which American enterprise has girdled the Pacific, thereby rendering greatly easier and more frequent communication between the two countries. It will presently lead to closer union and a better mutual understanding of each other's aims and sympathies, and of their common interest in the prosperity of the Philippines and the education and development of the Filipinos.
>
> It is not inappropriate to incorporate in this the first message across the Pacific from the Philippines to America an earnest plea for the reduction of the tariff on Philippine products, in accordance with the broad and liberal spirit which the American people desire to manifest toward the Filipinos, and of which you have been an earnest exponent.
>
> Taft.

Not long after the President's message had been sent, another message was started, this one to go around the globe. It was from the President and was addressed to Clarence Mackay at Oyster Bay. Mr. Mackay was in the telegraph office there and watched the sending of the message, which was to come back to him after circling the earth, it was hoped within an hour. This was the message:

> Congratulations and success to the Pacific cable, which the genius of your lamented father and your own enterprise have made possible.
>
> Theodore Roosevelt.

President Roosevelt's message to Governor Taft at Manila and the latter's answer were also successfully flashed under the waters of the Pacific, as well as the congratulatory words from Mr. Roosevelt to the president of the Commercial Cable Company, Mr. Clarence H. Mackay, which was sent completely around the world.

Mr. Mackay announced the official time for the President's message going from east to west as twelve minutes. It left Oyster Bay at 11.21 and returned at 11.33. Mr. Mackay addressed a reply as follows to the President:

> Oyster Bay, July 4.
>
> *To the President:*
>
> I thank you deeply for your message and I earnestly hope the

Pacific cable, by opening the wide horizon of the great East, may prove a useful factor to the commerce of the United States.

CLARENCE H. MACKAY.

This message was sent eastward, going over the old European route to Manila and back by way of the new Pacific cable to San Francisco. It started at 11.55 o'clock and at 12.04 it came ticking back again—just nine minutes being consumed in its journey around the world.

A number of other messages with the Philippines and Governor Taft were exchanged by ex President Cleveland, Secretary of War Elihu Root, General Miles, Mayor Low, Archbishop Ireland and others. All the officials of the Commercial and Postal Telegraph companies participated actively in the memorable exercises.

Recent Electrochemical Developments.

RECTIFYING ALTERNATING CURRENTS.

It has long been known that an aluminum electrode allows an electric current to pass, when it is used as cathode, while it interposes a very high resistance, when used as anode. For this reason the aluminum electrode has been called an "electrolytic valve" and various inventors have endeavored to utilize it for converting alternating into direct current, the differences between the various schemes consisting mainly in the use of different aqueous solutions as electrolyte and in details of the arrangement of the apparatus. The German storage battery manufacturing firm of Pollak experimented with such electrolytic rectifiers for a period of several years and used them for charging batteries from the Frankfort alternating-current mains. These experiments were, however, discontinued, for reasons not exactly known. More recently Mr. Nodon, a Frenchman, has placed an electrolytic rectifier, with an aqueous solution as electrolyte, on the market, but it is still too early to say anything concerning its commercial success.

In all these former experiments, aqueous solutions were used which have serious disadvantages. The principal defect is that there are considerable current losses, causing the development of heat in the cell. If the temperature is permitted to rise indefinitely, the efficiency of the cell is greatly diminished and the cell may be destroyed. In a patent for an "asymmetric conductor," granted on June 30 to Mr. Carl Hambuechen, of Madison, Wis., it is claimed that these disadvantages may be eliminated or greatly reduced by the use of a fused electrolyte, as for instance the nitrates, hydroxides, chlorates and bichromates of the alkali metals. These materials are at ordinary temperature non-conductive and must be preheated when operation is to be started. When the temperature has been raised sufficiently, the special heating device may be disconnected, as the heat due to the current is sufficient to hold the electrolyte in a molten or conductive condition.

It will be remembered that in a paper presented before the American Electrochemical Society by the inventor jointly with Prof. C. F. Burgess (ELECTRICAL WORLD AND ENGINEER, Vol. 39, p. 651), a number of data were given which appear to substantiate the claims made for the apparatus. If it proves to work as well on a commercial scale as it is said to have worked in the laboratory, it should be very useful for many purposes, even although there may result some competition between the electrolytic rectifier and the Cooper Hewitt static converter which serves the same purpose.

APPLYING HEAT TO ELECTROLYTES.

A patent has been granted to Prof. C. F. Burgess and Mr. Carl Hambuechen, of Madison, Wis., for an electric method of heating an electrolyte, by passing through it a low voltage alternating current, this heating circuit being distinct from the electrolyzing circuit. If for instance it is desired to heat the electrolyte in the neighborhood of the anode, the low voltage alternating current is passed through the anode and an auxiliary electrode. This method seems to have been devised by the inventors for use in connection with their electrolytic rectifier, but has of course a wider application.

SILICON AND ALUMINUM FROM SILICATES OF ALUMINA.

A patent granted on June 30 to C. H. Homan, of Christiania, Norway, is another example of the use of aluminum as a reducing agent in metallurgy, which has already found various applications. The inventor proposes to treat materials containing silicates of alumina—for instance, common clay—in the following manner: The clay is heated in an electric furnace at a temperature of about 4,500° F., with aluminum as a reducing agent in such quantity that the silicic acid and certain bases—for instance, ferric oxide—are reduced, while the oxide of aluminum remains unreduced. The resulting products are silicon, together with the metals of the respective bases, and a slag substantially containing oxide of aluminum. If other silicon products are to be obtained separately—for instance ferrosilicon—the reduced silicon may be tapped out at different stages of the process, so that at one stage of the process pure silicon and at another stage ferrosilicon is obtained. The remaining slag is treated to obtain the aluminum, originally contained in the silicate, as well as the aluminum which had been used as reducing agent.

PURIFYING WATER BY ELECTROLYSIS.

In a patent, granted on June 30, to Mr. W. R. Chipman, of New York City, the inventor describes an anode for electrolytically purifying liquids. Its effect consists, according to the inventor, in the production of oxyhydrates which form with the nitrogenous matters in solution or in suspension a coagulum which is easily filtered out, leaving the liquid pure. The anode is composed of metallic aluminum as the "oxyhydrate developing element," of Straits tin as the "binding element," and of nickel as the "hardening element." With these elements a suitable flux is used.

Recent Development at Niagara.

The most important news that industrial Niagara has heard in some time, is the statement, recently confirmed by Mr. W. B. Rankine, of the consolidation of the MacPherson Switch and Frog Company, of Niagara Falls, N. Y., with the Ramapo Iron Works, of Hillburn, N. Y. This consolidation means that the works of the company at Niagara Falls will be enlarged very substantially, and a number of skilled operatives employed. A meeting of the new company is to be held early in July, at which time officers are to be elected, and other important preliminary business transacted.

On the Canadian side, a section of one of the five great penstocks which will conduct the water to the turbines in the wheelpit of the Canadian Niagara Falls Power Company's new plant is now in place. The pit is being rapidly completed, and work on the extension will soon begin. The present pit has a capacity for but five turbines, while the extension will hold six. A portion of the stone arch bridge over the intake canal has been erected, and is very beautiful. The concrete foundations of some portions of the power house are being laid, and before long the handsome stone edifice will begin to rise. Every part of the work is progressing in a manner highly satisfactory, both to the contractors and the power company.

The temporary power house constructed at the Dufferin Islands by the Ontario Power Company to furnish power for the construction of their works, was put in operation June 25.

The construction of the great dam of the Toronto and Niagara Power Company out into the rapids of the Niagara is being pushed forward, in spite of the great natural difficulties. The swiftness and dash of the rapids caused one of the great cribs to snap its retaining cables several days ago, and it now lies, a complete wreck, on a reef of rock farther down the river. Some seventy-five feet are to be added to the dam in its present direction, after which the structure will be continued down stream and toward the shore.

All Space Full of "Juice."

Advices from Denver, Colo., state that a representative of the Whitney Electric Development Co. is there to arrange for transporting a 13-in. cannon to the summit of Pike's Peak or some lofty pass in the mountains to prove the theory of Mr. Whitney, of Chicago, that by penetrating the atmosphere surrounding the earth he can secure from the electrical sea above unlimited current for earthly power plants. Mr. Whitney, when he secures and locates his monster gun, will fire a spherical iron magnet vertically. To this projectile will be attached a coil of wire twenty or thirty miles in length. Mr. Whitney believes that, once beyond the pale of the law of gravitation, the magnet will be drawn into the electric sea, the wire will hold it and by attaching larger wires he can draw from above limitless electric power. It will be a great pity if this theory is not allowed to demonstrate its insanity—or its soundness.

Telephone Exchanges.--VI.

By ARTHUR V. ABBOTT, C. E.

PERMANENT MAGNETS.

THERE are three properties desirable in material for permanent magnets. First, to minimize bulk, the material should have a high permeability in order that it may accept a large amount of magnetism. Second, after magnetization the material should retain as large a proportion of the flux created as possible. The quality of magnetic *retentiveness,* or the ability of a substance to retain and keep the flux impressed upon it, is termed *remanence.* Third, the remanence should be *permanent;* that is, the magnetic state should not gradually change and decay, but should always remain, otherwise the usefulness of the mechanism will sooner or later fail. The ability of any substance to retain permanently magnetism impressed upon it, may be measured by the amount of *demagnetizing force,* which has to be applied, in order to return it to the neutral condition. Thus the specimen from which the curve of Fig. 15 were plotted required a negative magnetomotive force of 40 to cause its magnetism to disappear, while for the one shown in Fig. 16 only 1.9 gausses were expended. The first sample would be said to be about twenty times as permanent as the second. The amount of negative magnetomotive force that must be expended to cause a body to return to neutrality after having been magnetized is termed *"coercive force,"* and such diagrams as are exemplified in Figs. 15 and 16 are valuable means of estimating magnetic characteristics.

For any specimen of magnetic material the *remanence* is shown by the induction or value of *B* on the vertical scale, when the value of *H* is reduced to zero on the return path from a much greater magnetization. The coercive force is measured by the amount of negative magnetomotive force that must be applied to destroy the remanence. Thus in Fig. 19 for the specimen marked 1,294 *L* the remanence is 9,100 and the coercive force 14. There is no means of predicting *a priori* the magnetic characters of any sample of iron or steel, and so much depends on chemical and physical qualities that are at present very obscure that different lots made by the same manufacturer by identical processes will vary widely from a magnetic standpoint. The only sure way is to test a sample of each lot purchased and plot for each test piece a characteristic curve.

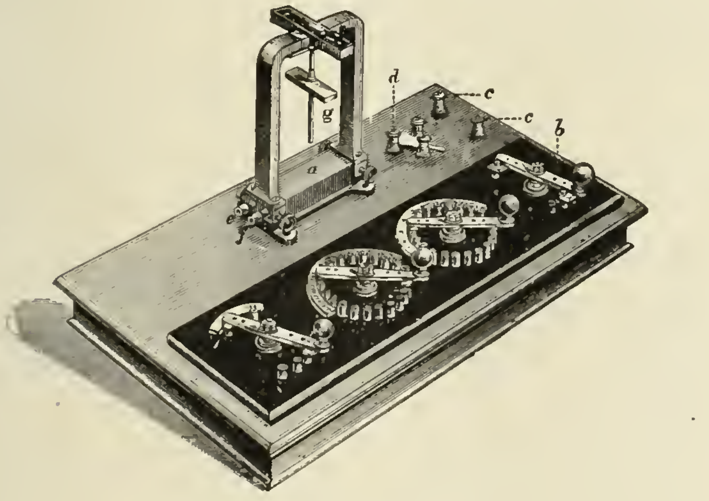


FIG. 17.—PERMEABILITY BRIDGE.

Fortunately apparatus can now be found on the market with which the $\mathfrak{B} - \mathfrak{H}$ curve of any sample can be plotted as easily as the resistance of a relay spool can be measured with a Wheatstone bridge. In fact, Ewing's permeability bridge, shown in Fig. 17, performs exactly the office for reluctance that Wheatstone's does for resistance. The operation is as follows: The vertical U bar, *g,* on the rear of the baseboard carries a compass needle. At the base of this U are two holes, *e* and *f,* into one of which a standard piece of iron or steel is placed, whose $\mathfrak{B} - \mathfrak{H}$ curve is carefully determined. This corresponds to a standard resistance coil. Alongside of this standard is placed the bar to be tested. Magnetizing coils are provided in the base of the apparatus controllable by the sliding contacts of the switch handle seen in front. Now, if the magnetic condition of the standard bar and the test bar are exactly the same no effect is produced on the needle on the top of the yoke, but if they are not the same, the needle deflects an dthe magnetizing effect of the coils is altered till the needle comes to zero exactly as in a Wheatstone bridge the pegs are moved till the galvanometer reads zero. To measure hysteresis the same inventor has produced the apparatus shown in Fig. 18. The sample to be measured is clamped on the spindle that can be rapidly rotated by the gear and crank. It is then set in motion and whirled between the poles of a suspended magnet. This magnet is supplied with a long pointer moving over a graduated arc on the top of a column to which the magnet hangs, and the hysteresis is measured by the deflecture of the needle. With such facilities at command there is little excuse for any manufacturer who fails either to provide the best magnetic materials or maintain a uniform standard.

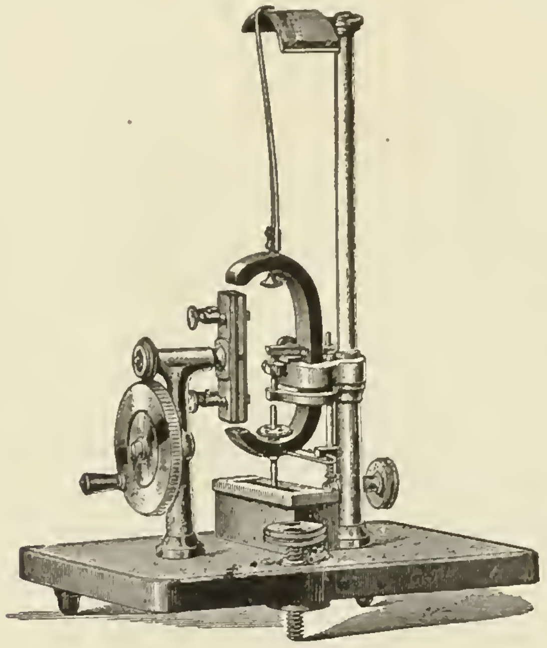


FIG. 18.—HYSTERESIS METER.

From time to time many investigations of the magnetic qualities of various irons and steels have been made. The chief early workers in this field were Ewing and Hopkinson, from whose researches, as well as from various other sources, the general data of Table I is compiled. But it must be remembered that while such information is of value as a general guide it can by no means supplant the necessity for each maker to watch and test the particular brands he employs; as well expect an engineer to built a bridge on general principles, without exacting tests of the particular channels, eye beams and eye bars that he uses.

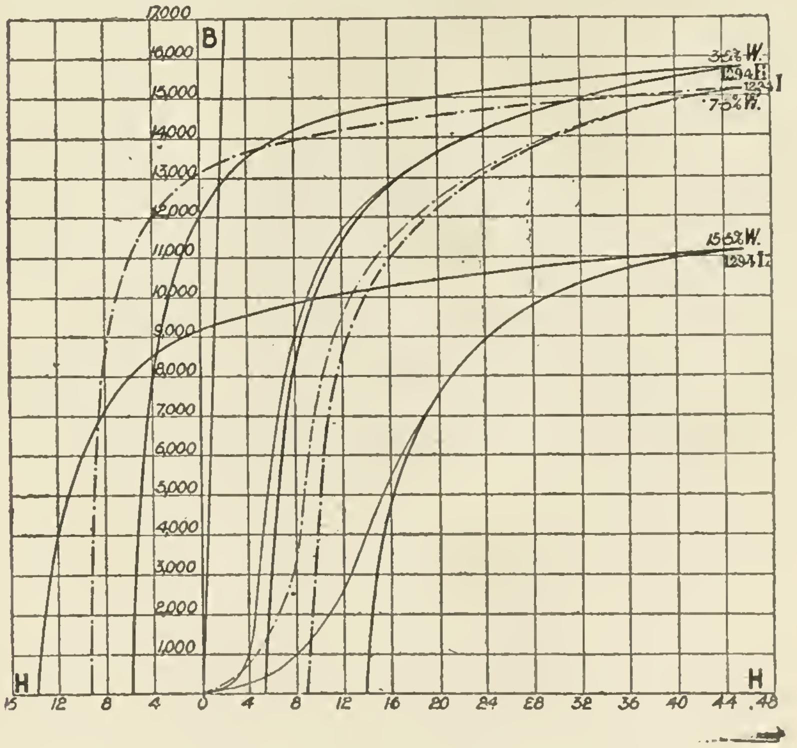


FIG. 19.—CURVES FOR TUNGSTEN STEEL.

Recently Messrs. Barrett, Brown & Hatfield have made a very extended investigation upon the magnetic properties of the more modern steels and irons, the results of which have appeared in a paper before the Institution of Electrical Engineers.* A portion of the results obtained by these investigators that are of particular value to telephonists as showing that some peculiar alloys of iron would seem to be specially adapted to the magnetic system of receivers.

TABLE I.

REMANENCE AND COERCIVE FORCE OF VARIOUS SAMPLES OF STEEL.

Kind of steel and observer.	Max. H applied.	Max. B attained.	Residual B	Coercive force.
Ewing.				
Steel wire, hard drawn	57	14,300	8,200	16
Steel wire, annealed	53	14,600	11,700	17.5
Steel wire, glass hard	55	9,400	6,800	39
Piano forte steel wire, normal temper	92	14,600	11,800	27
Piano forte steel wire annealed	94	14,300	10,500	24
Piano forte steel wire glass-hard	98	12,700	9,600	41
Cast iron	16	3,700	2,600	8
Very soft iron wire	17	13,500	11,000	1.9
Annealed wrought iron	90	16,200	12,700	3
Whitworth mild steel, annealed	250	16,120	10,740	8.3
Hopkinson.				
Whitworth mild steel, oil hardened	250	16,120	8,736	19.4
Chrome steel, as forged	250	14,680	7,568	18.4
Chrome steel, annealed	250	13,233	6,489	15.4
Chrome steel, oil-hardened	250	12,868	7,891	40.8
Tungsten steel, as forged	250	15,718	10,144	15.7
Tungsten steel, annealed	250	16,498	11,008	15.3
Tungsten steel, hardened tepid water	250	15,610	9,482	30.1
Tungsten steel, (French) oil-hardened	250	14,480	8,663	47.1
Tungsten steel, very hard	250	12,133	6,818	51.2
Weber, common steel magnet			3,947	
Von Waltenhofen tungsten steel, glass-hard			4,638	
Perry, Jowitt's steel			12,600	
Preece, Wall's steel			1,519	
Preece, Ashford's steel			1,704	
Preece, Saunderson's steel			1,435	
Preece, Jowitt's steel			1,435	
Preece, Vicker's steel			1,174	
Preece, Crewe "rivet steel"			186.6	
Preece, Crewe "spring steel"			1,391	
Preece, Clemandot steel (compressed and tempered)			2,264	
Preece, Clemandot steel (compressed but untempered)			1,333	
Preece, Marchal steel			2,540	
Preece, Allevard steel (mercury-hardened)			1,315	
Preece, Allevard steel (water-hardened)			1,660	
Gray, magnet steel, glass-hard			6,536	
Evershed, Wall's and Jowitt's steels (mean)			4,000 to 5,000	
Brown, magnet steel, glass-hard			6,000 to 7,000	

The data exhibited in these tables show there is a wide variation in the properties of the various steels obtainable for permanent magnets. In Table II the steels that appear the most valuable to the telephonist are those containing manganese, nickel and tungsten, and to exhibit the properties of these steels more completely Figs. 19, 20 and 21 give the hysteretic curves for the various samples referred to in Table II. From these curves it is easy to pick out by inspection four samples that are seemingly the best suited to the manufacture of permanent magnets. The relative qualities of these specimens are shown in Table III.

In selecting a steel for a permanent magnet two somewhat opposing qualities must be balanced. A high permeability and, in general, relatively great remanence is usually coupled with a low coercive force. Hence while such steels exhibit the ability to develop (temporarily at least) a large magnetomotive force per unit of volume they are apt to soon decay, and lose the magnetism impressed on them. Magnets made of such material may be of light weight and of small volume. On the other hand, steels which show a high coercive force indicative of great permanence have relatively low remanence because their permeability is small, and it is impossible to make them retain even with the most intense fields more than 5,000 to 8,000 gausses. Magnets made of such steels, while exhibiting great durability, can only emit a relatively feeble magnetomotive force per unit of volume, so such magnets must be large in volume and correspondingly heavy. On the whole for telephone receivers great coercive force is to be preferred, but the quality of remanence must not be entirely ignored or the magnet will become too bulky. Of the specimens in Table III, sample No. 3 showed the highest coercive force, but the remanence is very low. While such a steel would be "permanent" its power of producing magnetomotive force would be small, necessitating a large and heavy magnet to secure the requisite flux. Sample No. 4 shows very great remanence, and excellent coercive force. Such a steel would be better suited to receiver magnet manufacture than any of the others.

TABLE II.—MAGNETIC PROPERTIES OF IRON ALLOYS.

Group.	Mark.	Percentage of main element alloyed with iron.	Maximum induction for H = 45.	Permeability μ for H = 8.	Remanence in terms of B.	Coercive force in terms of H.	Energy dissipated per complete cycle. Ergs. per c. c.
Carbon steels	B	0.03C.	16,800	1,625	9,770	1.66	10,760
	LSS	0.05C.	15,720	1,500	9,090	1.66	11,300
	611	0.58C.	15,610	1,035	10,370	2.56	22,200
	613	1.00C.	14,000	654	9,000	6.43	32,750
	614	1.25C.	14,000	375	9,040	6.43	33,330
Manganese steels	48	0.50Mn.	16,000	1,165	10,000	3.20	19,650
	4147	1.00Mn.	15,540	1,100	11,320	3.4	22,150
	53	2.25Mn.	14,720	1,080	10,460	6.0	30,580
	39	4.00Mn.	9,370	125	5,950	16.2	39,500
	34	4.75Mn.	8,320	73	5,420	19.6	39,400
	945A	7.00Mn.	3,820	23	2,230	20.0	19,650
Nickel steels	1287D	1.92Ni.	16,000	1,380	9,140	2.67	15,300
	1287E	3.82Ni.	16,190	1,375	9,320	2.76	15,860
	1267B	4.75Ni.	10,500	125	6,910	14.28	39,800
	1287I	11.39Ni.	8,190	118	4,630	17.33	32,050
	1447B	12.10Ni.	4,170	....	4,500	22.40	21,850
	1447A	12.70Ni.	4,480	....	3,900	22.10	24,280
	1287K	19.64Ni.	7,770	90	4,770	20.00	36,850
	1287L	24.50Ni.	4,230	32	2,790	22.50	22,200
	1449	31.40Ni.	4,460	357	1,720	0.50	803
Tungsten steels.	1294F	1.0 W.	16,000	1,400	10,000	3.23	14,150
	1294H	3.5 W.	15,720	1,280	12,720	5.73	25,050
	1294I	7.5 W.	15,230	500	13,280	9.02	47,500
	1294L	15.5 W.	11,090	125	9,320	13.92	44,000
Aluminum steels	1167D	0.75Al.	16,000	1,500	10,500	1.80	11,000
	1167H	2.25Al.	16,900	1,700	10,500	1.00	8,000
	1167I	5.50Al.	13,000	1,200	4,150	1.00	6,500
Silicon steels	898E	2.5	16,420	1,680	4,080	0.90	7,900
	898H	5.5	15,980	1,630	3,439	0.85	6,500
Coper steels	1264A	1.59	14,600	....	10,520	5.0	....
	1264B	2.5	14,300	....	10,410	5.4	....
Chromium-aluminum steels	1178B	1.74Cr. 0.75Al.	14,490	1,040	10,350	6.0	25,750
	1178D	1.5 Cr. 2.25Al.	13,890	1,180	9,680	3.52	17,550
	1178E	1.5 Cr. 4.5 Al.	13,150	1,060	8,560	1.77	13,420
	1179B	3.5 Cr. 1.0 Al.	13,540	466	9,550	8.0	34,700
Chromium-Nickel steels.	1286A	0.75Cr. 2.75Ni.	16,480	1,210	7,730	3.0	....
	1286C	1.75Cr. 2.5 Ni.	15,150	485	11,110	7.9	....
	1210D	4.5 Cr. 2.5 Ni.	13,650	....	9,800	13.1	....
Manganese-nickel steel	1254C	3.75Mn. 4.0 Ni.	6,410	121	3,770	19.6	....
Silicon-nickel steels	1103A	2.0 Si. 3.25Ni.	15,750	1,085	6,780	2.0	....
	1103C	3.25Si. 3.5 Ni.	15,480	1,240	7,050	1.9	....
Tungsten-cr. steel	1189B	2.0 W. 0.75Cr.	15,950	1,125	12,150	5.3	....
Tungsten-mn. steel	687	3.25W. 2.35Mn.	15,250	815	12,080	6.5	....

Not only does the permanent magnet depend for its success upon the kind of material from which it is manufactured, but as much is involved in the treatment which the metal receives at the hands of the smith in forging and tempering. A general impression exists that the harder the temper, the better the magnet will be; but like many other current ideas this is fallacious. It is more a question of careful working and *judicious* tempering, than the attainment of great hardness; furthermore, the temper to be given depends somewhat upon the shape of the magnet, for experiment has shown that short magnets should receive a harder temper than long ones. It is eminently desirable that all heating and forging should be done in a muffle with the greatest care; hammering should be avoided as much as possible and forming done in a die with a press, for a careless smith may irretrievably injure the very best steel.

TABLE III.

	Kind of steel.	Remanence.	Coercive force.
1	Manganese, 4%Mn	66%	66%
2	Nickel, 11.4%Ni	56%	75%
3	Nickel, 24.5%Ni	26%	100%
4	Tungsten, 15.5%Tn	100%	58%

There are two methods of hardening steel; one involves heating and suddenly cooling by plunging in water, oil or mercury, and the other by subjecting to the metal great pressure while in a molten or semi-molten condition. There is no doubt but that the latter gives by far the most satisfactory results, but this process requires an elaborate and expensive plant. The aim in tempering should be to secure as fine, uniform and homogeneous a grain in the finished bar as possible. Each manufacturer has some pet method to attain this result, but all of these dodges, and the various nostrums which are advocated as tempering baths probably possess but little actual influence upon the final physical condition of the steel, but have considerable influence psychologically upon the man who is making the magnets, and inspires him with confidence and care in their manufacture.

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* See *Journal of the Institution of Electrical Engineers*, Vol. xxi, No. 156.

It has been observed that the desirable degree of hardness for permanent magnets depends somewhat upon the size of the magnet, or rather upon the relation of its length to its diameter. No absolutely conclusive experiments have been made to determine the precise connection that exists between hardness and the ratio to length of diameter, but in a general way it is understood that short magnets should be harder than long ones.

Some experiments of Stonhal & Barus, while not final evidence of the dependence of permanent magnets upon hardness, and of hardness to shape of magnet are indicative of the relations which exist between these quantities.

TABLE IV.

RELATIVE MAGNETIC PROPERTIES OF STEELS CONTAINING MANGANESE, NICKEL AND TUNGSTEN.

		Relative length to diameter.				
		10	20	30	40	50
Designation.	Relative hardness in per cent. glass-hard = 100.	% Magnetization.	% Magnetization.	% Magnetization.	% Magnetization.	% Magnetization.
Glass-hard	100.0	100.0	87.5	65.0	54.5	50.5
Annealed 1 hr. in steam	88.0	94.0	84.0	62.0	52.0	48.5
Annealed 3 hrs. in steam	83.5	94.0	82.0	61.0	51.0	47.5
Annealed 6 hrs. in steam	80.0	94.0	82.0	61.0	51.0	47.5
Annealed 10 hrs. in steam	78.0	94.0	82.0	61.0	51.0	47.5
20 min. at 185 centigrade	66.0	85.0	82.0	63.5	54.0	51.0
1 hr. at 185 centigrade	63.0	86.0	90.0	66.	56.5	54.0
3 hrs. at 185 centigrade	58.0	87.0	92.0	71.5	61.5	58.0
7 hrs. at 185 centigrade	55.0	88.0	97.0	78.0	67.5	64.0
13 hrs. at 185 centigrade	52.5	84.0	98.5	80.0	69.0	69.0
10 min. at 240 centigrade	50.5	82.0	100.0	83.0	76.5	72.0
1 hr. at 330 centigrade	43.5	76.5	100.0	93.5	88.5	87.0
1 hr. at 420 centigrade	37.0	58.0	88.0	100.0	100.0	100.0
Annealed	34.0	16.0	21.0	25.0	31.0	40.0

The results alluded to are summarized in Table IV.

According to our present notions each molecule of a magnetic substance is surrounded by the same sort of a stream of ether as that which we imagine issuing from and returning to the poles of an ordinary bar magnet. In soft iron the molecules are heterogeneously arranged, consequently the ether stream from one particle is neutralized and annulled by those from its neighbors, consequently the entire piece is in a non-magnetic condition. When magnetized all of the particles are turned so that their respective ether currents flow in the same direction and thus the stream from one particle uniting with those of its neighbors gradually increase the flux until it becomes of sufficient volume to impress itself upon our senses. Annealed iron is so soft that it is easy for a slight magnetizing force to pull the molecules in line, and as soon as this force is removed there is so little tenacity that the particles readily drop back in their neutral condition. With hard steel the material possesses so much more resistance that it is difficult to impress magnetism upon it, and a much stronger magnetic force is required to produce a corresponding result. Owing to the greater tenacity of the piece, after it has once been magnetized the molecules are unable to return to their original positions and consequently it retains its magnetism. If this theory be correct anything which tends to disturb the molecular condition will correspondingly operate to injure and destroy permanent magnetism. This is abundantly verified by experiment, for if a piece of soft iron be magnetized it will, if undisturbed, retain a noticeable amount of the impressed magnetism after the magnetomotive force is removed, but if it be jarred in the slightest degree so as to set its particles vibrating, it will immediately lose nearly if not all traces of the magnetic charge. Similarly in the case of a piece of tempered steel, while it exhibits much greater permanency it is nevertheless sensitive to all kinds of shocks, and after magnetization care should be exercised not to pound or jar it.

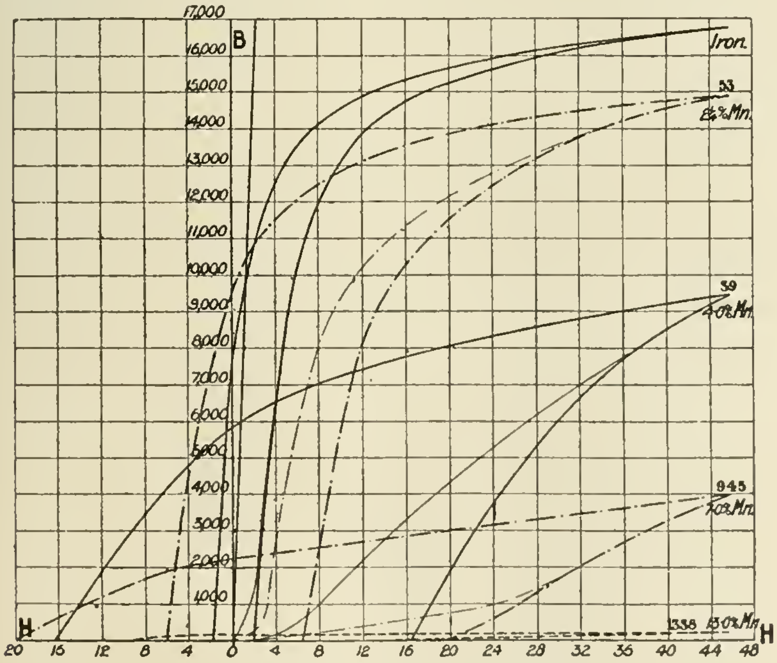


FIG. 20.—CURVES FOR MANGANESE STEEL.

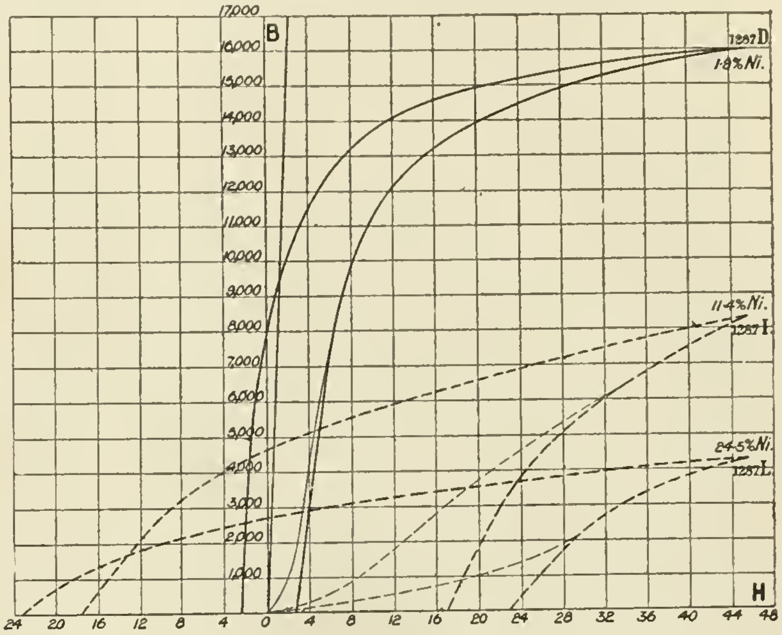


FIG. 21.—CURVES FOR NICKEL STEEL.

The tables and curves show that it is possible with some varieties of relatively hard steel to confer a flux of from 10,000 to 14,000 gausses. But such material shows so little coercive force that magnets made therefrom can hardly be called permanent, for even with the utmost pains to avoid vibration, pieces so highly magnetized will by mere lapses of time lose a notable fraction of the charge. Contrariwise other steels which cannot be magnetized more than 4,000 or 6,000 gausses, exhibit sufficient relentiveness to retain all the magnetism imparted for many years in spite of much ill treatment in the way of shocks and blows. To secure permanence, therefore, it is advantageous to artificially age magnets before they are used. After being carefully forged and properly hardened the magnet should be as powerfully magnetized as possible. Almost every maker has a pet method of charging, but all that any can accomplish is to subject the bar to as powerful a magnetic field as possible, and while under the magnetic flux it is well to jar it or pound it in order to bring as many molecules as possible into proper magnetic alignment. After the magnet has been charged it should be allowed to rest quietly for a few days, to allow the molecules to become accustomed to their new positions. Aging should then be performed by *cooking* the magnet; namely, it should be put in a steam bath or boiled at a constant temperature of 212° for some hours or even days. Under this treatment a portion of the magnetism is lost, but that which is retained may be considered highly permanent, for magnets made of the best steel, carefully forged, thoroughly magnetized and subsequently well aged, show almost no magnetic change even after the elapse of several years.

Niagara Meeting of the American Institute of Electrical Engineers.

As foreshadowed in the notice last week of the opening sessions of the Niagara meeting of the American Institute of Electrical Engineers, the meeting was by far the most successful in the history of the Institute. A high water mark was reached in attendance, the total of members and guests registered reaching 487. Almost 40 papers were presented, not including a number of written discussions of considerable length, and the discussions were as a rule animated and dealt with the important bearings of the topics considered.

Through the courtesy of the Natural Food Company, the sessions—excepting that of Monday evening—were held in an auditorium in the works of that company, which was excellently suited for the occasion in size, ventilation and acoustic properties. The local committee had made every provision for the social entertainment of the ladies of the gathering and for instruction and pleasure excursions to points of interest in the vicinity of the Falls. An untoward incident of one of these excursions—a night visit to the Gorge—arose from an accident to the railway system, which interrupted the service and held up the party until midnight. A particularly enjoyable feature was the dance on Tuesday evening at the Cataract House.

The usual visits were made to the plants of the Niagara Power Company and Niagara Falls Hydraulic Power & Manufacturing Company, and the members were permitted to inspect a rotary converter at the works of the Pittsburg Reduction Company. A trolley ride was provided over the country wherein the three new Canadian power houses are being constructed.

The excellent address of Prof. Scott is reprinted in part elsewhere. Owing to the number of papers presented and the extent of the discussions, the space available will not admit of the entire programme being covered in this issue. A portion of the report is, therefore, held over for the issue of next week.

ENERGY TRANSFORMATIONS IN THE SYNCHRONOUS CONVERTER.

With this title, Prof. W. S. Franklin presented a paper in which he gave a new method of analysis applicable to the rotary converter. The specific object of the paper was to determine, of the total energy which flows through a synchronous converter, the fractional part which is conductively transferred from supply mains to service mains; and the fractional part which is inductively transferred. The paper is highly mathematical in character and ends with a discussion on "The Criterion of Reality of the Component parts into which a Physical Aggregate is Resolved by Mathematical Analysis."

In the discussion, Dr. Sheldon criticised the division of a current flowing in a conductor into parts, for there never can be but one current and that always in phase with itself. In analyzing the actions in a converter he suggested the use of a series of current time curves piled on top of one another, on abscissa which may be termed time or angular abscissas of the armature coil. The drawing of such curves simply implies the use of a T-square and a templet which corresponds to the shape of the wave. Prof. Sheldon has applied this method to a three-phase converter and derived almost exactly the same results as those found by Prof. Franklin. Prof. Franklin stated that a synchronous converter cannot be looked upon as a synchronous motor in combination with a direct-current generator. As to Dr. Sheldon's graphical method, he stated that it is identically the same as the algebraic method which he submitted, except that the former is applied more easily when the alternating-current curves are not sinusoidal.

COMMERCIAL ALTERNATOR DESIGN.

In a paper with the above title, Mr. W. L. Waters gave an excellent discussion of the various factors entering into alternator design. The discussion was confined to the internal revolving field type, with each pole carrying a separate field coil of edge-on copper strap, the author considering that no other machines compare with this type for general all-around work. Credit is given to C. E. L. Brown and Ferranti for the establishment of this type, the evolution of which was followed up to the present. All the various factors entering into alternator design are discussed in an eminently practical manner, and much information is given for guidance in deciding upon the details of design of machines for various purposes. The matter of power factor is discussed at length, as is also the relation between air gap and pole density. It was recommended that the regulation be guaranteed for a low power factor and not for a non-inductive load. A tabulation is given of the data of three designs showing how changes in one or more of the details affect the cost of the machine. In conclusion is given a comparison between two machines, one designed in 1894 and the other in 1903, in order to illustrate the great advance that has been made in alternating-current design during that period. The 1894 machine of 50-kw capacity, weighed 7,400 pounds and contained material costing $455. The machine of 1903 is of 275 kw-capacity, weighs 11,000 pounds and contains material costing $490. Those interested in alternating-current machinery aside from their design will find much to interest them in this well-written paper.

Upon concluding his paper, Mr. Waters added that the point upon which he wished to lay stress was that of guaranteeing regulation on a low power factor, which is much better from a designer's point of view, and practically every load that an alternator carries in actual practice is to a certain extent inductive. It is a farce to guarantee regulation for ordinary everyday work at unity power factor, and it is practically impossible to measure regulation on a large machine at unity power factor. It would be a great deal more to the point if the regulation of an alternator was guaranteed at zero power factor, in which case a direct test could be applied, and there would be no need of calculation and making assumptions.

A lengthy communication in the discussion of Mr. Waters' paper was presented by Mr. D. B. Rushmore, in which the problems met in transmission work are considered, including those of insulation and the influence of harmonics. He spoke favorably concerning the inductor type of alternator and went into the subject of star and delta connections, and the relations between armature inductance and reaction and the effect of the latter on field poles. Mr. Ralph D. Mershon disapproved of the use of a temperature rise as low as 30° C., and favored 40 or 45°, which he considered safe with modern insulation. He referred to some alternators he had recently seen in Europe which, though beautiful machines mechanically, were inferior electrically, particularly with respect to power factor and regulation. The European plants that he had seen were also defective in their switching arrangements, no provision of switches being made to break the load in case anything happens. Prof. Harris J. Ryan, on the part of the Committee on Standardization, announced that a change would be made in the Institute rules dealing with the regulation of alternators. Mr. Waters referred to some remarks by Mr. Rushmore, on short circuits, and said that the general practice is, in case of a short circuit, to take either the choice of turning it out or having a circuit-breaker cut-out. An alternator with bad regulation in the case of a short circuit drops its voltage with the result that the operation of synchronous and induction motors is interfered with. An alternator that will stand a short circuit should be a thing of the past. He said that induction alternators can be made with good regulation, but he considered the revolving field alternator superior owing to its much lower cost, the difference being a matter of 30 per cent. He considered that the question of self-induction of the armature of an alternator is one that cannot be discussed theoretically, owing to the great complication of the subject due to the entry of numerous factors. Replying to Mr. Mershon, who had stated that a low temperature rise must be paid for, he said that it is no more trouble to design a machine for low temperature than it is for high temperature. He said that his company was designing machines for low temperature and found it a commercial proposition. While agreeing that in Europe there were some alternators badly designed, he had found that also true in this country, and gave an instance of a plant run by a 300-kw machine, in which the lamps went out when a 75-hp induction motor was started up. Mr. Mershon said that abroad he had seen alternators made by firms of the very highest standing and the impression that he had derived was that the requirements as to regulation were not so severe as in this country.

INSTITUTE BRANCH MEETINGS.

Prof. W. E. Goldsborough read a paper by Mr. Calvin W. Rice, entitled "Institute Branch Meetings, their Organization, Development and Influence," giving an account of the work of the Institute in this direction during the past year.

In the discussion Prof. Ryan spoke enthusiastically in favor of the development treated by Mr. Rice, and said that at Cornell the work of the local branch is a part of the regular engineering instruction. The plan there is to abstract the papers and present them before members of the senior and junior classes, as well as all the local members of the Institute resident in Ithaca. The papers are abstracted by members of the senior and graduating classes, assisted by the officers of instruction, which work is supplemented by brief analyses of the careers of the men who have been the authors of the papers. When the reports of the discussions come, they are gone over, somewhat abstracted and presented to the students. The students take the greatest interest in the papers, as well as in the discussions, and the results of this movement on the part of the Institute has been productive of excellent results. Prof. Goldsborough also spoke highly of the benefit derived from branch meetings at Purdue University, and also of the plan to enroll students as junior members of the Institute. The Purdue Electrical Society has become the Purdue branch of the American Institute of Electrical Engineers, and during the year the students have met every two weeks. Next year the programme will be to have the first meeting in the month given to local subjects, and the second meeting given to regular Institute business. Prof. Goldsborough said that at St. Louis regular monthly meetings had been held with great success, for which much credit is due to the secretary of that meeting, Mr. Swope. Mr. Peter Junkersfeld, of Chicago, said that the Chicago meeting is the oldest branch of the Institute, and made some suggestions as to increasing interest in the Chicago branch. He suggested that it might be well to combine with some of the other engineering societies in Chicago, forming a general engineering body. Secretary Pope spoke of the present facilities for getting papers rapidly into type and referred to the desirability of authors submitting their manuscript at the earliest possible moment. He thought that in time a local general secretary will be required to take care of the business of local branches.

COOPER HEWITT APPARATUS.

On Monday evening an exhibition was given of the Cooper Hewitt vapor lamp and converter, during which Dr. Von Recklinghausen explained the principles of the apparatus. He traced the use of mercury vapor as a conductor from the work of Prof. Way in 1860, referring to the work of Rappieff, Rosa, Langhaus and Arons. Hewitt's investigations not only taught how the most serviceable illuminating lamps may be made, but opened up entirely new applications of vapor electrical apparatus, the importance of which is far reaching. He showed that to obtain a lamp of the desired characteristics the radiating power of a lamp must be correlated to the energy spent inside the lamp, in order that the most favorable temperature or density conditions may be obtained for the efficient generation of light. An extremely important matter was to get the right ratio between the size of the condensing chamber, the size of the tube and the value of current. Hewitt also demonstrated the means of discriminating between positive electrode resistance, resistance of the current proper and the negative electrode resistance, the last being the most important. To break through the negative electrode resistance requires a good many thousand volts, after which but a few volts are required to keep the lamp in operation. He spoke about the great value of the Cooper Hewitt lamp for photographic purposes, owing to the light being extremely actinic; and the presence of these rays have led physicians to take a great interest in the lamp, as they expect to utilize it in curing certain diseases. Owing to the absence of red rays, the lamp furnishes a splendid light for places where fine mechanical work, reading, writing, and especially drafting, is done. Mr. P. H. Thomas described and showed the single-phase vapor converter, the latest development of Mr. Hewitt's work. In the polyphase converter there is never any interruption of current in the globe, and therefore no trouble is met in keeping the converter in continuous operation. In simple single-phase converter, however, the current would be interrupted at each alternation, whereupon the negative electrode resistance would assert itself. To obviate this, an auxiliary current is continuously passed through the converter, thus preventing the negative electrode resistance from asserting itself, which current may be derived from the main circuit through a shunt containing an inductance. Mr. Thomas described a vapor switch consisting of two electrodes in a sealed glass chamber, covered with mercury when the switch circuit is closed. By tilting the chamber so that one electrode emerges from the mercury, the circuit is interrupted. The circuit, however, is not broken at a high voltage that may exist in an alternating-current circuit when the electrode is bared, the current continuing until the cycle attains about 14 volts from zero, when the current is extinguished and will not start up again owing to the existence of the high negative electrode resistance. The advantages given for this type of the switch are that the contacts are perfect and will not deteriorate nor burn, and owing to the very short distance through which the current needs to be carried, it is easy to get a large cross-section, which makes a light apparatus. In reply to a question as to whether the efficiency of the vapor converter is measured solely by the ratio of the volts supplied to the converter and the 14 volts drop across the converter, Mr. Thomas replied that the only loss corresponds to this ratio.

Dr. Von Recklinghausen, in reply to a question, said that the converter will stand a variation in voltage from 7 to 8 per cent. either way. If the variations are excessive the lamp will go out. A lamp designed for a normal current of 3 amp. will not operate below 1.2 amp. Lamps can be made, however, for very low and very high currents. The lamp will operate with a trace of foreign gas, but with more than a certain small amount the lamp will not work satisfactorily. He said that experiments had been made with nitrogen, with which gas the color of the light is different from that when mercury is used. Some experiments have been made whereby the actinic rays are transformed by fluorescent action. So long as mercury does not contain a gas it does not matter whether it is particularly pure. As to the life of the lamp, he said that no lamps are given out having a life of less than 2,000 hours. The candle-power drops slightly, due to discoloration of the glass. The life of the lamp is terminated by the vacuum becoming poor and the leakage in all probability is lengthwise through the platinum wire sealed in the glass. After the lamp has gone out, it is re-exhausted and then is as good as a new lamp. A special glass is used for making the tubes, its composition being a secret. With some types of lamps it is necessary to have a ballast resistance. Lamps can be constructed for a voltage as low as 15 volts. In starting, a lamp will take 4½ to 5 amp., and then in a few seconds work down to 3 amp. A separate starting device is used for each lamp or each series of lamps. Heating the mercury will not assist in starting up the lamp. At a voltage of 120 there are 15 volts in the electrodes and 20 volts in the ballast, this giving 85 volts in the lamp. The negative electrode has a lower temperature than the positive electrode, energy being absorbed at the former. A jet of flame is given out at the negative electrode, which is deflected by a magnet, but no cathode ray action has been detected. The lamp has an efficiency of .3 watt per hour candle-power, which figure takes account of the electrode resistance but not of the ballast. The pressure in the lamp is about 2 mm.

In reply to a question from Mr. Mailloux, Mr. Thomas said that the vapor converter will eventually be used for railway work. At present no practical apparatus is being made, all attention being directed to studying the different problems presented in its development. He said, however, that a converter had been made through which 120 amp. would pass continuously. As to cost, he said it was the plan of the company to collect statistics as to the cost of rotary converters and base the selling price of the vapor converter upon this. As to overloads, the only difficulty is with respect to the heating of the electrodes and globes. The heating is in proportion to the current, but not to its square. While a vapor lamp will go out under too great fluctuations of voltage, this is not true of the converter with respect to fluctuations in load.

HIGH-SPEED ELECTRIC RAILWAY PROBLEMS.

One of the most important papers read before the meeting was that of Mr. A. H. Armstrong, having the above title. The paper is of particular value on account of the great amount of data which it contains in the form of curves. There are seven sets of curves based upon three friction curves that have been very carefully determined, one of which applies to the operation of a car weighing in the vicinity of 40 tons; another for two cars in a train, and the third to eight or more such cars in a train. With these curves as a basis, other curves are calculated, showing the possible schedule speeds and the energy consumption required for the given speeds up to and including 75 miles per hour maximum, the gross accelerating rate being assumed to be 120 pounds per ton, the average braking effort at 120 pounds per ton and the duration of stops 15 seconds, the track being assumed to be perfectly straight and level. One set of the speed and energy curves refers to the first mentioned friction curve, another set to the second friction curve, and the third set to the third friction curve.

The paper also contains four other sets of curves, which, together with those first mentioned, furnish a complete basis for calculations for a proposed electric road, and they are applied in the paper to a case of a third rail road 100 miles long, on which stops of 15 seconds' duration will occur every four miles, the motors being supplied with direct current from sub-stations fed from a single central generating station. By reference to the curves, it is found that a schedule speed of 40 miles per hour can be obtained with a maximum speed of approximately 48 miles per hour with one stop every four miles, the consumption being 82 watt-hours per ton-mile, with four 110-hp motors operating a single 40-ton car with a temperature rise of 60°.' These data enable the sub-station equipment to be calculated, and finally the approximate first cost per mile for a single-car train and the approximate first cost per mile for a two-car train. The example serves to illustrate the great value and very broad application of the curves given. Although it is necessary to assume a number of constants, such as acceleration, braking, coasting, etc., these pertain to average operation and can vary considerably without making a serious difference in the results. The contribution of Mr. Armstrong is consequently a most valuable one to practical electric railway engineering.

STORAGE BATTERY INDUSTRIAL LOCOMOTIVES.

A paper by Mr. F. L. Sessions with the above title contains descriptions, together with illustrations, of several types of storage battery locomotives and gives a number of tables of data, as follows: The kw-hours and draw-bar pull required to move one ton 100 ft. under different friction loads and on various grades at any speed; the total loads in tons that can be held by a 100-kw-hour storage battery 100 ft. per minute, the locomotive having an efficiency of 100 per cent.; the kw-hours required to move 100 tons 100 ft. per minute under different frictional loads and on various grades when the locomotive efficiency is 100 per cent.; the kw-hours required to change a battery to move one ton 100 ft. when discharging at various rates and operating trains against various loads and grades, the energy efficiency of the battery on an 8-hour discharge rate being 75 per cent. and the locomotive efficiency being 100 per cent.; and the total kilowatt-hours available and the kilowatt discharge rates for storage batteries of different 8-hour ratings. In conclusion, Mr. Sessions stated that from results obtained through both calculation and experience, it appears that the electric storage battery when properly designed for its duties can be employed with greater advantages and economy than any other known form of energy storage supply for industrial locomotives.

Mr. Sessions, in reply to a criticism, said that he did not consider a circuit-breaker introduced complication if of a special form particularly adapted for the work it has to do. He admitted that a table referred to by Mr. Berry was not entirely accurate, but considered that an error of 2½ per cent. is hardly worth considering, as the refinements of the art are not such as to demand calculations within that limit. Referring to criticism of another table, he said that storage battery capacity depends so radically upon the method of forming plates that the figure which he gave is justifiable. The use of resistance in connection with storage batteries has proved a very satisfactory arrangement, the energy losses not being considered large enough to be ordinarily an objection. As to charging a battery whilst the line is supplying current for operating a locomotive, the method had proved highly satisfactory and economical in several instances. Mr. Elmer E. Sperry considered that the storage battery locomotive is going to fill a need that compressed air has failed to meet. He referred to some comparative tests of the storage battery and compressed air locomotives, which showed a marked superiority of the former. In the case of a compressed air locomotive using air under a pressure of 3,700 pounds to the square inch, the amount of energy capable of being supplied per ton of equipment, was, as compared with the storage battery locomotive, less than one-quarter. Moreover, the efficiency of the compressed air locomotive decreases as the pressure lowers, whereas in the case of the storage battery, the efficiency curve is almost ideal. The storage battery locomotive is particularly suitable for yard and mining use and in other cases where wiring over tracks is objectionable.

PREDETERMINATION IN RAILWAY WORK.

Mr. F. W. Carter in a paper with the above title, lays down a method whereby, given the profile of a road with its stops, curves, etc., and the particulars of the train and its equipment and the mean voltage and train friction, a time table for the train can be laid down and the energy it requires calculated. The paper first discusses the kinematics of the subject, after which it is shown how to determine the energy used and the motor losses. Illustrative examples follow the general treatment. The information necessary in employing the method is given in the form of curves and simple equation, which can be used without reference to the underlying analysis. The author first lays down universal speed time and distance curves which can be applied to any practical conditions. The author then establishes a current equation and equations for the energy required and for the copper and iron losses. With these data all the constants corresponding to a given railway problem can be very simply and accurately determined. The final portion of the paper gives practical examples worked out according to the method laid down.

Mr. C. O. Mailloux spoke highly of the paper by Mr. Carter and then proceeded to a discussion of plotting railway curves by the point to point method, which method involves no assumptions whatever, with a possible exception relating to the rate of retardation in braking; all the data can be obtained from the starting tests and experiments, and once the fundamental curve is obtained it is possible to plot curves for any set of conditions with accuracy. The method of Mr. Carter approximates this method, which formed the subject of a paper by Mr. Mailloux at the Great Barrington meeting. He pointed out that plotting acceleration curves for all sets of values and for all possible conditions, leads to complication, which is an objection to one part of the method outlined by Mr. Carter. He spoke of an improvement to his own method, made by Mr. Freudenberg, of Lehigh University, which simplifies somewhat the method. In conclusion Mr. Mailloux said that by his method or that of Mr. Carter, the solution of a problem becomes nothing but a matter of simple mathematical manipulation. One can introduce changes of grade and distances of resistance and all possible conditions and have them absolutely correct and determine the results without any approximations.

INTERURBAN CAR TESTS.

Prof. W. E. Goldsborough and Mr. P. E. Fansler, in a paper, gave the results of tests made on the cars of the Union Traction Company of Indiana. This company operates a system extending over five counties and connecting the principal towns between the cities of Indianapolis, Anderson, Muncie and Marion, Ind. At the time of the tests the company was operating over about 160 miles of track, 100 miles of which is interurban, the remainder local. The tests were made on the interurban line between Indianapolis and Muncie, the country being quite rolling with few level stretches. The grades as a rule do not run above two per cent., although there are a few which run as high as three per cent., but they are relatively short. The paper gives the method of the tests and is accompanied by a large number of curves representing test data. The tests are discussed at considerable length with relation to the maximum and minimum kilowatt-hour consumption over the road, the general effect of stops and the personality of the motormen as factors in car consumption economy. Special car tests were also undertaken to ascertain how nearly the car equipments were being worked up to their rated capacity.

After reading his paper, Prof. Goldsborough added that in a case where coal is very expensive and the cost of power very high, a condition might arise under which it would be advisable to select a motorman to operate cars only in one direction and then ride back doing no work, having other men take the cars in an opposite direction, the reason being that it was found that some motormen are more efficient in taking grades and curves in one direction than in an opposite direction. Messrs. E. P. Roberts and I. H. Sherwood submitted a communication giving an account of car tests over the line of the Northern Texas Traction Company. In the discussion of the results it was shown that the average output of the motors was slightly over one-quarter of the rating, this not considering the time for lay-over, which gives an opportunity for cooling. The tests indicated the advisability of considering heating effect as well as rated horse-power; also the gear ratio required to obtain a specific schedule, and whether it is necessary to climb over grades in multiple in order to maintain the schedule, or whether a series connection will ordinarily be sufficient.

ELECTRICAL AND MECHANICAL SPECIFICATIONS OF TROLLEY INSULATOR.

Prof. Samuel Sheldon and Mr. John D. Keiley contributed a paper entitled, "Some Recommendations Concerning Electrical and Mechanical Specifications of Trolley Insulators." With a view to formulating specifications of such material a series of tests were made to determine the electrical and mechanical properties of materials used in the manufacture of trolley insulators, and the paper describes the manner in which these tests were conducted and gives the results. As a result of the tests, the following specifications were formulated, the specifications applying to "Globe" and "Brooklyn Strain" insulators:

All samples tested shall break in the eye. The average ultimate tensile strength of all samples subjected to mechanical test shall not be less than *A* pounds, and no individual sample shall show a tensile strength of less than 85 per cent. of the average tensile strength of all the samples that are tested. The average break-down voltage, for samples which have been broken in the eye in the mechanical test, shall not be less than *B* volts, and no individual sample shall break down at less than 90 per cent. of *B* volts.

As to the values to be specified for ultimate tensile strength and break-down voltage, the following are suggested, where high-class insulators for use on 500-volt lines are to be specified:

	Ultimate tensile strength in lbs.	Breakdown voltage.
2½ inch globes	6000	7000
3 inch globes	9000	10000
Small Brooklyns	9000	10000
Large Brooklyns	18000	10000

Owing to the comparatively low softening temperature of the insulating materials generally used, and to the close proximity of the working conductor when in service, it is important that specifications for round-top hangers should impose a test for softening temperature, and the following is suggested:

Round-top hangers when suspended free from draught in an inverted position by means of a bronze ear weighing 8 ounces and being 5½ inches long, the ear clamping the middle of a round rod of soft iron ¼ inch in diameter and of at least 20 inches length between connectors, must be able, without breaking down or becoming permanently deformed by more than 1/16 inch, to sustain a weight of 200 pounds from the cap for one hour, a current of 200 amp. being passed continuously through the iron rod, the rod being cold at the start.

Mr. Joseph Sachs highly commended in general the recommendations of the paper, but considered that the mechanical test was defective in that it did not take account of the knocking and vibration to which an insulator is subjected in regular service. All trolley line insulators should, moreover, be so constructed that under service conditions the two parts cannot be torn asunder should the insulator be ruptured. He thought that the strength recommended—18,000 pounds—was rather high, as it is seldom that insulators in actual continuous service are subjected to a strain of more than 8,000 or 9,000 pounds. The softening point of trolley line insulators can be increased, but at the expense of insulating properties, for the reason that increasing the strength necessitates adding ingredients such as metallic oxides having a high specific heat, thus bringing down the insulation resistance and dielectric strength. He considered that too much stress was laid on dielectric strength and not enough on surface insulation, as more trouble arises from surface leakage than from actual puncturing. He believed that small insulators should be subjected to the same break-down tests as large insulators. It is a simple matter to obtain a high initial insulation resistance, but the presence of a crack and of moisture lowers this very considerably. In tests of insulators, leakage, internal resistance and dielectric strength should all be considered. Mr. Mershon said that if the tests had been made with direct current better results would have been obtained for the reason that under alternating current insulators containing shellac soften to a great extent. Mr. Sachs added that alternating currents produce a hysteretic effect in insulators, which of course is not present when they are tested with direct current. Mr. Mershon said in some tests which he had made the softening effect was present in a marked degree, the insulator when tested with alternating current softening and breaking down after a time, whereas when direct current this did not occur. The insulators were tested at a frequency of 60 cycles and 500 volts, the length of the test being several minutes. Mr. Sachs said that the matter of the softening of insulators is merely a question of the amount of surface. Dr. Sheldon considered that the break-down test is properly made with alternating current for the reason that an insulator is subjected to inductive kicks, which are much more of the nature of an alternating than a direct-current effect. In the test described, surface leakage was taken into account. Mr. Mershon disagreed with Dr. Sheldon, being of the opinion that the test should not be made with alternating current owing to the heating action, which does not accompany inductive kicks. Mr. Sachs said that while the softening effect had been noted when alternating current was used, it was absent under direct current.

THE STORAGE BATTERY IN SUB-STATIONS.

In a lengthy paper on this subject, Messrs. W. E. Goldsborough and P. E. Fansler give a complete report of a test made in 1902 on the large interurban system, with nine sub-stations, of the Union Traction Company in Indiana. At the time of the test the company operated over 160 miles of track. At the main station the generators give alternating current at 400 volts. It is stepped up to 16,000 and transmitted to the sub-stations, where it is stepped down to 330 volts. Synchronous converters then change the current to 550 volts direct current, which is used on the trolley system. One sub-station contains three 250-kw converters, a 20-kw booster and a battery of 264 chloride cells, giving 400 amp. for one hour and 100 amp. for 8 hours. Five other sub-stations are equipped each with a 250-kw converter and a battery of 264 cells, giving 160 amp. for one hour and 40 amp. for 8 hours, and an 8-kw booster. The remaining three sub-stations contain each two 250-kw converters, one 16-kw booster and a battery of 264 cells, giving 320 amp. for one hour and 80 amp. for 8 hours. The all-day efficiency of the high-tension distribution from the low-tension bus-bars in the generating station to the direct-current terminals of the rotaries was found to be 73½ per cent.

In each sub-station the booster is so connected in the battery circuit as to automatically adjust the battery voltage to the demand on the sub-station; in other words, the battery charges and discharges automatically, feeding out to the line when the demand is above a given amount, and being charged by the rotaries when the demand falls below that amount. The potential at which the battery will float on the system or the demand on the system corresponding to which the battery is inactive, can be adjusted at any point by the switchboard attendant.

In a preliminary test the "efficiency of equalization" in one sub-station was determined. This is defined as the ratio of that portion of the rotary load curve that is above the average load curve to that portion of the line load curve which is above the average load curve. In the sub-station tested this efficiency of equalization of the battery was found to be only 11.9 per cent., which is rather low. This indicated that the adjustment in this sub-station was somewhat faulty.

The results of the main tests of the batteries are given in a great many diagrams. Over four-hour periods, the highest discharge performance in one sub-station was that the battery developed 39 per cent. of its discharge capacity; at three other sub-stations the batteries never developed more than 28 per cent. of their discharge capacity over a four-hour period, and at another station it did not exceed 14 per cent. These figures show that, as gauged by the averaged demand on the sub-stations, the batteries are amply large enough to take care of variation in the demands made on the sub-stations by the trains. It is believed, however—and this has a bearing on the result mentioned above obtained in the special preliminary test—that the motors driving the booster armature were not heavy enough to hold up to the momentary demands which rapid changes in the load bring upon the sub-stations. Heavy balance wheels placed on the booster shafts would cause the batteries to show a very much higher charge and discharge kilowatt performance during four-hour intervals, and they would serve to reduce the fluctuations reflected through the sub-stations from the trains to the central station. An improvement in the variations of the load coming on the central station will in time increase the economy of the generating station. This is a point to which attention should be given in laying out sub-stations for work of this character.

The average commercial performance of five batteries during the three days of the test was found to be 74, 88, 96, 76 and 112 per cent. Taking the ratio of the total discharge of all the batteries to the total charge of all the batteries in these five sub-stations, an aggregate efficiency of 95 per cent. for the batteries in the sub-station is obtained; or if the efficiency values are averaged as obtained for the five sub-stations, the average efficiency of the batteries during the time is 89 per cent. These values are high, and yet they continue so for relatively long periods without any special indications of deterioration in the batteries.

Mr. Stott stated that in the Manhattan sub-stations the rotaries have worked under 68 per cent. overload He thought a test would be interesting during which the sub-stations were worked one week with storage batteries and one week without storage batteries Prof. Goldsborough said that in the test he described, it was attempted to cut the storage batteries out of some of the sub-stations, but it was found rather disastrous with respect to the main stations, the engineers in charge not desiring to submit the generating plant to the additional strain. The advantages of the storage battery begins at the generator, since the engines will operate more efficiently when the load on them is maintained constant. Moreover, the current in the high-tension lines and through the transformers and rotaries will be much more constant, and consequently the copper loss will be less. The matter of a storage battery equipment properly adjusted to its work is thus an important element.

OPERATION OF RAILWAY MOTORS IN SERVICE.

Mr. Clarence Renshaw read a paper entitled, "Some Notes on the Operation of Railway Motors in Service." The subject matter is divided into two parts under the respective heads, "The Equivalent Effect of Service Loads," and "Test on Electric Car in Speed Service." The first part describes a simple means by which engineers in charge of railway systems can determine the loads on motors, and whether these loads are within the capacity of the motor or not. An ammeter in the circuit of one motor and a voltmeter at the terminals of the same motor read at suitable intervals during a typical round trip over a given route, give sufficient data for determining the loads which a motor is carrying in service. From the current readings, the root mean square current is found, and from the voltage readings the average or the equivalent voltage. In choosing a motor for a given service, the root mean square current and the equivalent voltage can be calculated from the speed time curves, and a comparison with the values allowable for a motor in question will determine its fitness. Where motors are already installed the continuous equivalent of the service can be found by means of comparatively simple tests, and the relation of actual loads carried by the motors, to their safe capacity, thus determined. There is a common tendency to select motors which are too small, and such a simple method of determining what are the service loads on an average motor in actual use, or what they will do in a proposed case and whether these loads are within the capacity of the given motor or not, has a wide field of usefulness which a more elaborate method would be unable to reach.

The second part of the paper gives an account of tests on an electric car made over Pittsburg lines. The results of the tests given are not only of interest in themselves, but illustrate the method employed. A simple and convenient method is described for measuring the watts lost in the field of a motor by means of a railway type wattmeter, and of deducing the value of the root mean square curve from this.

Dr. Cary T. Hutchinson, referring to Mr. Renshaw's remark that the predetermination of the temperature rise of railway motors at given loads and under any given service conditions is a difficult and complex problem, said that he had deduced a set of curves by which this predetermination can be made for a motor of any given heat constants; that is, a motor under any load, and any temperature and radiation constants. Knowing these constants, a set of curves can be laid down which will give the temperature rise for any particular run. Calculations are first made and plotted for all variations of initial acceleration, within the range of practical operation and for various values of maximum velocity. The square of the currents is then plotted, there being for each velocity a curve showing the average square of the current, and from these curves the average copper loss is obtained for all initial accelerations. A core loss curve is then laid down, and from this the average loss found for the different accelerations. From these curves the average heat loss in a motor during the acceleration period may be determined. The next step is to determine the ratios of the time of acceleration to the total time, and these multiplied into the average losses at the point of maximum velocity give the average losses during a run. There are also required test records showing the degrees of rise for given watt losses. In addition to determining the average heat losses, a curve of copper and core losses is laid down in such a way that the ratio of distribution is determined for every set of core losses. Knowing then the ratio of distribution for any schedule and the ratio of average heat losses to total heat losses, another set of curves is prepared. Knowing from the several sets of curves what the average losses will be in a motor for every run for each particular acceleration, and knowing the ratio of distribution that pertains to each of these points for each motor by comparison with the test results shown by the motor, the temperature can be determined for any point Dr. Hutchinson then illustrated by examples how his method is applicable to any given set of curves. An example was worked out for an express run on the New York Rapid Transit.

REVERSE-CURRENT CIRCUIT-BREAKERS.

Mr Leonard Wilson, in a paper entitled "Reverse-Current Circuit Breakers and the Protection of Transmission Lines," laid down the following as among the more important requirements for this type of apparatus:

(1) A reverse current equal to 25 per cent of the normal must be sufficient to operate the breakers. (2) The releasing force must continue to increase with an increase of the reverse current so that any sticking of the mechanical part will merely cause the breaker to operate at a slightly higher current, and that if the reverse current suddenly attains a very high value the operation of the breaker will be the more certain. (3) A failure of the potential coil from whatever cause arising must not operate the breaker. (4) The device must in some way continuously indicate whether it is in working order or no. The best practice, he said, seems to be to have quick-acting relays set for a moderate return current, 25 per cent. having been found a very suitable value. If for any reason a combined reverse and excess current breaker is required it will be found better to provide two separate tripping coils as a combination of the two in one necessitates a certain compromise in the characteristics of the device.

An efficient system of protection for multiple transmission lines should, while normally allowing all the lines to be in use at once, be capable of preventing any excessive rush of current in case of a fault on one of the lines, and should include devices for entirely cutting out such faulty line without serious disturbance of the rest of the system. Attempts have been made to provide such protection by the use of excess current breakers at the generating end and reverse current breakers at the receiving end, but with very little success, the failures being due to one or both of the following defects in the system: (1) That it does not prevent the sudden rush of current through the healthy mains to the faulty one. (2) In the case of a low resistance fault the pressure falls so low at the receiving end that the reverse current breakers (if they depend on the action of potential coils) fail to operate. This latter defect is obviated by the use of a circuit breaker, which operates when the current in either of the feeders reverses, and it depends for its action entirely on the series current, no potential coils being used. The paper gives a description in detail of an English system devised by Mr. L. Andrews, which includes a choking coil that absolutely prevents any excessive rush of current in case of a fault on one of the mains; this, in combination with automatic cutout devices is stated to fulfil the necessary conditions for complete protection without interruption of the supply.

In reply to an inquiry Mr. Wilson stated that both the positive and negative lines could be protected in the same way, a choke coil being placed in the leg of each circuit. The method can also be applied to a number of lines; as, for example, in the case of a three-phase circuit with 10 or 20 feeders.

President Scott's Address.

The opening portion of the address of President C. F. Scott before the Niagara meeting of the American Institute of Electrical Engineers dwelt upon the wide sphere of action of the electrical engineers and the far-reaching influence of his work. He defined the engineer as "one skilled in the application of the materials and forces of nature to the use of man." Once he dwelt almost wholly with materials—some do so still. Others combine materials and forces. The electrical engineer deals with forces, he energizes and vitalizes the systems constructed by engineers of many kinds. Hence the phenomenal rate of electrical extension—it is not a new thing separate and apart from other things, it enters into them, operates, awakens, unites, combines, transforms.

The advent of electricity as a definite factor in the world's work has produced indirect effects which are even more remarkable than its immediate results. Aside from the fact that many results can be secured more effectively by its use than is possible by other methods, it produces results of a different kind, it leads to new methods, it revolutionizes the arts and industries to which it is applied and they in turn extend their influences in new ways. It is for this reason that the results of electricity are not definite and simple, but are broad and far-reaching.

The electrical reports in the United States Census show that the mean rate of increase in electrical activity as measured by the capital invested is 20 per cent. each year—it doubles in four years. Technical schools, electrical courses and labratories have increased wonderfully, but their output does not supply the demand. It is the far-reaching influence of the new physical relation which is not so easy to discover.

In this new era the American Institute of Electrical Engineers represents the profession which is youngest in years yet foremost in activity. To meet the present demands of this new era, to prepare for an expanding future, we may well ask, what should our Institute be? What should it do? Shall we adopt the methods of the old-time learned society? Shall we imitate the ways of societies in profession whose methods are established and whose rate of change is slow? Shall we reserve preferment for those with hoary locks or well-rounded years of experience? In this engineering age, this electrical age, so replete with its physical, commercial, industrial and social changes, what are the new conditions, the new opportunities, the new responsibilities which have come to engineers, and how shall we meet those which have come to the electrical engineer?

President Scott then referred to his address of last year on "Proposed Developments of the Institute," in which several specific ways were proposed by which the work of the Institute might be advanced during the year. These suggestions were taken up for review, and their bearing upon the future noted.

As to increase of membership, his convictions were expressed during the year in the following words: "We have failed to catch the spirit of the times and the keynote of electrical progress if we do not realize that we must expand and broaden and progress as well as maintain high standards of excellence. Full membership should be exclusive, associate membership should be inclusive." The membership list on September 15, 1902, included 1,630 names. Since that time nearly 1,000 applicants have been elected as associates. Who are the men who have come among us? What is their age, what has been their training, what is thier present position?

The new men range in age from 19 to 65. The ages of those who have been elected are given below:

Over 50 years, 2 per cent.; 45 to 50 years, 2 per cent.; 40 to 45 years, 6 per cent.; 35 to 40 years, 10 per cent; 30 to 35 years, 24 per cent.; 25 to 30 years, 34 per cent.; 20 to 25 years, 21 per cent.; under 20 years, 1 per cent.

Approximately, 60 per cent. are between 25 and 35 years of age, and are presumably young men who are getting under substantial headway in life and are in their accelerating period.

Forty-four per cent. of these men are graduates of schools of recognized standing. Of the graduates 45 per cent. graduated within the past five years (not including 1903), and 77 per cent. within the past ten years. Cornell University leads the list with 12 per cent. of the graduates; the Massachusetts Institute of Technology is second with 8 per cent.; Columbia, Purdue, Ohio State, Princeton, Worcester Polytechnic Institute, Lehigh, University of Michigan and the University of Wisconsin follow next, and there are substantial numbers from McGill, Stevens Institute, University of Pennsylvania, University of Illinois, University of Minnesota, Pennsylvania State College, University of Nebraska, University of California, Harvard, Yale and Rose Polytechnic Institute. In addition there are representatives from as many other institutions.

The present position and occupation of the new members is difficult to classify definitely and satisfactorily, but a general summary shows the following:

	Per Cent.
Electrical engineers with manufacturing companies	30
Electrical engineers with operating companies	25
Managers and superintendents, duties presumably executive rather than technical	16
Consulting engineers	10
Electrical engineers with mills, mining plants and the like	6
Students	6
Professors and instructors	4
Mechanical and electrical draftsmen	3

Other plans proposed at the beginning of the year were that papers should be solicited and discussions invited from a larger proportion of the membership; local meetings of the Institute in various cities to broaden the interest of its work and generally extend its benefits; universities and technical schools with electrical engineering departments to organize local meetings of the Institute.

These three lines of activity have developed most satisfactorily and are closely related to each other. General plans were presented for the formation of local branches, and such branches have been formed among members in a number of leading cities; also in many of the principal technical schools and universities. In some cases local members and students unite. The methods have been simple, there is a minimum of organization and formality; the primary purpose is to bring electrical men together, to awaken interest, to consider and discuss important engineering topics.

At the beginning of the year definite subjects were assigned for each month for the meetings in New York. Usually several papers were secured from experts upon each subject. Printed copies of the papers together with the stenographer's report of the New York discussion have been sent promptly to the secretaries of the local branches. As the meetings are usually held ten days or two weeks subsequent to the meeting in New York, they have the advantage over the first meeting in having the discussion as well as the papers. This material is presented in suitable form by the members of the local branches and the discussion is continued. Such material as is new and valuable is reported to the secretary for publication in the transactions. By this means the latest phases of electrical engineering work are presented and discussed, not in one meeting only, but from more than a score. Those who have taken up the local work usually report that the interest, the activity and the attendance surpass expectations. In nine cities in which local branches have been formed the total membership has practically doubled. The attendance is not limited to members, as others are welcome. A number of professors have spoken of the interest taken by students and the avidity with which they enter into the work. One professor recently remarked that the Institute papers were giving him a new insight into present electrical engineering and such papers as those upon central station practice made him realize how far practical engineers were in advance of the lecture room and the laboratory.

The element of greatest importance in this extension of Institute work is not so much the mere technical knowledge which it may diffuse, but the broader aspects of up-to-date problems which it presents, and the sentiment of unity and co-operation among electrical men. Electrical engineers have not the advantage of long-time acquaintance to unite and bind them together. Herein we have an effective means of bringing electrical workers together, of uniting them in a common interest, and of directing the studies and the work of young men along definite and effective lines.

At the beginning of the year it was indicated further that the collection of engineering data and the establishment of standard practice in electrical engineering is one of the important functions of the Institute. The present years are formative years. Elctrical engineering is crystalizing. In addition to our Committee on Standardization two new committees have been formed, one on high-tension transmission, the other on engineering data. The Transmission Committee is collecting specific data with respect to present practice in high-tension transmission, and will formulate this data for the use of electrical engineers. It has further prepared a number of short papers as introductions to discussions upon a number of important branches of transmission, which is calling forth the opinion and experiences of engineers at large. The committee is composed of engineers of recognized standing. A consulting engineer is the chairman and representatives from several large manufacturing companis and a Western university complete the committee.

The Committee on Engineering Data has been appointed for collecting and publishing electrical engineering data upon new and special subjects, which are evolving daily throughout the country in the practice of the engineering profession. There is much important data which has not found its way into text-books and hand-books, and about which little is generally known. Such data, if allowed to follow existing channels, either never reach the public, or only after a long period. The committee is composed of men of high standing under the direction of the Electrical Engineer of the Niagara Falls Power Company. The first subject to be taken up for investigation is insulated electrical conductors. Under this general subject is included the heating of cables of various character under different conditions, the life of cable insulation, the methods of ventilation in conduits, the effects of short circuits and general data bearing upon the operation of cable systems.

Such work as has been undertaken by these committees is of the highest importance to the Institute and its members. These committees are dealing with matters of the most vital importance to substantial progress. They are the means of carrying out one of the highest functions of the Institute in bringing together the diversified achievements of many workers which in the aggregate constitute a single total of accomplishment which we designate as progress. They bring definite positive results out of what is otherwise indefinite and chaotic. They lay the foundation for advancement.

As a further department of our work it was stated at the beginning of the year that the Institute library merits a cordial support. The generous contributions of members in the past have been continued during the present year by substantial additions to the valuable collections, not only in contributions of present volumes, but in endowment provision for the extension of sets which have been presented. Plans are now under consideration for giving the transactions—a panoramic history of American electrical engineering—greater value by preparing a general index to be issued both in pamphlet form and also on cards, which may be distributed alphabetically through the card catalogues of public and private libraries.

The crowning event of the year was in a measure anticipated by these sentences of last September: "Permanent quarters for the Institute should be an object of plans and anticipations. . . . Personal acquaintance and social intercourse are influential factors in unity of sentiment and of action."

The story of our Library Dinner with its distinguished guest, who spoke in happy mood of American engineers and of co-operation among them and of "institutions like this of the Electrical Engineers which do so much," is already familiar to you as well as the events of the following day, when he called to his house two of our members to talk further of what an engineering building should be, and of plans for its realization. Mr. Scott said that he counted as the most memorable privilege of the present year the opportunity given of sitting next to Mr. Carnegie on the evening of our Library Dinner and the hour in his own library on the following afternoon. He was in the best of spirits, alert, active and ever interesting as conversation shifted easily from one topic to another. The talk was pleasant and appropriate to the hour, but never trivial. One topic after another came up, it was the more serious, the more definite, the substantial idea which he brought out before turning to something else. The happy response to his toast was almost throughout a repeating of the ideas and the sentiments which he had expressed in the conversation of the preceding hour.

In discussing at his house the next day the project of an engineering building, his mind was evidently seeking the way and the means by which he could realize an ideal. He was not very familiar with the organization of the several engineering societies, he knew little of their methods and of their financial means and their facilities. But he saw a need, not merely the physical need of accommodations, but the higher need of elevating and developing engineering and engineers. He used about these words: "Yes, engineers need to get together, they need to get acquainted and to meet socially. You can provide for that, can you not?" In his address as president of the Iron and Steel Institute since that time he has discussed methods of industrial organization, particularly the relations between men, and he has emphasized the advantages of a general partnership and common co-operation. When a few days after the first conversation estimates and a general scheme of procedure was presented, Mr. Carnegie did not care to go into the details of method. He seemed to have confidence that engineering organizations could develop their plans in the ways which would be most efficient. He set no restrictions. The great gift to engineering is presented in a single sentence shorter even than the superscription of the letter which proffers a million dollars. Four of the organizations (the fifth has not yet taken final action) which were designated in the letter have without hesitation formally accepted the administering of this generous gift to engineering, and their representatives are now actively developing plans These plans look forward to the realization of an ideal long cherished by some of the foremost and far-seeing engineers of the country, an ideal in harmony with the new era in engineering and with the trend of American development, an ideal which brings within its scope the advancement of the engineer, and of his profession both within itself and its outward relations. In short, an ideal the realization of which will strengthen modern engineering which is the very basis of prosperity and of progress, and will exert far-reaching influences which are beyond our power to discern.

The remaining specific way mentioned at the beginning of the year for advancing the interests of the Institute was on the co-operation with similar institutions in other countries. The relation of the Institute with the Institution of Electrical Engineers of Great Britain in particular are most cordial and beneficial, and it is hoped to have it meet with the Institute at the time of the Engineering Congresses to be held at the St. Louis Exposition next year. But the idea of co-operation has had its development along domestic rather than foreign lines, and Mr. Scott gave the substance of a suggestion which he presented to the Committee on Affiliated Societies which now has the general subject under its consideration.

First.—A plan should be outlined providing for special departments or sections of the Institute for such lines of electrical work as may demand greater attention than can be given by the Institute as a whole, and which can be more efficiently conducted in this manner than by the formation of new specialized societies.

Second.—Affiliation or co-operation is desirable with other electrical associations by which the Institute may work in harmony along certain lines, such as standardization, adoption of the National Electric Code, the collection of engineering data and other matters of a general nature. Many associations dealing with specific industries have both commercial and engineering interests. I would make the Institute the electrical head or center—the hub—bringing into a unity the electrical engineering of all these associations, not restricting but broadening their work and making them constituent parts of a great whole.

Third.—There is opportunity for close relations between the local branches and local engineering societies or clubs. In two or three cities the local societies are considering plans of uniting work and increasing the efficiency of their societies with local branches of the national societies. The success which has attended the Institute organizations augurs well for further etxension by similar methods for awakening and stimulating a general interest in engineering subjects.

Fourth.—There should be a co-operation—without affecting their present individuality—between national engineering societies in the nature of a National Engineering Congress for promoting closer relations between the various branches of engineering work and for representing the engineering profession as a whole.

Mr. Scott emphasized particularly the establishing of permanent committees to be continued from year to year to carry on lines of work such as the committee on standardization, on transmission, and on engineering data. The value of the results is unquestioned, but the amount of work necessary is not so readily appreciated. We must depend for our best work upon the men who are busiest and who are in a way least able to give it. We must efficiently utilize small contributions of endeavor and assistance from many men. This requires organization and direction, they should have the fullest assistance from men who are paid to carry out directions and care for details by men paid for such work. The Institute expenses do not exceed its income, because the governing body has been watchful, restricting expenditure at every turn. In order to expand and to carry out the lines of work which are most valuable to the members as individuals and for the substantial promotion of electrical engineering and of electrical industries, money is needed.

In the Union Building for the engineering societies it devolves upon the societies to provide the land upon which the Carnegie gift is to be placed. To provide for the Institute in this matter a committee has undertaken the raising by subscription of a fund for this purpose. This magnificent supplement to what Mr. Carnegie is doing will give the Institute its rent free, its building for library and general meetings, for offices, reading and reception rooms, and the like. This will enable funds to be devoted to technical purposes which would otherwise be required for rent, which item is considerable now, and would be greater in the future.

Substantial contributions are anticipated from those who have reaped a rich reward from the applications of electricity. Their wealth has come in no small degree from the work of electrical engineers. Whatever the Institute may do in raising the standards and increasing the effectiveness of electrical engineering brings rich returns to those men and particularly to those companies commercially interested in electrical pursuits. The farmer saves from his surplus the best seeds for the coming season—should not some of the wealth which engineering effort has produced be returned to train men and to develop methods for the future? Is not the whole-some recognition of the engineering profession by Mr. Carnegie coupled with his generous gift, but the beginning of a new attitude towards engineering and of better things to come? Researches and investigations and tests requiring large sums of money should be undertaken. It is not too much to hope that if we use well the talent which has been given us more may be entrusted to our keeping.

Electrical enterprises depend upon manufacturers, upon industrial captains and financial managers, upon those who construct and apply and use and direct the results of engineering work. It is well for engineers to know these men and to work in harmony with them. The new Union Building—the Capitol of American Engineering—not only brings engineers of different professions together but it recognizes broader relations. It is fortunate that the engineering societies will be adjacent to a social club, "composed of engineers and others who may be interested in or connected with the engineering profession."

The engineer is not merely the man in the closet surrounded by slide rules and tables. There is a commercial side to engineering—not mere selling, but the adaptation of engineering work to definite industrial and commercial conditions in such manner as to bring the best results. We have a professional standing to maintain and ideals toward which to strive, but let us also be awake to the times and in touch with modern methods. Let us make the work, the methods and the ideals of our Institute in full harmony with that profession which deals with kinetic energy—and whose units of measure are the units of activity and whose mission it is to energize, to operate, to awaken, to unite, to combine, to transform, to make effective.

CURRENT NEWS AND NOTES.

DEMANDS OF TELEGRAPHERS.—The telegraph operators of the Pennsylvania Railroad Company have made demands to the officials of the company for an equalization of wages and working hours. The men also ask for a vacation.

OIL SWITCH.—A patent was granted on June 30 to Mr. H. P. Ball, of New York, for an oil switch. A vessel filled with oil, contains a series of insulated contacts separated from each other and immersed in the oil. These contacts depend from a supporting cover, while protecting screens are arranged on opposite sides of these contacts. A bridging rod is provided which can be moved across the oil well to make or break circuits between pairs of contacts. The motions of this bridging rod is controlled by an electromagnetic device, so that it may be operated from a distance. One advantage claimed for the construction is that the bridging devices during their movement are always immersed at practically the same depth in the oil.

STARTING COIL FOR METERS.—A method of compensating friction in electric meters is the subject of a patent granted June 30 to F. P. Cox. In order to overcome the friction which counteracts the tendency of an electric wattmeter to start, various arrangements have been devised in which an auxiliary starting coil is employed, which just balances the frictional resistance. The inventor connects the starting coil in the shunt potential circuit of the meter and secures it to a guide by which it may be shifted relatively to the series field coils which carry the load current. By means of such a coil, adapted to slide to or fro over parallel planes, simplicity and compactness of construction, together with the desired degree of adjustability, is obtained.

PREVENTING HUNTING.—Two patents granted on June 30, to Messrs. E. W. Rice, Jr., and E. J. Berg, of Schenectady, relate to a method of an apparatus for maintaining synchronous rotation of dynamo-electric machines, especially synchronous converters. For this purpose it has before been proposed to encircle the field poles of the converter with short-circuited windings in order to oppose that component of armature reaction which tends to vary the strength of field. The inventors claim that this method has distinct disadvantages, and instead of opposing the variations in the field of the converter, they propose to oppose only that component which tends to strengthen and weaken the pole corners, without necessarily varying the strength of the field. In other words, they endeavor to oppose the cross-magnetizing tendency of the armature reaction. This is accomplished by the use of shunt circuits placed between the field poles or tips and omitted from the field proper.

RADIUM AND CANCER.—A cable message from Vienna, Austria, of July 3 says: "Medical circles here are greatly interested in a report communicated to the Viennese Society of Physicians and read at a recent meeting of the Imperial Academy of Science, to the effect that a long-standing case of cancer was cured by radium rays at the clinic of the late Prof. Gussenbauer. The patient, who was sixty-one years of age, had long suffered from cancer of the palate and lip and had repeatedly been operated upon fruitlessly until the autumn of 1902, when the physicians of the Viennese Hospital declared it was absolutely useless to operate again. One physician determined as a last resort to try radium rays, and treated the afflicted parts by exposing them to the light of radium bromide, the strongest radium preparation in existence. He was rewarded by a gradual and complete disappearance of the tumors. Physicians at the same meeting reported that radium rays had cured a case of melanosarcoma (a tumor containing a black or other dark coloring matter), and several cases of red mole."

ELECTRICAL CONTRACTORS' CONVENTION.—As already announced in these pages, the National Electrical Contractors' Association of the United States will hold its annual convention at Detroit, Mich., July 14, 15 and 16. This is the third annual gathering of the kind, and promises to be in every way successful. With the co-operation of the Electrical Contractors' Association of Michigan an exhibit of electrical apparatus is to be made in the Light Guard Armory, which some of our readers will perhaps remember has having been used for the Street Railway Convention exhibits several years ago. Mr. Frank J. Miner is chairman of the Electrical Exhibition Committee, and informs us that the success of the exhibition is also assured, as the space is already about taken an displays will be made by some of the largest and best concerns in the country. The exhibit will include standard and special supplies and apparatus used for electrical housework, lighting, power and electrical construction. The National Association does not give out any programme as to its proceedings, the business being discussed practically all in executive session. A large attendance of prominent men is already indicated. A special convention train will leave New York for Detroit, via the New York Central & Hudson River Railroad at 8 p. m., July 13. A rate of one fare and a third on the certificate plan has been granted by the trunk line and New England Passenger Associations. Delegates may go to Detroit from Buffalo by steamer or by the Michigan Central Railroad.

LETTER TO THE EDITORS.

Aging of Wood.

To the Editors of Electrical World and Engineer:

Sirs:—For some years I have been experimenting now and then with the rotating disks as described in former articles. I used calcium chloride to remove the humidity and water vapor in the tight boxes containing the disk arrangement, and have frequently examined the condition of the wood and glue used in the interior of the boxes to see in what condition it was required to be to obtain rotations of the disks, as I could obtain no fixed and certain rotation without a long application of the calcium chloride when I used wood under the electrodes. I found that where the wood which was used under the electrodes, that is, when I obtained rotations, had become aged; that its fibres were stiff and more easily broken; and when an attempt was made to bore holes in it, it would be apt to split. The glue became like glass in a manner and held the wood very firmly, but could be more readily torn away, taking part of the wood with it.

I also found that when once it got into that condition neither the wood nor the glue returned entirely to the original condition in which it was before being treated; but I could return it to near its original aged condition by the application of dry heat and obtain rotations of the disks. Now, wood in its normal condition has its fibres generally flexible. These when bent do not always return to their original shape. Of course there is a great difference between different kinds of wood. Where the fibres are treated as above described, they return quickly or break. The glue, if not supplied with an excess of moisture, remains in somewhat the same condition.

I am also led to the conclusion that wood and glue where left for a great number of years will reach approximately the same condition as the wood and glue in the boxes described, and I further believe that the wood from old musical instruments, such as old violins, if used under the electrodes of rotating disks after a small application of heat would give good rotations.

Take a piece of cardboard, for instance. Before being treated it can be bent into a different shape, but after treatment it will either break or quickly return when bent, showing its rigidity has been increased. Wood and glue in such a condition as described will vibrate much better than when in their ordinary condition, the fibres of the wood being more rigid; and the glue being in a manner like to glass does not allow the vibrations of the wood to be deadened, but holds the wood firmly.

I would think musical instruments, where there is a dependence of the vibrations upon wood, would be improved if treated in the same manner as the wood and glue in the tight boxes

While the time of treatment depends to some extent upon the condition of the wood, the amount of chloride of calcium and the temperature used, it will not do to treat for only a few weeks, but the treatment must continue for months in an air-tight glass or metal box before the results are obtained. Wood is very unyielding to the treatment, much more so than cardboard.

Baltimore, Md. Alfred G. Dell.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Experimental Investigation of Direct-Current Machines.—Arnold.—A very long article, illustrated with numerous diagrams, relating to a study of the phenomena of commutation, the eddy current losses in the armature copper and the determination of the efficiency by running without load and short-circuited. The author first investigates mathematically the form of the current distribution under the brushes, the contact resistance of the brushes and constructs the curve for the mean local current density. Experiments are described which were undertaken to find out whether the short-circuit current curves calculated from the brush potential curves, agreed with those obtained experimentally. The brushes were placed in three positions, namely, in the geometrically neutral zone, in a position 10° in the direction of rotation, and 10° opposite to the direction of rotation for the machine running as generator and as motor; both copper and carbon brushes were used; it was thus ascertained that the curve obtained by integration of the brush potential curves agrees with satisfactory accuracy with the short-circuit current curve found experimentally. The dependence of the short-circuit current on the commutating field is also taken up, as well as the estimation of the curve of the commutating field from the brush potential curves. The author states that the experimental proof has been furnished to show that the curve of the short-circuit current depends primarily upon the amount and direction of the additional e.m.f.'s, and that it is not correct, in the calculation of the commutation, to take account only of the so-called reactance potential and to consider its amount as only influencing the formation of sparks. The author next takes up the investigation of the commutation with short-circuited machine and states that one should require of a machine which has the right dimensions, that with a position of the brushes most favorable for half load and short-circuited, it should sparklessly commutate half the current. The brush potentials for the loaded machine, which have been obtained by superposition, agree well with those found by experiment. That potential, at which it is still possible to notice the slightest formation of sparks, between the approaching or receding edge of the brush, and the corresponding point on the commutator, is designated by the author as the spark limit. This he finds with copper brushes is 0.15 to 0.25 volts. At potentials above 0.25 volts the sparking can be plainly seen; between 0.38 to 0.55 volts there is strong sparking and a rapid heating of the commutator. Even at potentials of above 0.3 to 0.32 volts the mesh of the brushes is destroyed by the sparks. With carbon brushes the spark limit is variable between wider limits, the material of the carbon, the state of the commutator and the temperature of the carbon playing a considerable part. For one kind of carbon it was found to be between 1.8 to 2.5 volts, while with another it was 2.4 to 2.6 volts; the current density was as high as 20 amp. per sq. cm. These are average values and apply to smooth and not to blackened commutators. Experiments to determine the eddy current losses in the armature copper were also carried out, with 6 amp. of different forms of grooves of a 4-pole 5-hp motor. The bars had different cross-sections and were supported differently in the grooves. The experiment showed that a subdivision of the bars at right angles to the groove is more efficient than parallel to the groove, because the greater part of the eddy current losses is caused by a field at right angles to the groove. The experiments also confirm the experience, that it is advisable to place the massive bars not quite on the outer edge of the groove, because the field of the grooves is very strong there, and that with massive bars of large cross-section high tooth saturations are to be avoided, especially with high period numbers. Experiments are also described to determine the efficiency by running without load and short-circuited.—*Elek. Zeit.*, June 18.

Power.

Internal Combustion Engines for Driving Dynamos.—Humphrey.—A paper presented before the Electrical Section of the English Institution of Civil Engineers, with discussion. The author gives a table of the various types of gas engines, with the number of impulses per revolution and the horse-power up to which each type is constructed. The types are discussed in detail. He thinks that the central station engineer is now fully alive to the fact that the gas producer and gas engine constitute the cheapest means of generating electric power, where coal is the basis of energy. He states that the internal combustion engine is rapidly reaching sizes which are large enough to suit even the large tramway stations, and when suitably designed has proved quite as reliable for driving alternators in parallel, as the best steam engine. In the author's opinion sufficient attention has not been given to the construction of gas engines intended to take a supply of both gas and air, separately stored under pressure. For central stations of large size the previous compression of the gas and air, so that they may be drawn as required from reservoirs, has much to recommend it and involves, with proper precautions, no special danger. The advantage of the two-cycle gas engine would then be attained, without the complication of each engine carrying its compressing plant, together with all the extra valves and gear required. In the discussion the statement was made by Dr. Hopkinson, that at full load the difference between the steam engine and gas engine were quite insignificant, but in considering the conditions of a generating station, where the load factor on the average did not exceed 25 per cent., the comparison took a different turn. Eight pounds of coal per kilowatt was not a bad result for a steam-driven station, but the losses on a gas-producer could be stopped instantly by stopping the gas. A producer which would consume one ton of fuel when running, would not consume more than 20 pounds an hour at the outside when standing idle. It would thus be found that about 3 pounds of coal per kilowatt would be a figure, which would compare fairly with the 8 pounds for steam.—Lond. *Elec.*, June 18.

Dynamos With and Without Accumulators.—Pahde.—The author gives a detailed statement of the cost of installation and running of a plant furnishing power for a large machine works when the power is furnished by dynamos only or when a storage battery plant is installed to take the peak of the load during the time of maximum consumption. The plant for dynamos only consists of two 700-amp. machines, while a small machine of 232 volts and 70 amp. furnishes power during the dinner hour and the night. There has to be a large and a small reserve machine provided and the necessary amount of boiler capacity. The current consumption from the large machines is irregular and can reach its maximum of 1,400 amp. any time during the day. The machines will, therefore, work uneconomically. For the equipment with storage batteries a large dynamo of 900 amp. is provided, with 1 reserve machine of the same capacity, and a storage battery of a 2,592 amp.-hours' capacity with maximum discharging current of 864 amp. For this case the machine works uninterruptedly at full load and the storage battery furnishes the amount required in excess. The author calculates for the cost of running by machines only a yearly outlay of $26,848, and for machines plus storage battery $19,074, showing, therefore, a sum of $7,774 in favor of the latter system. The cost per kilowatt-hour in the first case is calculated as 3.3 cents, and in the second case as 2.22 cents.—*Elek. Anz.*, May 24, 28.

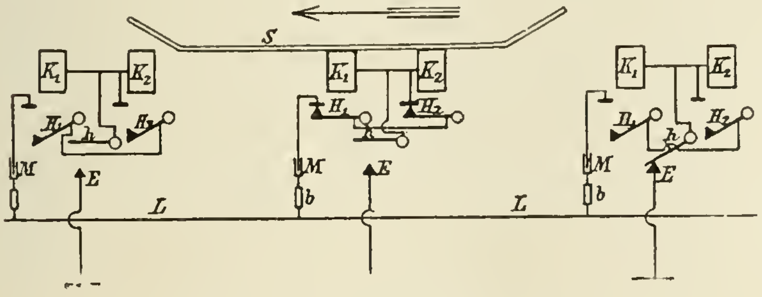
REFERENCES.

Britannia Steel Works, Middlesbrough, England.—A well-illustrated description of the large reconstructed works. Electric driving is used throughout the mill. Each melting furnace has its own ladle and these are most expeditiously handled by three powerful 70-ton electric cranes. The reheating furnaces are fed by an electrical charging machine, the side elevation, plan, etc., of which are given in the article. The straightening machines are also electrically driven. —*Eng'ing*, June 12.

American High-Pressure Hydro-Electric Plants.—Perkins.—A short illustrated article with a condensed description of the equipment, etc., of several western installations.—*El'ty*, June 17.

Traction.

Surface-Contact System for Electric Traction.—Loewy.—An illustrated description of the various contact systems, from a paper read by the author before the Electrochemical Society of Vienna, with discussion. At the conclusion of the paper the system invented by an Austrian, Dr. Hillischer is given in detail. The advantage of this system is said to be in its simple mechanism, combined with the security which it affords, against the danger of a contact remaining alive, after the car has passed it. The accompanying illustration shows diagrammatically the arrangement, the car being supposed to pass in the direction of the arrow. The system is an electromagnetic one. Two contact points, K_1 and K_2, are connected with the feed cable, *L*, by means of two levers, H_1 and H_2, of cast iron with a core of cast steel. The contact shoe, *S*, of the car is an electromagnet, and when it touches the two contact points they also become magnetic and attract the two levers, thus closing the circuit. The two levers do not act at the same time, but one is made heavier than the other, so that the heavier one is attracted last and released first, when the car has passed. By this arrangement of two independent interrupters the remaining alive of a contact is nearly excluded, for the current is interrupted, if only one of them is released. But in order to interrupt the circuit even if both levers fail to fall off, an earthing lever, *h*, is provided, which connects them to earth as soon as the car has passed. On account of the short-circuit thus produced, a fuse, *b* melts, whereby the contacts loose their current. This earthing lever is very light, so that it is attracted easily by the contact shoe. By this means the contacts are disconnected from earth before they come into contact with the shoe. This earthing lever also renders stray currents, which pass from live contacts to earthed contacts, innocuous. Nearly all constructive parts of the apparatus are arranged in the lid of the contact pot, which can easily be removed and replaced by a new one, if necessary. In order to avoid remanent magnetism in the contacts, the electromagnets of consecutive cars are magnetized in opposite direction.—*Zeit. f. Elek.*, May 17, 31.



SURFACE-CONTACT TRACTION SYSTEM.

Electric Traction on Suburban Railroad.—An illustrated description with diagrams, of the equipment of the suburban railroad between Berlin and Lichterfelde, which has been adapted for electric traction. The line is run with direct current at 550 volts, furnished by a 1,600-kw steam dynamo. The trains are composed of two third-class and one second-class motor car and weigh 123 tons. The third rail is supported by a steel casting, which in its turn carries an insulator of artificial granite, on which the rail rests. At road crossings the third rail is discontinued and connection made by cables. Each motor car has two 100-hp motors, so that 600 hp are available for the whole train. After 8 seconds the train reaches a velocity of 4 m per second. Then the motors are connected in parallel, whereby the mean acceleration is 0.21 m per second, so that the train reaches a velocity of 10 m per second in 50 seconds. The controlling takes place by the multiple unit system, with 9 relay circuits of small wires, running through the whole train.—*Elec. Zeit.*, June 11.

REFERENCES.

Electric Railroad from Paris to Versailles.—An illustrated popular article describing this new road.—*Scien. Am. Supp.*, June 6.

The Electrical Equipment of the Mersey Railway.—A long illustrated article on this road, previously described in the Digest.—*Elec. Rev.*, June 20.

Toronto Street Railway.—An illustrated article, describing the power houses and equipment.—*Can. Elec. News*, June.

Hampshire Light Railways.—A short illustrated description of a new line from Portsmouth to Horndean, a distance of 6 miles. Direct current is purchased from the Portsmouth Corporation, feeding at 550 volts, two motor-generator sets, each consisting of a four-pole continuous-current shunt motor, directly coupled to an eight-pole, three-phase alternator. The output of each alternator is 250 kw of 5,500 volts with 375 r.p.m. This current is transmitted to a substation about midway along the line, where it is transformed again, the details of the machinery corresponding with that at the main power house.—Lond. *Elec.*, June 18.

Installations, Systems and Appliances.

Poplar, London, Electricity Works.—A long illustrated article giving a detailed description of the installation for the borough of Poplar in the City of London, England. The district contains the large docks and many large works situated around them. The central portion of the area is fed directly from the generating station, but owing to the elongated shape of the borough, and the large demand for power in the docks at its southern extremity, it has been found necessary to adopt direct-current, high-pressure transmission at 1,500 volts, which is lowered to 460-230 volts in a reducing house near the docks. The steam raising appliances in the station are described in detail. The machinery in the generating plant consists of two 100-kw, four-pole dynamos, coupled to triple-expansion, three-crank engines running at 550 r.p.m., two 200-kw,, four-pole dynamos coupled to engines of similar type, running at 380 r.p.m., and two 500-kw dynamos coupled to triple-expansion three-crank engines at 270 r.p.m. All the machines are shunt wound and generate current at 440 to 470 volts. The auxiliary machinery is described in detail. There are two batteries of 210 cells each. Each battery has a capacity of 600 amp.-hours at 80 amp. discharge rate, and 320 amp.-hours at 160 amp. discharge. Two balancer booster sets are installed, one of which consists of two four-pole balancer dynamos, each rated at 115 amp., 220 to 285 volts at 700 r.p.m., with a four-pole booster coupled between them capable of generating 200 amp. at 0 to 100 volts; the booster is used for charging and regulating the storage battery. The larger set consists of two four-pole balancers, each taking 315 amp. at 220 to 285 volts, at 640 r.p.m., coupled together, with a battery-regulating booster of 380 amp. capacity at 0 to 100 volts coupled to one end of the shaft, and a generator of 90 amp., 570 volts, coupled to the other end. The last-mentioned machine is used in connection with the high-pressure transmission system at light loads. The generating station bus-bars are boosted up 500 volts on either side, either by steam or motor-driven boosters, making the pressure between the high-tension bus-bars approximately 1,500 volts. High-tension feeders from these bus-bars go to the reducer house sub-station; the current they carry passes through the reducers and is delivered on the reducer house low-tension bus-bars at 460 to 520 volts, according to the amount of regulation on the reducer fields. Each line of reducers is composed of two separate machines mechanically coupled, each having a doubly-wound armature and an auxiliary magnet system, by means of which latter the low-tension voltage from the machines may be varied over a wide range. In the reducer house are three lines of reducers, each line having an output of 300 kw. There are also two auxiliary field type balancers, each capable of dealing with 200 amp. of unbalanced current in the middle wire. A diagram shows the high efficiency at light leads. The low and high-tension switchboards are also described in detail, as is also the distributing system.—Lond. *Elec. Eng.*, June 19.

REFERENCE.

Electrical Installations in a Theatre.—A description of the electrical installations in the Prince Regent Theatre in Munich, with details as to the distribution of the current on a large stage, for obtaining the scenic effects. Current distribution takes place by the three wire system for 2 x 110 volts, 204 storage cells with a capacity of 855 kw hours are installed.—*Elek. Rundschau*, June 15.

Electro-Physics and Magnetism.

Radioactivity of Ordinary Materials.—Strutt.—The author has carried out a series of experiments with a view to decide whether the nature of the walls of a vessel had any influence on the rate of discharge of a charged body inside of it. The walls of the vessel used could be lined with any desired material by inserting a cylinder composed of it through the removable bottom. The author found that there were very marked differences in the rate of leak when different materials constitute the walls of the vessel. He finds the following figures in scale divisions per hour: Tinfoil, 3.3; another sample, 2.3; glass coated with phosphoric acid, 1.3; silver chemically deposited on glass, 1.0; zinc, 1.2; lead, 2.2; copper (clean) 2.3; copper (thoroughly oxidized), 1.7; platinum (various samples), 2.0, 2.9, 3.0; aluminum, 1.4. He states that there can, therefore, be little doubt that the greater part, if not the whole of the observed ionization of air is not spontaneous at all, but due to Becquerel rays from the vessel. It is interesting to find that the phenomena of radioactivity, which have hitherto been regarded as rare and exceptional, are present everywhere. The rate of leak with various pieces of tinfoil from the same stock was always the same, as nearly as the experiments could show, but a piece from another stock gave a different amount of leakage. The same holds good for platinum, one specimen tried being twice as active as another. Ignition did not affect the radioactivity of a given sample of platinum. The above-mentioned substances were then compared for activity with uranium nitrate, which latter was found to be 3,000 times greater. The author thinks that it is possible that this radioactivity of ordinary materials may be due to traces of the more active substances; which would explain the varying activity of different samples of the same material. Only an infinitesimal proportion of radium would be required, as it is at least 100,000 times more active than uranium, and uranium 3,000 times more active than the most active common material he experimented with, so that one part of radium in three hundred million would suffice to account for the observed effects.—*Phil. Mag.*, June.

Electrostatic Deflection of Rutherford Rays.—Des Coudres.—An illustrated paper, in which the author describes experiments by which he succeeded in showing that the above rays can be deflected by an electrostatic field. From these experiments he deduces the velocity of the rays as = 1.65 × 10 to the 9th power, or about 1/20 the velocity of light. He confirms Becquerel's result for the deflection in a magnetic field.—*Phys. Zeit.*, June 1.

Ionization of Air by Water.—Himstedt.—The author found that air, which was furnished by an ordinary water-jet pump, showed a much higher conductivity than ordinary room air. The result was not due to its containing a larger amount of water vapor, as it did not disappear when the air was dried by conducting it through long tubes filled with phosphorus pentoxide, or by letting it stand over phosphorus pentoxide and metallic sodium. The high conductivity could, however, be completely taken away, by conducting the air through a coil dipping into liquid air. If after such an experiment the coil was allowed to rise again in temperature the high conductivity of the air was re-established. All experiments to find a radioactive agent in the substance, which had frozen out in the coil, failed. When air was forced under a certain pressure through distilled water, rain water, hydrant water and solutions of sodium chloride, copper sulphate and sulphuric acid, the same amount of conductivity was given to it. No increase of conductivity could be observed when air was forced through petroleum, paraffine oil or benzine.—*Phys. Zeit.*, June 1.

Crystallization in the Electric Field.—Schmidt.—An article, illustrated by a diagram, describing an experiment in which the author allowed a solution of sulphur in carbon bisulphide, to crystallize in an electrostatic field, maintaining a difference of potential of about 40,000 volts. The surprising result was obtained that the crystals of sulphur were obtained only at the anode, the cathode being entirely free from crystals. The author thinks that the phenomenon can be explained by assuming that the crystals of sulphur in nascent state take an electronegative character, and are therefore repelled from the cathode.—*Phys. Zeit.*, June 1.

The Volta Effect.—Simpson.—The author measured the difference of potential between a cage of galvanized iron wire 1 meter high and wide and ½ m long, and various metals in the form of wires, sheets or gauze, which were supported on a isolated support. The cage and one pair of quadrants of an electrometer were connected to earth, while the metal was connected with the other pair of quadrants. The difference thus found was negative for sodium and for an alloy of magnesium-aluminum (magnalium), and positive for the other metals investigated. The results were: Copper, + 0.7; iron, + 0.40, tin, + 0.25; lead, + 0.23; magnalium, — 0.28, and sodium, — 0.70 volts. These numbers agree very well with the Volta difference of potential between these metals and the zinc, the cage acting as the zinc electrode.—*Phys. Zeit.*, June 1.

Units, Measurements and Instruments.

The Giorgi System of Units.—Emde.—A long description of this system preceded by introductory remarks and including a large table of comparisons of various systems. The system was described by Giorgi in *L'Elettricista*, January, February and November, 1902. It appears to consist chiefly in using the weber and kilogram in place of the centimeter and the gram, as the fundamental units, and in shifting the troublesome factor 4π by taking it out of the value of the magnetomotive force, magnetic induction and what he calls the electromagnetic conversion factor, and placing it into the value of the permeability, thereby eliminating it from the more important relations between various units, and making it possible to measure with nearly every unit both an electrical and a magnetic unit, thus reducing the number of units to nearly one-half. It is claimed to give a "rational" and consistent system involving scarcely perceptible changes; also that it brings into better record the systems of measurements of the mechanical and the electrical engineer and requires no international agreement for its adoption; it is also thought to facilitate instruction. The electrical units remain the same and the ampere-turn becomes the unit of magnetomotive force.—*Zeits. f. Elek.*, June 7.

Telegraphy, Telephony and Signals.

Wave Telegraphy to and from Moving Trains.—Schmidt.—The conclusion of the article previously noted in the Digest. The present installment contains an account of the experiments carried out under the supervision of the German Government on the Berlin-Zossen military road. Waves of 200 m. length were used and the conductor on the train consisted of a wire, strung on insulators along the upper edge of the cars. The waves traveled along wires on the telegraph poles. It was found that satisfactory communication with the station could be had for 20 km, 10 km before and behind the station. It was also found that although the wires were carried on the telegraph poles, that neither the telegraph nor the railroad signal service was affected in any way by the waves and the telephone only to a slight degree. A slight crackling noise is heard in the telephone, but it is not strong enough to interfere with communication. The wave telegraphy, however, was strongly disturbed by the telegraph service, because the small sparks which appear at the telegraph instruments gave rise to rapid electrical oscillations, which traveled along the conductor and influenced the coherer. This disturbance was finally overcome by suppressing the sparks by connecting polarization cells or inductionless resistances in parallel to the telegraph keys.—*Elek. Anz.*, June 18.

Electrical Syntony and Wireless Telegraphy.—Maskelyne.—A discussion of the manner in which the author succeeded in interfering with Prof. Fleming's recent lecture experiments on syntonic electric wave telegraphy with the Marconi system before the Royal Institution. It was done to test the Marconi people's claim of having perfected the tuning devices and to see whether any interference was possible with an ordinary 10-inch induction coil, fitted with a mercury jet interrupter, running at 2¼ amp. primary current. No attempt was made, according to the author, at tuning the receiver. This interference drew forth an angry letter from Fleming in the *Times* of June 11, to which Maskelyne replied as the author of the interference, giving his motives for doing so and repudiating the charge of "scientific hooliganism," made in Fleming's letter. Then followed another letter of Fleming, which was in turn followed by another one from Maskelyne calling attention to several contradictions in Fleming's lectures. These letters are reprinted after the article under consideration. The subject is attracting considerable attention in England, being made the subject matter of editorials in the Lond. *Elec. Eng.*, Lond. *Elec. Times*, and Lond. *Elec. Rev.*, the editors being inclined to take Maskelyne's part. The Lond. *Elec. Rev.* goes so far as to remind Fleming that in his dual capacity of savant at a learned institution and expert to a commercial undertaking, the public have nothing but courtesy and respect to offer to the one, while they have searching criticism and still more searching experiment to oppose to the statements of the other.—Lond. *Elec.*, June 18.

Miscellaneous.

Danger to Firemen from Water Thrown Against Wires Carrying High-Potential Currents.—Heincke.—A description of experiments made to ascertain whether there is any danger and if so how much, of firemen being exposed to shocks by the stream of water which is thrown from the hose, striking against a live wire. The author experimented with ordinary hydrant water, which in his case was not a very good conductor, and also with water to which was added 0.5 per cent. of soda to make it conduct better. The copper nozzle of the hose was very well insulated from earth and the potential of the stream of water against the earth was measured with precision voltmeters. From these potentials he calculated the current strength, based upon the resistance of the human body of 15,000 ohms, as ascertained by Prof. Weber in Zurich. Experiments were conducted with triphase current of 6,000 volts and 125 volts, and direct current of 240 volts and 550 volts with both kinds of water mentioned above. Detailed tables of the results are given. The experiments with triphase current were conducted with star connection, 6,000 volts between two lines, the neutral wire being earthed. The places where the stream of water struck the wires they had been previously bared. It was shown that with ordinary water a length of the stream of 300 mm is sufficient to render the effects of the electric current on the body harmless, while with 0.05 per cent. soda in the water the minimum length is 1,000 mm. It is to be remarked, however, that disagreeable sensations still show themselves in the body of the person under consideration. With the experiments of 3 × 125 volts alternating current, a dangerous potential was not reached, as was the case also with 240 volts direct current. With 550 volts direct current and pure hydrant water a dangerous potential was also not obtained, but with the good conducting water it showed itself at a distance of 80 mm. It is shown by these tables that the danger resulting from the playing of water on current conducting wires is not by far as great as had previously been thought and feared, especially if it is considered, that perhaps only in the rarest cases have wires which carry a potential of 3 × 6,000 volts will come into consideration.—*Elek. Zeit.*, June 18.

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New Books.

Proceedings of the Tenth Annual Meeting of the Society for the Promotion of Engineering Education. New York: Engineering News Publishing Co. 300 pages Price to members, $1.50; to libraries, $2.00; to others, $2.50.

This is a well-edited volume nicely bound in sky-blue. It commences with lists of officers, to the number of twenty-five, and members to the number of 278, by one method of reckoning and of 275 by another. The constitution then follows and is succeeded by the Proceedings.

The proceedings embody a presidential address, and thirteen papers on educational topics, with discussions. The papers are very interesting and of a high standard. The discussions are also clear and well-worded, with special interest, as revealing the diversity of opinion which exists and perhaps always will exist on such questions.

At the end of the book, before the index, are five important statistical tables containing engineering educational data derived from 118 colleges or technical institutions, nearly all on the North American continent.

These tables will bear much study and pressure for the extraction of useful material.

They show, among other things, that the number of enrollments of students in engineering courses in the United States is 16,433, with 15 females, or one female per thousand enrollments. The number of academic or non-engineering enrollments in the same institutions is 18,830, of which 12,457 are males and 6,373 (33.8 per cent.) females. Consequently the tables show that taking the returns of these 118 institutions, there are nearly as many engineering students as non-engineering students, and restricting consideration to males, there are 132 engineering students to 100 non-engineering students. The proportion varies greatly in different institutions, some of the technological colleges having no academic or non-engineering enrollments, while others have very few engineering students.

It is not clear whether these statistics cover all the educational institutions of any importance, or whether they are picked colleges, but the evidence seems to be that all have been consulted.

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Directory of Electrical Societies, Etc.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting Atlantic City, N. J., September 2, 3 and 4, 1903.

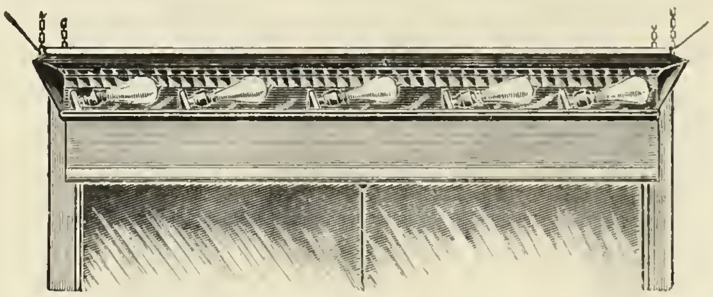
National Electrical Contractors' Association of the United States. Annual Convention, Detroit, Mich., July 14, 15 and 16.

American Street Railway Association. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meething, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

The Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Window Reflector.

The window reflector shown in the illustration herewith, made by Mr. Nelson Weeks, 217 William Street, New York, departs from conventional lines in one respect, which is claimed to be an important improvement. It is a well-known fact that the method of illuminating a show window from the top is the most desirable method on account of the direct illumination that is given, and the fact that the lights do not interfere in the slightest with the view of the window decorations or articles shown. In the Weeks reflector, the lamps instead of being laid lengthwise throughout the entire width of the reflector, project at a slight angle from it. The illuminating effect is equal to the case where the lamps are laid in the other direction, but by thus tipping or planting the lamps it is possible to add other lamp bases under the projecting face of the lamp, so that more lamps can be installed in this type of reflector in a given length than other reflectors of the same dimensions. It is stated that this has been found to work so satisfactorily that one of the large construction companies of New York after making exhaustive tests of this kind of window reflector with others, selected the former for use in large department store work.



WINDOW REFLECTOR.

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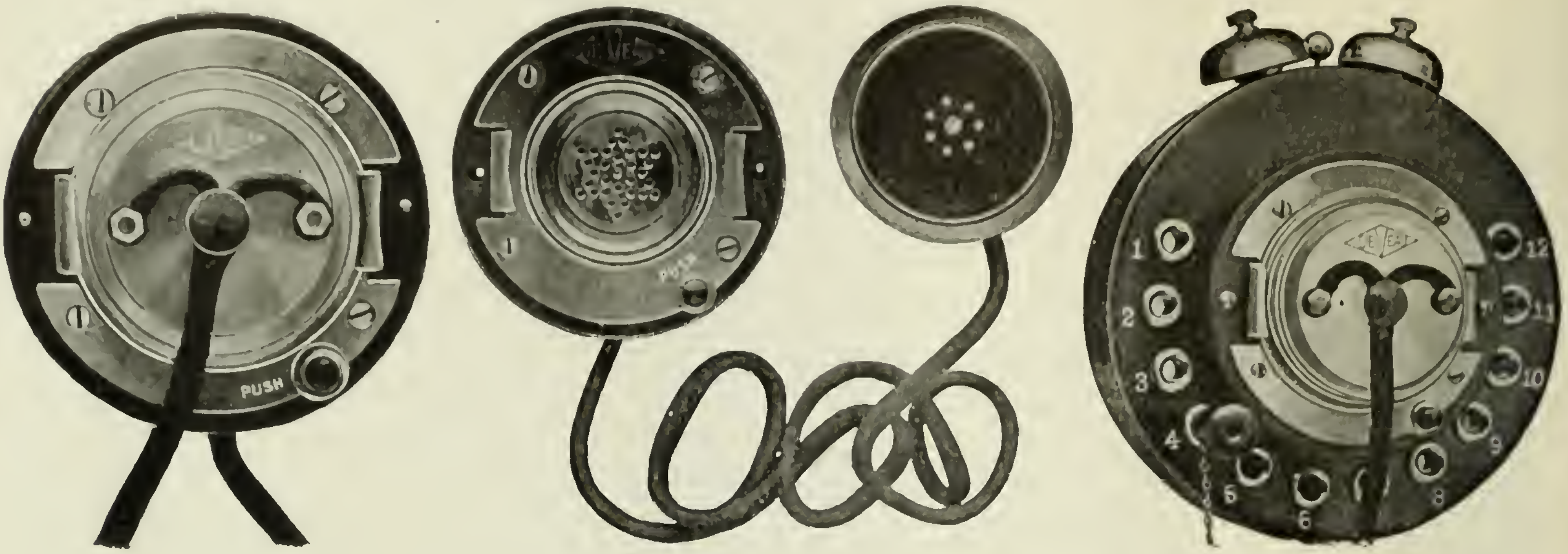
Push-Button Telephone.

The accompanying cuts illustrate a type of push button telephone being placed on the market by the De Veau Telephone Manufacturing Company, 27 Rose Street, New York. As will be seen, it resembles the ordinary push button, and can be used as such, but is yet a complete telephone instrument and may be used for intercommunicating, switchboard or straight line work. The instruments are equipped with double-pole receiver and long-distance transmitter. All springs are of phosphor-bronze, have a long leverage and are not turned at short angles, and thus are not weakened and apt to break. The base of the instrument is of composition and the metal parts may be finished to match the hardware.

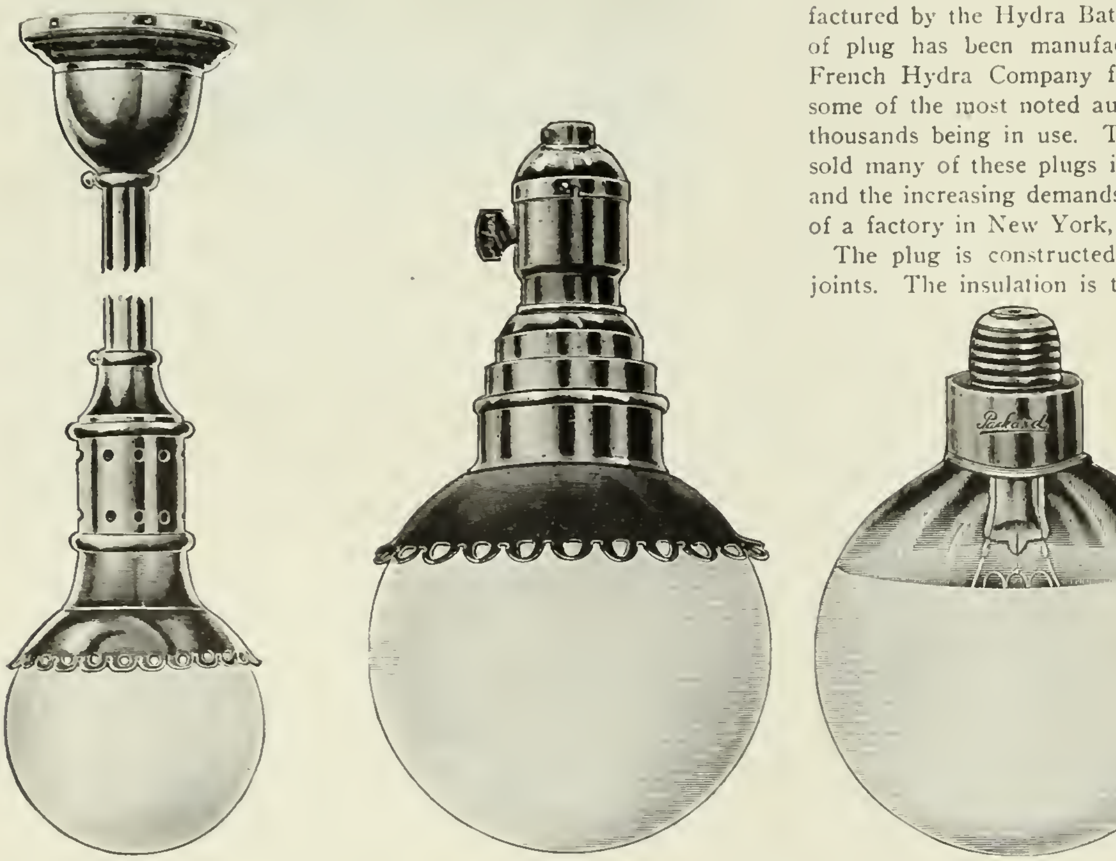
The dimensions of the wall set are: Diameter, 3½ in., and depth, 2 in. The size of the intercommunicating block used with the wall set is: Diameter, 5¼ in., and depth, 1½ in.

Where electric bell or annunciator wires are in use the push button telephone can be connected up in a few minutes, using the present system of wiring, batteries, etc. The watch case receiver is of aluminum, making it light and attractive. The push button is of hard rubber.

Fig. 3 shows the telephone with the addition of an intercommunicating plug block. The plug sets into a metal head, thereby insuring a perfect contact at all times. In telephones where the plug is inserted between a metal ring and button, if the wood at any time on which these parts are mounted becomes damp or warped it changes the position of the ring and button, causing the plug to catch in the wood, thus failing to make connections. With the all-metal head this is impossible. The plug is held by a chain, which carries no current whatever, being merely attached to the plug so that it will not get lost. The plug can be left in any jack and any station called, which makes the instrument almost automatic, inasmuch as it is not necessary to return to the home station to receive a call. With this type of telephone, together with a 12-station outfit, six pairs can be talking at one time without interference. Each instrument is equipped with a plug board, making the entire system intercommunicating.



Figs. 1, 2 and 3.—Push Button Telephone.



FIGS. 1, 2 AND 3.—DIFFERENT FORMS OF HIGH CANDLE-POWER INCANDESCENT LAMP.

Large Incandescent Lamps.

The Electric Appliance Company, of Chicago, is introducing the Zenith incandescent lamp. This lamp is an intermediate between the arc lamp and the incandescent lamp, yet retains the simplicity of the incandescent lamp. It is made in two sizes—25 and 55 cp, at two efficiencies, 1.9 and 2.18 watts.

This new type of incandescent lamp gives a particularly brilliant, yet soft white light, which is evenly distributed beneath the lamp. The range of voltage of this lamp is from 90 to 250, and it is furnished regularly in Edison bases, but can be furnished also with Thomson-Houston base. The fact that it can be used on either alternating or direct current and requires no attention during life, renders it a desirable addition to forms of lighting. A simple collar adapted for use on any style of fixture, or it is furnished complete with ceiling stem, as illustrated.

Jump Spark Plug.

The accompanying illustration shows a jump spark plug manufactured by the Hydra Battery Company, of New York. This type of plug has been manufactured in France at the factory of the French Hydra Company for some time and has been adopted by some of the most noted automobile manufacturers in Europe, many thousands being in use. The American company has imported and sold many of these plugs in this country, and the success met with and the increasing demands for a good plug have led to the erection of a factory in New York, at 70 and 72 Reade Street.

The plug is constructed in one solid body, thus avoiding loose joints. The insulation is the best grade of imported mica washers. The platinum points are extra heavy, and the use of a brass head, prevent rust in the cylinder head. The plugs are manufactured either with the standard American or metric threads.

JUMP SPARK PLUG.

High Tension Cross-Arm and Insulator.

In Fig. 1 is shown a type of pole cross arm which the well-known French firm, E. H. Cadiot & Cie. have applied to several important transmission lines. It will be seen that the cross arm is of metal-iron or steel, and that the insulator pin is secured in a sleeve which latter is then clamped into the end of the arm. The advantages claimed for this system is ease in mounting and in replacing a broken or defective insulator, the additional insulation secured by the use of the sleeve as compared with the usual metal cross arm system, and the less area of contact with the pole, and the greater structural strength of the arrangement. Among the recent installations of this type of cross arm is that on the lines of the 15,000-volt Fuilla transmission plant in the south of France (Pyrenees Orientales).

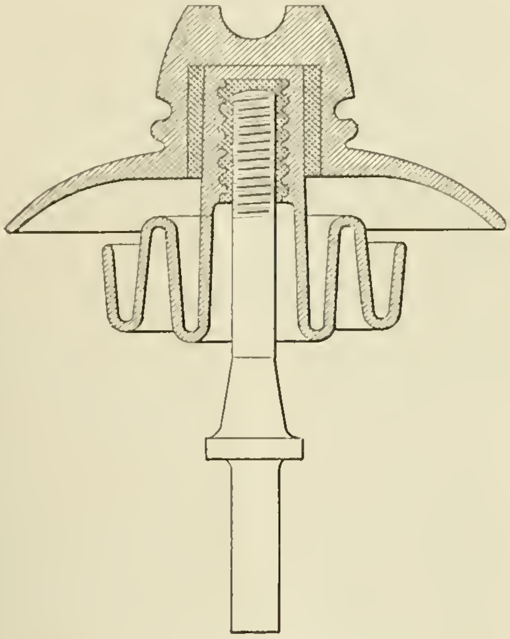


FIG. 2.—HIGH-TENSION INSULATOR.

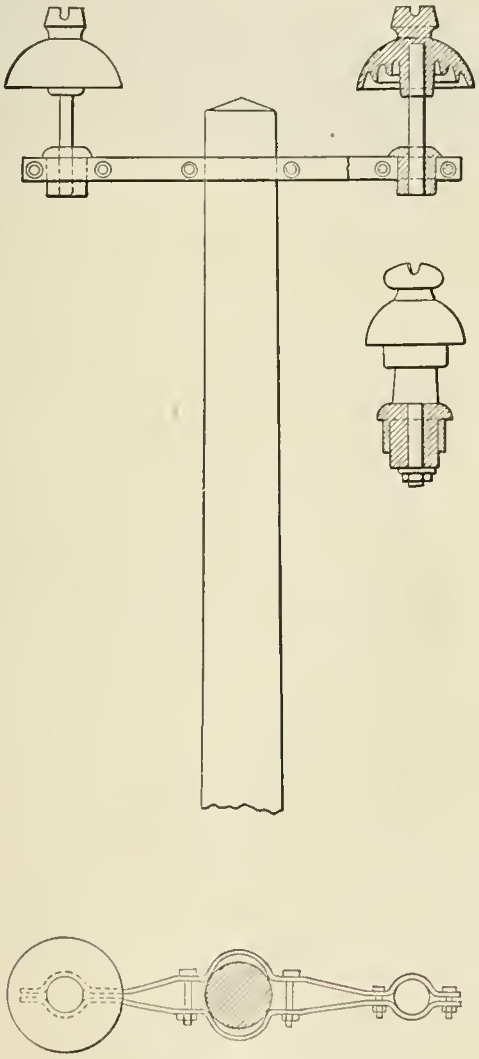


FIG. 1.—POLE CROSS ARM.

Fig. 2 illustrates a type of high-tension insulator which has been applied by the same firm to a number of transmission lines, and known as the 'Cloche Mehun" insulator. In some tests the leakage at 38,500 volts was only .4 milliampere per insulator. When submitted for 30 minutes to a voltage increasing progressively from 6,500 to 40,500 volts at a frequency of 42 periods, the insulator being plunged in acidulated water, only one broke of a large number submitted to the test.

Porcelain Letter Electric Signs.

An interesting departure in the production of electric lighting signs is shown in the accompanying illustrations, which portray the devices of the Colonial Sign Company, Akron, Ohio, which is now putting on the market porcelain letters for such work.

These letters are made of a perfectly vitreous china with a beautiful non-crazing glaze, in three standard sizes of letters, 12 in., 16 in. and 22 in. Upon removal to its new factory, the company will be able to make any size letter up to 10 ft. high, and will also be equipped to manufacture illuminated porcelain specialties such as trade marks, etc.

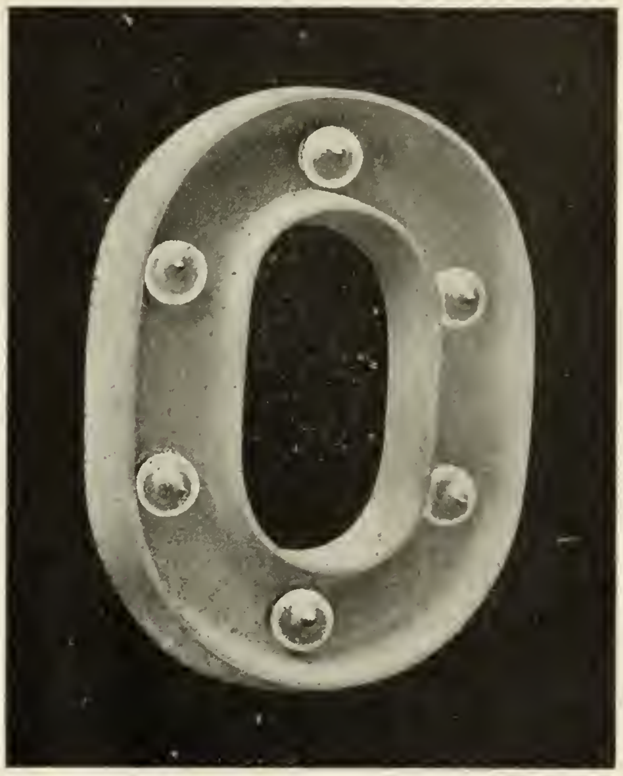


FIG. 1.—PORCELAIN LETTER.

Porcelain will appeal to the practical man at once as being an ideal material for this class of work. It is not affected by heat, moisture, electricity or decay. Once installed, the sign, except for the renewal of lamps, should last a lifetime without further attention. The letters are shaded in any color desired, but thus far the demand has been for a white-faced letter with gold shading. The

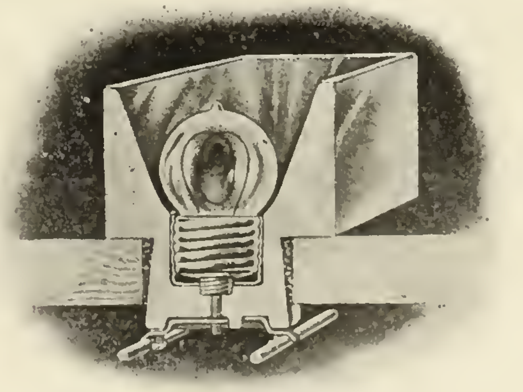


FIG. 2.—SECTIONAL VIEW OF A LETTER.

colors are burned on the china and are permanent. The letter and sockets are composed of one integral piece of porcelain, and there is no wood or other combustible material in close contact with the lamp or the wiring.

Owing to the shape of the concave face of the letter, the company is able to use fewer and lower candle-power lamps, producing a great saving in operating expense, also a bright, sharply defined letter which can be read from a great distance, and at a very acute angle without blurring.

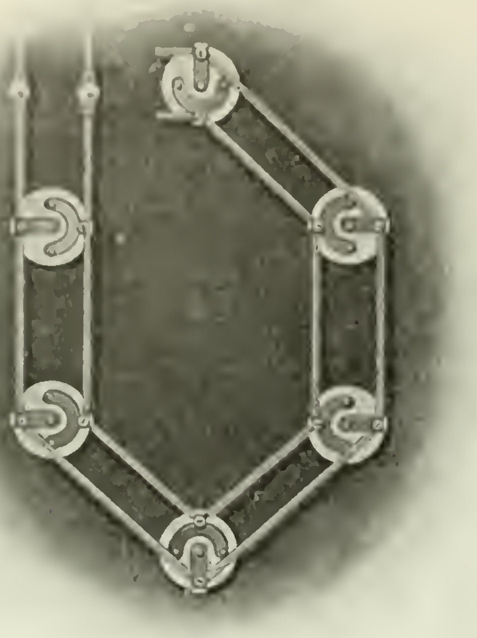


FIG. 3.—INTERIOR CONSTRUCTION OF SIGN.

The Colonial Sign Company is building and will shortly move into a new factory in South Akron 160 x 140 in size. This will enable it to handle a rapidly increasing business. The officers of the concern, some of whom are well known in the electrical field, are: H. B. Camp, president; G. P. Good, vice-president; C. R. Quinn, secretary; J. E. Good, treasurer, and G. D. Chapman, general manager.

Mechanical and Electrical Equipment of a Cotton Mill.

The mechanical and electrical equipment of the cotton mills of the Davis Mill Company, at Fall River, Mass., is in many ways exceptionally up-to-date, including a fan-and-heater system of heating and ventilation, induced draft in place of a chimney and electrical motor-drive throughout. To provide flexibility in the boiler plant and insure against shut-down, the induced-draft plant has been installed in duplicate. Two seven-foot blast wheels, running in three-quarter, steel-plate housings, are driven by center-crank, horizontal engines. The fan wheels are overhung in the housings and are furnished with special wide, water-cooled bearings. The engines themselves are provided with extended shafts upon which a pulley is mounted between each fan bearing the respective engines. These pulleys are in reality the flanges of the couplings of the two parts of the shafts, the belts running directly on the flanges. They are used for driving the economizer scrapers.

The air connection between the fans contains a flat swinging damper, which is so arranged that either fan can be shut off and the other run separately if desired. The outlet connections are likewise provided with dampers and the operating attachments are so placed that both can be changed at once by hand. The engines receive steam at 80 pounds and are furnished with a balanced valve, which can be used in connection with a damper regulator.

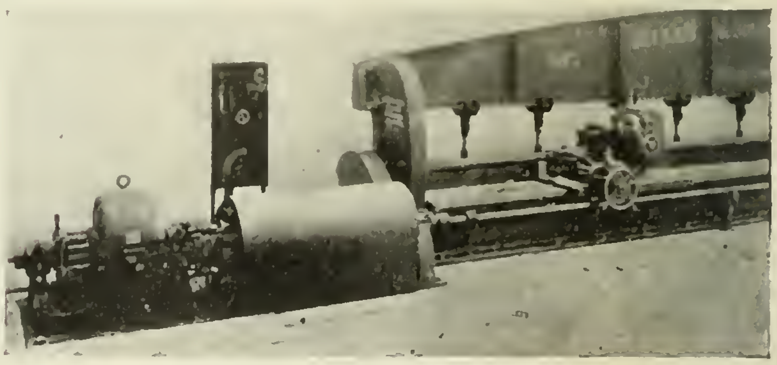
The heating plant of the Davis Mills is a duplicate of that installed at the Arkwright Mills some years ago. It consists of a large exhaust wheel drawing air through a steam pipe heater. The fan wheel is provided with one tight and two loose pulleys and the engine has an extra wide, flat-face, fly-wheel for shifting the belt. A second belt connects the fan pulleys with the line shafting of the mill. This arrangement makes it possible in the summer time to run the fan from the line shaft, thus taking advantage of the economy of the large mill engine, while in the winter when the exhaust of the fan engine can be utilized in the heater, or at night when the large engine is not running, the fan is driven by the fan engine.

The heater is built up of 1-in. pipe erected on cast-iron sections which rest at one end on ball bearings to allow for expansion and contraction. It is so arranged that the exhaust steam from the engine can be used entirely in one group of sections, making it possible to condense all the exhaust before it is necessary to use any direct steam, which is added at a reduced pressure when necessary. The outfit also includes a Kendall receiving tank, with a water-gauge and a safety valve, and a duplex Worthington steam pump. The heating apparatus will heat the mill to 70° F. when the temperature outdoors is zero.

The electrical equipment consists of two belted direct-current generators, one of 50 kw and one of 75 kw, operating at 125 volts, no load and compound-wound. These generators supply current for lighting and for a 27-hp motor and one of 43 hp. The oiling devices of the motors are so arranged that they can be hung from the ceiling. The above apparatus has been furnished by the B. F. Sturtevant Co., of Boston, who also designed and constructed the heating and ventilating and mechanical draft plants.

Electrically Driven Plate Planer.

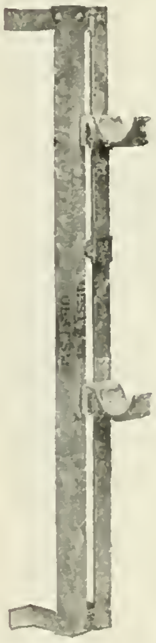
The illustration herewith shows a 32-ft., heavy plate planer built by Messrs. Hilles & Jones, of Wilmington, Del., and recently installed in the United States Navy Yard at Charlestown, Mass. Direct-connected to the main driving screw of the planer, through gearing and magnetic clutches, is a 50-hp Westinghouse, multipolar motor of 220 volts and running at slow speed, which furnishes ample power to enable the machine to plane two-inch armor plate, taking a heavy chip. A thorough test proved the machine to be a powerful tool in every respect.



ELECTRICALLY-DRIVEN PLANER.

The saddle of the planer is designed to carry two tools, one cutting in each direction, also a third tool for vertical feed, the saddle and tool holder being shifted automatically at any point desired.

New Cable Bracket Frame.



CABLE BRACKET FRAME.

In the accompanying illustration is shown the Gest bracket frame being placed upon the market by G. M. Gest, of Cincinnati and New York. The frame is made of angle iron heavily galvanized. It is supported at top and bottom with anchors which with the frame itself are built in the wall, the face of the frame being flush with the wall, thereby taking up no room in the manhole.

The cable bracket, of galvanized cast iron, is secured to the frame by means of a galvanized T-head bolt with a special nut so designed that the bracket is removed by being lifted straight up. By means of this nut the bracket can be adjusted to any angle and as the slot in the frame is unobstructed from top to bottom the bracket can be adjusted to any height desired.

The frames are made in the following lengths: 12-in., 24-in., 30-in., 36-in., 42-in., and the brackets are made in three sizes—single, double and triple. Longer frames than the above are made to special order. The brackets and bolts are removable at any time and very little time is required to change from a single bracket to a double or triple type. All parts being heavily galvanized, they will last as long as the conduit system itself.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed quiet and was offered with considerable freedom, the rates being 4½ per cent. for 30 to 90 days, and 4¼ to 4½ per cent. for four to six months' time. The stock market was dull, and showed a tendency toward lower prices at the end of the week. The public participated in the market very slightly. The labor situation is still deemed an uncertain element, although no change or improvement has taken place in that respect during the week. Neither is there any material alteration in the position of the iron industries. United States Steel securities showed considerable strength without any advance in their prices. In the industrial group one of the few important movements was in Brooklyn Rapid Transit, which was very strong, and rose to 59½ on buying, this being accompanied by confident reports from inside sources about the large traffic and earnings of the system. Outside support was lacking, however, and the stock receded later in the week. This stock closed at 58, thus gaining 2 points net over the quotations of the previous week. Metropolitan Street Railway showed a little more firmness and made a net gain of 1 point, closing at 123 after having touched 122¼. In the electric list General Electric closed at 179, the range of prices being between 178 and 180. One thousand two hundred and twenty-five shares of this stock changed hands during the week. Westinghouse closed at 190, which was the ruling figure throughout the week, and Western Union Telegraph closed at 85⅜, being a net gain of ⅞ of a point. American Telephone and Telegraph rights closed at 6⅛—⅛ of a point higher for the week. Amalgamated Copper was largely manipulated but showed a tendency to sell off in sympathy with adverse reports about the condition of the copper market. Following are the closing quotations of July 7:

NEW YORK.

	June 30.	July 7		June 30.	July 7
American Tel. & Cable	80	80	General Electric	179	..
American Tel. & Tel.	134	131	Hudson River Tel.	..	..
American Dist. Tel.	30	30	Metropolitan St. Ry.	123¼	122⅝
Brooklyn Rapid Transit	57½	57⅝	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	162	..	N. Y. & N. J. Tel.	112	..
Electric Boat	17	17	N. Y. E. V. T. Co.	5½	5½
Electric Boat pfd.	40	40	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1	1	Western Union Tel.	85	..
Electric Vehicle	6⅛	7¼	Westinghouse com.	190	..
Electric Vehicle pfd.	13	13½	Westinghouse pfd.	190	..

BOSTON.

	June 30.	July 7		June 30.	July 7
American Tel. & Tel	154¼	132	Western Tel. & Tel. pfd.	90	90*
Cumberland Telephone	..	..	Mexican Telephone	1¾	1⅝
Edison Elec. Illum.	..	..	New England Telephone	125½	129
General Electric	..	..	Westinghouse	93	..
Western Tel. & Tel.	12	13	Westinghouse pfd.	93	..

PHILADELPHIA.

	June 30.	July 7		June 30.	July 7
American Railways	45	..	Phila. Traction	95¾	95¾
Elec. Storage Battery	60	60	Phila. Electric	6¼	6⅛
Elec. Storage Battery pfd.	60	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	8¼	8⅜	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	June 30.	July 7		June 30.	July
Central Union Tel.	..	..	National Carbon pfd.	93	93
Chicago Edison	150	..	Northwest Elev. com.	..	..
Chicago City Ry.	190	190	Union Traction	3½	4
Chicago Tel. Co	125	..	Union Traction pfd.	30	30
National Carbon	22	23			

*Asked.

CONSOLIDATION IN ST. LOUIS.—With the passing of the Missouri-Edison Electric Company into the hands of the North American Company of New York, a plan is reported for the consolidation of all the electric-power companies with the street railways of St. Louis, into one gigantic corporation, with a capital of $141,000,000. For the re-organized Missouri-Edison Company William F. Nolker, a director in the Missouri Valley Trust Company, was elected president, and August Gehner, also a director in that institution, was made vice-president. The new directors are Charles H. Huttig, H. C. Stifel, C. Marquard Firster, E. H. Benoist, Philip Stock, Henry Semple Ames, William D. Orthwein and Messrs. Gehner and Nolker. The reorganization is a temporary one, it being the intention of the new owners of the property to consolidate with the Union Electric Light and Power Company. A special stockholders' meeting of the Missouri-Edison will be advertised without delay, so the consolidation can be effected not later than September. J. Pierpont Morgan, who dominates the North American Company, is said to be the moving spirit in the proposed consolidation. That company recently purchased the Laclede Gas Light Company, and it owns the controlling interest in the Union Electric Light and Power Company. The Union Electric Light and Power Company has in course of erection a $6,000,000 plant, located at the foot of Biddle Street. This plant will have a capacity of 25,000 kw, and will, when completed, be one of the largest electric power plants in America. The company has a contract with the World's Fair Company to furnish light and power during the Exposition period. The contract is for not less than 7,500 kw, to be supplied at a minimum cost of $338,976. The power for this contract will be supplied by the new plant. At the close of the Exposition this surplus power will be for sale to consumers generally. Among the consumers who will be customers of the Union Company after the World's Fair will be the St. Louis Transit Company. That company, it is said, will purchase in the neighborhood of from 15 to 20 per cent. of its power from the lighting company. All the old directors and executive officers of the Missouri-Edison retire with the acquisition of the company by the reorganized concern. There will be no change, it is said, in the operating officers and employees. The power-houses of the company will continue in operation, as heretofore. The terms of the purchase, as was announced recently, are: $55 for the preferred and $25 for the common stock. All stockholders of the company have an opportunity to dispose of their holdings at these figures. The new owners have purchased something more than 85 per cent. of the stock.

MICHIGAN TELEPHONE.—At the recent annual meeting of the Michigan Telephone Company Vice-President H. J. Pettingill presided. The number of shares represented, either in person or by proxy, was 39,112, and there was no opposition to the re-election of the old board, as follows: Philip Dexter, Frederick P. Fish, W. S. Hutchinson, H. J. Pettingill, Hugh McMillan, Thomas Sherwin and Dudley E. Waters. The business of the meeting, what little there was transacted, was practically directed by George V. Leverett, of Boston, general counsel for the Western Telephone Company. The report of the treasurer showed that the earnings of the company for 1902 were $1,549,531. The expenses for the same period were $1,632,230, leaving a deficit of $82,699. The total deficit of the company as shown by the ledger balances December 31, 1902, amounts to $501,296. Loans and accounts payable on the same date amounted to $2,538,176. No salaries are being drawn by the executive officers now, and the entire purpose of the meeting, as stated by Mr. Leverett, was to keep the organization going, and to have officers to represent it in court. All debts for labor and material, for which the stockholders would be individually liable, were paid up to the time the receiver was appointed. The motion was made to approve all the acts of the board of directors and executive committee for the past year. Objection was made, and the secretary was compelled to read the entire records from the time the directors met in Boston after the last annual meeting for organization. Those in control of the meeting, however, had the votes, and the acts were ratified. No one was present to represent the Union Trust Company as receiver.

PORCHESTER (N. Y.) ELECTRIC ROAD.—The New York Court of Appeals handed down a decision upholding the permission granted by the State Railroad Commission to the Port Chester Electric Railroad Company to construct its road from the Harlem River through Westchester County to Mount Vernon, New Rochelle and Port Chester. The new company is to construct a third rail surface road to connect with the rapid transit underground road. The New York, New Haven & Hartford Railroad Company opposed the construction of the Port Chester road on the ground that no public necessity demanded it. Mr. August Belmont, president of the Interborough Rapid Transit Company, has emphatically denied that his company is in any way interested in the Port Chester Railroad Company, rumors to that effect having been in circulation. This is the road with which Mr. C. O. Mailloux and Mr. W. Gotshall are so prominently connected.

PARIS GAS PLANT.—A cable dispatch from Paris, of July 3, says: The Municipal Council to-night, after a discussion which has occupied the main part of the last few sessions, finally rejected all propositions to grant concessions for the supply of gas in the City of Paris to foreigners, notably the so-called American scheme of Devaleuz and Duchaney, who it is alleged, represented Anthony N. Brady, the American capitalist, which proposition was strongly indorsed by the committee which inquired into the matter. The opponents of the scheme urged that it would really place a monopoly of the supply of gas and electricity in Paris in foreign hands, and they pointed out that the guarantees offered while being nominally $6,000,000, in reality only amounted to $2,000,000. After rejecting the American proposition the Municipal Council decided on a municipal monopoly of gas, the city to manufacture gas on its own account and reap the whole profits on its sale to consumers.

DIVIDEND.—The Electric Company of America has declared the regular semi-annual dividend of 30 cents per share out of the earnings for the six months ending June 30 last. The dividend, which is at the rate of 6 per cent. per annum, is payable July 31 to stockholders of record July 20.

NASHVILLE RAILWAY AND LIGHT.—It is stated that the Nashville Railway and Light Company has filed articles of incorporation with the Secretary of State of Tennessee, and has been given authority to issue $6,500,000 stock.

Commercial Intelligence.

THE WEEK IN TRADE.—The warm weather improved the general situation and induced favorable conditions for the winter wheat harvest; helped corn and cotton, and enlarged the retail trade in summer goods. Altogether there is a much more cheerful feeling as to the outlook for business generally. Additional reports as to six months' trade are quite favorable, despite earlier unfavorable conditions. Farm products show a general downward tendency, though uncertainty as to the real condition of the cotton corner clouds this particular situation. Some revival in export trade is reported as a result of the price reaction. In the iron and steel trades there were few developments, a slightly better feeling being noted. New buying is still small though better than for some weeks past. The placing of large rail orders, 500,000 tons in all, for next year lends confidence to the situation. Foreign iron and steel are apparently out of the market to stay. Hardware is in better demand, though not so good as a year ago, but manufacturers are reported to have agreed to maintain prices at last year's rates. Copper was weak, with rumored sales at ¼c. reduction, and the demand was extremely light. Official prices are unchanged, both Lake and electrolytic being quoted at 14½c. and casting at 14c. The business failures for the week ending July 2, according to *Bradstreet's*, numbered 162, against 171 the week previous and 138 the corresponding week last year. The failure returns for the first six months were, according to the same source of information, the smallest in number reported in 20 years, though a comparatively few large suspensions, unrelated to one another, swell liabilities to 5 per cent above those of last year.

BELLEVILLE PORTLAND CEMENT COMPANY.—A novel application of induction motors is to be made by the Belleville Portland Cement Company in its current plant at Belleville, Ont., which is to be equipped throughout with electrical apparatus. A recent order placed with the Westinghouse Electric & Manufacturing Company comprises two 450-kw. engine--type alternators, one 100-kw, direct-current, engine-type generator and a motor-generator set consisting of a 100-kw. direct-current generator, and a 150-hp, three-phase induction motor. These two direct-current machines are to be used for exciting the fields of the alternating-current generators, for supplying lighting circuits and for the operation of a tramway locomotive. Sixty-two induction motors will supply the motive power. These include forty-six constant speed motors, ranging in capacity from 10 to 50 hp; ten variable speed induction motors, each to be direct-geared to a rotary kiln and provided with a controller permitting the operation of the motor at any one of four speeds; two type F motors, each to be direct-connected to a hoist and provided with standard non-reversing hoist controller; also four 400-volt, variable-speed induction motors for the operation of two overhead traveling cranes, these being provided with reversible crane controllers. Included in the equipment is a Baldwin-Westinghouse mining locomotive for operation on a 24" gauge track with double trolley. Altogether this will be a novel and interesting plant, as the operation of rotary kilns by direct connection to variable speed induction motors is a new departure from the usual method of supplying power to this class of machines.

KELLER, PIKE & CO., Philadelphia, Pa., have been awarded the contract for the entire electrical equipment in the new Pennsylvania State capitol building, at Harrisburg, Pa. This contract covers six engines, aggregating 1,200 hp, six direct-connected generators amounting to 800 kw, a white Italian marble switchboard, consisting of twelve panels with Weston instruments and Cutter circuit-breakers, electric wiring for motors aggregating 200 hp, and over ten thousand incandescent lamps. It also includes an annunciator system, connecting each member of the Senate and the House with a central station, and another system connecting the head of each department with the subordinates, as well as a telephone exchange connecting the governor with the heads of the twenty departments, the president of the senate with twenty committee rooms, and the speaker of the house with forty committee rooms. All the rooms in the building are also connected by a telegraph system with a central office. This contract makes a notable addition to the already extensive list of important installations of Messrs. Keller, Pike & Co., which includes among others, the National Export Exposition, the U. S. Mint, of Philadelphia, and the department store of Gimbel Brothers.

SOLVAY EXTENSIONS.—Westinghouse, Church, Kerr & Co. have recently received orders for additional boiler and economizer equipments for the Detroit plant of the Solvay Process Company. The Solvay Company operates at Detroit, and Syracuse, N. Y., two of the largest chemical establishments in the United States. The Detroit plant is located at Delray, a suburb on the Detroit River, and near the enormous salt deposits occurring in the marshland at this point. Steam power is furnished from a central boiler plant, which at present aggregates 7,200 hp. Roney mechanical stokers are used throughout, and the several batteries of boiler are also equipped with Roney high pressure, circulating type economizers. The plant is laid out in batteries of six boilers each. The additional equipment will consist of a new battery, comprising six 300-hp Babcock & Wilcox water-tube boilers, fitted with Roney stokers, together with four additional economizers, two of which will complete the equipment of a previously installed battery. A conspicuous feature of this plant is a massive brick stack 16 feet in diameter and 260 feet in height.

CARS FOR BROOKLYN.—The Brooklyn Rapid Transit Company is in the market for 200 closed cars, which involves an expenditure of about $500,000. The Brooklyn system has been adding materially to its equipment during the past few years, and is getting in position to handle the increased traffic which it will have to contend with when the new bridge is opened to New York. The Brooklyn Rapid Transit Company intends to make extensive improvements during the present year, and $14,008,719.73 has been appropriated for this purpose. Of this amount $6,000,000 is to be used for a new power-house on Kent Avenue, with a capacity of 80,000 horsepower; $3,124,962 is to be expended in the enlargement of other power-houses; $1,821,500 for the improvement and equipment of the elevated and surface lines; $1,295,935 for miscellaneous work, including new tracks and new buildings; $1,153,823 for the construction of underground conduits for carrying feeder cables, and $612,500 for the purchase of real estate.

BIDS WANTED AT MINNEAPOLIS.—Five of the prominent implement and machine jobbers of Minneapolis, Minn., whose buildings are located in close proximity, are figuring on the advisability of putting in a joint plant for the purpose of heating, lighting and furnishing power for their buildings. Four of these buildings are each seven stories high, and the fifth is five stories high. They are occupied by the Advance Threshing Machine Company, J. I. Case Threshing Machine Company, J. I. Case Implement Company, Bement-Darling Company, and Adland Transfer and Storage Company. Parties wishing to figure on this installation may address their communications to the J. I. Case Implement Company, 622-628 South Third Street, Minneapolis.

FIRE IN MANHATTAN SHOPS.—On July 4 a costly fire occurred in the shops of the Manhattan Elevated Railway Company between Ninety-eighth and Ninety-ninth Streets and Lexington and Park Avenues. In the buildings were about fifteen new cars, valued at $6,000 each, and the ten motors worth $3,300 each. These were destroyed, together with about $4,000 worth of mill work and a large number of valuable plans and the two center buildings, making a total estimated loss of about $150,000. The only cause suggested for the fire is that rockets may have been shot through the open skylights. No work of any kind was going on.

THE HAMMOND PACKING COMPANY has abandoned its plant at Hammond, Ind., having spent over a million dollars in the construction of a fine, new plant at the Union Stock Yards, Chicago. The new offices are lighted by three and six-glower Nernst lamps, sold through the Chicago sales office of the Nernst Lamp Company, and it is stated that a large additional number of these lamps will soon be installed in its extensive packing house.

NEW YORK CENTRAL CHANGE.—At a meeting last week of the directors of the New York Central and Hudson River Railroad Company, and also at a meeting of the directors of the New York and Harlem Railroad Company, the agreement with the city for depression of tracks in the Grand Central yards and for changes from steam to electricity as a motive power was approved, and the contract has now been executed.

H. O. S. ENGINEERING COMPANY, 88 Warren Street, New York, reports its business as steadily increasing in the switchboard and panelboard field. It has recently received orders for the switchboard for the United States Mint, Denver, Colo.; panelboards for the Navy Yard, Brooklyn, N. Y.; panelboards for the Lyric and Metropolitan theatres, New York City, and panelboards for the Hotel Victoria, New York.

General News.

THE TELEPHONE.

STERLING, ILL.—The Interstate Telephone Company is making preparations to build a toll line to Prophetstown.

WAVERLY, ILL.—The capital stock of the Waverly Telephone Company has been increased from $5,000 to $35,000.

ROANOKE, ILL.—The Local Telephone Company has been organized here. J. R. Claudin is president and H. D. Hollenbeck secretary.

BERWICK, ILL.—The A. B. C. Telephone Company has been incorporated, capital stock, $2,000. Incorporators: L. H. Robertson, Thomas Meadows, C. L. Miller.

CHICAGO, ILL.—The council committee on gas light and electric light has recommended for passage the ordinance asked by the United Telegraph, Telephone & Electric Company, by which that company can extend its service to all parts of the city. It now has a small exchange in the district known as Hyde Park.

MOORESVILLE, IND.—The Mooresville Home Telephone Company has increased its capital stock from $10,000 to $25,000. The company proposes to extend its line and service to Edgerton, and make other extensions.

CONVERSE, IND.—A stock company composed of business men has been organized with a capital of $25,000 to purchase and operate the Converse telephone plant, owned by H. S. Bowers. The price paid is $8,000. The telephone lines will be extended and the plant otherwise improved.

INDIANAPOLIS, IND.—The strike among the local telephone linemen has assumed a serious phase. For four weeks they have held out and commanded the field against all comers. Last week the telephone companies procured police powers for a number of "watchmen." These "watchmen" turned out to be electricians and were put to work stringing wires and repairing telephones. The strikers are alleged to have assaulted a workman who resisted by using his revolver. A striker was shot in the shoulder. The police powers have been revoked and the whole matter submitted to labor commissioner McCormack, who will endeavor to bring about a settlement of the trouble.

WABASH, IND.—After twenty-five years of service in this city the Central Union Telephone Company has abandoned the local field. The company's franchise expired by limitation a few days ago and no new application for a renewal was made. The business of the company has dwindled until the plant was operated at a considerable loss each year, the Home Telephone Company taking practically all the valuable connections. When the Home Company's independent service was established seven years ago, the Central Union gave service substantially free, but in spite of the free competition the independent company thrived and a year or more ago the Central Union returned to the old rates, which are 50 per cent. higher than its competitor's, with the result that it got no new business and lost nearly all of the old. It is semi-officially announced that the company will maintain a toll station here.

CHICKASHA, I. T.—The El Reno & Topeka Telephone Company, which has just absorbed the Chickasha local exchange and toll line system, will make many improvements. A new distributing board, new cable to all terminals, new toll line board and a metallic circuit to Anadarko will be put in at once. W. D. Devarney, general superintendent, will remain in charge for the present.

ANITA, IA.—The Rural Telephone Company has purchased the line of the Musson Brothers.

CRESTON, IA.—The Creston Mutual Telephone Company has increased its capital stock to $100,000.

CHARTER OAK, IA.—A new telephone company has been formed here with a capital of $10,000.

DALLAS CENTER, IA.—The Farmers' Telephone Company has been incorporated with a capital stock of $20,000.

WASHINGTON, IA.—The Washington Telephone Company, L. D. Robinson, president, has been incorporated with a capital stock of $50,000.

WICHITA, KAN.—The Wichita Independent Telephone Company has been incorporated, among the directors being F. L. Brown. The capital stock of the company is $200,000.

NICHOLASVILLE, KY.—The Jessamine Telephone Company has been incorporated with a capital of $30,000.

VERSAILLES, KY.—The Cumberland Telephone & Telegraph Company has applied for a telephone franchise in this place.

WHITESBURG, KY.—Citizens of this town are organizing the Whitesburg Telephone Company and will install a local exchange at once.

CORUNNA, MICH.—The Laingsburg Telephone Company has been incorporated with a capital stock of $2,500.

BAINBRIDGE, MICH.—The Bainbridge Telephone Company with a capital stock of $2,000 has been incorporated.

WATERLOO, MICH.—The Rural Telephone Company has a 100-drop board and 265 subscribers at $12 per annum.

SAUGATUCK, MICH.—The Saugatuck & Gauger Telephone Company operates four boards of 50 drops each and one of 75. The subscribers number 190.

JACKSON, MICH.—The Citizens' Telephone Company operates 1,650 drops of a 3,000-drop switchboard; has 1,950 subscribers and 75 miles of toll line. Rates are $30 and $18.

PLYMOUTH, MICH.—The Plymouth Telephone Company has outgrown its capacity and will soon install a large board. It will soon have connection with every independent line in the state. There is now a 120-drop board, 155 subscribers, two toll lines, 20 miles of farmers' lines and more projected.

KIBBIE, MICH.—The Kibbie Telephone Company is just finishing a toll line connecting its system with Schoolcraft. It has a fine new office at Paw Paw with over 200 subscribers. A new switchboard is ordered for this place which has between 700 and 800 subscribers and 300 miles of toll line. Rates are $15.

IRON MOUNTAIN, MICH.—The Menominee Range Telephone Company is extending a copper metallic line to Pembine, Wis., to meet the Wausaukee Telephone Company and get service to Menominee, Mich.; Marinette and Green Bay, Wis., a distance of 90 miles. The company has a 300-drop board, 500 subscribers and 45 miles of toll line. It has 11 exchanges and two toll stations.

ST. JAMES, MINN.—A telephone franchise has been granted here to the Minnesota Valley Telephone & Telegraph Company.

MAZEPPA, MINN.—The Mazeppa Telephone Exchange, owned by Mr. J. W. Kingsley, has a 100-drop board and 50 subscribers.

WASECA, MINN.—The Waseca Telephone Company operates a 200-drop Kellogg board, with 178 subscribers and 15 miles of toll line.

MANKATO, MINN.—The Citizens' Telephone Company will construct a line from here to St. Clair and from Lake Washington to Madison Lake.

FRANKLIN, MINN.—The Franklin Local & Rural Telephone Company has been incorporated with a capital stock of $15,000, by H. B. Cole and others.

HENDRUM, MINN.—The Hendrum Telephone Company has been incorporated with a capital stock of $5,000, Mr. V. H. Moffatt being among the directors.

HASTINGS, MINN.—The Hastings Telephone Company has a 200-drop board, 220 subscribers and 15 miles of toll line, the rates being $1 and $2 per month.

LAKE CITY, MINN.—Mr. G. M. Dwelle expects to add 150 new subscribers during this summer to his rural service in the towns of Glasgow, West Albany and Lake.

CHATFIELD, MINN.—The Peoples' Telephone Company has 28 subscribers and many miles of toll line in several directions, besides connecting with the lines of other companies.

LONG PRAIRIE, MINN.—Minnesota Central Telephone Company operates a 150-drop board and has 116 subscribers. There are 2,000 miles of toll line and great improvements are contemplated. Metallic circuits will be built.

AUSTIN, MINN.—The Interstate Telegraph & Telephone Company is just commencing to build a full cable system; no bare wires to be in the city. It will install a central energy switchboard capable of taking care of 1,600 subscribers and will connect with many small towns.

GRAND MEADOW, MINN.—The Home Telephone Exchange which is owned and managed by Mr. C. F. Greening operates a 100-drop board and 200 subscribers. There is more demand for extensions than can be furnished, but it is the intention to cover this territory thoroughly. Farmers are very anxious for service. Rates are 10c. for five minutes, $12 per year.

MINNEAPOLIS, MINN.—The Twin City Telephone Company has 33,600 switchboard capacity, 9,500 subscribers and 500 miles of toll line. Rates are $30 and $48. This company is growing steadily at the rate of 300 subscribers per month, and is building toll lines in this state. It expects to build main trunk lines in Minnesota, North and South Dakota in the next two years.

HOUSTON, MISS.—This station is owned by Messrs. Williams Bros. It has a 25-drop board with six subscribers and 70 miles of toll line.

TUPELO, MISS.—The Amory & Tupelo Telephone Company has been incorporated with a capital stock of $10,000. Mr. R. E. Camp is one of the directors.

OXFORD, MISS.—The Oxford Telephone Company operates a 225-drop board and has 210 subscribers with 25 miles of toll line. The entire system was rebuilt last year.

PONTOTOC, MISS.—The Alabama, Mississippi & Tennessee Telephone Company has all its lines grounded. There is a 100-drop board, 70 subscribers and 140 miles of toll line.

LEXINGTON, MISS.—The Lexington Improvement Company is now putting in a new cable. That it is prospering is evidenced by the fact that a ten per cent. dividend was declared at its recent meeting.

MACON, MISS.—The Macon Electric Telephone & Water Works Company has just begun operations under a new ownership. The switchboard capacity is 100 drops. It has 95 subscribers and 500 miles of toll line, with 200 miles more projected.

BOONEVILLE, MISS.—The Booneville Electric Light & Power Company operates a 100-drop board with 258 subscribers and 156 miles of toll line. The company expects to double its system this year owing to the great demand for telephones.

YAZOO CITY, MISS.—The Mutual Telephone Company operates a Kellogg 400-drop board and 460 subscribers. It owns 100 miles of toll line and has 350 outside, besides 100 more projected. The company is very prosperous and has large territory to work over.

COLUMBUS, MISS.—The Citizens Tel. & Tel. Company operates in Columbus and Aberdeen with a 400-drop capacity in Columbus and 200 in Aberdeen; and 398 and 235 subscribers respectively, with 320 miles of toll line. Extensions to Memphis, Tenn., and Birmingham, Ala., are projected. The Columbus company connects with other independent exchanges within a radius of 60 miles and a number of farmers' lines.

EDINA, MO.—Mr. E. B. Berberet operates the exchange here. He has a 200-drop board and 115 subscribers, with 11 miles of toll line.

FAIRFAX, MO.—The Fairfax Telephone Company operates a 200-drop board has 350 subscribers, and is about to build 175 miles of party lines.

FREDERICKTOWN, MO.—The Citizens Telephone Company operates a 225-drop board, has 200 subscribers and 40 miles of toll line. Rates are 15c. and 25c.

BOWLING GREEN, MO.—The Bowling Green Telephone Company has a 250-drop board, with 200 in use. There are 190 subscribers at $12 and $24 per year.

ELY, MO.—Sidney Corder is one of the directors of the Union Valley Telephone Company, which has been incorporated here with a capital stock of $1,000.

KEARNEY, MO.—The Stromberg-Carlson Telephone Manufacturing Company has recently sold the Kearney Telephone Company, of Kearney, Mo., a 100-drop switchboard and 200 telephones.

EVERTON, MO.—Nearly all farmers in this district have a telephone in their houses. The Everton Telephone Company operates a 100-drop board, has 50 subscribers and 25 miles of toll line. A new exchange is to be built.

CALIFORNIA, MO.—The California Telephone Exchange has a 250-drop board, 175 installed and 175 subscribers. There are 100 miles of toll line. The Kinloch system of St. Louis is building a trunk toll line through here.

CLINTON, MO.—The Missouri Union Telephone Company operates a 500-drop board in Clinton, 200 in Windsor, 550 subscribers in the former, 250 in the latter place. A new 600-drop board is to be put in, also 6,000 feet of cable.

HUNTSVILLE, MO.—The Huntsville Telephone Company operates 250 drops of a 300 capacity switchboard; has 214 subscribers and 25 miles of toll line. This company has been steadily increasing since it commenced operations three years ago.

EXCELSIOR SPRINGS, MO.—The Citizens Telephone Company has 400 switchboard capacity, 370 installed, 362 subscribers and 65 miles of toll line. Five hundred additional telephones are to be installed. Fifty miles of metallic toll lines are under construction. The charge is $1.50 per month, 10 telephones to the line.

BOLIVAR, MO.—The McKee-Drake Telephone Company and the Bolivar Exchange are both the property of Mr. J. C. McKee. A 220 drop board supplies service to 100 subscribers of the former and 400 of the latter. An increase of 100 miles is projected by the company and [illegible] more subscribers are to be added at once.

CALHOUN, MO.—The Tebo Telephone Company operates a 100-drop board, has 90 subscribers at $9 to $12 and has recently added farmers' lines with 15 subscribers. The company intends building a toll line to Thrush, a neighboring village, and installing an automatic switch to connect several farmer lines at $12 per year.

WINDSOR, MO.—The Missouri Union Telephone Company has exchanges at Windsor, Calhoun and Clinton. Extensive farm line connections are being made in Henry, Johnson and Benton counties. The farmers pay an installation fee of $25 and $1 per month afterwards. There is a 200-drop board here, with 250 subscribers and 100 miles of toll line.

BUTLER, MO.—The proprietor of the Butler & Rich Hill Telephone Exchanges operates a 300-drop board at the former place and 200 at the latter. There are 395 subscribers, 77 miles of toll and farmers' lines. Mr. Reinheimer proposes using $25,000 for building up the systems and will have long distance connection with the Kansas City independent system, which again will give connection with Chicago, St. Louis and all eastern cities.

BOZEMAN, MONT.—The West Gallatin Telephone Company has 15 miles of toll line and 15 subscribers. This line is connected with the Rocky Mountain Bell Company.

LEWISTON, MONT.—The Lewiston Telephone Company handles also the business of the Lewiston & Grass Range Telephone which has 12 stations. The former operates a 200-drop board with 165 subscribers, has 240 miles of toll line with 37 offices.

YORK, NEB.—The York Independent Telephone Company has increased its capital stock from $50,000 to $500,000.

ST. EDWARD, NEB.—The Shedee Independent Telephone Company has been incorporated in this place with a capital stock of $10,000.

ALBION, NEB.—The Albion Telephone Company operates a 200-drop board, has 200 subscribers and 16 miles of toll line. Improvements are projected.

BROKEN BOW, NEB.—The Central Telephone Company operates a 260-drop board, has 275 subscribers and 700 miles of toll line. Farmers rates are $1 per month. A new exchange at Ansley has just been completed and many farmers' lines are being constructed.

PLATTSMOUTH, NEB.—The Plattsmouth Telephone Company has 1,000 subscribers and 175 miles of toll line. An increase of line into Lincoln, Neb., is projected. There is a great demand for independent telephone systems in this state and Iowa. Omaha and Council Bluffs offer attractive conditions to large independent systems.

CHADRON, NEB.—Mr. W. T. Wilson informs us that he started his line four years ago. This season he has built 100 miles of toll line and expects to build 75 more. He cannot supply the farmers' demands fast enough. The Chadron Telephone Company, of which he is owner, has developed into a fine property; operates a 100-drop board with 150 subscribers and has 340 miles of toll line.

ROSWELL, N. M.—The Roswell Telephone & Mfg. Company operates a 400-drop board and 300 subscribers, 10 long distance, with 35 miles of toll line.

CARLSBAD, N. M.—An electric power, light and telephone system is operated here. The latter has a 200-drop board and 140 subscribers; 40 miles of copper line and 65 miles of fence line. More toll lines are projected.

SCOTCHTOWN, N. Y.—The Citizens' Telephone Company has a three-drop board, 18 subscribers and 15 miles of toll line.

CORINTH, N. Y.—The Corinth Telephone Exchange operates a 60-drop board and has 78 subscribers at $15 and $18 per year.

HANCOCK, N. Y.—The Kelsey & Bannersville Telephone station has a five-drop board and 18 subscribers with five miles of toll line.

PENN YAN, N. Y.—The Friend Telephone Company has been incorporated with a capital stock of $5,000, among the directors being J. K. McConnell.

WAYNE, N. Y.—The Wayne Telephone Company is a short connecting link with Keuka on the Bell line. It has two miles of toll line and 11 subscribers.

SCHROON LAKE, N. Y.—The Schroon Lake & Crown Point Telephone Company operates a 60-drop board, has 100 subscribers and 40 miles of toll line. Rates are $12 and $18.

DOWNSVILLE, N. Y.—The East Branch Telephone Company has 36 subscribers and 38 miles of toll line. This company was organized for the accommodation of the stockholders and will pay about six per cent. on the investment.

ARCADE, N. Y.—The Wyoming & Cattaraugus Telephone Company operates a Eureka 50-drop board and has 185 subscribers and 18 miles of toll line. It has just closed a contract with the Inter-Ocean Telephone & Telegraph Company of Buffalo for outside connections, and toll service into Buffalo and other points.

WELLSVILLE, N. Y.—The Wellsville Telephone Company has just installed a new switchboard, common battery system which is giving very satisfactory service. There is a 200-drop board supplying 235 subscribers and connection is made with the Inter-Ocean Tel. & Tel lines. Rates are $20 and $12 The subscription list is growing rapidly.

CANANDAIGUA, N. Y.—The Peoples' Telephone Company has increased its capital stock from $8,000 to $25,000. The additional capital will be used in extensions along the shore of Canandaigua Lake and into the towns of Gorham and Hopewell. At the recent meeting of the company, officers were elected as follows: President, H. W. Blake; vice-president and superintendent of construction, John Litzendorf; secretary, G. B. Hemenway.

WAYLAND, N. C.—The Wayland Independent Telephone Company operates a 100-signal 12-bell switchboard; has 100 subscribers and 10 miles of toll line. It has a common battery system.

ELIZABETH CITY, N. C.—The Norfolk and Carolina Telegraph & Telephone Company operates 135 miles of toll line at an average rate of 25c., and is now constructing a 50-mile extension. The company was formed in 1902 to take over the properties of the Camden Telephone Company and the Portsmouth & Cornland (Va.) Telephone Company. Since then it has increased the former 30 miles; extended circuits to Edenton (30 miles) and will soon complete to Moyock (30 miles).

WALHALLA, N. D.—The Northwestern Telephone Company will extend its lines from Langdon to Hanna.

CASSELTON, N. D.—Mr. C. R. Meredith started a telephone line here three years ago with 44 instruments. Now there are 200 subscribers getting service from a 150-drop board and 40 miles of toll line. Rates are $1.50 and $2.

HELENA, OHIO.—The Helena Telephone Company has a Eureka 50-drop board and 100 subscribers.

FITCHVILLE, OHIO.—The Clinton Air Line Telephone Company has been incorporated by S. M. Sly and others, with a capital stock of $6,000.

OXFORD, OHIO.—The Oxford Telephone Company has secured a franchise for four lines to extend from Oxford to Collinsville, Jacksonboro, Somerville, Reiley and Hamilton.

SPRINGFIELD, OHIO.—The United States Telephone Company is building new long distance lines between Kenton and Springfield. The new exchange in Springfield will be ready for operation in the near future.

CINCINNATI, OHIO.—The United States Telephone Company is extending its long distance lines to the city limits of Cincinnati. This is taken to indicate that the independent people have strong hopes of building an exchange in the city in the near future.

ALBANY, OHIO.—The Albany Home Telephone Company operates a Kellogg switchboard of 2,160 drops. It has 2,000 subscribers. Connection is made with the long distance company now being built here. Rates, $48 and $24. The switchboard capacity is to be increased to 3,360 lines.

DAYTON, OHIO.—The Montgomery County Telephone Company has been incorporated with $20,000 by L. Raugh, H. C. Kiefaber, J. T. Barlow, Edward Canby and others. The company will build telephone lines throughout Montgomery County and will operate in connection with the Dayton Home Telephone Company.

CLEVELAND, OHIO.—The directors of the United States Telephone Company have decided to make a new issue of $500.000 of 6 per cent, preferred stock. The stock of this company is owned wholly by the Federal Telephone Company and the new issue will be used to liquidate certain of the debts of the latter company.

PORTLAND, ORE.—The City Council has sustained the mayor in his veto of the ordinance granting a franchise to the Hoosier Telephone Company. A new franchise ordinance will be passed with provisions regulating the rate to be charged and limiting the time of completion. The managers of the new company say they are now ready to contract for the erection of wires and construction of the system which is to cover 21 counties.

OTTAWA, ONT.—The thriving towns of Port Arthur and Fort William, at the head of Lake Superior, are eminently satisfied with the principle of municipal ownership, having given it a thorough test not only as to water works and electric light, but also latterly in the matter of a telephone service. Fort William installed its own telephone system, in opposition to the Bell Company in December last. The central energy system was put in at a cost of about $15,000, including central equipment, poles, lines, and telephone boxes complete. There are already some 350 subscribers and the present income derived amounts to $5,000 per year at $1 per month for domestic and $2 for business telephones. The apparatus was furnished by the International Telephone Company, of Chicago. Port Arthur, which is three miles distant from Fort William, has a similar system and there is free exchange between the two towns. By parliamentary enactment neither town may sell, lease or impair its system without the consent of the majority of ratepayers of both towns. The cost of maintaining the system is not over $3,500 per annum for each town, which also includes interest and sinking fund payments on 20-year debentures, provision for depreciation of plant and operating expenses. It is fully expected that by the end of the current year, the system will be earning from $1,000 to $1,500 net profit to each of the towns.

ROBY, TEX.—The Orient Telephone Company has been incorporated by A. L. Green and others. The capital stock is $20,000.

PARIS, TEX.—The American Long Distance Telephone Company has been incorporated here with a capital stock of $50,000. Mr. A. H. O'Neill is one of the directors.

SHREWSBURY, VT.—The Cuttingville & Shrewsbury Telephone Company has 15 subscribers and 10 miles of toll line. It rents instruments from the New England Telephone Company for the privilege of switching on to its lines.

POMFRET, VT.—The Union Telephone Company owns 20 miles of toll line and has 28 subscribers. It is a private concern, mostly farm lines, extending to stores, post offices, railroad stations, doctors, etc., for the convenience of the subscribers.

NEBAGAMON, WIS.—A local telephone company has been formed at this place.

PLEASANT PRAIRIE, WIS.—The Pleasant Prairie Telephone Company has been incorporated with a capital stock of $3,000. Mr. H. Crowe is one of the directors.

MILWAUKEE, WIS.—The Diamond Grove Telephone Company of Miflin has been incorporated with a capital of $1,000. Mr. H. A. Rundell is one of the directors.

ELECTRIC LIGHT AND POWER.

OZARK, ALA.—Bids are wanted by Marion McDonald, Supt. Water Works, for the construction of an electric light plant, to cost about $8,000. Bids will be received for the entire contract, or for all material at a specified price for the city to install.

CORONA, CAL.—F. C. Cooper has applied for a franchise for an electric light and power plant.

SAN FRANCISCO, CAL.—The California Power & Development Company has been incorporated to supply certain sections of the State with electrical and water power; capital, $2,000,000. Directors: K. H. Plate, of San Jose; J. I. Hohn, of Oakland; R. E. Filcher, of San Francisco, and others.

GLENWOOD SPRINGS, COLO.—The Colorado Power & Irrigation Company has been incorporated with a capital of $5,000,000. It will receive its power from Shoshone Falls, nine miles east of Glenwood Springs, and expects to secure 40,000 horse-power. At first power will be supplied to Leadville, Aspen and the surrounding towns, but later will be transmitted to Denver. Incorporators: Albert Sherwin, Leadville; J. R. De Remer and E. E. Lucas, of Glenwood Springs.

NEW MILFORD, CONN.—A bill has been passed in Legislature authorizing the New Milford Power Company to erect a dam at Gaylord's Bridge on the Housatonic River.

GRIFFIN, GA.—The citizens have voted to issue $100,000 bonds for lights, water and sewerage.

SAND POINT, IDA.—The Sand Point Electric Company is reported incorporated, with a capital of $25,000, by T. C. Marshall, R. G. Rowland and M. R. Rutherford.

CHERRY VALLEY, ILL.—It is reported that C. K. Luhman contemplates constructing an electric light plant.

ALTON, ILL.—The city is preparing to re-let the city lighting contract for another year, a long time contract with the Alton Railway, Gas & Electric Company having expired.

BEDFORD, IND.—It is stated that the Bedford Electric Light & Power Company contemplates extensive improvements.

LOGANSPORT, IND.—The city council has ordered the city clerk to advertise for bids for the furnishing of two high-pressure boilers for the electric light plant, each having a capacity of 350 horse-power.

BUTLER, IND.—This city has purchased the local electric lighting plant of W. H. McIntire for $9,400. In consequence of the sale the injunction suit brought by McIntire has been dismissed. The plant will be operated as a municipal venture.

CONVERSE, IND.—A stock company has been organized here to purchase for $6,000 the local electric light plant. The company will build a new power-house and operate the plant in connection with the telephone system, which it has also acquired.

RICHMOND, IND.—The report of the municipal electric lighting plant for the year ending May 31, shows that the receipts have been a little more than expenses, notwithstanding the temporary loan made for its betterment. Mayor Zimmerman opposes the employment of a general manager on the ground that it would add another name to the pay roll, and make it that much harder to show a profit. The commissioners are capable of handling the plant without a general manager, he says.

DES MOINES, IA.—The Edison Electric Light Company is having plans prepared for an extension to the east wing of the Center Street dam, at a probable cost of $50,000.

HORTON, KAN.—The Horton Water & Light Company, of Horton, has been incorporated, with a capital of $60,000.

JACKSON, KY.—The Jackson Electric Light & Power Company is stated to has secured a charter to operate an electric light plant in Breathitt County, Ky., and other places; capital, $25,000. Incorporators: Louis B. Dailey, M. Mitchell and others, all of Jersey City, N. J.

GREENFIEL,D MASS.—The Greenfield Electric Light & Power Company is stated to have purchased water power at Gardner Falls, and will expend about $75,000 in the construction of a dam, canal and power plant.

MERIDA, MEXICO.—A large electric light and power plant is being installed here by the Siemens & Halske Company. It will replace the plant of the company which recently went into bankruptcy.

GUANAJUATO, MEXICO.—It is stated that the Guanajuato Power & Electric Company will have its great electric plant completed by August 1 of this year. The falls where the plant is being built and where the electrical energy will be generated are situated on the Duero River, near the city of Zamora, a distance of 110 miles from this city to which place the transmission lines will extend. H. H. Filley is chief engineer. The copper cables will rest on steel towers, each 46 feet high. These towers have already been erected.

ONTONAGON, MICH.—The Diamond Match Company will install an electric light plant.

BOYNE, MICH.—E. A. Stowe and C. C. Follmer, of Grand Rapids, are reported interested in the construction of an electric light and power plant at Boyne.

BOONEVILLE, MISS.—The Booneville Electric Light & Power Company operates a 100-drop board with 258 subscribers and 156 miles of toll line. The company expects to double its system this year owing to the great demand for telephones.

BOZEMAN, MONT.—The People's Electric Light & Power Company, of this place, has filed articles of incorporation. The capital stock is $50,000 and the incorporators are F. L. Benepe, George Flanders and G. L. Hogan.

FORT STANTON, NEW MEX.—An electric light plant is to be installed here. M. H. Fisher is interested.

PENN YAN, N. Y.—The Village Trustees are reported to be considering the question of installing an electric light plant.

NIAGARA FALLS, N. Y.—Bids are wanted by the Toronto & Niagara Power Company for a power wheel pit. It will be 480 feet long, 180 feet deep, and 27 feet wide, cut through solid rock. It will cost about $1,250,000, and will develop 225,000 horse-power.

LEXINGTON, N. C.—The Lexington Water & Light Company, capital $75,000, has been chartered by F. W. Subert, of Waterbury, Conn. W. G. Penry and others.

PORTSMOUTH, OHIO.—L. E. Smith and others are stated to have petitioned for a franchise for a lighting plant.

WILLIAMSBURG, OHIO.—The village has voted favorably on a proposition to issue bonds for the purpose of building a municipal lighting plant. Plans are being prepared.

BAKER CITY, ORE.—The Rock Creek Power & Transmission Company has commenced work on the installation of an electric power plant at Rock Creek. The incorporators are Al. Welsh, A. Lennox, W. H. Shumaker and W. H. Gilbert. Power will be transmitted to this city for the operation of its lighting and street railway systems. A site for the plant has been purchased and the necessary machinery has been ordered from the East.

LEBANON, PA.—The Edison Company has secured the contract for lighting the city for ten years at $79.92 per light per year for arc lights and $16.80 for incandescents.

LEXINGTON, S. C.—The Lexington Water Power Company has applied for a charter. The capital will be $50,000. C. G. Guignard, G. A. Guignard and others are interested.

SAN ANTONIO, TEX.—W. H. Weiss has petitioned the City Council for a franchise for an electric light plant.

KYLE, TEX.—T. C. Johnson, of San Marcos, writes that it is proposed to construct an electric light plant to light oil mill property.

BAY CITY, TEX.—The Bay City Ice, Light & Power Company has been organized here with a capital stock of $50,000. I. Marks is president.

CLARKSVILLE, TEX.—The Clarksville Light Company has been organized here for the purpose of installing an electric light plant. It has a capital stock of $30,000. The incorporators are B. S. Silvey and W. H. Miller, of Clarksville; R. W. Wortham, of Paris, Texas.

PETERSBURG, VA.—It is stated that the Virginia Passenger & Power Company will build a dam across Appomattox River west of the dam above Ferndale Park.

SPOKANE, WASH.—The Washington Water Power Company will construct an electric plant at Post Falls, to cost $500,000.

ONALASKA, WIS.—The City Council has granted the La Crosse Gas & Electric Company a franchise to install an electric lighting system in Onalaska.

INDEPENDENCE, WIS.—The Village of Independence will receive bids July 14 for constructing a complete electric light building, pole line, 70-h.p. boiler and engine and 40-kw. dynamo and switchboard.

THE ELECTRIC RAILWAY.

SANDERSVILLE, GA.—The City Council has granted a franchise for the building of an electric railway between Sandersville and Tennille. The promoters of the enterprise are Jeff. A. Irwin and Lake B. Holt.

HONOLULU, HAWAII.—The Public Works Department has approved of the plans of the Rapid Transit Company for its proposed street car route along the water front.

ALTON, ILL.—Announcement has been made of the proposed consolidation of the Alton & East Alton Railway & Power Company and the Alton Railway, Gas & Electric Company.

CHICAGO, ILL.—The directors of the Northwestern Railway have decided to make the extension to Ravenswood an elevated structure the entire distance. The extension will be a little over one and three-quarters miles long and the cost will be about $1,300,000. The money will be obtained through a sale of bonds.

CHICAGO, ILL.—The South Side Suburban Railway Company has been incorporated with a capital stock of $50,000. The incorporators and first board of directors are Cornelius J. Ton, Charles C. Heisen, Frederick C. Bendle, Clayton R. Taylor and Gustav Nelson, of Chicago. It is proposed to construct a road from a point in the City of Chicago to the boundaries of Cook County.

EAST ST. LOUIS, ILL.—The Interstate Transit Co., of East St. Louis, which formerly conducted automobile traffic on the Eads Bridge, has secured a 50-year franchise for an electric light and power plant on the East Side. The company, of which L. G. McNair, of St. Louis, is president, agrees to give the city of East St. Louis two per cent. of its gross earnings during the first ten years of the life of the franchise and five per cent. during the succeeding ten years.

NEW YORK, N. Y.—The Escalator at the Twenty-third Street station of the Sixth Ave. Elevated Railway, which has been shut down recently has now resumed regular operation. Some time ago the motor driving the escalator was connected to take current from the third rail. It was found, however, that the voltage fluctuates over a considerably wider range than had been anticipated and the shut down was necessary in order that alterations might be made in the motor to secure better speed regulation.

NEW INDUSTRIAL COMPANIES.

THE UNDERWRITERS' ELECTRIC COMPANY, Chicago, has been incorporated, with a capital of $2,500. It is proposed to manufacture electrical apparatus. The incorporators are F. S. Munro, J. Hall and C. M. Thompson.

THE WELLINGFORD MICA & MINING COMPANY has been established at Ottawa, Ont., with a capital of $500,000. The directors are all Americans. They are Messrs. Shirley, Seamans, Gibb and Floyd, all of Boston, Mass. The company is incorporated under the laws of the State of Maine. The product of the company's mica mines, which are situated near Ottawa, will be principally manufactured for electrical purposes.

LEGAL.

TIME RECORDERS.—On June 30, 1903, U. S. Circuit Court, Boston, Judge Hale, granted a preliminary injunction against John C. Wilson doing business as the Automatic Time Stamp Company, restraining him from the manufacture and sale of an instrument for measuring and recording elapsed time called "The Timometer" for infringement of patents Nos. 424,291 and 583,320, owned by the Calculagraph Company.

ELECTRICAL WORKERS BOYCOTT ILLEGAL.—Attorney-General Bell, of Texas, and District Attorney Bee, of Bexar County, in that State have brought suit against the Electrical Workers' Union, of San Antonio, Texas, under the Anti-Trust law for $6,000 penalty for conspiracy and an injunction to prohibit a boycott by the union or its members. When the Anti-Trust law was passed, the labor unions protested against it, declaring that it would operate unfavorably against them, and they asked that they be exempted from the provisions of the statute. Gov. Lanham opposed this and expressed the opinion that the law could not interfere with workingmen in their rights and privileges. The suit brought by the Attorney-General shows that these rights do not include the boycott. The present case arose over the boycott of the Herf Building, a big business block in the best business part of the city, which was boycotted by the unions because the electric wiring was done by a firm that was on the union's unfair list. Negotiations were pending for the lease of the building when the parties who wanted to lease were notified by the unions they would be boycotted if they attempted to do business in the structure. This threat caused the proposed lease to fall and no man or firm will now lease the block. The matter was placed before the Attorney-General, who at once filed a suit against the boycotting union.

PERSONAL.

MR. S. F. B. MORSE, assistant passenger traffic manager of the Southern Pacific Railway, with headquarters in Houston, Tex., has tendered his resignation, to take effect on Aug. 1. Mr. Morse went to the Huntington lines from the Big Four.

MR. WILLIAM CURRIE, of the Stanley Electric Mfg. Company, who, for some time past, has been at the Pittsfield works as Mr. C. C. Chesney's assistant has been appointed sales engineer of the Chicago office of the company.

MR. H. F. SANVILLE, of Philadelphia, has been fortunate in securing the services of Mr. A. E. Meixell to represent his various lines of street railway supplies throughout the country. Mr. Meixell was, until very recently, superintendent of the Fairmount Park Transportation Company. He has just returned from his maiden trip, on which he met with decided success.

SKINNER & SETHMAN, consulting and contracting engineers of Denver, Colo., have recently secured a contract for installing an electric light and power plant of the Pueblo Insane Asylum. The generating units will consist of two Chase simple engines, direct-connected to 250-kw, 250-volt Crocker-Wheeler generators. The contract includes the wiring of the grounds for 16 arcs and the wiring of the buildings for about 1,000 incandescents, all wires being placed in conduit. Some motors are to be installed later. The contract price is $12,850.

MR. J. D. MAGUIRE, who has been for some time president of the Magnet Wire Company, of New York, has resigned his position with that company and become associated with the National Electric Company, of Milwaukee, Wis., the successor of the Christensen Engineering Company. Mr. Maguire's office is at 135 Broadway, New York. As was announced in these columns recently the National Electric Company was organized by the interests in control of the Christensen Company and took over the control and management of the latter concern. It is now continuing the manufacture of the Christensen Company's air brakes and electrical apparatus. By securing Mr. Maguire's services and experience the National Company acquires an added element of strength in its business organization.

MR. W. E. COREY, president of the Carnegie Steel Company, has just been selected as assistant to President Schwab, of the United States Steel Corporation. In a biographical sketch of his as chemist, laboratory expert, practical manager, etc., the New York *Herald* says: "It was during his administration that the old trouble in annealing plates was corrected. Previously many armor plates had been spoiled by overannealing, which resulted in cracking, and by underannealing. It was largely a matter of guesswork when a plate was properly annealed. This meant the loss of thousands of dollars in the long delays incident to the tardy process of armor manufacture. Mr. Corey sought Professor R. A. Fessenden, of wireless telegraphy fame, then professor of electrical engineering at the Western University, and together they invented a scheme for the introduction of one end of a wire in the annealing furnace, and the exposure of the other end in the cold air outside of the mill. A heat measuring device in the center of the wire told the heat of the furnace. It has since saved small fortunes annually."

OBITUARY.

MR. J. A. HESSE, of Atlanta, Ga., died suddenly in Boston, June 29, while on a business trip to that city. Mr. Hesse had been identified with the commercial side of the electrical industries for many years, and for the past four years represented the Fort Wayne Electric Works in the South. He was very well known to many of the pioneers in the trade and this notice will be read with sorrow by a large circle of friends throughout the United States. The funeral was held at Lima, Ohio, Thursday, July 2.

MR. GEORGE S. MORRISON, the celebrated civil engineer and bridge builder, died last week. He was at one time president of the American Society of Civil Engineers and was well-known among electrical engineers. Five bridges across the Mississippi, ten across the Missouri, and many other important structures are his most fitting monuments. The most important work being the bridge at Memphis, with a single truss span of 790 feet. He served as a member of the Isthmian Canal Commission, as a member of the commission appointed by President Cleveland to locate a deep-water harbor in Southern California, as consulting engineer of the Dock Department of New York, and in other distinguished capacities.

EDUCATIONAL.

OHIO STATE UNIVERSITY.—Prof. H. B. Brooks reports the following graduates in electrical engineering this commencement from the Ohio State University, Columbus, Ohio. F. R. Kunkel, Instrument Standardizing Dept., Westinghouse Electric & Manufacturing Co., Pittsburg. C. B. Ross, with Hoppes Mfg. Co., Springfield, Ohio. R. D. Nye, apprentice, Westinghouse Electric & Mfg. Co., Pittsburg. W. R. Youmans, apprentice, General Electric Co., Schenectady. F. M. Webber, with Ft. Wayne Electric Works, Ft. Wayne, Ind. G. L. Mooney, not located, home address, Woodsfield, Ohio. C. F. Sloctemyer, with Jeffrey Mfg. Co., Columbus, Ohio. H. B. Brooks, laboratory assistant, National Bureau of Standards, Washington, D. C.

Trade Notes.

THE HEINE SAFETY BOILER COMPANY, St. Louis, Mo., has increased its capital stock from $430,000 to $500,000, 60 per cent. of the increase being paid up.

THE ELECTRIC CHAIR COMPANY, of St. Louis, Mo., increased its capital stock from $75,000 to $500,000, $200,000 of the increase to be preferred stock at 8 per cent.

REMOVAL.—The Boston office of the Gould Storage Battery Company has been moved from 53 State Street to more commodious quarters at 89 State Street in the Fiske Building.

THE WESTERN ELECTRIC COMPANY has added two handsome pamphlets to its attractive line of trade literature. No. 3030 is on the subject of sewing machine motor equipments and the other (No. 6005) relates to automatic circuit breakers for direct current. Both catalogues are completely illustrated with half-tone views and diagrams.

THE NORTHERN ELECTRICAL MFG. CO., Madison, Wis., in leaflets Nos. 100, 101, 102 and 103, illustrate the application of Northern motors to the operation of a cement mill; a portable radial drill, the driving of a collar and cuff ironer in laundry work and the driving of a 28-in. lathe, respectively. The principal features of construction of the motors and their adaptability are briefly pointed out.

AMMETERS AND VOLTMETERS.—The Jewell Electrical Instrument Company, Chicago, Ill., in its circular No. 1050, illustrates and describes the Jewell circuit-breaking ammeters and voltmeters, which are designed for the protection of the various forms of electrical apparatus and for the automatic handing of electricity. This device was described and illustrated in our issue of April 4, 1903.

THE C. W. HUNT COMPANY, West New Brighton, Staten Island, N. Y., in pamphlet No. 034, just issued, describes and illustrates very completely the different forms of industrial railways for manufacturing establishments, and in catalogue 035 the subject of coal handling machinery is gone into very thoroughly. The illustrations in both publications show many actual installations and the various types of apparatus, etc., used.

COLORS AND SPECIFICATIONS.—The Joseph Dixon Crucible Company, Jersey City, N. J., is sending out a new folder entitled, "Colors and Specifications." In it are contained five examples of steel and iron construction which have been painted with Dixon's protective paints. The folder contains samples of four colors of Dixon's silica graphite plant for steel and iron construction, tin, iron and shingle roofs. The specifications suggest best methods for construction and maintenance in the painting of steel and iron. This company has had an experience of forty years in the manufacture of protective paint.

PITTSBURG TRANSFORMERS.—The Pittsburg Transformer Company is sending out a circular giving a copy of a letter from the Atlantic Coast Electric Light Company, Asbury Park, N. J., which speaks very favorably of Pittsburg transformers. The point is made that in five years' time not a single Pittsburg transformer has been burned out, nor has any of them caused the slightest trouble. Mr. A. H. Mustard, 120 Liberty Street, New York, is sales agent for the Pittsburg Transformer Company. Mr. Mustard will be very glad to send a copy of this circular to any one interested in the subject of transformers.

THE COPENHAGEN AUTOMATIC FIRE ALARM CO., Sheboygan, Wis., has just issued an interesting and attractive pamphlet descriptive of the "Copenhagen" automatic fire alarm. On the principle that an ounce of prevention is worth a pound of cure this device stands on ground that cannot be shaken. The manufacturers point out how it has saved much valuable property from destruction by the simple function of ringing an alarm when undue heat is present. With so simple a device there seems to be no excuse for permitting property to go unprotected against fire. Everyone interested should look into the merits of the "Copenhagen." A copy of the catalogue tells what it has done and what it will do.

THOMAS E. CLARK WIRELESS TELEGRAPH-TELEPHONE COMPANY, of Detroit, Mich., represented by G. F. Riefstahl, secretary, and Ackling Stirling, exhibited several of its wireless telegraph sets at the recent independent telephone convention in Chicago. One very compact set, intended for schools and colleges, and other light experimental work in wireless telegraph attracted much attention on account of its reasonable price and efficiency. This outfit was contained in two cases about the size of an ordinary dress suit case. The company also makes larger apparatus good for operation up to ten miles. All these sets were shown in working order, one set with a recording tape in connection.

UNDERGROUND CONDUITS.—The American Stone Conduit Company, of Chicago, is manufacturing an underground conduit that is rapidly growing in popularity with electrical and contracting engineers and electric lighting, power, telephone, telegraph and street railway companies. This conduit is made in single duct, 6 ft. lengths, 4½ in. in diameter, with a 3⅛ in. bore, the materials of construction being crushed limestone and the best quality of Portland cement. In the process of manufacture the conduit is subjected to an interior pressure of 3,500 pounds per square inch, giving great strength to the walls and a highly polished inner surface. In a recent pamphlet issued by the company are given six illustrations of actual installations of these conduits, besides others showing the construction of the conduit, method of making joints, etc. The company's office is at 94 La Salle Street, Chicago.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 30, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

731,805. TELEPHONE-NOTATION REGISTER; Joseph P. McKee, Allegheny, Pa. App. filed April 21, 1902.

731,899. ELECTRICAL INDICATOR FOR TELEPHONIC TOLL-COLLECTING DEVICES; Romeo B. Hazlett, Philadelphia, Pa. App. filed Jan. 30, 1902.

732,014. INDUCTION COIL; John Splitdorf, New York, N. Y. App. filed April 8, 1903. A supplemental condenser is used in parallel with the main condenser and the circuit breaker, the purpose being to insure a strong discharge across the points. (Issued June 23.)

732,047. ELECTRODE; William R. Chipman, New York, N. Y. App. filed May 8, 1902.

732,062. POWER TRANSMISSION AND CONTROL; Justus B. Entz, Philadelphia, Pa. App. filed March 29, 1898. (See Current News and Notes.)

732,088. INSULATOR FOR HIGH-TENSION CURRENTS; Karl Selim Lemstrom, Helsingfors, Russia. App. filed September 9, 1902. (See Current News and Notes.)

732,098. CENTRAL-ENERGY TELEPHONE SYSTEM; Kempster B. Miller, Chicago, Ill. App. filed February 4, 1901.

732,114. MAINTAINING SYNCHRONOUS ROTATION OF DYNAMO-ELECTRIC MACHINES; Edwin W. Rice, Jr., and Ernest J. Berg, Schenectady, N. Y. App. filed Aug. 28, 1899. (See Current News and Notes.)

732,130. SYSTEM OF CONTROL FOR ELECTRICALLY-PROPELLED TRAINS; Elmer A. Sperry, Cleveland, Ohio. App. filed Sept. 14, 1898. (See Current News and Notes.)

732,131. SELECTIVE PARTY-LINE TELEPHONE SYSTEM; Albert J. Springborn, Cleveland, Ohio. App, filed June 12, 1901.

732,141. ELECTRIC-ARC LAMP; Christian J. Toerring, Philadelphia, Pa. App. filed June 25, 1902. (See Current News and Notes.)

732,144. TROLLEY; John H. Walker, Lexington, Ky. App. filed March 14, 1902. A construction of harp and wheel hub affording good contact and lubrication.

732,145. TROLLEY; John H. Walker, Lexington, Ky. App. filed Nov. 20, 1902. A modification of the preceding patent.

732,147. TELEPHONE-TRANSMITTER; Mathias Weisser, Milwaukee, Wis. App. filed Jan. 11, 1902.

732,153. INDUCTION MOTOR; Andrew E. Averrett, Schenectady, N. Y. App. filed April 21, 1903. To prevent an initial rush of current at starting, a portion of the secondary winding is made of iron, replacing the usual copper and thus introducing a resistance which keeps the current down.

732,157. ELECTRIC RAILWAY; Arthur B. Bedworth, Boston, Mass. App. filed Nov. 13, 1902. A car entering a block on a single track railway cuts off current from a short section of the track in the block ahead to prevent other cars entering the block from the opposite direction.

732,170. ELECTRIC SWITCH; Theodore O. Chouinard, Quebec, Canada. App. filed June 21, 1902. Details.

732,171. BRUSH HOLDER; Alexander Churchward, Chicago, Ill. App. filed Nov. 13, 1899. The carbon brushes can be removed from the holder and replaced without altering the spring tension.

732,174. AUTOMATIC CUT OUT DEVICE FOR ELECTRICAL TRANSFORMERS; De Witt C. Conkling, Cincinnati, Ohio. App. filed July 2, 1902. Shutting off current from the last lamp, automatically opens the primary circuit, thereby cutting out the transformers and upon again closing the secondary or service circuit at any point, the primary circuit is likewise closed through the transformer.

732,176. COMPENSATING FRICTION IN ELECTRIC METERS; Frank P. Cox, Lynn, Mass. App. filed Jan. 22, 1902. (See Current News and Notes.)

732,182. ELECTRIC ARC LAMP; Richard Fleming, Swampscott, Mass. App. filed Jan. 30, 1901. The principal improvements consist of spring-supports for the magnet spools, spring-connections between the armatures and connecting rods, and a balanced rocker-arm connecting the series and shunt armatures with an adjustable weight to enable the lamp to be adjusted to the proper strength of current.

732,196. TERMINAL SOCKET; Carl Leichtenschlag, Berlin, Germany. App. filed March 10, 1900. A lamp receptacle in which the threaded sleeve has extending portions interlocking with cavities in the porcelain base to fasten it thereto.

732,200. ARMATURE; John A. Little, St. Louis, Mo. App. filed Sept. 20, 1902. An armature core built up of uniform sections, any of which may be readily removed and replaced.

732,201. ELECTRIC CONTROLLER; John A. Little, St. Louis, Mo. App. filed March 16, 1903. Details.

732,204. PHASE TRANSFORMATION; Alexander D. Lunt, Schenectady, N. Y. App. filed June 25, 1900. Consists in combining magnetic fluxes having phase relations corresponding to those of the currents of a polyphase system of a given number of phases and inducing by the resultant fluxes electromotive forces having a different number of phases.

732,235. ELECTRIC MOTOR; Peter Swan, Calcutta, India. App. filed Jan. 13, 1903. The commutator segments have longitudinal holes terminating in enlarged cavities, to receive the ends of the armature conductors.

732,238. AUTOMATIC REGULATOR FOR ELECTRIC GENERATORS; William A. Turbayne, Buffalo, N. Y. App. filed July 19, 1902. (See Current News and Notes.)

732,239. AUTOMATIC REGULATOR FOR ELECTRIC GENERATORS; William A. Turbayne, Buffalo, N. Y. App. filed July 31, 1902. (See Current News and Notes.)

732,240. BRUSH HOLDER; Louis E. Underwood, Lynn, Mass. App. filed May 19, 1902. A construction whereby the pressure on the brush in the direction of commutation and the pressure in the direction transverse thereto are maintained at a definite relation to each other.

732,247. CONTROLLER FOR ELECTRIC MOTORS; Eddy R. Whitney, Swampscott, Mass. App. filed May 2, 1903. A controlling switch adapted to connect the motor across low potential mains to obtain a certain speed and then connect it across higher potential mains, a variable field being used on each circuit to further increase or vary the speed.

732,253. CIRCUIT BREAKER; Henry P. Ball, New York, N. Y. App. filed Jan. 29, 1902. An operating handle for the switch blade which will exert a gradually increasing leverage thereupon.

732,254. CIRCUIT BREAKER; Henry P. Ball, New York, N. Y. App. filed April 18, 1902. Details of the latch-releasing mechanism of an underload circuit breaker.

732,255. OIL-SWITCH; Henry Price Ball, New York, N. Y. App. filed Aug. 18, 1902. (See Current News and Notes.)

732,272. SIGNALING SYSTEM; Harold G. Brown, Melrose, Mass. App. filed Oct. 10, 1902. In railway systems employing a direct current for both power and signal service, the object is to prevent the return current in the rail from operating the signal system when a part of the circuit of the latter includes the rail.

732,273. ELECTROMAGNET; Charles A. Brust, Memphis, Tenn. App. filed Aug. 21, 1902. A special form of magnet intended to remove iron particles from cotton seed as it is fed to the crushing mill.

732,282. ALARM CLOCK; William Edwards, Easton, Pa. App. filed Nov. 7, 1902. A burglar alarm in connection with a lock, the signal at the same time serving as an ordinary door bell.

732,284. TELEPHONE TRANSMITTER; Ernest B. Fahnestock, New York, N. Y. App. filed May 7, 1900.

732,285. TELEPHONE TRANSMITTER; Ernest B. Fahnestock, New York, N. Y. App. filed Dec. 5, 1901.

732,286. TELEPHONE TRANSMITTER BASE; Ernest B. Fahnestock, New York, N. Y. App. filed Oct. 7, 1902.

732,287. TELEPHONE HOOK SWITCH; Ernest B. Fahnestock, New York, N. Y. App. filed Oct. 25, 1902.

732,316. ELECTRIC IGNITER; Albert F. Ganz, Hoboken, N. J. App. filed Jan. 20, 1903. An improvement upon the Le Pontois magneto-sparker whereby each impulse of current generated may be of longer duration than is afforded by the aforesaid device.

732,351. SYSTEM OF MOTOR CONTROL; George H. Hill, Schenectady, N. Y. App. filed April 1, 1903. A hoisting motor in which the field is connected constantly across the supply mains, so that when the armature is short circuited for braking purposes, the field will not be affected by armature currents.

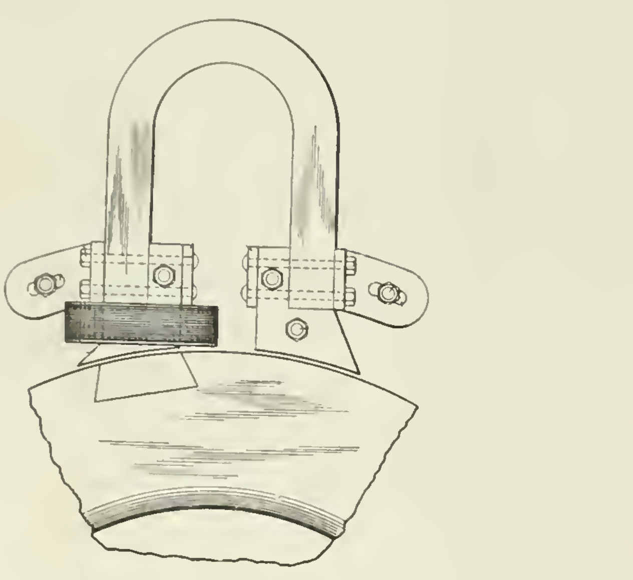
732,364. ELECTRIC IGNITER; Herbert G. Mears, New York, and Henry W. Aylward, Brooklyn, N. Y. App. filed Nov. 10, 1902. An improvement upon the Le Pontois igniter with the object of simplicity of construction.

732,365. IGNITER FOR INTERNAL COMBUSTION ENGINES; Herbert G. Mears, New York, and Henry W. Aylward, Brooklyn, N. Y. App. filed Nov. 10, 1902. A further improvement of the Le Pontois igniter by which the timing of the ignition can be accurately and readily effected.

732,366. ELECTRIC IGNITER; Herbert G. Mears, New York, and Henry W. Aylward, Brooklyn, N. Y. App. filed April 3, 1903. A further improvement in the Le Pontois igniter wherein the pole pieces of the magnet are arranged parallel to the axis of rotation and upon the opposite sides of an inductor in the shape of a disk.

732,371. GENERATOR FOR ELECTRIC IGNITERS; Leon J. Le Pontois, New York, N. Y. App. filed Feb. 15, 1902. The ignition device referred to in above patents and consisting essentially of a rotating magnetic inductor having a cutaway peripheral portion and moved with respect to a coil carried by a stationary magnet so as to generate impulses for igniting the explosive charges in a gas cylinder. The engine fly-wheel is preferably used as the inductor.

732,372. GENERATOR FOR IGNITERS; Leon J. Le Pontois, New York, N. Y. App. filed Aug. 8, 1902. A modification of the preceding invention.



732,371.—Generator for Electric Igniters.

732,377. ELECTRICAL MOTOR; Harold Rowntree, Chicago, Ill. App. filed Nov. 15, 1899. An electric motor having its armature and field simultaneously revoluble in opposite directions, in combination with a hoisting mechanism, driven faster by one of said parts than by the other, and with means whereby the slow-driving part may be actuated and its brake released without releasing the brake of the fast-driving part.

732,410. MANUFACTURE OF SILICON AND ALUMINUM FROM SILICATES OF ALUMINA; Christian Harrebow Homan, Christiania, Norway. App. filed Oct. 13, 1902. (See page 62.)

732,443. TELEPHONE; Fred C. Redfield, Nashua, N. H. App. filed April 3, 1902.

732,449. TELEPHONE TRANSMITTER AND RECEIVER; Oliver P. Sammons, Denison, Tex. App. filed July 14, 1900.

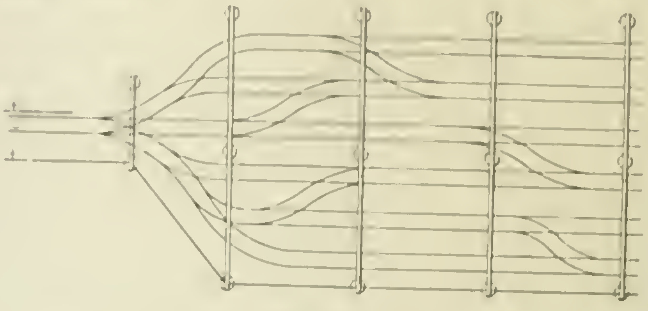
732,477. ELECTRIC SWITCH; Isaac G. Waterman, Santa Barbara, Cal. App. filed Aug. 2, 1902. Details of a push switch.

732,488. ELECTRIC-ARC LAMP FOR CONSTANT-POTENTIAL CIRCUITS; James J. Wood, Fort Wayne, Ind. App. filed June 14, 1902. (See Current News and Notes.)

732,489. RHEOSTAT FOR ARC LAMPS; James J. Wood, Fort Wayne, Ind. App. filed April 25, 1903. (See Current News and Notes.)

732,495. TROLLEY; George I. Aiken, Pittsburg, and George Zimmer, Allegheny, Pa. App. filed April 5, 1903. Details of a device for retaining the wheel on the wire.

732,512. ELECTRIC RAILWAY; Edward C. Boynton, Newburgh, N. Y. App. filed March 5, 1903. In a train or switching yard, the current for the switching engine is carried by overhead rails extending across all of the tracks and the locomotive carries a shoe long enough to bridge from one rail to another, thus receiving current at all times without the necessity of overhead switches.



732,512.—Electric Railway.

732,559. ELECTRIC SIGNAL; George F. Hilton, St. Augustine, Ill. App. filed July 21, 1902. An electric bell is put into circuit with a bond, one terminal of which is insulated from the rail but mechanically connected therewith by the car wheel, the signal being used to indicate the approach of the train.

732,586. SAFETY DEVICE FOR ELECTRIC ELEVATORS; Gustaf T. Rennerfelt, Brooklyn, N. Y. App. filed Sept. 17, 1902. The brake magnet is in series with two circuits, one of which is open while the motor is driven as a generator, while the other is opened whenever the main circuit is interrupted, the object being to prevent the disablement of the brake in case the main circuit is opened while the motor is being driven as a generator.

732,598. CLIP; Louis Steinberger, Brooklyn, N. Y. App. filed Sept. 12, 1902. The connection between the ear which holds the trolley wire and the clip is more or less yielding to provide for strains brought upon the ear by the trolley wheel.

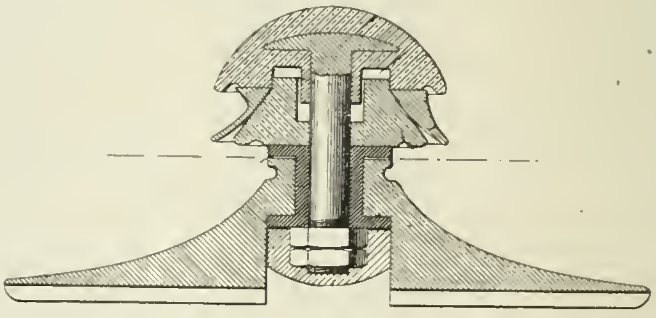
732,599. TURNBUCKLE STRAIN; Louis Steinberger, New York, N. Y. App. filed Feb. 24, 1903. Details.

732,608. ELECTRICAL CONTACT CONTROLLING FLOAT; Isaac G. Waterman, Santa Barbara, Cal. App. filed Aug. 4, 1902. Details.

732,616. METHOD OF APPLYING HEAT TO ELECTROLYTES; Charles Frederick Burgess and Carl Hambuechen, Madison, Wis. App. filed March 12, 1903. (See page 62.)

732,619. CONTROLLER FOR ELECTRIC HOISTS; Philip J. Darlington, Glenridge, N. J. App. filed Oct. 3, 1902. A reversing cylinder controller having a contact adapted to shunt the armature of the motor in downward running.

732,631. ASYMMETRIC CONDUCTOR; Carl Hambuechen, Madison, Wis. App. filed Jan. 19, 1903. (See page 62.)



732,598.—Clip.

732,644. SWITCH FOR DOUBLE FILAMENT ELECTRIC LAMPS; Levi Lobenthal, New York, N. Y. App. filed Dec. 30, 1902. A switch for throwing in either filament as desired.

732,648. TELEGRAPHIC TRANSMITTER; Horace G. Martin, Brooklyn, N. Y. App. filed Oct. 6, 1902. The transmitter is constructed to make all dots automatically, leaving it in the power of the operator to adjust the length of the dot, the idea being to relieve the operator of some of the nervous strain involved in the operation of an ordinary Morse key.

732,654. MEANS FOR MAINTAINING SYNCHRONOUS ROTATION OF DYNAMO-ELECTRIC MACHINES; Edwin W. Rice, Jr., and Ernest J. Berg, Schenectady, N. Y. App. filed Aug. 28, 1899. (See Current News and Notes.)

732,665. INSULATING SYSTEM FOR ELECTRIC TRANSMISSION CIRCUITS; Alvah W. Underwood, Pittsfield, Mass. App. filed Dec. 18, 1902. The main insulator is supported upon a bridge whose ends are fixed to two auxiliary insulators carried by the cross arm.

732,672. ELECTRIC SWITCH; Henry P. Ball, New York, N. Y. App. filed July 6, 1900. The operative parts are constantly immersed in oil and the contacts are separated by insulating partitions to avoid any possibility of a short circuit.

Electrical World and Engineer

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ELECTRICAL WORLD AND ENGINEER.

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THE AMERICAN PACIFIC CABLE.

Closely following the British Pacific cable, the American Pacific cable has been completed, and thanks to the courage and enterprise of the Mackays and the Commercial Cable Company, this country is now in direct communication with all its dependencies and possessions in the Far East. As soon as the next link is carried to the shore of China, we shall have an American cable route of our own all the way to that part of the world with which the destinies of this country are being so closely interwoven, and shall command direct communication with it as freely and instantaneously as now with Europe. The benefits to the United States from this work will be immediate, and in the long run incalculable; and the memory of the late John Mackay will be forever associated with this great and honorable achievement, on which all would have been glad to see him alive to enjoy the congratulations extended to his son by President Roosevelt. Not only can our government at once administer in the Philippines with greater efficiency, but our merchants can save enormously in the time and cost of their cable messages and push their Oriental trade with greater success than ever before. We trust the cable will be profitable, and beg to offer our hearty felicitations to the managers and leaders in this great undertaking, which, in its way, means just as much as the battle of Manila, and is a bloodless, peaceful conquest over the obstacles of Nature for the lasting good of mankind. An interesting reflection is whether this great work would be now completed and so satisfactorily, if those had prevailed who fought so strenuously for government ownership of a Pacific cable. None, we believe, will deny the advantage of private ownership in the case of such a great auxiliary to commerce, and the government should be thankful that it was not burdened with a charge that held possibilities of a kind now being revealed in the investigation of the Postmaster General's department. Indeed, it may be said that Mr. Mackay in taking up the project as a commercial venture, incidentally performed a considerable public service.

THE GROUNDED WIRE AS A PROTECTION AGAINST LIGHTNING.

One of the papers presented at the recent Niagara Falls convention of the American Institute of Electrical Engineers was read by Mr. Ralph D. Mershon on the important question of the protective influence of grounded aerial wires over transmission wires. Lightning is one of the outstanding hazards of electrical transmission which cannot be reduced to simple arithmetic, and for which no reliable estimates can be prepared in advance. Some plants suffer heavily by lightning every year. Others never spend a dollar on the score of injuries due to lightning. Much depends upon the locality of the plant and the topographical conditions.

Mr. Mershon makes a definite attempt to compute the shielding influence which a grounded wire exercises over a working wire in its neighborhood. The computation indicates that a marked degree of shielding may be expected. In a question of this sort, however, theory can only be taken as a rough guide. There is nothing more wonderful than the freaks of lightning. Sometimes lightning seems to delight in bidding defiance to every known law of electromagnetism. The forces invoked are so sudden and so powerful that the phennomena are much more complex than any we deal with experimentally. It is only by accumulating experience and practical observation on the protective value of safeguards against lightning that we can form a reliable estimate of their value. There have been many instances of the use of grounded guard wires over transmission circuits, and the data have been collected to a certain extent. These data seem to indicate a distinct protective influence afforded by the aerial grounded wire. In telegraphy it has long been known that the topmost wires of a number of wires on a pole line were more likely to suffer by lightning than a lower wire, or a single wire. We know that to bury a wire underground is to insure it against lightning disturbance, except for connections with overhead wires. In other words, a subterranean or subaqueous cable conductor, whose terminals were not allowed to reach above ground, would be perfectly safe from lightning. The use of grounded aerial wires over a working wire on a pole line is a rough attempt to bring the ground above the level of the working wire, and ought to have some advantage.

As for the barbed wire, we quite agree with Mr. Mershon that the barbed wire presents no advantage over plain wire. Barbed wire fences may keep out cattle, but they cannot keep out lightning. Even if there were an advantage in barbed guard wires over plain wires, it would have to be a marked advantage to compensate for the great disadvantage of handling and suspending barbed wire. It is awkward to transport, handle and suspend. It is also much more apt to cross mechanically with other wires than a smooth wire. It is difficult to see on what theory the use of barbed lighting guard wire could be supported. It is probably a relic of the belief in pointed lightning rods, and while there has been some argument advanced for sharp points on a lightning rod, this question is a moot point. At all events, we do not find people taking pains to sharpen the tips of their lightning rods every summer, and it is certain that a great many lightning rods act effectively in which the tip has been very blunt.

RAILWAY MOTORS IN SERVICE.

The Niagara paper of Mr. Renshaw, an abstract of which appeared in our issue of last week, is a clearly wrought piece of investigation that ought to set engineers to thinking. The modern railway motor is really a very wonderful machine. Those of us who can run back in memory to the early days of the art realize fully how great has been the improvement, and what important feats of engineering are embodied in the standard railway equipments in use to-day. A railway motor works under manifold disadvantages. It has to stand many and severe overloads and the roughest sort of usage; it is so boxed in to protect it from dirt and moisture that it radiates heat slowly, and it is run so continually that it never gets a chance to really cool off properly. Mr. Renshaw's curves show plainly how severe are the temperature conditions even under average service. The coils may have to work for hours at a temperature of from 80° to nearly 100° Centigrade, and during the rest in the car barn may not get down to within 20° C. of the atmospheric temperature. Mr. Renshaw's method of getting the temperature was certainly effective, and while at times the armature may have risen a trifle higher than the figures recorded, the point investigated in the inside of the field coils probably fairly represents the average conditions. That insulation stands up for a long life under the trying ordeal speaks volumes for its quality.

By an ingenious application of wattmeters, Mr. Renshaw succeeded in getting the mean current corresponding to the service conditions of heating, so that an equivalent load can be fairly determined. But it seems to us that the thing even more necessary than the reduction of the service load to an equivalent uniform load is a supplementary investigation by the same method of heating conditions near the limit of load. Danger to the insulation comes from extreme conditions and the thing of most importance practically is the behavior of the motor when severe overloads are thrust upon it after it has already become severely heated. In one of Mr. Renshaw's curves the effect of this sort of thing is excellently well shown. In this instance a couple of trips were made with a trailer attached, and while the average current for all day was changed by less than 2.5 per cent., the immediate effect was to drive the maximum temperature, which is the real danger factor, up from 75° C. to 98.5° C. It is evident that these overload conditions are specially worth investigating and we hope that Mr. Renshaw will take up the work of doing it.

That standard railway motors are often seriously overloaded in service is tolerably clear, and while the increment of current may not seem especially severe, as shown on the ammeter, the increased heating may be all out of proportion to it. It is by no means impossible that enclosure of the motors has been slightly overdone in some cases, and that a lower maximum value of the temperature could be attained by some special precautions for ventilation. In spite of all the current work of improvement, the service requirements of railway operation more than keep pace, and motors are continually called upon for severer efforts. A more frequent study of the actual conditions in service would give a great deal of valuable information, and the results would, we fancy, often be rather startling. It is not always safe to judge one route by another in selecting motors for the equipment of the line, and according to our experience people seldom err on the side of safety.

STORAGE BATTERY LOCOMOTIVES.

Mr. Sessions' Institute paper is interesting evidence of the change in opinion regarding storage batteries in the last few years. After twenty years or so of struggle the storage battery is now gradually coming into its own. In its earlier days it suffered greatly from the unwise enthusiasm of its friends, from too vigorous exploitation and from inherent defects that could be worked out only by long experience. More than from anything else it suffered by reason of general ignorance of its real properties. Through patient experimenting and at the cost of much time and money, it has come to be understood and each year gains importance as a most convenient and useful auxiliary in many branches of applied electricity. Mr. Sessions has done a useful service to the profession in gathering in convenient and systematic form a large amount of valuable data regarding the storage battery locomotive. That it has manifest advantages in case of industrial railways is beyond dispute. The mere fact that it can run on any track that will support it, permanent or temporary, is a very material advantage, while its freedom from fire dangers allows it to be used in places where an ordinary locomotive could not safely be employed. Data on that exact performance of such machines are presented in a cautious and conservative spirit. Mr. Sessions, indeed, was charged in the discussion with being over-conservative in his claims as to the performance of the batteries, but in the light of past experience over-conservatism on this particular subject should be easily forgiven.

Indeed in one particular we should be inclined to go even further than Mr. Sessions in caution. A one-hour discharge rate is a pretty stiff proposition for any battery to face, and with batteries as they are found in commerce, it is likely to produce more rapid depreciation than economy would dictate. Particularly in the case of locomotives for haulage, where considerable weight is needed for securing the requisite adhesion, we are inclined to think that the discharge rate should be kept low both in starting and running. A battery does so much better work on a 6 or 8-hour discharge rate, to say nothing of lessened depreciation, that it should be kept at about that pace as far as is feasible. Of course, grades and curves have to be taken under unfavorable conditions, but much of the advantage of a storage system is lost if it has to be helped out by a trolley or third-rail system, even in the way of charging while in action. For convenience, a locomotive should have battery capacity enough for its day's work with perhaps a little charging during enforced idleness, and then it can be regularly charged at night. It is hard to reduce this condition to a definite equivalent discharge rate, since locomotive haulage is the most irregular sort of task that could well be imagined, but it corresponds in general to a rather conservative condition. It is interesting to learn that regular charging en route has proved successful, but it strikes us as an inadvisable complication in the ordinary case. As to methods of control, Mr. Sessions is inclined to favor the very simple one of motors in parallel and batteries in four groups, with intermediate resistance steps to soften the shock in passing from one grouping to another. Rheostatic control is rather undesirable in battery working, as was remarked in the discussion, but it seems the lesser evil as compared with the strains put upon the battery by demanding sudden acceleration. Storage batteries have been much improved in life during recent years, but it is still desirable to order their existence after strict hygienic rules.

The Factors Which Affect the Energy Losses in Armature Cores.

A paper embodying a mass of experimental data, including, it would seem, twelve thousand observations, was communicated by Messrs. Esterline and Reid to the recent Niagara convention of the American Institute of Electrical Engineers, a brief abstract of which appears elsewhere in this issue. The object of the investigation was to study iron losses in a small experimental dynamo, under conditions as nearly practical as the small scale of construction would permit. The field ring and the bearings were almost the sole constant portions of the experimental dynamo, the field cores and the armature cores being varied in the different experiments. The number of pairs of poles was varied between one and four, and the pole cores tried were both laminated and unlaminated. The armature was tried both smooth-cored and tooth-cored, and also in several core depths of each type. The miniature dynamo was driven by a little motor through a spiral spring dynamometer, and the increase of torque with dynamo field excitation measured the iron losses under the conditions of each experiment.

The iron losses per unit mass involve both hysteresis and eddy currents. The former increases directly with the frequency, the latter as the square of the frequency. The former also varies as the 1.6th power of the density or gaussage, the latter as the square, approximately. The iron loss thus depends in theory upon two variables in any given structure—frequency and gaussage. But owing to the fact that the gaussage is never uniform throughout the entire cross-section of the armature, the loss depends in practice upon four variables, namely, frequency, average gaussage, depth of armature core and number of poles. Looking at the same facts in another way, the iron losses per unit mass ought to be the same in a shallow smooth-cored armature as in a deep smooth-cored armature, provided that the frequency and average armature gaussage is maintained constant. But in a deep armature the gaussage varies considerably between the superficial layer and the deepest layer; so that the integrated core loss per pound for a given gaussage and frequency will be appreciably greater than in a shallow core in which the gaussage is more nearly uniform, or varies less from the average.

The results of the investigation are expressed graphically in eleven curve sheets accompanying the work. There is not an equation in the entire paper. This analysis and presentation has certain advantages and certain disadvantages. The principal advantages are that the results are readily open to inspection, and are not likely to be influenced by preconceived opinions on the part of the observers. The principal disadvantage is that the results are incapable of being summed up and reduced to explicit statement, without a considerable expenditure of effort on assimilation and digestion. Most of the curves, moreover, are drawn with the independent variable on the line of ordinates and the dependent variable on the line of abscissæ, so that to bring the curves and diagrams to the customary opposite condition, the reader must first hold the page sideways and then inspect it in a mirror, or perform the equivalent operations mentally. It would seem that the curves are susceptible of yielding much information under analytical treatment. Certain inferences are immediately deducible from an inspection of them. Taking the diagram connecting watts per pound as dependent upon frequency, it is evident that the core loss per pound of tooth-cored armatures is 38 per cent. greater than that of smooth-cored armatures for nearly all frequencies up to 120 cycles per second. The range of variation is surprisingly small, being between 35 per cent. at lowest frequencies, up to 41 per cent. at the highest. Each of the two curves may be fairly represented by a linear equation containing only the first and second powers of the frequency, according to theory, and it seems to be a mere chance, depending upon the structural dimensions selected, that this ratio should remain nearly constant.

In the succeeding diagram, connecting core loss per pound with gaussage, the results with the tooth-cored armatures were always about 37 per cent. greater than with smooth-cored armatures at all gaussages above 9 kilogausses. Below 9 kilogausses—that is, for low average densities—the ratio does not remain uniform. The physical interpretation of the result appears to be that the tooth-cored armatures introduce losses in the field poles due both to eddies and hysteresis, following the same generic law as that controlling the losses in the armature core. In the diagram showing the effect of laminating the field poles referred to kilogauss-cycles per second, the loss with unlaminated poles is evidently almost exactly 20 per cent. greater than the loss with laminated poles throughout the entire range of the independent variable. It would be interesting to know how far this ratio of 1.2 would be likely to hold in larger structures in practice. It must be expected to vary with the air-gap and with the armature reaction, as well as with the thickness of the field laminæ; but it is possible that the ratio might not vary widely.

Like all papers that embody a large amount of experimental observation, this paper grows in interest with study; but there seems to be room for another paper on the mathematical analysis of this. The broad generalization to which the paper leads is that in order to secure the great mechanical advantages offered by toothed-core armature construction we not only increase the armature iron losses by about one-third, but we also have to laminate the poles, or else increase the loss again one-fifth. On the other hand, however, tooth-cored construction somewhat tends to reduce air-gap reluctance, and thus enables a slight reduction to be made in field copper loss.

Details of American Street Railway Operation.

In connection with the figures quoted in these pages last week from the United States Census report on American street railways, based on the inquiry conducted last year, a variety of other data of interest may be noted. In fact, while the final report will not make its appearance for some time, there is in the preliminary bulletin such a wealth of material it is particularly difficult to make a selection.

It was already known that electric railways were doing considerable lighting and power business, owing to the operation of incidental apparatus or the ownership of lighting companies that had been thoroughly absorbed. From the Census Bulletin it now appears that the railway companies received no less than $7,703,574 in the year 1901-2 from the sale of current for light and power; while probably a little work of a kindred character is concealed in the miscellaneous receipts of $3,853,420. As to the electric lighting of the cars, it is noted elsewhere in the bulletin that there were 66,784 cars of all classes, of which 62,330 were lighted, and of these 55,673 had electric lights. If the lights were averaged at 10 to the car, it would represent nearly 600,000 lamps in daily service of that nature. More than half the cars are reported as being heated, and of these 10,021 or 63.07 per cent. were warmed by electrical apparatus, and 11,138 or 36.93 per cent. by stoves, hot water, etc. It may be repeated here that of the number of cars, 50,699 had electric equipment, so that many cars, such as trailers, had the benefit of electric lighting. Nor is this all, for the Census Office was careful to inquire as to the extent of electric lighting in the shops, car barns, etc., of the street railway companies, and it appears that no fewer than 5,282 arc lamps and 235,955 incandescent lamps were thus employed.

Returning to the subject of electric lighting, we note that in Table 17 the figures of 118 companies operating light and power plants are brought to account, while Table 18 gives details as to the apparatus. These companies show an aggregate of $6,469,726 from such service, of which $4,074,684 was from commercial lighting and $1,417,985 from public lighting, while no less a sum than $768,040 was earned from motor service. This income was derived from the operation of 33,863 arc lamps, of which 2,582 were open and 13,603 enclosed, in commercial use; and 10,868 open and 6,860 enclosed, in public use. In the way of incandescent lighting there were 1,442,685 lamps in service, of which the vast majority, or 1,313,303 were of 16 c.p.; while all but 19,026 of the larger number were in commercial as distinguished from public, use. As to motor service, the street railway companies report supplying current to 10,049 stationary motors of 35,688-h.p. capacity. There were also 56,601 meters on the circuits. As has been noted, these are the figures given by 118 companies keeping separate accounts that enabled the compilation of these detailed statistics. There were, however, 252 companies which generated current for sale for light and power purposes.

We come now to the power plant figures of the street railway industry. There were 766 companies reporting the use of electricity or other mechanical motive power. The motive power, however, was not all generated in the 805 power-houses shown, as some companies rent motive power from light and power companies.

Steam was used by 540 companies as the primary motive power to generate electric current. The statistics concerning steam power classify the engines according to horse-power. There were, in all, 2,336 engines, with a total horse-power of 1,298,133, or 556 horse-power per engine. Of this number 1,588 engines were reported as having 500 horse-power or under each, and a total horse-power of 420,551, or an average of 265 for each engine. There were 431 engines having a horse-power of over 500 but under 1,000 each, the total horse-power being 297,757, of 691 per engine, and 317 engines having a total horse-power of more than 1,000 each, the total being 579,825 horse-power, or 1,829 per engine. The Pittsburg Railways Company, of Pittsburg, Pa., reports 47 engines, which is the largest number returned by a single company. The greatest amount of steam horse-power, 79,075, was reported by the Interurban Street Railway Company, of New York. The greatest number of large engines, *i. e.*, engines having more than 1,000 horse-power each, is reported by the Union Traction Company, of Philadelphia, which had 21 engines with a total of 37,800 horse-power, but the Interurban Street Railway Company, of New York, with only 15 engines, reported a horse-power capacity of 78,600; the Boston Elevated Railway Company, with 20 engines, reported a total of 48,200 horse-power.

As shown in a supplementary table there were 159 water wheels, with horse-power of 49,153, used as the primary power in the generation of electric current. The average horse-power per water wheel was 429. There were 129 wheels of 500 horse-power or less, 12 of over 500 and under 1,000, and 18 of 1,000 and under 2,000. Of the total horse-power 44,214, or 89.61 per cent., was reported by 16 companies in the States of California, Georgia, Maine, Minnesota and New York. The largest plant of this character was shown for the Twin City Rapid Transit Company, of Minneapolis, Minn. This company reported the use of 12 water wheels, 10 of which had 1,000 horse-power each. The report also shows 15 gas engines of 1,925 horse-power used for miscellaneous purposes; 301 auxiliary steam engines were reported, with horse-power of 10,074, used by 84 companies for miscellaneous purposes, driving pumps, etc.

There were 3,853 steam boilers reported, with an indicated horse-power of 903,205. The number of steam boilers exceeds the number of main and auxiliary steam engines by 1,216, while the horse-power of the engines exceeds that of the boilers by 405,002. The average capacity of the boilers is 234 horse-power. In general such steam plants should have an engine capacity larger than the generator capacity and a boiler capacity larger than the engine capacity; otherwise they would be wanting in a factor or margin of safety. An examination of the returns would indicate, however, that the apparent departure from this criterion is caused by different methods of providing reserve power, and that a great many power-houses have dynamo and engine capacity in duplicate or reserve against a possible breakdown of any unit or for changing the "load" over from one set of apparatus to another. The inference is, nevertheless, that the boiler capacity reported is being worked to its full possibilities. Direct-current and alternating current dynamos are segregated according to the horse-power, and below are given the totals for the United States:

	Direct Current.		Alternating Current.	
Generators.	Number.	H.P.	Number.	H.P.
Total	2,861	972,314	441	231,924
500 H.P. or under	2,324	422,924	329	61,935
Over 500 H.P., but under 1,000	328	218,934	54	36,418
1,000 H.P. and over	209	330,456	58	133,571

The use of direct-current machines, each having 1,000 horse-power or over, was reported by 59 companies. The use of small machines still predominated, more than three-fourths of all the machines being rated at 500 horse-power or less, their combined horse-power being 422,924, or 43.5 per cent. of the total for all classes. The detailed statistics of alternating current are presented in a supplementary table. There were 441 alternating-current generators reported, with a total of 231,924 horse-power. These machines were used by 163 companies, and of this number 128 reported that current was generated for sale for light or power. Considering all machines of this style, the average horse-power per machine was 526. There were 22 machines for each of which the indicated power was more than 2,000 horse-power. The Interurban Street Railway Company, of New York, reported 11 machines having over 2,000 horse-power each, the combined horse-power being 53,075, or an average of 4,825 for each machine. The Manhattan Railway Company (elevated), of New York, reported 4 machines with a total horse-power of 26,800, or an average of 6,700 for each machine.

In all cases where companies reported equipment of this character it is noted. There were 219 companies using auxiliary electrical equipment of some character and 105 which operated substations. The auxiliary equipment consisted of transformers, storage batteries, boosters, auxiliary generators, rotaries, and electric motors used in plant or substations for miscellaneous work. The total kilowatt hours and horse-power of current for the year and the average per day are shown for each company, with totals for each State and the United States. In a few cases this information was not available, and in others the companies were not in operation during the entire year, so the totals should not be accepted as exact. Attention is again called to the fact that in many cases the electric current is used for other purposes than the operation of the street railway, and therefore no comparison should be made between the car mileage and the quantity of current. It appears that the power plants noted, doing an electrical service, reported an output for the year of 2,261,484,397 kilowatt hours, or 6,249,910 kilowatt hours daily, this being roughly but not exactly equivalent to 3,018,320,717 h.p. hours for the year, or 8,338,190 h.p. hours daily. Hence the 1,204,238 horse-power of dynamo capacity would appear to be employed on the average as nearly as possible seven hours daily, which, all things considered, is probably very close to the mark.

Utica Home Telephone Company's Exchange.

By F. L. Martin.

THE most recent advance of independent telephony in the east is marked by the opening of the exchange system at Utica, N. Y. The Utica Home Telephone Company was incorporated December 13, 1901, with an authorized capital stock of $500,000, and with an authorized bond issue of $1,000,000. The franchise was granted January 7, 1902, the construction work was started May 12, 1902, the system was put in operation April 1, 1903, and was complete in all respects May 1, 1903. In this period a complete telephone system was constructed, including the erection of an office building, a complete underground system, cable and aerial system, and including the installation of the central office and subscriber's sub-station equipment.

The system was formally put into operation April 1, 1903, with 1,300 subscribers connected. This number has been increased to over 1,800 in approximately 2 months' time, and the number of new lines being connected is being increased daily. The effect on the number of subscribers connected by the Bell Company is interesting, in that while on April 1, 1903, there were 1,600 Bell telephones connected, this number has already been decreased to about 1,200.

The rates of the Utica Home Telephone Company are: For business connections, metallic circuit, unlimited service, $36, and for residence connections, metallic circuit and unlimited service, $22.

The central office building consists of a handsome two-story structure of fire-proof construction. The front of the building presents a very fine appearance with an ornamental entrance of Gothic design. The first story front is finished in stone and the second in press brick with stone trimmings. The front of the first floor is devoted to well-appointed business offices and the remaining portion of the building for central office equipment, operator's quarters and stock rooms. Good sanitary conditions and ventilation provisions are made so as to make this building especially adapted for the purpose for which it was erected.

The outside construction work consists of a complete underground system in the business portion of the city, and a pole line system for distribution purposes and for leads into the residence districts and suburbs. A complete cable system was likewise erected and so distributed as to require the minimum amount of exposed line work. All telephone circuits are metallic. The underground system consists of 247,500 ft. of conduit, with 96 manholes. The cable system consists of 73,958 ft. of underground cable, 58,485 ft. of aerial cable. The underground cable is of Nos. 19 and 20 gauge, and the aerial cable No. 22 copper wire. Twenty-three 150-pair cables are terminated in the central office on the main distributing frame, thus making a total of 3,450 metallic circuits. There are provided 174 cable distributing points for connecting the cable system with the aerial distributing system. The aerial distributing system consists of 3,250 poles having carried thereon 593 miles of copper wire.

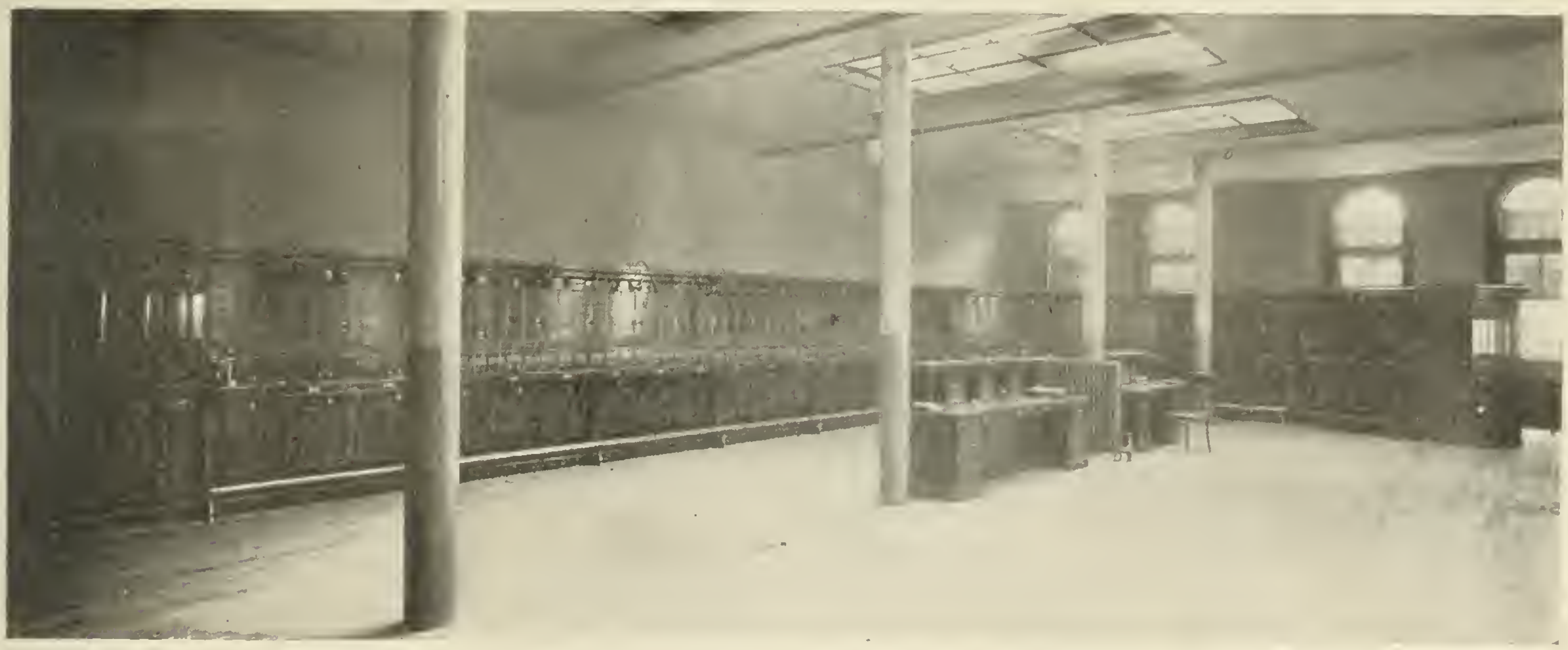

FIG. 1.—GENERAL VIEW OF UTICA HOME TELEPHONE COMPANY'S SWITCHBOARD.

It may be remarked that the rates of the Bell Company previous to April 1 were respectively $80 and $45. The local Bell Company, in order to compete with the rates of the Independent Company, made no changes in the above rates, but put into operation a system of party lines and limited service as follows:

Unlimited service, 2 party line, business, $63; unlimited service, 2 party line, residence, $38; limited individual line service, business, 800 calls, $39; two party line service, business, 800 calls, $30; four party line service, residence, 500 calls, $25; four party line service, 800 calls, residence, $27.

It will be noted that the rates offered by the Utica Home Telephone Company are less than any rates offered by the Bell Company, party line service included.

The new telephone company is rapidly constructing a system of toll lines that will eventually put the local system in connection with service throughout the State and independent systems in general. The Utica Home Telephone Company has already erected a branch exchange at New Hartford, a suburban village, and operating 51 telephones at the present time. Franchises are being secured for other neighboring towns. The company has three No. 10 copper toll lines from Utica to Rome, four No. 10 copper toll lines from Utica to Ilion, Herkimer, Mohawk and Little Falls, two direct lines from Utica to Clinton and two from Utica to Waterville and one to New Berlin. This enables the Utica company to connect with all the independent systems in the State.

Ample provisions are thus made for immediate increase in the number of telephones to be installed, and the cable system is so designed that congested distributing points can be readily relieved and additional cables installed to care for additional business. The construction work was erected along the most recent and most modern plans, and nothing but first-class material was used. Particular attention was paid throughout to reducing the cost of maintenance to a minimum.

The switchboard installed in the central office is a relay multiple central energy switchboard of the latest design, having an ultimate frame capacity of 12,600 subscriber lines and equipped for the immediate operation of 2,400 independent lines. It has frequently been the case that telephone companies make insufficient provisions for future growth, but at this exchange very liberal provisions are made, both for future growth in the switchboard equipment, also for central office building requirements and corresponding growth of outside construction system.

The switchboard consists of 10 sections of 12,600 lines capacity switchboard frames, each of three operator's positions of the 9-panel type, both in the multiple, trunk and answering jack space. The first section is reserved exclusively for the handling of trunks both for local service as well as for trunks with neighboring exchanges, and is fully equipped with multiple jacks so as to enable the operators at this section to have complete access to the multiple.

Each of the three positions of the second to and including the ninth section, are equipped with 100 subscriber line equipments, making a total of 2,400 line equipments. The first position of the tenth section is being utilized at the present time as a multiple annex position and is equipped with the necessary multiples for the proper operation of the third position of the ninth section

Each equipped operator's position is provided with 100 lamp line signal line equipments. The corresponding keyboards are equipped with 15 pairs of cords with double lamp supervisory signals ringing and listening keys with associated apparatus, likewise an operator's telephone equipment complete, consisting of an operator's solid-back transmitter supported by means of flexible cords from an adjustable transmitter arm mounted on the upper part of the switchboard frame; an operator's head telephone and band attached to a plug, two operator's cut in jacks, wired in multiple and provided with battery contacts for opening the operator's transmitter circuit when the plug is removed from either jack. The second jack is utilized for learning operators or other purposes as desired Each position is further equipped with a line call pilot lamp, to light when calls are made on the respective positions; also a ringing supervisory pilot lamp, to light when the operator rings, indicating to the operator the condition of the line. If the line is open for any reason the ringing lamp fails to light.

Each finished section of switchboard is fully equipped at the present time with 2,400 multiple jacks, which are multipled in each section, thus enabling each operator to have complete access to all lines without passing cords in any position.

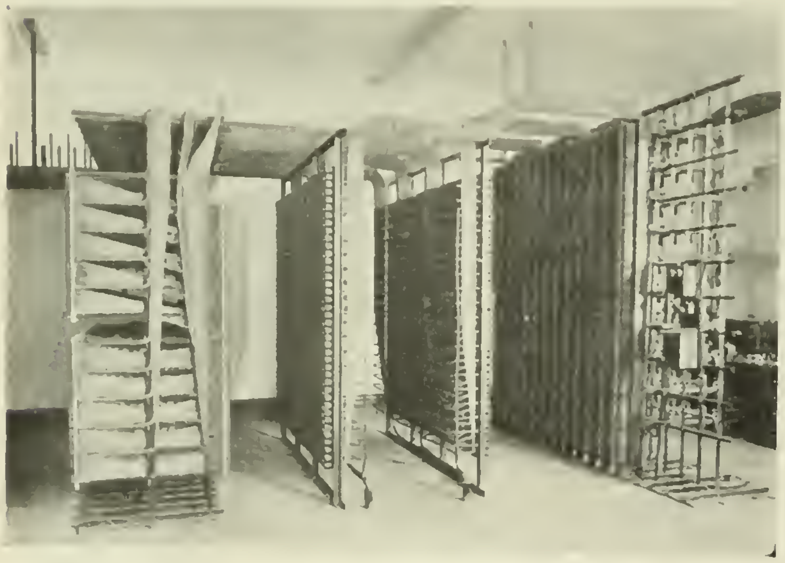

FIG. 2.—DISTRIBUTING FRAME, LIGHTNING ARRESTERS AND RELAY RACKS.

Each multiple jack is provided with individual tip and sleeve springs and thimble, all made of German silver of the best quality, with no contacts in any of the jacks, including the answering jacks. Provisions are made for increasing the number of multiple jacks in each section for an ultimate capacity of 12,600 lines, without in any way changing or altering the present installed cables. The multiple jacks are numbered in banks of 100 on the stile strips and arranged in rows of 20 each, each row of 20 being further divided by distinct vertical lines into groups of five to facilitate the selection of the individual jacks.

The answering jacks are mounted in strips of 10 with associated lamps immediately above the jacks. The lamps are provided with individual opals so as to enable access to be made to the individual lamps. The answering jacks are numbered by means of removable number plates, numbered to correspond with the subscriber lines as the subscriber lines may be located in any position of the switchboard so as to adjust the operator's loads by making cross connections on the intermediate distributing frame and not change the position of the corresponding multiple jacks.

The switchboard frames are made of structural steel assembled to form rigid frames: these frames are arranged in the form of a horseshoe, growing from left to right and so planned as to ultimately form an ellipse. The frames are covered with quarter-sawed oak, finished in golden oak with a piano polish and provided with hinged keyboards and made up of 5 layers of quarter-sawed oak, securely glued together to prevent warping. The plug boards are covered with belt leather. The front and rear panels are made removable so as to permit access to the interior of the board. The answering jack and multiple cable runs are built in the interior of the switchboard section so as to avoid the necessity of separate running boxes or using any troughs in the floors other than the ducts extending to the supervisory desks. The supervisory apparatus associated with the cord pairs is also mounted in the individual position and provided with the necessary battery bus-bars and other local terminals. All otherwise unfilled answering and multiple jack space is filled in with neat ebonized strips

A supervisory desk consisting of a combination three-position chief operator's desk, trouble clerks and information clerk's desk, and a single position monitor's desk are provided in the central portion of the operating room Each position of the chief operator's desk is equipped with local exchange lines, private lines connecting with the monitor's wire chief's and manager's desks, special incoming trunk lines from multiple switchboard, outgoing trunks terminating on plugs and cords and cords in the trunk position of the multiple board; also, the necessary connecting devices for answering incoming calls on the local lines and making calls on the outgoing trunks together with the necessary order wire keys and operator's equipments Very complete and quick service is thereby gained as all inquiries are referred to this desk, thus enabling the subscriber operators to devote their attention to prompt answering of calls and completing connections.

The monitor's desk is equipped with jacks and associated lamps corresponding to each switchboard operator's position. The lamps are wired in multiple with the corresponding line call pilot lamps in the respective operating positions, thus indicating to the operator all incoming calls The jacks are connected with a tertiary winding of individual operator's induction coils, thus enabling the monitor operator to listen in on any monitor circuit, without in any way indicating to the operators that they are being monitored. A corresponding monitor key is likewise installed, one for corresponding to each operator's position. There are likewise provided connecting cords, private lines to other desks and a limited number of exchange line connections, together with an operator's complete telephone equipment. These desks are made of quarter-sawed oak, finished to correspond with the main switchboard and consist of flat-top desks with turrets on top for mounting thereon the necessary apparatus and so designed that the operators seated at these desks can readily look over the top of the turrets and have ocular supervision of the operators and thus maintain perfect discipline in the operating room, which is so essential to good operating.

The operating room is located on the second floor of the telephone building, well lighted, both from one side and the end of the building and also by means of skylights with suitable shades so as to get proper illumination in the room, without, however, interfering with the prompt detection of the lighting of the line lamps in the operator's positions. The operating room is also artificially lighted by incandescent lamps. The switchboard is illuminated by means of incandescent lamps mounted on brackets on the switchboard and provided with shades so adjusted as to throw the light on the multiple space of the switchboard section and shading the necessary jack space. The alternate lamps are connected on two independent circuits controlled by switches.

The operator's quarters are provided in the front quarter of the second floor with suitable locker, recreation and toilet rooms. The recreation room is very neatly furnished for the comfort of the operators when off duty. The operators' hours are so arranged that they are allowed recesses in order to rest or partake of lunches as they desire, their places at the board being taken by relief operators.

The terminal apparatus and power apparatus is mounted in the rear of the first floor, the front portion being used for long-distance toll room, general offices and private offices. The terminal racks consist of combination main, relay and intermediate distributing frames made up in sections of 800 capacity each and so designed that there may be added additional sections as may be required in sections of 800 capacity each. The main distributing frame is equipped with Cook combination carbon and sneak current lightning arresters in strips of 200 pairs each and provided with terminal strips made of rubber with terminal clips, 25 pairs each mounted on shelves. Flameproof jumper wire is used for connecting any pair of cable terminals with any pair of lightning arrester terminals. The street cables are carried through the basement from the underground system on cable racks and terminate on the terminal side of the main distributing frame, leaded switchboard cable being spliced directly into the underground cables. The lead sheath is cut off the cable above the floor line so as to enable the cables to be fanned out to the respective terminal strips. The terminal strips are numbered to correspond with the cable pairs in the underground system.

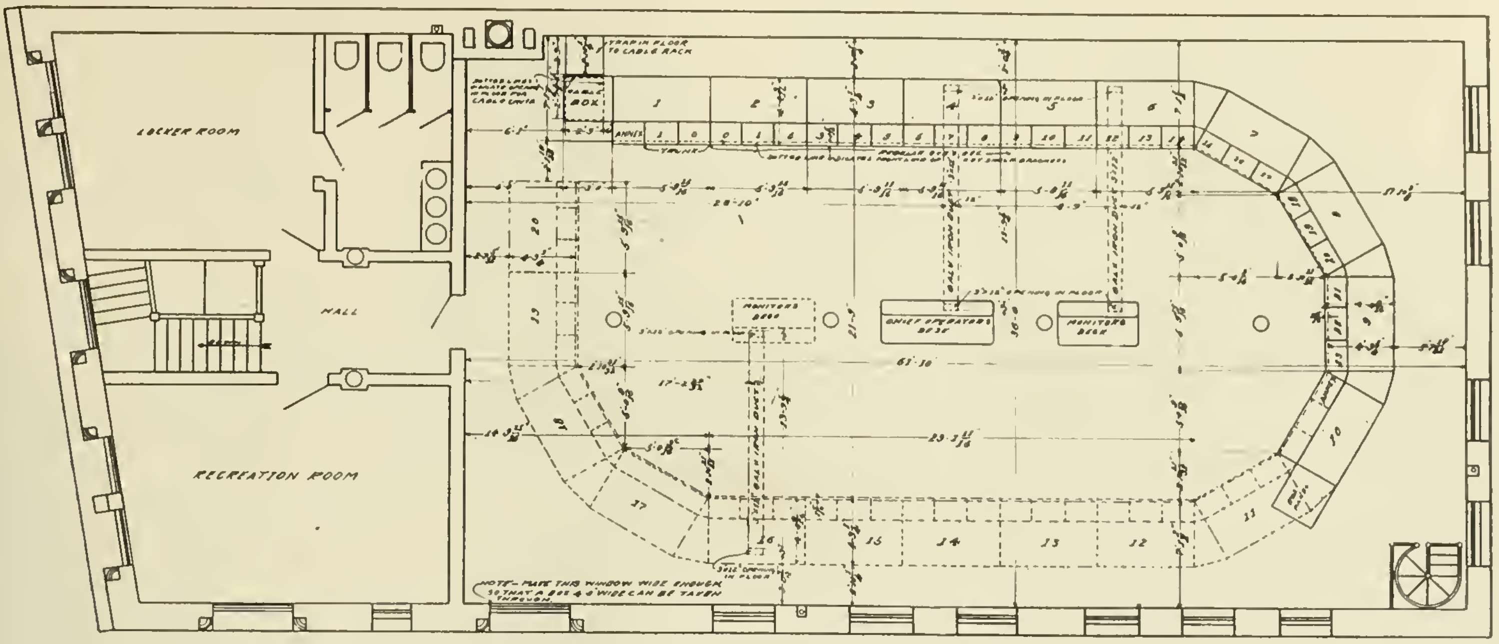

FIG. 3.—SECOND FLOOR PLAN.

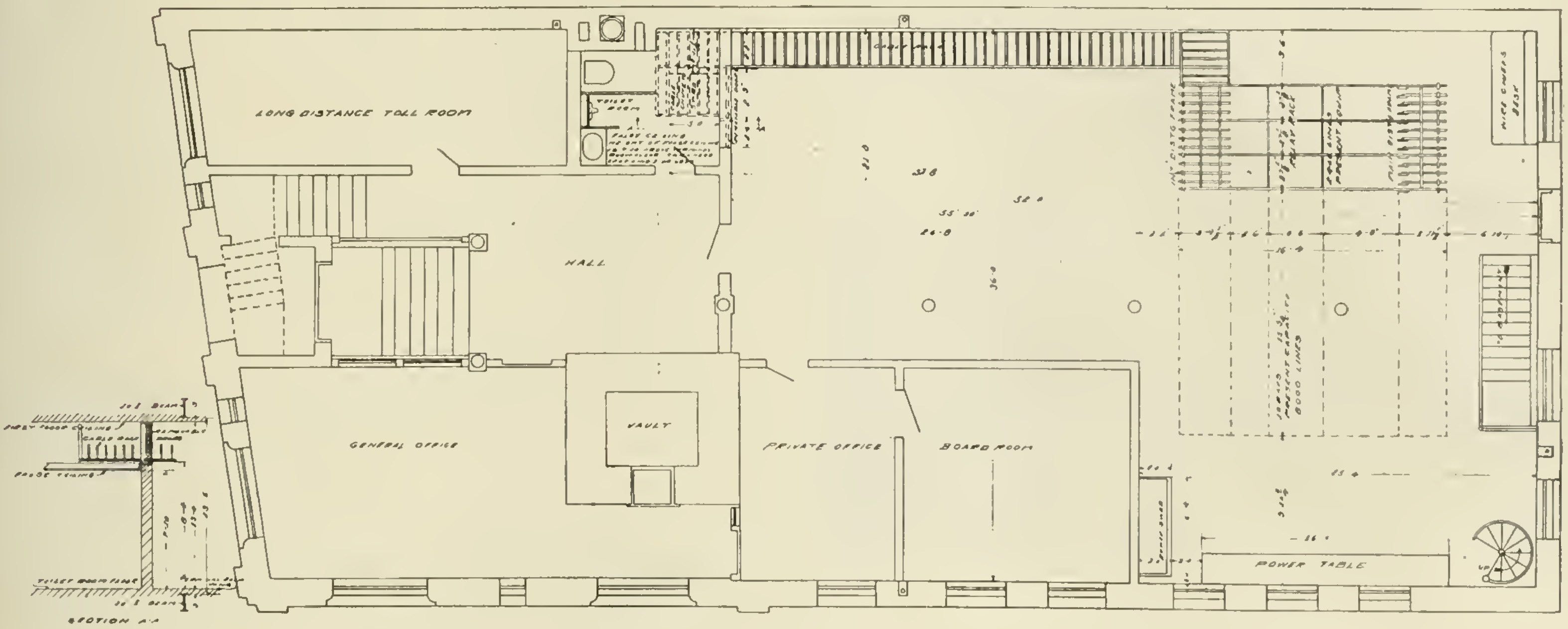

FIG. 4.—FIRST FLOOR PLAN.

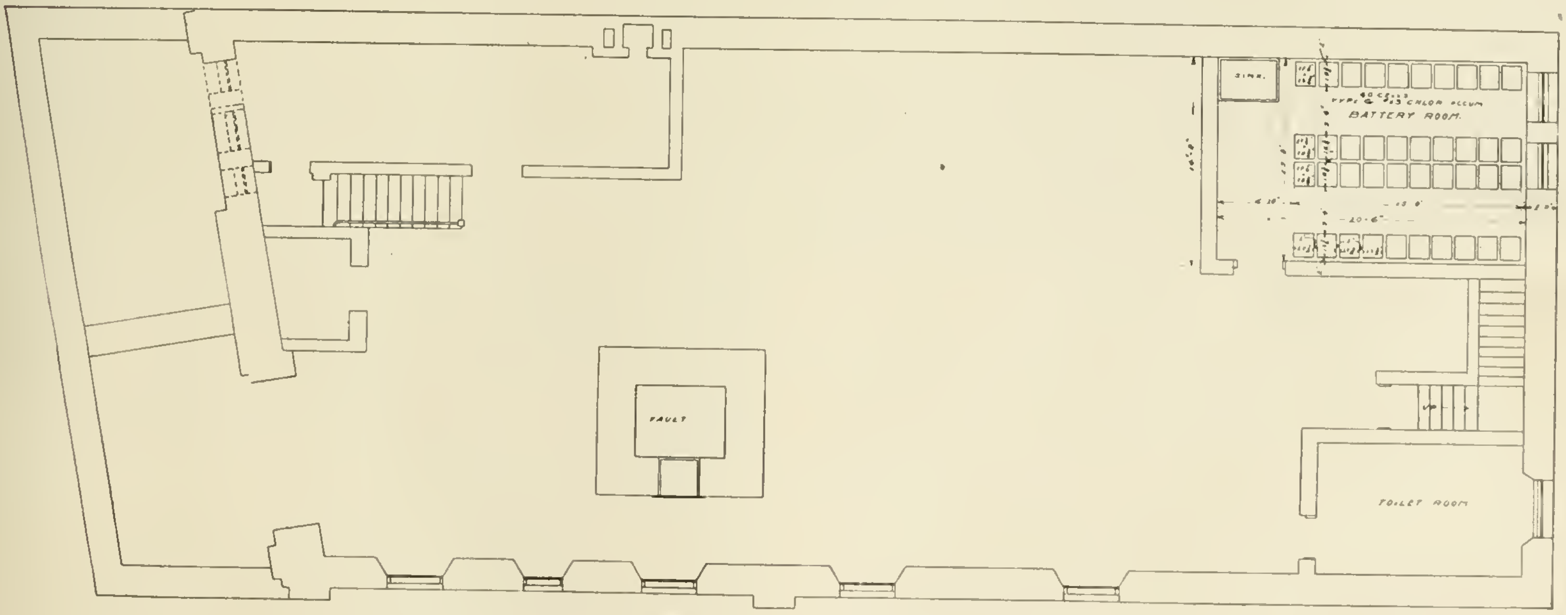

FIG. 5.—BASEMENT FLOOR PLAN.

UTICA HOME TELEPHONE COMPANY'S EXCHANGE.

From the lightning arrester side of the main distributing frame are carried switchboard cables to relay rack and from relays mounted thereon to the intermediate distributing frame. The intermediate distributing frame are likewise provided with a set of terminals on each side to facilitate cross connections. The terminals on these frames are also mounted on rubber strips.

The multiple cables are carried from the multiple side of the main distributing frame on an overhead cable rack to the first setion of the multiple switchboard, utilizing 100-pair cable for compactness and providing individual cables for each run of 100 multiple lines. The answering jack cables are similarly carried on the cable rack to the respective operator's positions. All cables are carried overhead, thus avoiding the laying of any cables on the floors which might otherwise render them subject to damage due to accidents or floods, the insulation of the cable is thus unimpaired in any manner.

A two-position wire chief's desk is provided accessible in position to the terminal apparatus and power apparatus. This wire chief's desk is of the same design as the supervisory desks and provided with exchange lines, incoming trunk lines from multiple switchboard, outgoing trunks terminating on the "B" position of the multiple board. The test lines terminate on plugs on the main distributing frame, enabling the wire chief to test any pair of conductors out in underground cables, or bridge his apparatus across the lines under test. He is provided with special cords for making all necessary tests of grounds, condenser crosses and reverses, utilizing a portable voltammeter in connection with the main 40-volt storage battery.

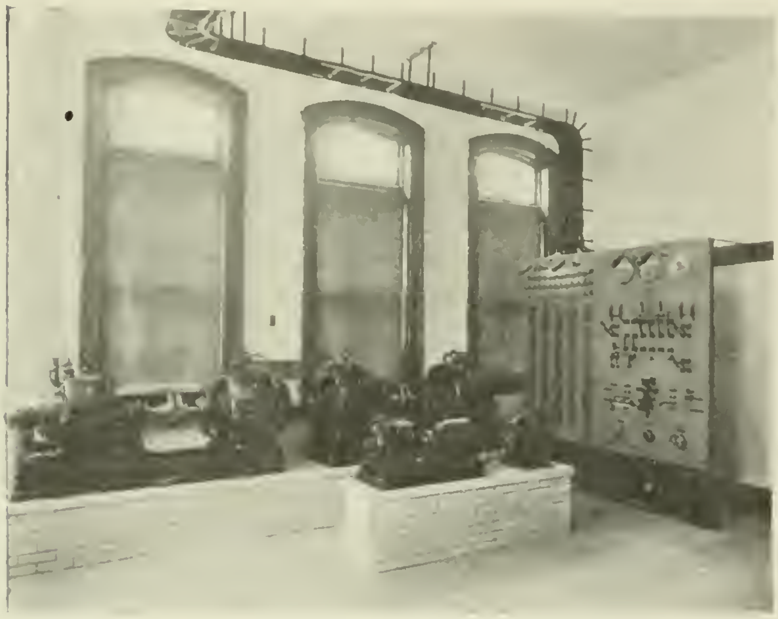

FIG. 6.—CHARGING MACHINES.

The power apparatus consists of a two-panel pink Tennessee marble power board having mounted thereon two Weston flush type direct-current ammeters, one to indicate the discharge and the other to indicate the charge of the storage battery; one Weston flush type double-scale voltmeter; one Crouse-Hinds 6-circuit voltmeter switch, one series overload and underload circuit-breaker, all necessary switches for the operation of the power board suitably provided with designation plates, back-connected rheostats and starting boxes with wheel handles and index plates, and bus-bars.

Terminals are also provided for each battery lead to the multiple switchboard and also ringing generator lamps with fuses for the ringing generator leads. The power board is well illuminated by means of brackets and incandescent lamps.

The charging machines used for charging the storage batteries consist of two Wagner alternating-current motors direct-connected to Roth generators, each machine having capacity for charging the storage batteries at their ultimate charging rate. One direct-connected Wagner alternating-current motor and Roth self-excited ringing generator, and a direct-current Roth ringing dynamotor for operation from the storage battery are used for ringing purposes, each of the ringers being provided with howler, busy back and periodic attachments. The machines are substantially mounted on brick piers with white enameled finish and hard wood tops. All concealed wiring is in iron-armored conduits laid in the tile floors.

The storage battery plant consists of two sets of 20 chloride cells in lead lined tanks having an ultimate tank capacity for 1,200 lines and equipped with the necessary elements for the immediate operation of 3,000 lines. The storage batteries are installed in the rear of the basement in rows of 10 cells each, ample space being provided for the proper inspection of the individual cells.

All power for signaling, talking and the operation of the supervisory lamps is furnished from the main central office storage battery, which is equipped in duplicate and further provided with duplicate ringing and charging machines.

The calling is automatic. By the simple raising of the receiver from the hook, the subscriber lights the line lamp. The operator in putting up the connection utilizes two lamps per pair of cords, each indicating the operation of the telephone with which it is connected. When the subscribers finish their conversation, the corresponding lamps in the cord circuits light, indicating to the operator to disconnect. There is no occasion for the operator to listen in on connections, as he is only required to listen in while answering the subscriber. The pilot lamp system is multipled in the monitor's desk, enabling the operator to supervise the service of the individual operators. The monitor operator is thus kept in complete touch with the operation of the switchboard. A night bell system is provided for operation at night when the service is light, so as to attract the night operator's attention as soon as the calls are made.

All central office apparatus was furnished and installed complete by the Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., and Chicago, Ill., including the telephones, under the plans and specifications compiled by Mr. W. C. Polk, engineer of the Central Telephone Construction Company, which company constructed the system complete.

The Utica Home Telephone Company is now in operation under the management of Mr. C. H. Poole, secretary and general manager, with Mr. James S. Brailey, Jr., general manager, and Mr. W. C. Polk, engineer, assisted by Mr. Samuel Fraser and Mr. Edw. L. Cline, who has since been appointed superintendent of construction for the local company.

* * *

Plotting of Speed Time Curve From the Acceleration Speed Curve.

By L. A. Freudenberger.

FROM the performance curves of a motor, knowing the train resistance at various speeds, the curve showing the relation between speed and acceleration may be plotted.*

Thus, the acceleration, $\frac{dv}{dt}$, corresponding to various speeds, v, is known. It is required to find the speed, v, corresponding to various time values, t.

$$a = \frac{dv}{dt}. \quad dt = \frac{1}{a} . dv. \quad \int dt = \int \frac{1}{a} . dv. \; t = \int \frac{1}{a} . dv.$$

Hence if values of $\frac{1}{a}$ are plotted on a base of speed, the area included between the curve and the speed base will represent time values corresponding to different speeds. Areas may be measured by means of a planimeter or an integraph. Thus time values corresponding to different speed values are known, and the speed time curve may be plotted. By integrating the area included between the speed time curve and the time base, the distance time curve may be plotted in the usual manner.

In the figure let A represent an acceleration speed curve which to a different scale of abscissæ will represent the resultant torque speed curve.† The acceleration remains constant at 0.316 miles per hour per second until a speed of 10.9 miles per hour is reached, when the acceleration rapidly diminishes and becomes zero when a constant speed of 14.45 miles per hour is reached.

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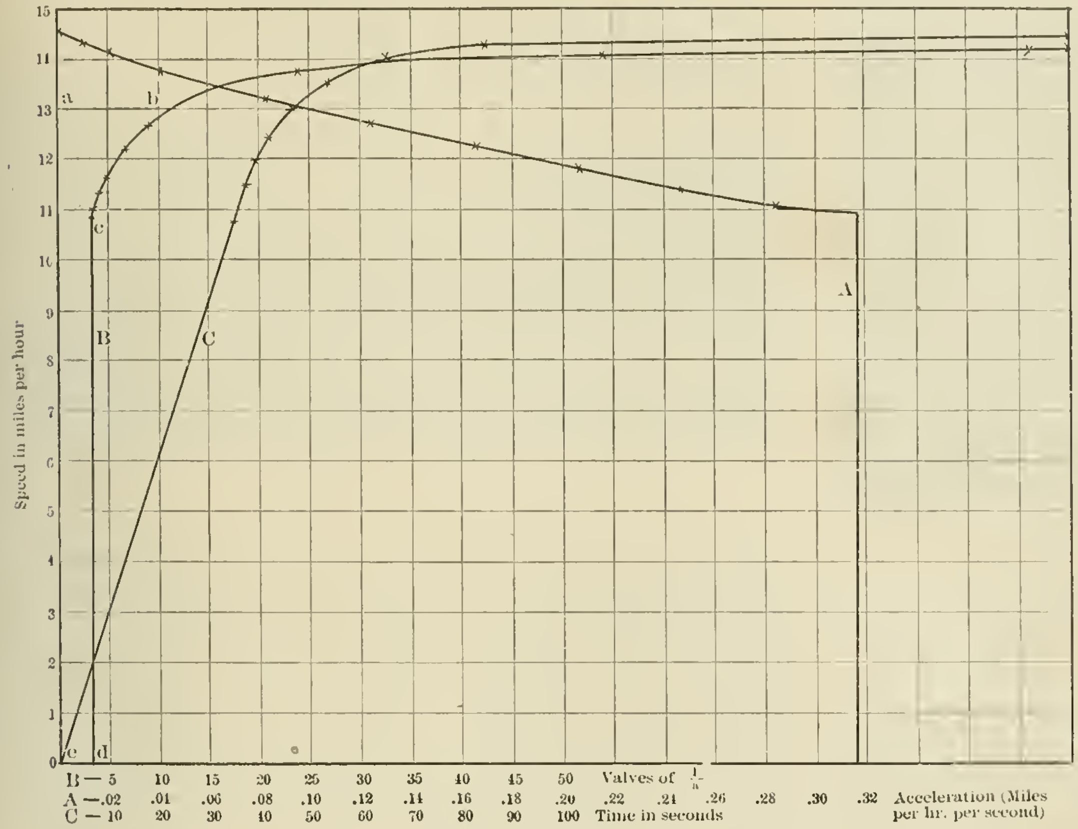
* See "Notes on the Plotting of Speed Time Curves," by C. O. Mailloux. Transactions of American Institute of Electrical Engineers, vol. 19.

† The resultant torque speed curve was taken from C. A. Carus Wilson's "The Direct Current Motor," page 163.

In curve *B*, abscissæ represent values of $\frac{1}{a}$ and ordinates the corresponding speeds. The area *a b c d e*, for instance, represents a time value (45.9 seconds) corresponding to a speed of 13.0 miles per hour. Thus a number of points on the speed time curve may be determined sufficient to plot the speed time curve, *C*.

The curves are based on data of two series-wound motors permanently connected in series, the armatures being directly on the axles without gearing. The resistance of each motor was .387 ohm; line voltage, 400; wheel diameter, 27 in.; weight of train, 35 tons of 2,240 pounds; maximum current per motor, 150 amp.; frictional torque assumed constant at 5,760 inch-pounds.



SPEED TIME CURVES.

Why the Disc of an Induction Wattmeter Rotates, and Why the Torque on the Disc Varies With the Watts of the Load Which the Meter Records.

By T. W. Varley.

In Fig. 1, *O A* is the direction of the applied volts upon the load. For a power factor of 1.00, this would also be the direction of the load current. The applied volts cause a current to flow in the potential circuit of the wattmeter, which lags some 82° behind the volts, as *O B*. This current sets up a magnetic field and causes lines of force to cross the disc of the wattmeter. It is these "lines" which are made to lag 90° behind the applied volts as *O C*. One way of causing this is to partially bridge the poles of the shunt or potential magnets. The lines of force crossing the disc are thus caused to lag behind these of the bridge shunt, the lagging being adjusted to be 90° behind the applied volts.

The lines of force crossing the disc set up e.m.f. circles in the disc, 90° behind them, as *O D*. As the disc resistance is non-inductive, these e.m.f. circles set up circles of current in step with the e.m.f. circles, or 90° behind the magnetism, caused by the potential, or in step with the applied volts, and of opposite sign. The opposite sign is of no consequence as it only affects the way the disc shall rotate in the original design. The currents in the disc now look as in Fig. II.

Notice that the currents are in opposite direction. The disc does not rotate as yet, for there is no field to give it torque. This is all that takes place from the potential effect.

The volts applied to the load are in the direction *O A*, and for a load P.F. of 1.00, the current being also in the direction *O A*, there is set up a magnetic field in step, or in the same direction, *O A*.

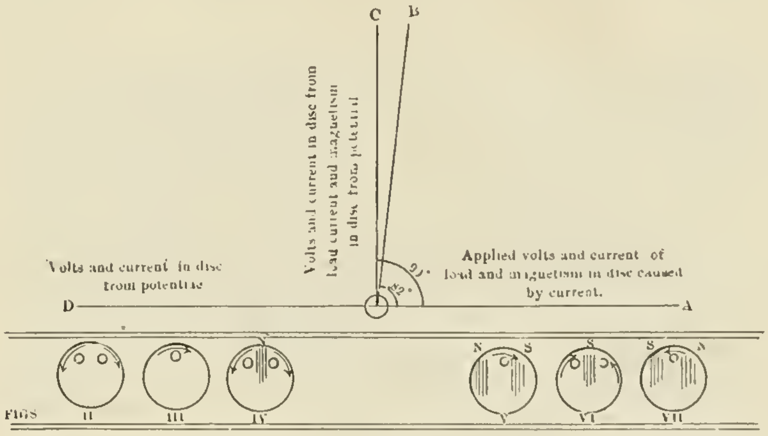
These lines cross the disc, setting up circles of e.m.f. 90° behind, or in the direction of *O C*. These circles of e.m.f. set up circles of current in step, or in the same direction, *O C*. The currents are as in Fig. 3. Notice that the currents are between those caused by the potential of Fig. 2.

To return to Fig. 1, the disc currents caused by the potential are in step with the magnetic "lines" through the disc, caused by the load current and as they are out of position with respect to each other, one set will repel and the other attract, so that the disc will receive a torque or pull in a certain direction as in Fig. 4. This torque will vary as the product of the disc currents and the "lines" through the disc, and as these effects are caused, respectively, by the potential of load and current of load, the torque will vary as the watts of the load. If this were all the torque would come in impulses, one for each alternation.

Return again to Fig. 1 and notice that 90° later than the action mentioned above another action takes place. The disc currents are now caused by the load current and are in step with the "lines" caused by the potential, or of the opposite conditions to that of the first as in Fig. 5. The disc will be rotated in the same direction as before and the torque will again vary as the watts of the load. Thus the disc will experience two pulls, one 90° behind the other and each of which blends into the other, so that its torque will not be in impulses, but of a uniform nature.

180° behind *O A*, the reverse action takes place to that first mentioned as in Fig. 6. The pull still being in the same direction. At 270° behind *O A* the last action takes place as in Fig. 7. The pull is still in the same direction. This brings us around to *O A* again, where all is repeated or the cycle of operation ends.

To show the necessity of lagging the magnetic lines through the disc, caused by the potential to 90° behind the potential. Any slight divergence from the 90° position causes the meter, which is made correct for unity power factor, to be "out" on other power factors.



C
B
Volts and current in disc from load current and magnetism in disc from potential
Volts and current in disc from potential
Applied volts and current of load and magnetism in disc caused by current.
90°
82°
D
A
N
S
FIGS
II
III
IV
V
VI
VII

DIAGRAM OF WATTMETER DISC ROTATIONS.

For instance, if the magnetism lags 5° over the 90° position and the meter is made correct for that position, which means making it 4 per cent. faster, then it would be 14.2 per cent. fast at a load P.F. of .50. If it leads 5° under the 90° position, then for the same P.F. of .50, it would be 17.8 per cent. slow.

Any lag of the load current behind the applied volts, causes a lag of the magnetism through the disc (from the effect of the load current) to lag behind *O A*, the applied volts a similar amount 90° later, the currents in the disc (from the effect of the load current) are lagged an equal angle behind the magnetism through the disc, from the effect of the applied volts. Thus the meter torque varies as the power factor of the load.

Gold Pan Mining Plant at Breckenridge, Colo.

Breckenridge, Colo., is a growing mining town with a population of about 1,000, located 110 miles west of Denver, and practically in the center of the State. Here the Gold Pan Engineering & Mining Supply Company has recently entered quite extensively into placer mining and is probably operating the largest placer mine in Colorado. The center of the company's operations at present is shown in Fig. 1. In the foreground are seen two sets of vertical water pipes, which act as hydraulic elevators for raising the sand and rock to the flumes above. Water under high pressure is forced down one pipe and drawn up the other. The two ends are moved around wherever desired and the sand is drawn up with the water. These vertical pipes at present are 80 ft. long. They discharge into wooden flumes and the material is carried along over the "riffles" where the gold is separated and taken out. The rocks and refuse sand are carried away and dumped by means of the conveyor and trestle seen at the right.

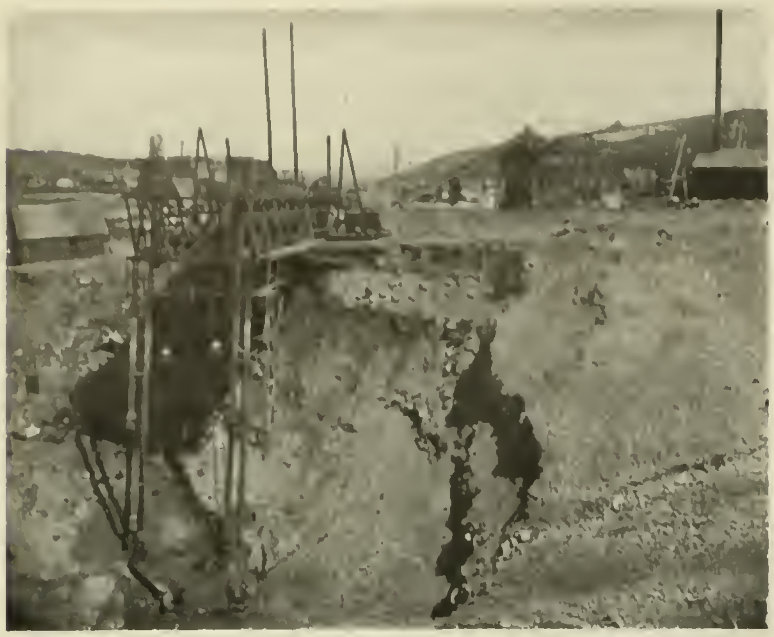


FIG. 1.—PLACER MINE AT BRECKENRIDGE, COLO.

The Gold Pan Company is now installing a 150-hp induction motor in the pit shown in Fig. 1. This motor will drive a centrifugal pump to assist the hydraulic elevator in keeping the working free from surplus water. In order to handle large rocks and carry them out of the way two portable cranes of the boom type will be installed. These cranes will run on tracks and each will be operated by a 30-hp Westinghouse induction motor mounted directly on the crane. Current will be supplied to the motors through flexible cables.

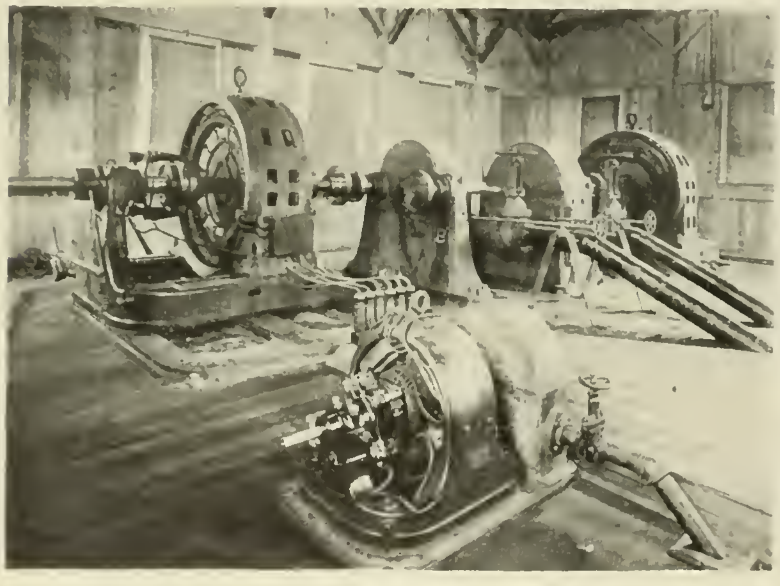


FIG. 2.—POWER STATION ON SPRUCE CREEK.

The power plant which supplies power for these motors is located on Spruce Creek, about five miles distant from the mine. Water is brought to the power house through an open canal for about a mile to a hill back of the station and then carried to the water wheels through steel pipe. The effective head under which the wheels operate is 425 ft.

An interior view of the generating station is given in Fig. 2. There are two main water wheels of the Pelton type, each direct-connected through shafting to a 200-kw Westinghouse revolving field two-phase, 440-volt alternator. The arrangement of water wheels and generators is a novel and ingenious one, in that it provides a flexible means of connecting each generator to either wheel. The shafts of the wheels are parallel and are carried out with a coupling on each end. The shafts of the generators are normally connected to the Pelton wheel shafts in the manner indicated in the sketch, Fig. 3. Each generator is mounted on an extension foundation and is provided with a special moving lever (shown on one machine at the left in Fig. 2), so that it can be quickly moved from its normal position into alignment with the other waterwheel shaft and coupled up for operation. In this way both generators can be driven from either water wheel, and also each generator may be driven independently by either of the water wheels. In event of accident to either pipe line or to a water wheel or generator this flexible arrangement will undoubtedly be found of considerable value.

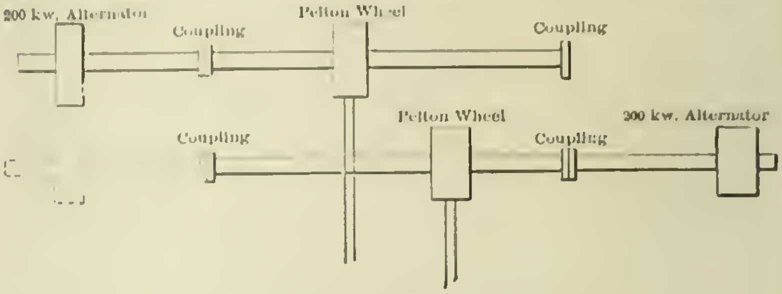


FIG. 3.—DIAGRAM OF METHOD OF COUPLING.

For supplying exciting current there are installed two 11-kw, 125-volt exciters, each directly driven by a separate Pelton water wheel. One of these exciters is shown in the foreground in Fig. 2. This pitcture also illustrates the method of carrying flexible leads from the generator to a row of insulating blocks from which the wires run in a covered box to the switchboard. The flexibility of these leads allows the generator to be moved from one position to the other without disconnecting any wires.

Each water wheel has a gate valve controlling the flow of water, but no automatic regulator is provided. The speed of the wheels is varied by means of the hand wheels at the end of long rods, which may be seen in the picture. These rods serve to raise or lower a hood in front of the nozzle, thus varying the direction and quantity of the water discharged. The nozzles are not of the deflecting type, such as are used on larger wheels.

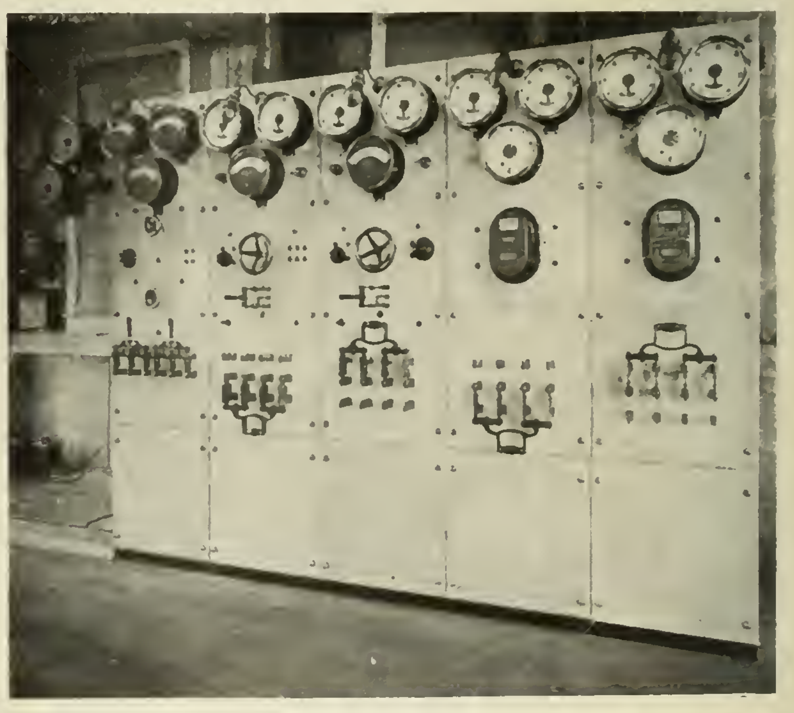


FIG. 4.—SWITCHBOARD IN POWER STATION.

The station switchboard shown in Fig. 4 is built of blue Vermont marble and consists of five panels. The left-hand panel contains switches and instruments for both exciters. Panels 2 and 3 control the two generators, each being provided with two alternating-current ammeters, one direct-current ammeter, field rheostat and main generator switch. The remaining two panels control the two feeder lines leading to the transformers. Each panel is equipped with two ammeters, an indicating wattmeter, a polyphase integrating wattmeter and a four-pole, double-throw switch. Wattmeters of the indicating and integrating types are used, as the company sells a good deal of its current for power and lighting and the registrations are necessary in keeping the accounts of the customers. The switchboard has a double set of bus-bars so that the lighting and power loads, which are controlled from separate panels, may be thrown on either generator. At the left of the board on a swinging bracket are mounted voltmeters and a frequency meter.

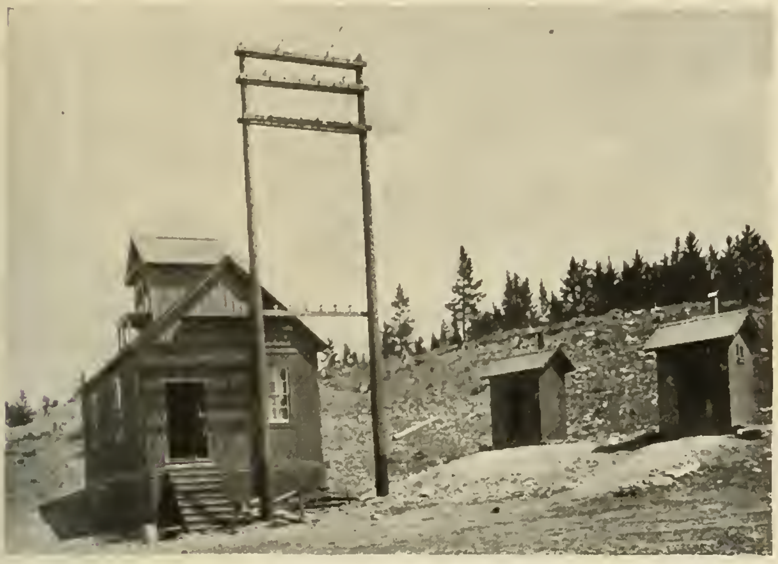


FIG. 5.—BRECKENRIDGE TRANSFORMER SUB-STATION.

The two 440-volt, two-phase circuits are carried from the switchboard to the transformer room, located in a separate but adjacent building, where four 100-kw oil-cooled single-phase transformers raise the potential to 10,000 volts, three-phase, for transmission to a sub-station in the town of Breckenridge, five miles distant. The transmission wires are of No. 5 bare copper and are mounted on Mershon triple-petticoat glass insulators. The sub-station is shown in Fig. 5, the two three-phase, 10,000-volt circuits coming into the building at the right and the three four-wire, two-phase circuits leaving at the left. The transformer equipment in the sub-station, shown in Fig. 6, consists of five 100-kw oil-cooled transformers (one for reserve) used in stepping the 10,000-volt current down to two circuits at 2,000 and 440 volts. There are also three 25-kw transformers (one being in reserve) for supplying a 2,000-volt circuit for lighting. The company has a franchise for lighting the streets of the town with incandescents and also supplies a commercial incandescent service, the distribution being at 110 volts. Enclosed arcs are also supplied for commercial lighting and are used in lighting the pit and grounds of the Gold Pan Company, as the mining operations are carried on continuously day and night. The 2,000-volt and the 440-volt circuits from the 100-kw transformers are used for the company's own power and also for customers in the vicinity, the power being used chiefly in lode mines for driving compressors, hoists, etc. Type C Westinghouse induction two-phase motors are used throughout. One 50-kw motor is used to drive the company's own machine shop where the hydraulic pipe used in the mining operations is manufactured.

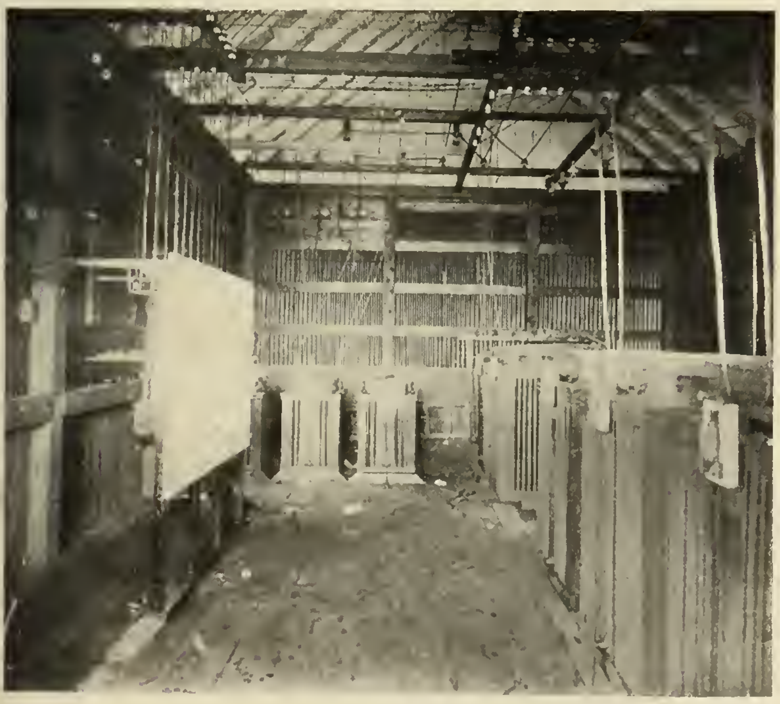


FIG. 6.—INTERIOR OF BRECKENRIDGE TRANSFORMER SUB-STATION.

The tail water from the power plant is carried down to the mine and is there used by the company for the hydraulic elevators.

As the placer mining operations cannot be carried on during the winter months on account of the snow and the freezing of the water, the water power plant is shut down and a relay steam plant located at the mine is called into service for supplying the lighting load in Breckenridge. This plant consists of two 50-kw, 2,000-volt, two-phase Westinghouse alternators driven from a line shaft by means of a Corliss engine.

The water wheels at the power station were manufactured by the Pelton Water Wheel Company, of San Francisco, and all the electrical equipment was furnished by the Westinghouse Electric & Manufacturing Company, through its Denver office. Credit for the design of the power station and the other electrical equipment and the installation of all the plant is due to George H. Evans, engineer and manager of the Gold Pan Engineering & Mining Supply Company.

"Aerial Electric Ladder" Experiments.

In our last issue reference was made to the proposed experimental tests of the "electric ladder," invented by Mr. Albert Gallatin Whitney, of Chicago. We have since received from a correspondent some details of a coming experiment and its object. Mr. F. X. Schoonmaker has charge of the work and he is now in Colorado examining the principal mountain peaks in that State with a view to the selection of one on which the experiments may be conducted.

The "electric ladder" is stated to be a combination, in proper proportions, of copper, steel and silver spheres, connected by wires, which it is planned to project from the earth, or, to use the inventor's words, to "let fall out" of the atmosphere into the ether. Mr. Whitney believes that the planets and other bodies of matter in the universe are immersed in seas of electricity, and that the orbits and motions of the planets and other members of the universe are caused by currents in these seas of electricity. So, by projecting a conductor connected with a magnetizable receiving apparatus from the earth's surface, he figures that the earth's atmosphere may be pierced and that the great force of electricity beyond will pull the receiver away from the earth and hold it there, thus affording through the conductor a supply of electricity that may be used for commercial purposes.

The inventor is taking out a number of patents on his "electric ladder." He bases his invention largely on a personal theory of matter and claims that the Newtonian theory of gravitation is incorrect when applied to bodies outside of the earth's atmosphere. He asserts that the French Academy of Sciences and also the higher authorities in the German Patent Office have accepted these new theories after careful and full investigation.

Mr. Schoonmaker states that a private test of the Whitney electric ladder has been made on a small scale in New Mexico and that it was successful, incandescent lamps being lighted by the electricity brought down from the electrical ether. The object of securing a mountain peak in Colorado for further operations is that the mountain tops there are all attained with comparative ease, and the atmospheric conditions at the altitudes reached are such that men can stay there continuously if necessary without any serious effects.

Pike's Peak is favored by Mr. Schoonmaker for the reason that it has a railroad running to its summit. The method of projecting the conductors and receivers into the ether has not been disclosed as yet. Some years ago the same inventor issued a pamphlet describing a similar means of obtaining electricity from nothing by a "combination of spheres," the pamphlet containing a portrait and highly eulogistic personal sketch.

Brake Horse Power and Efficiency of a Small Motor.

By J. I. Dickson.

HAVING had occasion some time ago to measure the brake horse-power and efficiency of a small motor, it has occurred to me that an account of the method might be of some interest to your readers.

The apparatus used was a standard ammeter, a voltmeter, a speed counter, a prony brake, a resistance box and current from a direct-current dynamo. The accompanying diagram shows just how the apparatus was set up. *M* represents the motor, *A M* the ammeter, *V M* the voltmeter, *T T* the terminals, which were connected to the mains of a direct-current dynamo, *R* the rheostat and *S* a switch cutting out the last resistance of the rheostat.

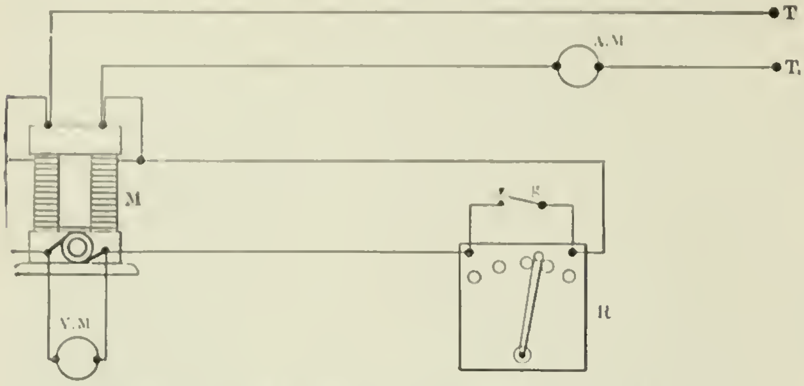


FIG. 1.—DIAGRAM SHOWING ARRANGEMENT OF APPARATUS.

The prony brake, which is not shown in the diagram, consisted of a leather strap held in place over the belt pulley by means of two cords, which in turn were fastened to two spring balances, the object of the balances being to measure the pull on each side of the pulley; the balances were fastened to a bracket, which was attached to the wall.

The input was determined from the current supplied, as measured by the ammeter, and the voltage at the brushes of the motor as indicated by the voltmeter. The output was determined from the pull of the brake, circumference of the pulley, and the revolutions per minute. The circumference of the pulley measured 11 in. The input and output were determined for various loads, as shown in the following table:

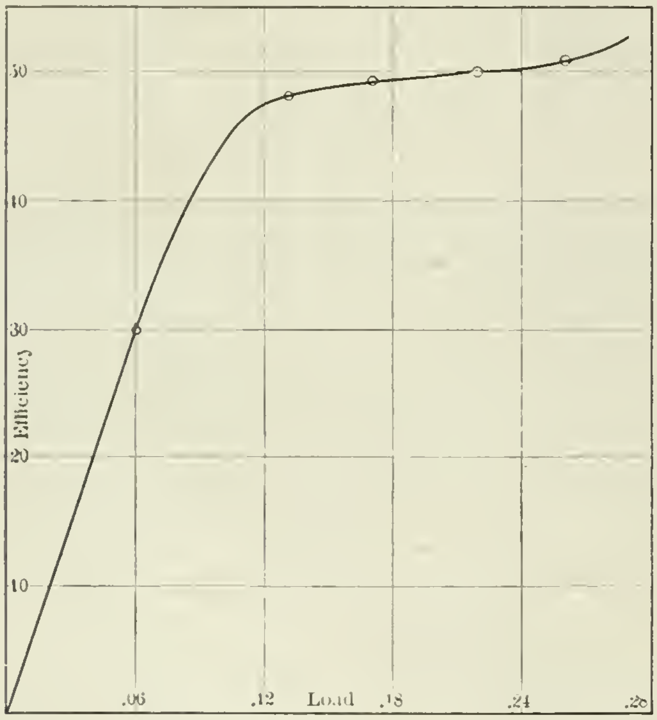


FIG. 2.—CURVE SHOWING RELATION BETWEEN LOAD AND EFFICIENCY.

Reading.	Volts.	Amperes.	Balance B_1	Balance. B_2	R.P.M.
I	115	1.4	1 lb.	1 oz.	2470
II	114	1.8	2 lb.	1 oz.	2480
III	112	2.4	3 lb.	1 oz.	2130
IV	115	2.9	4 lb.	1 oz.	2012
V	115	3.4	5 lb.	1 oz.	1890

The input in horse power is the number of watts divided by 746, or for reading I was $\frac{115 \times 1.4}{746} = .20$ hp. The output is the number of foot pounds divided by 33,000, or $\frac{11 \times 1 \times 2,470}{12 \times 33,000} = .06$ hp.

The efficiency is the ratio of the output to the input, or $\frac{.06}{.20} = .30$, or 30 per cent.

The input, output and efficiency of the other four readings were calculated in the same manner, and the results are given in the following table:

Reading.	Input.	Output.	Efficiency.
I	.20 H.P.	.06 H.P.	30%
II	.27 H.P.	.13 H.P.	48%
III	.35 H.P.	.17 H.P.	49%
IV	.44 H.P.	.22 H.P.	50%
V	.51 H.P.	.26 H.P.	51%

From the above data a curve was plotted showing relation between efficiency and load, using per cent. efficiency as ordinates and load in horse-power as abscissæ. This curve shows that as the load increases the efficiency becomes greater; it also shows that the motor is doing better work when the load is greater.

The above is a rapid and neat method of obtaining the brake horse-power and efficiency of a motor for various loads.

The Pollak-Virag Rapid Telegraph.

At a general meeting of the Hungarian Academy of Sciences at Budapest on May 6, 1903, the Wahrmann prize of 2,000 kronen was awarded to the inventors of the Pollak-Virag Rapid Telegraph. A complete description of this system apeared in our columns several years ago, and it suffices to say here that in its latest form it is a writing telegraph requiring the use of two wires and a ground.

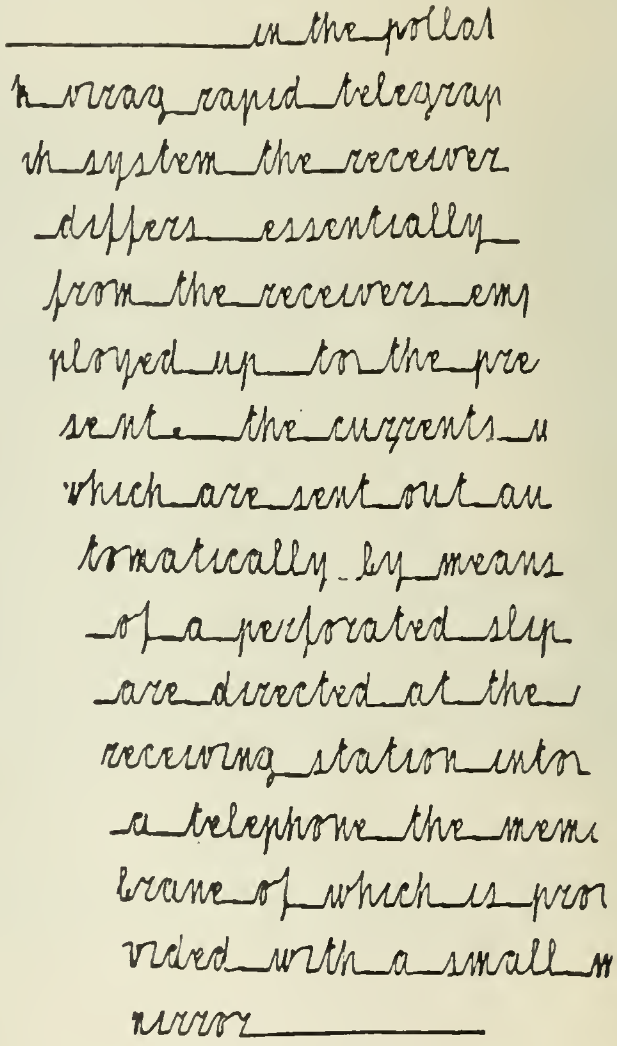

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FIG. 1.—FORM OF RECEIVED MESSAGE.

Fig. 2 is a fac simile of the transmitting tape and of the message as received. The upper row of dots corresponds to impulses sent over one line and the lower impulses sent over the second line. The first mentioned impulses act upon a diaphragm to give a vertical motion to a mirror and the second set act to give a horizontal motion. A pencil of light striking the mirror is thus given a motion compounded of the aforesaid horizontal and vertical motions, and when this pencil strikes a sensitized strip of photographic paper, the trace consists of the italic characters shown in the lower part of the cut. Fig. 1 is a reproduction of a message as received by the system.

It is claimed that 45,000 words per hour can be transmitted with this system as against 12,000 words by the Hughes typewriting system, and 18,000 by the Wheatstone rapid system. A perforating operator can perforate 2,000 words hourly, so that one set of rapid telegraph apparatus will keep 23 perforating machines at work. The inventors have been successful in constructing a photographic arrangement whereby the development requires only from five to six seconds and the fixing from six to seven seconds, at the end of which time the telegram comes out of the apparatus ready for delivery in the form shown in Fig. 1.

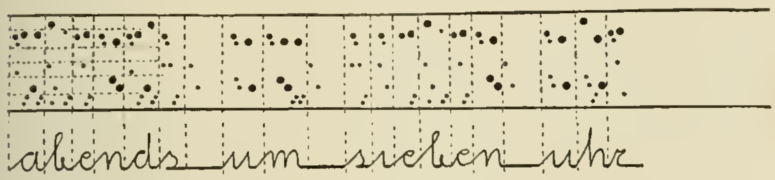


FIG. 2.—FAC SIMILE OF TRANSMITTING TAPE.

In official reports of experiments on Hungarian State telegraph lines, it is stated that messages were dispatched between stations 120 miles apart at the rate of 45,000 words per hour. In another experiment, the largest number of words transmitted was about 40,000 in an hour. The head of the Hungarian Postal Telegraph Department, in his report, regretted that the system could not be applied in Hungary, for the reason that there is not enough telegraphic service to provide sufficient work even for a short time for a rapid telegraph system. At present the system is being regularly worked over a line between Berlin and Frankfort, Germany, a distance of 360 miles.

Of the money prize awarded, one-half is to go to the widow of the late A. Pollak, whose family was left in straitened circumstances.

Recent Electrochemical Developments.

ELECTRIC FURNACE.

A patent was granted on July 7th to Mr. P. L. T. Héroult, of La Praz, France, who is best known as the inventor of the Héroult aluminium process (which is quite similar to the Hall process) but whose main activity in recent years has been in the electrometallurgy of iron and steel. The furnace shown in the adjoining diagram is especially intended for the production of cast-iron, ferrosilicon, ferromanganese. This reduction furnace is to be operated in connection with a preparatory furnace in which the ores to be treated are previously fused or sufficiently softened to descend progressively along the passage, *A*, to the point *e*, whence they fall into the well, *C*, of the furnace, where the reduction takes place. This well contains a column of coke, *Z*, through which the electric current passes, and with which the fused or pasty ore becomes mixed when it comes from the adjoining preparatory furnace.

As the coke is used up in reducing the ore, the coke column is fed at the top from a reserve contained in the upper part of the furnace. The current enters the furnace, through the carbon block, *G*, and leaves it through the crucible, *B*. This crucible has a tap-hole, *D*, for issue of the molten metal, and through the wall is a hole, *E*, for issue of the slag. The hot gases developed during reduction ascend and pass out between *e* and *h* into the preparatory furnace, where their heat is utilized.

The block, *F*, is called by the inventor a "false electrode"; it acts as an intermediate of bi-polar electrode, the current passing from *G* to *e*, through *F*, and from *f* to *B*. At the points *e* and *f* an intense heat is therefore developed and it is at these points where the heat is needed. The contacts through which the current enters and leaves the furnace are sufficiently remote from these points of highest temperature.

PLATING IRON WITH ZINC.

A patent, granted on July 7, to Mr. Emanuel Goldberg, of Moscow, Russia, is another example of that rather wide class of electroplating processes, in which an addition of an apparantly inactive compound to the plating bath is intended to give a bright and adhesive cathodic deposit. The inventor states that a pure white coating of zinc, which adheres well to the surface of the iron, is obtained, if to the zinc chloride used as electrolyte an organic compound is added which contains nitrogen. As suitable compounds he mentions amins, amids, cyanides, nitrites, etc., and states that the pyridin bases have given the best results. He dissolves 10 grams of zinc chloride and 10 cc. of pyridin in about 1 liter of water, and adds enough hydrochloric acid to dissolve the double salt which is formed. For electrolysis a cathodic current density not exceeding 0.2 amp. per sq. decimeter is used.

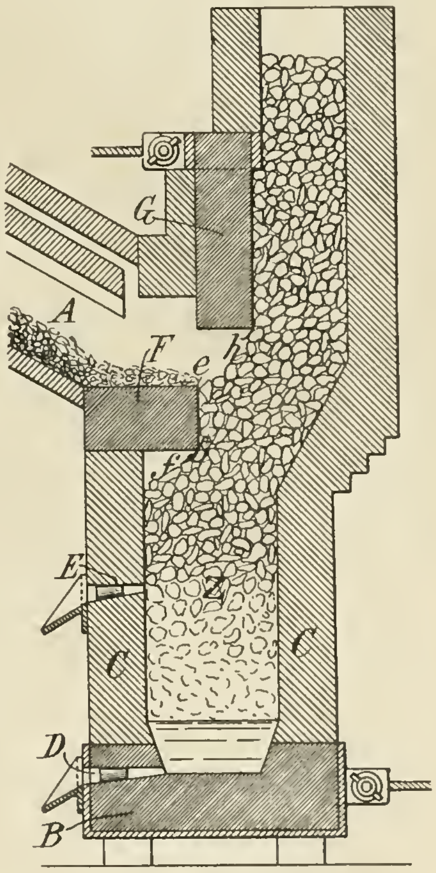
ELECTROLYTIC PRODUCTION OF CHLORATES AND PERCHLORATES.

A patent was granted on July 7, to Mr. Pierre Lederlin, of Chedde, France, for a process of electrolytic manufacture of chlorates and perchlorates. A cell is used without diaphragm, and as electrolyte a chloride, without addition of chromate or bichromate. An ampere-hour efficiency as high as 90 per cent. is claimed to be obtained, if the electrolyte is continuously maintained non-alkaline during electrolysis by suitable continuous additions of dilute hydrochloric acid.

STORAGE BATTERY INVENTION.

Two patents were granted to Mr. Wm. Gardiner, of Chicago, on July 7, for details of an alkaline storage battery with zinc as one electrode. When the cell is fully charged, the electrolyte is essentially an aqueous solution of caustic potash. During discharge zinc dissolves from the anode while the cathode—which is assumed to be an oxide of copper in one patent and an oxide of silver in finely granulated form in the other patent—is reduced. The cell is not an "oxygen-lift" cell, because the zinc goes into solution during discharge, the capacity of the cell depending upon the amount of zinc which can dissolve in the caustic potash solution, and therefore upon the quantity of electrolyte used.

As a solution of potassium hydrate is capable of dissolving but a relatively small quantity of zinc oxide, a relatively large quantity of electrolyte is required to get an appreciable capacity. The inventor believes he can get around this in the following way: In a strong solution of pure caustic potash he dissolves pure zinc oxide and uses this solution for charging the cell; zinc is therefore deposited from the electrolyte. He then removes this solution temporarily to another receptacle and dissolves again zinc oxide in it and uses it then again for charging the battery. This is repeated as many times as necessary to deposit as much zinc as corresponds to the capacity which the cell shall have. He then fills the battery with a fresh aqueous solution of pure caustic potash, containing no zinc oxide. The inventor believes that during discharge a far greater quantity of zinc is then dissolved in the caustic solution than would otherwise be the case; he believes this excess of zinc to be in an "unstable condition," so that it is "deposited almost immediately when the charging current is applied." Further explanations are not given. The cell is built up by placing a tray containing the active material of one electrode into a larger tray containing the active material of the other electrode, the bottom of the inner tray being of course perforated.



HÉROULT ELECTRIC FURNACE.

Proceedings of Niagara Meeting of the American Institute of Electrical Engineers. (*Continued.*)

Below appear abstracts of the remaining papers presented at the Niagara meeting of the American Institute of Electrical Engineers, together with abstracts of the following discussions, except the papers and discussions which dealt with high tension transmission. Owing to the very unusual extent of the discussion on the several subjects grouped under this head, the length of the report is such that we are obliged to carry it over to the following issue.

SOME NOTES ON CERTAIN UNDERGROUND HOISTING PROBLEMS ON THE WITWATERSRAND.

In a paper with the above title, Mr. A. W. K. Peirce sketched the present conditions in South Africa gold mines and the hoisting problems arising in connection with the more and more extended "deep level" operations. The principal power requirements of the mine equipment and the area over which the power is to be distributed this being several square miles—practically determine the use of a polyphase system at a moderately high voltage. For hoisting, however, the author thinks direct-current motors to be more suitable than alternating. He recommends conversion to direct current separately for each hoist unit, and the utilization of the conversion machinery for obtaining suitable control of the hoisting operations by the voltage control or Ward Leonard system.

THE FACTORS WHICH AFFECT THE ENERGY LOSSES IN ARMATURE CORES

Messrs. J. Walter Esterline and C. E. Reid gave an account of an experimental investigation made at Purdue University. They describe an apparatus, devised for rapid yet accurate testing of sheet metal used in armature cores, the specimens for test being in the form of ordinary armature punchings. The authors also studied the effect of certain factors upon the energy losses which occur in the armature cores of generators and motors. The results are given in a large number of curves, showing the relation between the core loss and any one of the four variables—frequency, magnetic density, number of poles and depth of core—for various types of armatures. Some special results are evident from the curves. The curve for the cores having teeth shows considerably higher losses, than cores having a smooth periphery; this is due to the energy loss in the pole faces and the increased hysteresis loss resulting from the high magnetic density in the teeth of the core. Relatively shallow cores in which the magnetic density is more nearly uniform, have the lowest values of core loss for the same average magnetic density and frequency. There is practically little change in the core loss for different numbers of poles, for the same magnetic density and frequency, so far as the smooth cores are concerned.

In concluding his paper Prof. Esterline stated that for each smooth core a toothed core was also tested, the depth between the teeth corresponding exactly with the radial depth of the smooth core; as a consequence, the results from smooth and toothed cores are readily comparable.

Prof. Goldsborough pointed out that the curves of the paper when analyzed give much more definite information in the matter of losses and armature cores than we have ever before had. He explained at length the different conditions of flux with two, four, six and eight poles, and showed that there is a great variation in the density of flux between the inner and outer edges of the different laminæ, which may be as great as 14,000 lines at the top to 2,000 at the bottom. With a two-pole machine there is more variation than in the case of a four-pole machine, and a six-pole machine gives still less variation. In the case of eight poles the density in the air becomes very high, and the maximum watt loss instead of being between the poles is in the iron immediately beneath the poles. In reply to an inquiry, Prof. Goldsborough stated that the density of the flux was found by boring a series of holes through the core, and then by means of exploring coils and simply exciting the magnets, the distribution of the flux was accurately determined.

Prof. Franklin said that an argument as to the distribution of flux in iron could not be based on the assumption that the pole faces may be considered to be equal potential surfaces. Prof. Goldsborough pointed out some considerations which he considered showed conclusively that the average density in the pole face of a dynamo is greater than the average density along the surface of the armature between two pole tips. This can be calculated and also determined experimentally. Mr. Wilson said that what the designing engineer really wants is some method of rapidly and accurately calculating the core losses; that is to say, the loss due to hysteresis in the core itself, in the field and the losses due to eddies in the pole face and in the conductors, etc. Having obtained methods for calculating these details, then by actual tests he needs to obtain some correction factor which will make the result approximately correct for generators as a whole. The core loss will vary in different machines up to perhaps the eighth power of the density, though an average figure is the fourth power of the normal density. There are eccentric variations of the core loss with frequency, and it is thus impossible to make a general test agree with the results obtained from detail tests of the various parts. As to the loss in the teeth at high densities, he considered that as the teeth get saturated there is a large amount of leakage at the slot, and consequently increased eddies in the conductor. At the bend in the saturation curve the flux varies very rapidly, perhaps something like the tenth power, which probably accounts for the high density when comparisons are made on the basis of watts per pound. Mr. Mailloux pointed out that the curves in the paper can be approximately expressed by a simple equation, and showed how this might be done.

In reply to a question, Prof. Esterline said that no effort had yet been made to separate the hysteretic from the eddy current losses, but he hoped in the future to continue the work. Mr. Scott, in referring to the form of curves, said that the workman in the shop by filing an armature more or less or bolting it together a little carelessly, can shift the curves and thus invalidate the equations.

POWER STATION ECONOMICS.

Messrs. W. E. Goldsborough and P. E. Fansler, in a lengthy paper on this subject, give the results of a careful test of the economy of the main power station of the Union Traction Company of Indiana. It contains eight 400-hp water tube boilers, three engines each with a maximum capacity of 2,000 hp, direct-connected with a 1,000-kw, three-phase generator. The methods of the test are described in detail. The results giving the thermal efficiency of the plant are as follows: The efficiency of the furnaces and boiler is 79.6 per cent., i. e., 79.6 per cent. of the whole heat in the coal as fired is delivered by the boilers to the engines in the steam. The average thermal efficiency of conversion between the boilers and engine cylinders is 9.11 per cent., i. e., 9.11 per cent. of all the heat delivered in the form of steam by the boilers is converted into work in the cylinders of the main engines. This value of 9.11 per cent. credits against the engines the steam used in the auxiliaries. If the assumption is followed out that 15 per cent. of the steam delivered by the boilers is consumed by the auxiliaries, the thermal efficiency of the engines works out to be 10.7 per cent. The average total thermal efficiency of the plant is 7.25 per cent. from the coal pile up to the engine cylinders, and the total average thermal efficiency of the plant from the coal pile to the switchboard, i. e., the ratio of the energy delivered by the generators to the total heat in the coal, is 6.39 per cent.

Although it is frequently stated that the thermal efficiency of the steam engine at a maximum is about 25 per cent., it is impossible that any engine of this class working under these conditions will convert more than 12 per cent. of the heat of the coal into work. The thermal efficiency of 6.39 per cent. up to and including the switchboard shows high economy as compared with other stations of a similar character. The total thermal efficiency of the Harrison Street station of the Chicago Edison Company has been estimated to be 4.5 per cent., while that of the generating station of the Blue Island, Chicago Storage Battery Road was found to be 5.5 per cent. Indiana block coal is used, which is delivered at a cost of $1.35 a ton. On this basis the cost of developing one kw-hour is 0.28 cent. This cost may be taken as the final estimate of the efficiency of any station; figures of this cost in various stations vary between 0.246 and 1.016 cent.

After the reading of the above paper, Prof. Goldsborough said that the station described delivers to the line 6.23 per cent. of the total energy of the coal, but that only 3.65 per cent. of the total energy gets to the cars. The efficiency of transmissions between the station and the cars is, therefore, only 50 per cent. Mr. M. H. Gerry said that if everything were included between the electrical output of the station and the electrical input at the cars, the total efficiency of the plant at the car axle would certainly be reduced 25 to 30 per cent. more, bringing the total ideal efficiency of the installation down to or around 2 per cent. Prof. Goldsborough considered this to be a fair assumption, but he pointed out that power is developed so cheaply that this becomes a small factor, one passenger per car pretty nearly paying the cost of the power used by a car from Indianapolis to Muncie, the fare, moreover, being only one cent a mile. A good deal of money is being made on this basis, the property being a profitable one.

Mr. Gerry said that the plant was not an example of a high efficiency or even of an average efficiency plant. Prof. Goldsborough replied that the plant has a very high financial efficiency, which he considered to be a better than a high power efficiency. To reduce the transmission losses would increase the capital charge, which increase might more than balance the cost of coal. Mr. Gerry said that he did not see why a high-efficiency station should be installed to make power cheap and then a low efficiency distributing system put up which will waste that power afterwards. If one can produce power cheaply and wants to keep down the first cost of a station, he should not put in a modern high-class system all the way through. In reply, Prof. Goldsborough said that if a low-class generating station, low-class transformers, low-class rotaries and batteries were put in, the cars would not get the required per cent. of power of the total energy generated. The present station has the highest class of generating machinery and should it become necessary to increase its earning capacity, all that would have to be done would be to increase the copper in the lines. There is no excuse for putting in bad machinery, but when it comes to the size of copper conductors, that is another thing. At present the voltage is 18,000, but in extending its system to Logansport the company will use 32,000 volts. Perhaps some day, instead of operating with a direct current of 5,000 volts, it will operate with an alternating current of 10,000 volts. Mr. Gerry, in reply, said that the highest efficiency machinery designed did not always give the best operating result, and to him it is a question whether in this case refinements were not made in the station and sacrifices in the transmission system.

Mr. H. G. Stott said that the ultimate object in any power plant is to deliver a kilowatt-hour to the receiving apparatus at a minimum cost, and that there is no other object in a power plant. If the coal is expensive, an extremely efficient plant must be put in; but if coal is very cheap one can afford to sacrifice a good deal and reduce the cost charges of the plant. In the end, however, one must consider the whole problem; that is, the cost of the kilowatt-hour delivered at the receiving apparatus. He considered that in the paper just read the fuel cost is only given, whereas the total cost of the delivery of power is the real test. In the New York Manhattan plant the cost of coal is 70 per cent. of the total operating expenses up to the track of the elevated road, and consequently an extremely efficient distributing system and power plant is required. He thought that any comparison of efficiencies was unfair when calculated merely on the ratio of indicated horse-power to kilowatt-hour output. Mr. Mailloux agreed with Mr. Stott and said that the real question is what is the kilowatt-hour is going to cost delivered. He said that recently he was approached by a representative of a concern making gas engines, in connection with a plant of 15,000 or 20,000 kw, which he is designing for railway work, who made the statement that he could enable him to save $100,000 a year in fuel. Mr. Mailloux found that he could, with the engines proposed, make a very material saving in coal, but that the additional cost of buildings would be greatly increased; for instead of being able to use three large turbine units of 4,000, 5,000 or 6,000 kw each, he would have to use ten gas engine units. The initial investment would be one-half million dollars greater, and considering the fixed charges and the cost of producing power, the proposition entailed a loss of $100,000 a year instead of that much gained. This example illustrates the necessity of taking all circumstances into consideration in making comparison of methods of producing and delivering current.

Mr. Gano S. Dunn referred to the vague manner in which the term "cost" is used, and thought that it would be well never to use that word without defining what it was intended to include. It would be desirable when costs are considered before the Institute or for statistical purposes, that they should include fixed charges, taxes, depreciation, sinking fund charges, interest on bonds, and every other factor, as well as the charge on any extra cost in the way of buildings or otherwise that a proposition entails. Our statistics on the subject of cost of power are of very little use, because of the lack of definitiveness in specifying what we mean and what we include when we say "cost." Mr. Paul Lincoln said that the question which Mr. Gerry raised seemed to be simply a question of Kelvin's law. Power can be developed for a certain sum at a station, and it is merely a question of how much of that shall be lost in the line. If power is cheap, more power can be lost in the line than if power is dear. It is for an engineer to determine whether he shall put money or energy into his line. Mr. Mailloux said that he could mention many cases where the cost of fuel has a very great bearing upon the selection of machinery and the design of the installation. Mr. John F. Kelly said that the heedless application of Kelvin's law would be apt to lead to considerable bad engineering. The law has an important proviso, namely, "provided that other things be equal." If the energy generated is used for lighting, it must be delivered at a practical constant voltage, which limits the application of the law in that particular case, and the same may be true in other cases. Referring to the system described by Prof. Goldsborough, he was inclined to think that the discrepancy between the two parts was due to the fact that the cheaper station was laid out by an engineer, and the other part put up by a lineman. He agreed with Mr. Gerry that very often the lower efficiency machinery is much more stable, may run better and last longer than the higher grade machinery. Mr. Gerry agreed with Mr. Dunn that power data as a rule are absolutely worthless because the various factors that enter in cost are either not included or are based on assumptions so much at variance that one plant cannot be compared with another. Another point which affects the cost of power is the form of the load curve. He suggested that for determining cost, certain rules be formulated, certain interest charges determined upon, certain relations established between average and maximum power; in other words, all station factors should be taken into consideration in a definite way, and we might then arrive at a form of stating the cost of power so as to make comparisons possible within a few per cent. of error. President Scott said that Prof. Goldsborough had rested upon the cost of fuel per kilowatt-hour output, which is an entirely accidental thing; for the cost of coal varies greatly, and the discovery of a coal mine in the vicinity might reduce its cost to half. It has been suggested that the total cost should include cost of handling and attendance, but that would depend upon the current rate of wages in any part of the country. He thought that in consideration of such problems, two things should be considered separately—first, the purely engineering problem, and then the application of the engineering to the commercial problem. In concluding the discussion, Prof. Goldsborough said that the reason no more figures were given in the paper was because he could not obtain the consent of the owners of the plant to print all the data which he had obtained. Replying to Mr. Kelly, he said that if one were to inspect the line in question, which carries 16,000 volts on the top of the pole, 500 volts half way down and a telephone line a little bit lower, all three of the lines working perfectly with no disturbance in the telephone system—he would not conclude that the line gave evidence of bad engineering.

CATHODE RAY ALTERNATING CURVE WAVE INDICATOR.

One of the most interesting papers read before the meeting was that by Prof. Harris J. Ryan, in which he describes an application of the cathode ray to a determination of alternating current wave forms. As well known, a cathode stream is subject to large deflections by comparatively weak magnetic fields, and taking advantage of this fact, Prof. Ryan has devised a very efficient wave indicator. The cathode ray tube is operated by a motor-driven electrostatic machine, and all of the rays are stopped at a diaphragm except a pencil, which passes through a small aperture at its center. The current whose wave form is to be indicated, passes through an electromagnet placed near to and at right angles to this pencil; a second electromagnet is arranged with its axis at right angles to the first mentioned one. Through one of the coils the current whose wave form is to be indicated is passed, and through the second a current of known wave form is passed. As a result of this disposition, the pencil of rays will trace on a fluorescent screen a curve which may be photographed; and as inertia does not enter, the trace is accurate in its indications. As this curve is resultant of two motions, one of which is known, the values of the unknown curve may be simply separated and plotted. One of the advantages of this method is that the phase position of the control or sine wave can be adjusted so as to cause the more intricate portions of the unknown wave form to occur at the time when the rate of change of the sine wave form is most rapid; consequently, the resulting cards can be so adjusted as to bring out the desired details to the fullest and clearest extent.

President Scott said that when he first came into electrical work, some fifteen years ago, a striking paper opening up a new field and illuminating it had just been presented by Prof. Ryan, on the wave forms of the e.m.f. on transformers of different sizes and under different conditions. Mr. Gano S. Dunn expressed his appreciation of the work of Prof. Ryan, though it might be asked, what has a direct current man got to do with wave forms? In point of fact, the direct current man has to do with frequencies between say 60 cycles per second and many hundreds of thousands per second. These frequencies occur in the complicated phenomena of commutation, and he explained in detail some of these phenomena and showed what an important influence they have with respect to sparking. In a specific case to which he referred, phenomena were present having a frequency all the way from 800 to 8,000 per second. The complications that might arise from this condition cannot be predicted, but with a wave tracer such as that of Prof. Ryan, he thought that the causes could be determined and thereby give a solution of the general problem, which would be a valuable contribution to the design of direct-current machinery.

In reply to a question, Prof. Ryan said it is not possible to photograph a single tracing, the light given off by the fluorescent screen not being strong enough. For periodic work, however, it is easy to photograph with an exposure of from two to five seconds. Mr. Hammer suggested that the Lenard tube with an aluminum window could be used, as by these means a record could be made directly on photographic paper. Prof. Ryan said that the suggestion was a very interesting one, but Dr. Sharp added that the cathode rays, after passing through the window of a Lenard tube are quickly absorbed by the atmosphere. Mr. Hammer, in reply, maintained the practicability of using the Lenard tube. Prof. Goldsborough moved that the Institute accord a vote of thanks to Prof. Ryan, which motion was seconded by Dr. Kennelly and carried.

THE LEGALIZED STANDARD OF E.M.F.

Prof. Carhart presented a paper in which he discussed the value of the e.m.f. of the Clark and cadmium cells. He recalled that the Chamber of Delegates at the Chicago International Electrical Congress, had fixed upon 1.434 as the e.m.f. of the Clark cell at 15° C. Germany did not legalize this value, and the Reichsanstalt has used the value, 1.4328. Prof. Carhart says it is quite certain that the actual e.m.f. is nearer 1.433 than 1.434. In 1899 Profs. Carhart and Guthe made an absolute determination of the e.m.f., which gave the value 1.4333 at 15° C. Later Dr. Barnes, of McGill University, made a series of determinations of the mechanical equivalent of heat in terms of the international electrical units, which agree with previous determinations of Reynolds and Moorby, made by a purely mechanical method, if the e.m.f. of the Clark cell is 1.43325 at 15° C.; and they agree with Rowland's determination if the e.m.f. is 1.43355.

During the past year Prof. Carhart has taken up the measurement of the e.m.f. of the Weston cadmium cell, and the electrochemical equivalent of silver. The Weston cell was chosen because of its low temperature coefficient and the close agreement between the different cells of a series. The ratio between the e.m.f. of the Clark cell at 15° C. and that of the cadmium cell at 20° C. has been carefully determined in a series of experiments at the Reichanstaldt, in one of which Prof. Carhart assisted, and found to be 1.40670. An absolute determination of the cadmium cell is, therefore, one of the Clark cell, as the ratio is known to a much greater degree of accuracy than the e.m.f. of either can be measured.

The investigation is not yet completed; a series of cadmium cells has been made and it has been found that the several cells agree well among themselves, the variations being smaller than the limits of accuracy that have been set. Prof. Carhart considers that the low temperature coefficient of the cadmium cell is an advantage of the greatest importance, and the marked uniformity shown by different series of cells is so marked as to constitute another count in its favor as a standard. In conclusion, Prof. Carhart made the following recommendations:

First. That the Institute appoint a committee of three to prepare a complete specification for the normal cadmium or Weston cell.

Second. That the cadmium cell, as thus specified, shall be adopted as the standard of e.m.f. by the Institute and that steps be taken to secure its legal adoption by Congress, provided it be dedicated to the public by the inventor, one of the distinguished past presidents of this Institute.

Dr. Sharp seconded the recommendations of Prof. Carhart. He considered that the matter of a universal standard e.m.f. is a very important one. The German volt, for example, differs from that in use in this country by 1 of one per cent., which difference is a matter of great importance in any work of precision. The Clark cell is troublesome to use, and he believed it advisable to replace it with the cadmium cell, which is in every way better adapted for use as a primary standard of e.m.f., being more easily prepared and intrinsically more easy to use. He referred to the fact that many laboratories do not have a potentiometer, and to his mind this instrument is of far greater engineering importance than the Wheatstone bridge. In engineering we wish to measure two things, e.m.f. and current, and for measuring both according to best methods a potentiometer is needed in connection with a standard cell. The standard cell is not as delicate as is generally considered, as it will submit to a great deal of bad usage and recover from it. If short-circuited its usefulness will be destroyed for several days, but it will then come back to normal and can be used again.

Mr. Carl Hering thoroughly agreed with the recommendations of Prof. Carhart, and suggested that specific names should also be determined upon for the two different cadmium cells, so as to avoid the confusion that now exists. At present it seems that the saturated cell is called the cadmium cell and the non-saturated cell the Weston cell. Mr. Hering thought that the first one being the real standard should bear the name of Weston. Prof. Goldsborough agreed as to the extreme value of a recognized standard of e.m.f., and he considered that such action as had been suggested would be hailed with pleasure by the officers of the National Standardization Bureau, at Washington. He suggested that the committee recommended by Prof. Carhart be appointed by the Board of Directors of the Institute with instructions to report at the St. Louis general meeting in September, 1904; and that 25 copies of Prof. Carhart's paper, together with the discussion of the same, be sent to the secretaries of each of the national electrical engineering societies abroad and also to the secretaries of the several standardizing laboratories of Europe, as well as that in Washington. Mr. Hering though that the report should be made as soon as possible in order to give time for expression of opinion both in this country and abroad before the congress meets; the object of the congress is to settle discussion, which should precede its meeting. It was finally decided that the committee should prepare its report at the earliest moment, in order that it might be sent out for discussion previous to the meeting of the congress. Prof. Carhart said that the National Bureau of Standards at Washington is entirely in sympathy with the work that he is doing, and that the bureau proposes to duplicate the electro-dynamometer which he has devised for use in the investigations.

THE MAGNETIC UNITS.

Dr. A. E. Kennelly discussed in a paper the subject of magnetic units and the nomenclature in general of units. The paper opens with a historical summary, giving an account of the action that has been taken with respect to electrical units from the first B. A. report in 1873 to date. While agreeing that a rational system which would eliminate the numerical constant 4π would be preferable to the present C. G. S. system, it would now be very troublesome to change to the latter. The one compensation for the trouble and expense would be a certain amount of scientific simplification in the theory of electromagnetism and a certain benefit to scientific computors. The electrical industries would not receive any practical benefit, and any benefit at all would be the small amount derivable from the simplification in theory already mentioned. As to the several ingenious expedients which have been proposed for effecting partially the rationalism of the C. G. S. electromagnetic units, it is very doubtful whether such half-hearted expedients can succeed, and it thus seems better to let the extending system alone. After years of experience, it is now easy to see that the correct original course would have been to christen the C. G. S. magnetic units without regard to practical magnitudes employed, and at the same time adopting a suitable series of prefixes for decimal multiples and sub-multiples. If, for example, the C. G. S. unit of current strength (10 amp.) had been originally christened the ampere, our present ampere would have been known as a deciampere, and we should have become as familiar with such a term as we are now with the ampere, as the use of the microfarad indicates.

Dr. Kennelly considers it very desirable that the international congress should complete the units of the magnetic circuit by bestowing names upon the C. G. S. units of magnetomotive force and of reluctance, for which the Institute has recommended the names gilbert and oersted, which are already in some use in this country. He also thought that the C. G. S. electromagnetic units should have names; this is desirable for scientific purposes, for educational purposes, and in the interest of progress. He suggested the expedient of employing the prefix ab or abs to a practical unit, in order to express the corresponding C. G. S. unit. Thus the C. G. S. unit of e.m.f. would become the abvolt, the unit of resistance the absohm, etc. The electrostatic units might be attended by the prefix abstat; thus the C. G. S. electric unit of e.m.f. would be the abstatvolt; the unit of current abstatampere, etc. He considered it desirable that such a system of christening the C. G. S. electromagnetic and electrostatic units should be adopted by an international electrical congress; and that it is also desirable that such a congress should sanction the use of the Hefner-Alteneck standard amylacetate lamp as a secondary standard of light intensity.

It is also desirable that steps be taken by such a congress to establish a uniform international basis for the standardization of electrodynamic machinery. It is perhaps impossible to carry the principle of international standardization very far into detail, since many details obtained depend in each country upon local and industrial conditions; but on the other hand, there are many underlying physical conditions that might receive notice among electrical engineers. For example, the dynamo ought to have the same rating based on temperature elevation all over the world.

In the discussion Prof. Goldsborough said that for a number of years past he had found it very convenient to make up new names for the magnetic units which thus far have not been christened, and to use them in discussing related matters with his students. He has found that as soon as a student is given a definite name for a specific thing he more readily gets a concrete idea of the thing. He made a motion that copies of Dr. Kennelly's paper when printed be sent with copies of Prof. Carhart's paper, to the secretaries of the various institutions mentioned, for the purpose of calling attention to the matters therein considered. Prof. C. D. Jackson seconded the motion, which was carried.

THE ELECTRICAL EQUIPMENT OF A GOLD DREDGE.

In a paper on this subject, Mr. Ralph L. Montague makes first some general remarks on placer mining and then describes at some length the first successful application of a gold dredge to placer mining in America, at Bannock, Mont., in 1895. He then discusses in detail the nature of the loads on the various direct-current motors in a gold dredge.

Mr. Scott said that the paper is of interest, not only in showing the means of application of power to an interesting and important work, but also as indicating the value and flexibility of electrical power in an industry of the kind, where power is wanted in fairly small units, and where it would be very difficult to get it in other ways. He considered that the application of electric power in mining is effecting great results in that industry. Mr. Skinner said it is interesting to see these dredges at work, going over ground that had been completely worked over by hand and getting good financial returns. Tremendously hard service is required of the motor driving the buckets; he has seen these stalled many times and burned out, it being necessary at times to reverse the motor and subject it to strains that twisted shafts supposed to stand any duties that the motor could be made to perform.

ENGINEERING EDUCATION.

Prof. W. S. Franklin, in a paper entitled "The Teaching of Physics to Engineering Students," pointed out that the ultimate object of the teaching of physics to technical students is to lead the young man by a shortened route to that familiarity with physical things which is possessed by such a man as John Fritz. The shortening of the route which leads to this result depends upon the fact that the teacher of physics has to do largely with an epitome of real knowledge, and consequently the primary object of physics teaching is to develop in the young man's mind a logical structure consisting of the aggregate of physical conceptions and theories. The teacher should never apostrophize the wonders of Nature to his class; he should never allow the slightest speculative tendency to enter into any of his teaching.

The author recommends the use of sharply, clearly and concisely written text-books, to give explanatory lectures of such character as to appeal properly to the student's imagination—theoretical lectures illustrated by the simplest kind of experiments—to require of the student a large amount of numerical calculation and to give a laboratory course based upon highly generalized printed directions supplemented by a vanishing series of verbal suggestions from an instructor. There is nothing in the teaching of physics so important as to develop in the student the ability to express physical conditions in mathematical form, geometrical or algebraic as the case may be, to reproduce or re-present the conditions of a problem adequately as a geometrical construction of as an algebraic formula. Nothing is so important as this for technical students.

In the discussion of Prof. W. S. Franklin's paper, Prof. Goldsborough was the first speaker. The students should have a thorough and complete drill in theoretical electricity and they should be taught to apply that theoretical training in practical work; they should not be sent out to college with a theoretical training and a practical training which to the student have no relation to each other whatever. It takes time for a student to become thoroughly familiar with even such elementary terms as volts and amperes, or with the more complex conceptions of alternating current theory. Students should not be allowed to jump to a final formula which shows a result; they must be made to go right back to the beginning and start and go right down through; until they understand what has gone before, until they comprehend all the factors entering, they have no business discussing the final formula.

Prof. Langsdorf said there are two ways of teaching laboratory work. The one is to give the student at the beginning the equation which represents the relation between the quantities which he is measuring, and allow him to have the data from the laboratory and verify the equations by substitution. The other method is to give him the apparatus, tell him to take the data, plot his curve and determine the equation from the curve. By this second method the student acquires an understanding of the meaning of formulas which he cannot acquire in any other way. And this second method is the only one which should be used, which should be thoroughly impressed on the mind of the student.

President Scott referred in this connection to an incident in his own education. When he left the college, the ampere and volt and coulomb and watt, all had about equal importance and significance to his mind. But when he got out among workmen and engineers he found there was one of the units for which they had the greatest respect and that was the watt and the kilowatt, *i. e.*, the unit of power, the unit of activity. Prof. Colwell said the student should be impressed with the importance of the original notes which he takes in the laboratory; they are more important than the report sheets.

Mr. E. H. Mullin, in a paper entitled, "Training an Artist in the Forces of Nature," presented a strong plea for education in its broader sense, as contrasted with mere storing of facts in the mind of the student. With knowledge alone, we live in a flatland, and realize our neighbors only when we touch them, whereas by the added culture we can rise above our surroundings, and by viewing the relations of our neighbors to each other, form a just estimate of our relation to them. The pure specialist, without sympathy and without comprehension, is simply a machine tool in the hands of a higher order of intelligence. It is not the knowledge of facts which makes a man educated, but the possession of method. To teach a man to learn how to learn is the true function of education, and to stuff his mind with facts beyond this point is merely to encumber him in pursuing his means of livelihood. Education is not so much intended for the elucidation of old problems as for the tackling of those that are new; and as a knowledge of facts without the power of reasoning is worthless for new adventures, and as every problem which meets us in life is a new venture, therefore method by itself is everything, and facts by themselves are nothing.

Mr. Mullin divides education into two branches—education as an art itself, and education as a science. In every stage of education as an art, there are two things to consider—the accumulation of a sufficient number of names and their connotations to give an ample nomenclature or set of tools, and also enough familiarity with this nomenclature or set of tools, to enable one instinctively to select the right tool and use it efficiently. Having obtained the tools through education as an art, the problem in education as a science is not to use them as we have been doing, but to apply them to new problems. Here not only is memory needed but imagination, and the highest function of education as a science is to make a man of average ability see resemblances and differences in things where he would otherwise be blind.

As to the essentials of an engineer's education, a sound knowledge of one's native tongue is the best substructure. The great engineers who have been deprived of this aid, have borne eloquent testimony by their efforts at self improvement in later life to what they considered would have been its usefulness at an earlier period of their careers. An elementary knowledge of Latin is almost indispensable to the clarification and consolidation of the knowledge of nearly every European tongue. Next to these is a good working knowledge of French because besides its obvious advantage as a language to be spoken, it imparts lucidity and precision to writing—a thing, by the way, which mathematics often fails to do. Early practice in mechanical drawing should also be given to every boy who feels within himself the stirrings to become an engineer, because facility with the pencil is easily acquired early in life, but is often one of the greatest stumbling blocks when taken up too late.

As the profession of an engineer always involves constant dealing with quantities and values, he ought to know mathematics as he knows the currency of his native country. In other words, he ought to be able to make change with ease, quickness and accuracy—not as if one were in a foreign country in a constant state of painful reckoning. A thorough knowledge of ordinary mathematics is prescribed, not any vain ascents with crippled wings into the empyrean.

The first part of the superstructure should consist in learning the principles of the applied sciences. These should be studied in books, assisted by oral teaching, and enforced and re-enforced by the practice of dozens or hundreds of examples. If one wants to know how each principle should be learned, he should watch a great singing teacher train a pupil. A false note in a scale demands a hundred perfect repetitions. A false note in an *aria* means back to the scale for a hundred more repetitions before attacking the *aria* a second time. Why should the future artist in Nature be less carefully prepared for his work Is that work likely to be less important? Or is it merely because his future audience is less likely to detect a false note?

With this, the education of our engineer ends, or rather begins. He may be fifteen, sixteen or any age. He may have studied in school, or in college, or at home. He is, however, a trained engineering soul, according to the measure of his talents. He is able to learn the art of engineering, or any other art, for which he has an aptitude, in months, where another man of equal ability might take years and not know it half so thoroughly. All he needs to ensure his success in life is to find a master who can utilize his powers.

Mr. T. J. Johnston, in a paper entitled "Engineering English," referred to the fact of everyday experience that no two engineers describing the same phenomenon will give anything like the same description, and this is due not to their want of knowledge of the phenomenon, but to the inaccuracy of their language. The author urges that English composition should be kept up in engineering schools and that engineers should be drilled in the use of English until they can express with entire accuracy the meaning which they so often commit to formulas. He refers to the inaccurate use of some terms common in the profession, such as static transformer instead of stationary transformer, capacity of a system instead of maximum output, field of a generator instead of field magnet, etc.

Mr. L. A. Osborne, in a paper entitled "Proper Qualifications of Electrical Engineering School Graduates, from the Manufacturer's Standpoint," pointed out that our technical schools to-day are admirably fitted to turn out men who are well grounded in the fundamentals of engineering; as a rule, they are good mathematicians, electricians, chemists and physicists, and have all the technical knowledge necessary for pursuing the profession, but they are as a class woefully lacking in that they have no comprehension whatever of many of the subjects which are inseparably connected with the practice of the profession. The majority of the technical school graduates leave college with but very hazy notions either of the function of tools, the principles of their design or the machine organization of a shop. A more thorough knowledge of works organization as applied to the personnel is highly important. There is no more vital subject facing the industrial world to-day than the relation between employer and laborer; a course is recommended which would bring to the student's attention the history of the relations between capital and labor and the economic laws relating thereto. The engineering course should also include a short course of law in its relation to contracts. The author believes that much of the manual training which now occupies such a large proportion of the "actual hours work" in the courses of most technical schools could be replaced with profit by lectures on the subjects mentioned.

"The Proper Qualifications of Electrical Engineering School Graduates from the Telephone Engineer's Standpoint," was the title of a paper presented by Mr. Bancroft Gherardi, Jr., chief engineer of the New York & New Jersey Telephone Company. The qualifications of electrical engineering school graduates are the product of two factors—the natural ability of the man himself and the training which he receives at the engineering school. Telephone engineering is one of those specialties into which electrical engineering in general is rapidly splitting itself, and in consequence of this fact, it has been assumed by some that the school training for the telephone engineer should be different from that given to electrical engineers in other branches. The author does not altogether agree with this proposition. After all, the telephone engineer's work is based upon the same essential principles which underlie the work of all of those engaged in electrical engineering. Instead of attempting to teach ultimate practical problems, the important matter is that engineering students should have discipline in the methods of solving engineering questions. Such discipline can be best given by a general training which will enable him to solve any question that may arise when he becomes acquainted with the conditions of that special problem.

The function of technical education is to train the student so as to convince him of the necessity of getting his facts and to teach him the best methods of getting the facts—to train him as to the methods of interpreting engineering data and reasoning thereon. It is the work of a lifetime to acquire the voluminous data representing the state of the art in the case of any branch of engineering. It would be impossible to attempt to teach such data. The author emphasizes that extraordinary efforts should be made to teach every engineering student to write a report or letter in clear convincing English, setting forth the facts and arguments and conclusions on any question which he may have to consider; but clear thinking must precede clear writing.

A student should receive a good training in elementary physics and analytical mechanics and the application of analytical mechanics to engineering problems; in mathematics the usual training leading up to and including the calculus is sufficient for general engineering work in telephony. In electricity, the student's work should, of course, be carried much farther than in the other branches of physics, and he should have a thorough knowledge of both direct and alternating currents. In experimental laboratory work he should have a fair amount of experience. A certain amount of practical experience in shop work should be given to the student so as to familiarize him in a general way with various classes of shop practice; but it is easy to run to excess in this respect. A student should acquire a certain amount of knowledge in regard to legal questions. Examples from practice should be used to illustrate the fundamental laws and to show the student how apparently remote scientific principles are really of the utmost importance in the solution of very many practical problems.

In his experience with technical school graduates, he has found a number of defects. Many graduates do not seem to appreciate that engineering is the determination of the most economical way of accomplishing a desired result; in too many cases they are satisfied when they have determined one way of accomplishing a result. Too often beginners in engineering think that an arithmetical error in their work or the use of a wrong number is no serious error; great emphasis should be laid upon accuracy. Errors due to lack of accuracy should never be condoned in the student's college work. Often graduates have too little appreciation of the relation between their theoretical knowledge and practice; they have no physical conception of what corresponds in nature to their theoretical information.

In a paper entitled "The Problems that Are Facing the Electrical Engineer of To-Day and the Qualities of Mind and Character which Are Needed to Meet Them," Mr. J. G. White summed up the qualities of mind and character needed by the electrical engineer of to-day. He should be accurate in his calculations, thorough in his investigations, logical in his deductions, lucid and concise in his statements. He should have untiring energy, an alert mind, abundant initiative and reasonable self-confidence. He should be absolutely honest in all his dealings, truthful in all statements, loyal to his clients, faithful to his emyloyer's interests, considerate of his own subordinates, diplomatic in his negotiations and tatcful in all his relations. The author, in discussing the question, What education should the engineer of to-day have? said that this is the age of great industrial combinations and of specialties. Not satisfied with this, the specialists now specialize. A few years ago many would have supposed that the problems of the "telephone engineer" were those of a high-classed artisan; now we have elaborate exchanges, and know that he may receive a very high salary and is expected to know something of architecture, the strength of materials and other factors entering into modern steel building construction, and many other subjects which should be a part of a broad engineering education, but which are not ordinarily supposed to come with the province of a telephone engineer.

It is at least equally important that other engineers who have specialized and must know well some part of the field of engineering, should likewise have a general knowledge of the sciences and of the broad underlying principles of engineering. Much of the special knowledge of an engineer must be acquired after he has commenced the practice of his profession. If unusually energetic and capable, all or any part of his education may be gained after he enters professional life, but it is preferable that his broader education be well started during his school years. More important, however, than a knowledge of any study, or group of studies, is the ability to master thoroughly any subject of which a knowledge is desired. In education quality is a much more important essential than quantity.

The author discusses in detail the various points which speak against an extended college education and those which are in its favor. More important than the knowledge actually acquired, is the learning how to know a subject, and where or in what direction to look for information specifically wanted. With equal industry and attention to his work, the young engineer of ability with a broad education will ultimately take a higher rank in his profession and be more successful in busines. On the other hand, the engineer of ordinary or less than ordinary ability will in practical life accomplish most by not attempting to spread his education over too wide a field, but by learning some special department thoroughly.

A young man should take for his motto thoroughness. His study should include first subjects of prime importance and only after they have been mastered, subjects of less importance. Preferable is a broad general education, supplemented by thorough technical training. This may and frequently will lead to a general college course, to be followed by a technical course of two or more years.

The author distinguishes four classes of studies, according to their importance. In the first class he puts the most important ones: English, arithmetic (mental and written), algebra, geometry and trigonometry, chemistry, physics (especially metchanics), general knowledge of principles of electrical engineering, practical ethics.

The second class includes calculus and vectors, surveying, Latin, French (speaking and reading), electrochemistry, advanced engineering studies, business law, general principles of modern accounting, civics.

These two classes cover the most important subjects, while the third and fourth class include subjects which will help in rounding out the education, although they are of less imbportance. The third class includes Spanish, geology, physiology and temporary care of injured, logic, quaternions; the fourth class includes mineralogy, botany, zoology, history, political economy, mental and moral philosophy, art, music, etc.

The author emphasizes the great importance of continuous training in English, and recommends the writing of laboratory reports, examination papers and other similar documents. More attention should be paid in the preparatory schools to algebra and arithmetic, especially mental arithmetic. He recommends a course in surveying; a summer spent on railroad location and construction will fe found to have been well spent. The most useful modern language for the engineer is French, and only if he speaks this language fluently should he undertake to learn another language; Spanish would then be the best language to acquire. He recommends a moderate amount of training in modern business methods and practices, in accounting, and in the fundamental principles of business corporation law. An engineer should at least be able to draw a contract which will be legal and explicit.

A modern engineer is dependent for his success largely on the financier. If the engineer does not know that bonds should pay interest and that stocks, if possible, should pay dividends, and has no conception of the difference between a stock certificate and a promissory note, the financier is likely to form an undeservedly low opinion of the engineer's technical konwledge.

If a young engineer will have before him constantly the ultimate and best interests of his employer, will endeavor always to be tactful and never to unnecessarily irritate, will—without flattery—say only what is pleasant, unless right demands a plain statement of an unpleasant truth, then his advance will be more rapid than if these things should be forgotten. The importance of these things should be pointed out and frequently emphasized by educators.

In the discussion of the above papers, President Scott remarked that during the last fifteen years the growth of engineering schools and of engineering courses has been phenomenal but students have come faster than the equipment and the facilities, and notwithstanding the size of the graduating classes, they are still inadequate to meet the growing demands for educated engineers. The conditions now existing in active life and practical work for the engineer; the demands of engineering work and the place it has taken, mark a new order of things in modern society. In the several papers under discussion the authors emphasize the want of engineers who are broad men; they call for quality of work in college, and not quantity; they call for discipline, for mental training, to give the ability to take up and handle new problems. President Woodward, of the Society for the Promotion of Engineering Education emphasized the great interest which papers written by practical men must have to professors and teachers.

Prof. Goldsborough said that until the engineers get to the point where they are willing to accept from professors criticism on the way in which they do their work, they should not be too quick to criticize the way in which professors do their work. He emphasized that the most important element in a young man's education is military discipline, military drill; this is the keynote of all education, to learn how to obey orders. He criticized Mr. Gherardi's requirement that telephone engineers should learn everything that electrical engineers learn, and a lot more; where shall the time be taken from for all of this? The boys who are going to be bone and sinew of the engineering profession are generally young men without financial means. Sometimes their fathers cannot speak English and they come right out of the backwoods; they have no advantages, but they persevere, and they materialize, and they are put in charge of the most important works of big companies, spelling or no spelling, English or no English. The thing for our boys when they graduate is to be given a chance to work into the field of engineering, to be encouraged by their employers to prepare work, to prepare papers, to broaden themselves. Prof. Goldsborough in conclusion expressed the opinion that the best training for the business man in our days is engineering training.

Prof. Jacobus stated that in several of the institutions of this country courses are suggested by which the student may obtain the college course and the engineering course in six years; by properly electing the work in physics, chemistry, geology and other subjects in such a way that he gets his degree of B. A. at the end of four years, he will be in a position to start right in at the beginning of the junior year and complete in two years the engineering course, and have all that is required in both.

Dr. Ganz, of the Stevens Institute, recommended inspection trips to the works of manufacturing companies; they should, however, be preceded by lectures on the things which the students will see. Prof. Colwell said it would be more desirable if practical men would state exactly what to leave out of the college course, not what to put in. Prof. Diemen recommended that students in electrical engineering should join the courses given to mechanical engineering students, in factory organization and shop economies.

Prof. Allen said it is impossible, for our engineering schools to turn out a finished engineer; the college is under obligation to provide the student with the proper theory, but proper theory cannot be given without practical applications. The engineering college can give only so much experience as is necessary to give point to theory and as is required to put the student graduate in the way of gathering the larger experience which shall make him a complete and valuable engineer.

Prof. C. A. Waldo asked Mr. White why he would retain Latin in the education of the engineer. Mr. White, in his reply, said he considered the study of Latin as only of secondary or tertiary importance, and it might be omitted. Prof. Goldsborough explained more in detail what he meant in some of the remarks made by him earlier in the discussion. Practical men in their papers on education of engineers, always speak of the courses on colleges, but it would be better if they would clearly outline and tell the course that the men are put through after they graduate, what is demanded of them and the order in which it is demanded. Then teachers will know what they must develop their boys for.

Prof. H. S. Carhart pointed out that there should be no differentiation in engineering training in the schools, the differentiation should come in practice, after the man is through with the technical school. In the university principles should be taught, with enough of laboratory or shop work to give point to those principles, to connect them with real practical affairs, and not to let the laboratory or the shop encroach upon the valuable time of the student further than this. Graduates can get more experience in practical affairs in six weeks in a large manufacturing establishment than they can get in college in four years. Instead of trying to make a complete mechanical, civil, electrical, marine, telegraph, telephone or any other sort of engineer in a training school, the course should be arranged so as to make an engineer. He may apply himself the adjective after he gets into his practical experience. The effort should be to lay a broad foundation in those subjects which the engineer must have to build upon.

President Scott called attention to a point brought out in Mr. Osborne's paper, namely, that probably only one-tenth of the engineering graduates go into engineering pure and simple, and the other nine-tenths into allied industries and executive positions. This indicates that there is a demand for engineering in the broader sense, that engineering training is useful in other lines of activity than pure engineering.

Mr. Rushmore referred to the "message to Garcia"—to get an order and do it, that is all. The principal thing in an engineer is not so much the information he has, but what he is in himself, his ability to go ahead, and above all things, accuracy. Instead of teaching a man all the small things that he might want outside, the college should give him a strong basis in fundamental principles; he will get the rest afterwards.

Prof. J. P. Jackson said that the ideal method of education is to give the boys a good four years' high school or academy course; a four years' college course, which runs along in the same way, but specialize, possibly, a little, and then give them a post-graduate course, say of two years. As most of the boys who would like to go through such a course are poor, manufacturing or operating engineering concerns should put something like a premium on such an extended course; this would have a tendency to uplift the whole scheme of education.

Prof. Kent said Mr. Osborne required too much from a graduate. Prof. D. C. Jackson considered himself too old-fashioned to agree with the radicalism of Prof. Franklin and Prof. Goldsborough. While he also is an ardent opponent of the spectacular in the teaching of physics and engineering, he claims it is of advantage to call the student's attention to the wonder of the great unity, the great continuity and the extreme persistence of nature and the way in which nature's laws are always fulfilled. He emphasizes the college should teach principles, not technical details.

TYPICAL COLLEGE COURSES DEALING WITH THE PROFESSIONAL AND THEORETICAL PHASES OF ELECTRICAL ENGINEERING.

Prof. Dugald C. Jackson, of the University of Wisconsin, presented a paper on this subject, after the meeting had been turned over to the Society for the Promotion of Engineering Education. He referred to the prejudice which formerly held against college men in the minds of so-called practical men. This old prejudice, so far as it exists, has now more particularly drifted into the way of criticism of the engineering schools rather than of the graduates. It is the business of the engineering college to produce, not finished engineers, but young men with a great capacity for becoming engineers. The problem to be met by the engineering colleges is more particularly a problem in "how to properly train" to the stated purpose. It is a teacher's problem rather than of the engineering profession. It must be met with all the directness and power of the engineer's best efforts, but it cannot be solved as solely relating to the engineering profession. Much error on this point lies in the minds of many who assume the part of critics of the curricula of the engineering schools.

The author discusses the question, What must the ideals of education consist of and how fairly should they be met by the college before its course in electrical engineering may be approved as of first rank? Electrical engineering demands industrial engineers; to reach his highest influence, each man must combine in one, a man in the physical sciences, a man in sociology and a man of business. This result must be achieved by a college in four years. Michael Faraday, whose conservatism and intellectual clearness are proverbial, said that it requires twenty years to "make a man" in the physical sciences. Hence the college can only lay the foundations of "the man."

The boys entering an engineering school from a high school or a preparatory school, are well equipped with physical vigor and latent mental strength. The electrical engineering course must include the following branches of learning, which are preparatory to the more strictly professional studies: A further training in the English language which is requisite to clear thinking or clear writing; the collateral art of expression in drawing; mathematics through an appropriate amount of calculus, with special emphasis laid on interpreting the meaning of equations; chemistry and physics, soundly taught; applied mechanics. Mechanics, the philosophy of matter, force and energy, is the backbone of the electrical engineer's college training. This ground cannot be covered with anything like reasonable success in much or any less than three years.

After covering these branches it seems to be the tendency in many colleges to fly off into superficial or descriptive courses relating to engineering practice. But this is absolutely wrong, as a resort to descriptive courses of instruction during the latter portion of the student's life in college largely neutralizes the advantage flowing from the instruction in the fundamentals before described. The students must now be taught many things relating to engineering life. The electrical engineering department should be divided into four subdivisions: applied electromagnetism, including dynamo machinery; the theory and practice of all those phenomena which accompany variable current flow; applied electrochemistry and electrometallurgy, and electrical installations. But through all this professional instruction of the latter part of the course, it is still principles, principles, principles, and rational methods of reasoning which must be taught, if full justice is done the students, until each student becomes a man of open mind, keen observation, analytical thinking and accurate powers of inference. This instruction should be kept close to the tests of good practice and the senses of the student should be constantly stimulated by illustrations and problems drawn from practice.

Students who have gone through such a course are not likely to enter immediately into positions of much responsibility, but rather go into the so-called "cadet" positions or "student" positions of great industrial enterprises for the purpose of gaining that experience in the crafts which may enable them to make the most extended use of their training in principles. Here they gradually find themselves and ultimately reach the influence in the industrial world for which their calibre and training fits them.

Niagara State Reservation and the Falls.

The annual report of the Commissioners of New York State Reservation at Niagara, just issued, is an interesting and voluminous document. Regarding the use of water from Niagara River for power purposes, the report says that the danger which threatens the integrity of Niagara Falls is not merely theoretical, but is a very substantial reality, and proceeds from three sources:

First, from the power companies now in operation on the American side, which take from the Niagara River between 7,000,000 and 8,000,000 gallons of water a minute, or about 6 per cent. of the total flow over the falls.

Second, from the construction of commercial and drainage canals, which will divert the waters of the Great Lakes from their natural outlet by way of the St. Lawrence system to that of the Mississippi. The Chicago drainage canal, designed to take 600,000 cu. ft. a minute from Lake Michigan, is a case in point; and among other suggestions which have been advanced is one for a canal across the State of Wisconsin from Lake Michigan to the Mississippi, and another for a canal from Lake Superior at Duluth to the Mississippi.

Third, from Canadian enterprises, like the Welland Canal and the proposed canal connecting the Georgian Bay with the Ottawa River; or, to come nearer to Niagara, from the Ontario Power Company, and the Canadian Niagara Power Company, whose works are now in course of construction within sight of our reservation, and from a third Canadian corporation to which the Commissioners for the Queen Victoria Niagara Falls Park have recently granted a similar privilege.

New Telephone Patents.

SPECIAL SUBSCRIBERS' LIST.

A few weeks ago a patent was issued describing a special subscriber's list arranged for mounting upon the face of transmitters and ruled to provide spaces for the names and numbers of subscribers frequently called. Another device of the same general type is that invented by Joseph P. McKee, of Allegheny, Pa., and patented under the title, "Telephone Notation Register." This device also clamps upon the front face of the transmitter, but the number chart is circular and divided into sectors by radial lines. Each of these sectors is of a size to accommodate one name and number. The number chart, which is rotatable, is concealed behind a stationary metal disc having an opening exactly corresponding to the number sectors. Behind this opening the desired name and number may be made to appear by rotating the number chart.

PREPAYMENT INDICATOR.

Present practice where automatic or coin collecting pay station devices are used, requires the operators at the central office to listen upon the lines in order to ascertain when a coin has been deposited. Two general methods have been available for determining the denomination of this coin. With one the coin sounds characteristic gongs or bells, while with the other the electrical circuits are automatically made and broken a different number of times for each different coin. The present invention, the work of R. B. Hazlett, of Philadelphia, is for use with pay stations of the latter type and provides an indicator with a step-by-step mechanism which registers visually before the operator the making and breaking of the circuit. By suitably marking the dial the operators can tell at a glance the total of all coins deposited. When a collection has been properly indicated, the pulling of a knob allows the pointer to restore to zero so that each collection may be independently and directly indicated.

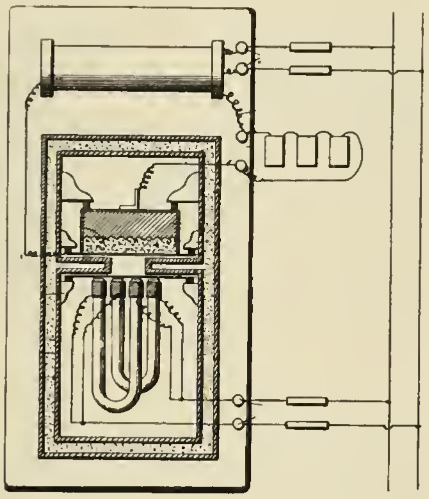


FIG. 1.—SAMMONS TELEPHONE REPEATER.

TELEPHONE REPEATER.

In Fig. 1 is shown a telephone repeater which has been patented by O. P. Sammons, of Denison, Texas. This is of the transmitter-receiver type. Within a sound proof-case a double horse-shoe magnet carrying four bobbins is mounted. This with the diaphragm near the bobbins composes the receives. Just above is mounted the transmitter with its diaphragm. Both diaphragms are supported upon soft jackings in such a manner as to form between them a sound chamber the equivalent of the ordinary mouthpieces. Although this device will undoubtedly be operative when wired as shown in the patent, if the line wires be broken between the receiver and transmitter taps, it will be operative in one direction. It is not possible to imagine it a successful repeater, however. Many earlier attempts have been made to use such apparatus and all have failed because of the poor quality of the speech transmitted, the quality or clearness being as much or more essential than volume.

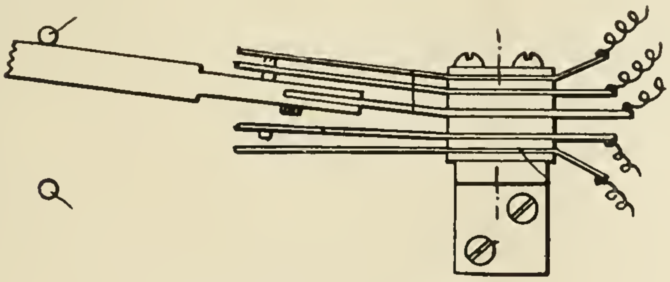


FIG. 2.—FAHNESTOCK HOOK SWITCH.

HOOK SWITCH.

The hook switch which has been the subject of invention and improvement ever since its inception has received additional modification at the hands of E. B. Fahnestock, of New York City, who has obtained a patent for the switch shown in Fig. 2. As will be noted, the switch springs are mounted in a manner akin to that found so successful in switchboard keys. The middle spring serves as a hinge for the hook to which it is riveted, and it also serves as the hook lifting spring. The two upper springs engaging with each other and the hook shank control the talking circuits, while the lower two springs operated by an insulating stud control the bridging bell circuit. This switch should be cheap to manufacture and fairly positive in action.

TRANSMITTERS.

The granular carbon transmitter continues a subject for many inventors. Patents for four novelties in this line have recently appeared. The objects which the various inventors have in view include the overcoming of almost every known transmitter trouble.

The first of the new transmitters to which consideration will be given is that shown in section at the right of Fig. 4. This is an improvement of that type of instrument in which reed resonators are provided tuned to the notes of the chromatic scale. Such a transmitter was described at length in these columns some weeks ago Unlike this earlier instrument, the present one has a diaphragm of the usual type to supplement the vibrators. It has in addition—and this is the point upon which the present patent focuses—a plate resonator so supported upon the movable electrode stud as to lend its sympathetic vibrations as an aid to those set up by the diaphragm and reeds. This improvement has been added by Fred C. Redfield, of Nashua, N. H.

At the middle of Fig. 4 is shown a sectional view of a transmitter of which the principal aim is the isolation of the metallic diaphragm from the electrical circuit. To this end the diaphragm is mounted upon an insulating cushion and the dampers bear upon insulating cushions. Upon the rear side of the diaphragm a thin carbon plate is mounted. This forms the front or movable electrode, and as the circuit wiring is attached to this carbon plate, the metallic diaphragm is entirely omitted from the circuit. The arrangement of stationary electrode and adjustments are self-evident from the figure. Mathias Weiser, of Milwaukee, Wis., is the inventor of this transmitter.

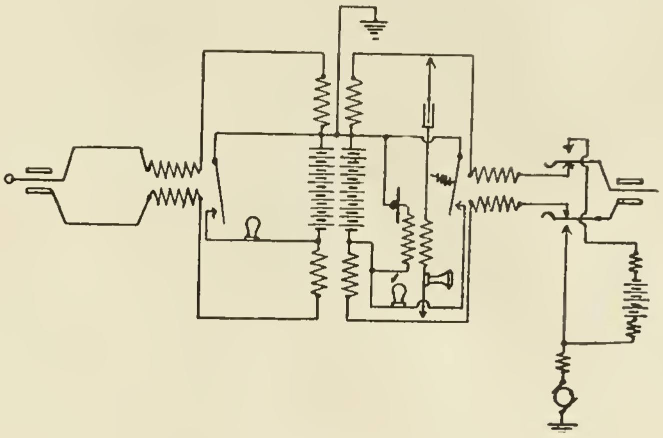


FIG. 3.—MILLER CENTRAL ENERGY SYSTEM.

E. B. Fahnestock, of New York City, has obtained three transmitter patents. The transmitter shown at the right of Fig. 4 is the subject of one of these. Diaphragms proper are wanting, but the circular faces of the carbon chamber both consist of mica discs carrying carbon electrodes. These discs serve as diaphragms. Adjustment is obtained by weighting up the micas with discs of metal, the exact weight required for any case being obtained experimentally.

Mr. Fahnestock's second patent provides a transmitter in which the electrodes are inclined to the horizontal. The friction between the granules and electrodes is thereby increased and thus the tendency of the granules to work together in the lower part of the carbon chamber, i. e., packing, is retarded. Furthermore, the carbon button is mounted within a square frame of metal, and this fact coupled with a proper design of electrical connections makes it possible to quickly remove the button, rotate it through 90° and to replace it. This act brings the packed side up and in position to effectively unpack itself.

The third patent granted to Mr. Fahnestock describes a clamp for horizontal transmitter arms, such as are used with wall sets. In this clamp the usual cast clamping lips are replaced by sheet spring lips, about the bases of which the clamp base is cast. This results in a strong but easily constructed clamp.

IMPROVEMENT IN KELLOGG TWO WIRE SYSTEM.

Mr. Kempster B. Miller has made an improvement in the cord circuits for the Kellogg two wire central energy system. In this system it will be remembered that the subscriber's line is normally disconnected from the jacks. A relay permanently wired to the jacks serves to connect the subscriber's line in parallel with its own high impedance coil whenever a plug is put into the jack. With this system it has been heretofore possible to open but one side of the line toward the calling subscriber when ringing. This is because one wire was continually required to supply current to the controlling relay. This difficulty has been overcome by Mr. Miller by the arrangement of circuit shown in Fig. 3. Here it will be seen that a special battery connected between impedance coils is substituted for the talking battery upon the depression of the double cut-off ringing key. By this means the alternating ringing current is kept in its proper course to the subscriber's bells, while the calling subscriber has no indication of the ringing current.

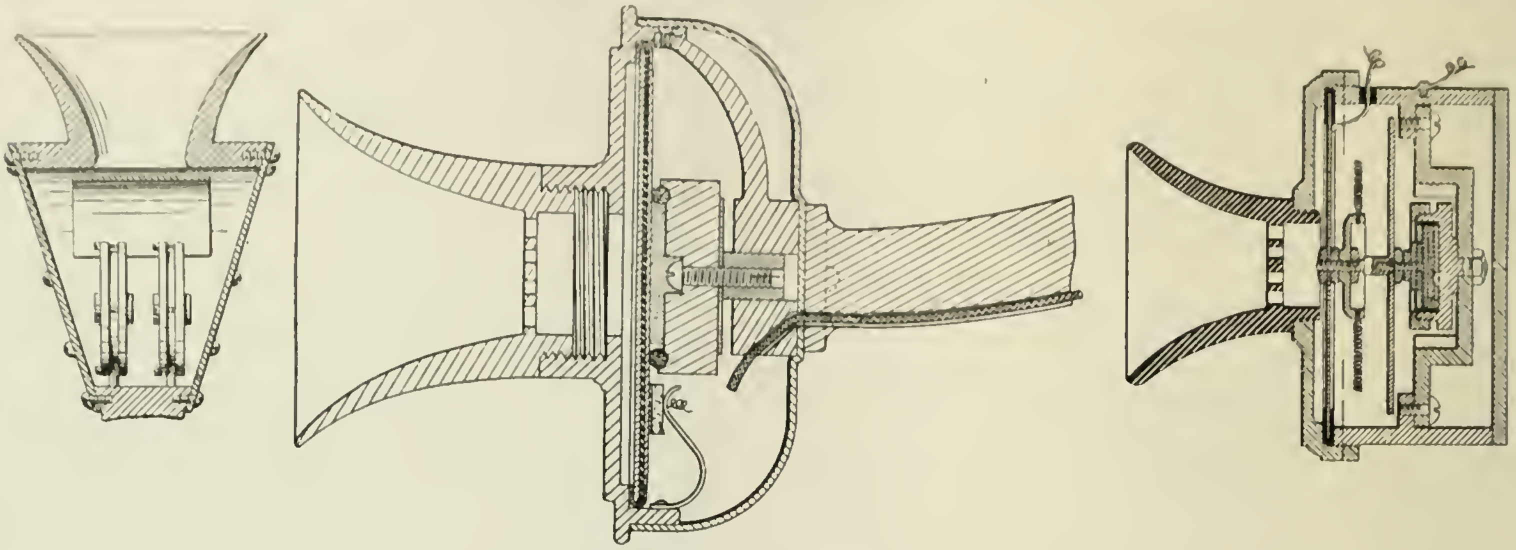


Fig. 4.—Some New Transmitters.

SELECTIVE SYSTEM.

A selective system of ringing has been patented by A. J. Springborn, of Cleveland, Ohio. Unfortunately selection depends upon the synchronous action of electrically wound clockwork mechanisms at not only all stations but at the central office. The difficulties of such a system are too well known to need mention and are of a nature such as to warrant the omission of any detailed description of the circuits and apparatus.

Subway Under Broadway, New York.

The New York Rapid Transit Commission's special committee, to which was referred the application of the Interborough Rapid Transit Company for permission to connect the Forty-second Street and Union Square stations of the subway by a tunnel under Broadway, at a meeting on July 10, decided not only to report favorably upon this scheme, but to recommend the building of a subway under Broadway from Forty-second street to the Battery. Chief Engineer Parsons was directed to begin the preparation of plans for a tunnel the whole length of Broadway below Forty-second Street. Mr. Parsons said he would have the plans ready by October.

While the contract for the Broadway route will have to be put up to public competition there can be but one bidder, since the city is committed to the policy of a single fare over all the underground lines.

Mr. Parsons said that he could not say whether the Broadway tunnel would be a two or a four-track route, nor was he ready to give any opinion as to whether it would join the tracks of the Brooklyn extension at the Manhattan post-office.

It is probable that some provision will be made to connect the new road with the Pennsylvania tunnel by a tunnel for the shuttle cars from a station at Thirty-fourth Street and Broadway.

The committee decided also to approve the plan of joining the East Side subway line with the Third Avenue elevated road at One Hundred and Forty-ninth Street and Westchester Avenue.

CURRENT NEWS AND NOTES.

THE TELECHIROGRAPH.—We are informed that since the article on the Telechirograph appeared in our columns (in the issue of June 20) the apparatus has been worked over a resistance corresponding to 185 miles of line. Telephone messages were sent simultaneously with telegraphic messages, the voltage being 15.

ALASKA TELEGRAPH LINES.—A dispatch has been received at the War Department at Washington, from Capt. Burnell, at Dawson City, reporting that the military telegraph line in Alaska, which was completed June 24, had been partly destroyed by forest fires before it could be put in operation. It will take about a month to repair the damage.

TROUBLE OVER A CABLE IN CHINESE WATERS.—A dispatch from Tokio to the London *Times* states that the Russians laid the cable between Antung and Yongampho without consulting Korea. Japan protested, since the convention between Japan and Korea binds Korea not to allow any foreign power telegraphic power interfering with Japan's vested interests.

WIRELESS IN ALASKA.—A telegram of July 3 from Tacoma, Wash., says: "Without depending on contractors, the United States Signal Corps itself will erect and equip government wireless stations in Alaska. The first station will be constructed at Fort Davis, Nome, comprising one mast and quarters for three telegraphers. The next post will be at Safety Harbor, twenty miles south of Nome, where two masts and quarters for four men will be installed. Another wireless post will be placed at St. Michaels. Wireless stations to be established in Ontario will comprise masts and buildings at Fort Piggons and Bates Rapids, connecting a land line from St. Michaels with Fort Egbert, and also with a line through Copper River Valley to Valdez, where a submarine cable will connect the Alaskan system with Puget Sound."

INDEX OF THE TECHNICAL PRESS.—The Association de la Presse Technique, 20 Rue de la Chancellerie, Brussels, Belgium, has issued the third number of a monthly publication indexing the articles of greatest technical interest appearing in periodical publications in the English, German and French languages. The June issue contains 1,714 entries, giving the title with a characterization of contents, the name of the author, the source, date of publication and number of words. The matter is printed on only one side of a sheet, and as the paper is thin, clippings may be pasted on a card for filing. The index entries are in the languages in which the article is written, those from English periodicals being in English, in French when the article appears in a periodical printed in that language, and similarly with respect to German. The briefs are well prepared and the publication should be of much value to those who keep up card indexes of technical literature, as well as to many others. The subscription price is 5 francs per annum.

TYPESETTING BY TELEGRAPH.—A cable dispatch from Paris of July 4 says: Prof. D'Arsonval this week submitted to the Academy of Science an invention for typesetting by telegraph, the electric current being made to perforate characters on a moving band connected with a typesetting machine. It is claimed that the contrivance, which is the work of M. Rodmal, will dispense with transcription altogether for press purposes.

ELECTRICAL UNION ENJOINED.—Judge C. Ray, of the Hennepin County (Minn.) District Court, has granted an injunction against the Electrical Workers' Union. He holds it to be illegal for the strikers, first, to conspire to injure the contractors' business; second, to interfere with such business by threats directed against customers or prospective customers; third, to notify customers that contractors are "unfair"; fourth, to go on premises where contractors are employed to interfere with their business, and fifth, to order union men to quit work on premises by reason of the fact that contractors may be employed thereon. This injunction is temporary, and it is said that unions will fight it to the court of last resort.

STRIKE IN A TELEPHONE FACTORY.—A strike was declared May 4 by the workmen employed in the factory of the Kellogg Switchboard & Supply Company, the course of which has been marked by much violence. There were 927 employees at the time of the strike, and of these 700 quit work. For several weeks the shops were practically closed, and when the company began to hire men the pickets became so aggressive that an injunction was asked for and granted, restraining the strikers from interfering with the business or the employees of the company. There have nevertheless been numerous assaults on employees. A few days ago Julius Glant, cashier of the company, was attacked by men with billies and brass knuckles and dangerously injured. The victims thus far number over 45, including a woman employee.

MULTIPLE UNIT CONTROL.—A patent granted on June 30 to Mr. Elmer A. Sperry, of Cleveland, Ohio, on an application filed September 14, 1898, describes a system of control for electrically-propelled trains. Each car is a self-contained unit, i. e., has its own motor contact device, controller and "master controller," which is used for regulating the action of the motor controller. These devices are connected to a cable and when the cars are united to form a train the ends of the cables are united so that corresponding wires are connected. The master controllers are connected to the cable in multiple and are so arranged that any one of them may be employed to regulate the speed of the train through the medium of the motor controllers. Since the motor controllers are regulated by electrical means and since the source of supply from a trolley or third rail is subject to interruptions, he uses a separate source of power for the regulating means. The cylinder of the motor controller is actuated both forward and back by means of a spring pilot motor, which consists of a spiral spring so arranged that it tends to unwind from both ends. In order to restore energy to the spring, a small electric motor is provided which is arranged to automatically start into operation as soon as the spring unwinds to a certain extent.

SINGLE-PHASE INDUCTION MOTOR.—Among the patents of July 7 is one on an alternating-current induction motor, issued to Charles S. Bradley on an application filed October 7, 1895, the patent being assigned to the General Electric Company. The motor is of the single-phase, split-phase type, two currents differing in phase being developed from a single-phase current by the employment of a condenser. These currents pass through coils angularly displaced on an annular core, and their joint action sets up a rotary field. After starting the reaction of the closed-circuit armature steadies the field and the motor runs with fairly uniform torque. The condenser is stored in the base of the motor and the field core is toothed, the notches being so disposed that the coils corresponding to the two current phases overlap. The windings are arranged to produce a multipolar field so that commercial rates of alternation may be employed. The winding which includes the condenser is of higher inductance than its companion winding to admit of the use of a comparatively small condenser to cooperate with the increased voltage in the condenser branch and to admit a better cooperation of the two windings. To accommodate the great number of conductor turns in the condenser winding the slots in the core which it occupies are made of greater capacity.

DYNAMITING AN ELECTRIC PLANT.—Early on the morning of July 5th a daring attempt was made to blow up the main generating station of the Colorado Springs Electric Company, located about four miles outside of the city of Colorado Springs, Colo. What saved the plant was the premature explosion of a stick of dynamite, which scattered the remaining 149 sticks of 1½-in. dynamite, weighing 75 pounds, that had been intended to do the work of destruction. Had the dynamite exploded the entire station would have been wrecked and it is also probable that 17 lives would have been lost, as five men were in the building at the time and 12 men were sleeping in a cottage adjoining the station. This power station supplies all the electric light used in Colorado Springs, Colorado City and Manitou, as well as furnishing all the electric power in Colorado Springs and vicinity, including the supply to the Portland, Telluride and Standard Mills in West Colorado Springs and Colorado City. The power circuits supply a three-phase, 6,600-volt current. General Manager George B. Tripp says he is at a loss to account for the cause of the accident. On the following night two attempts were made to short-circuit the main feeder by throwing obstacles over the wires.

LETTER TO THE EDITORS.

The Metric System.

To the Editors of Electrical World and Engineer:

Sirs:—I am loath to trespass further on your valuable space, and certainly far from wishing to dispute the editorial divine right to the last word on every subject; but your editorial of July 4 presents some further considerations concerning which a word or two further on the subject will not be amiss, inasmuch as on this one subject you are evidently still in the last century.

It is obvious that you do not yourselves appreciate the full significance of your pregnant remark that "the electrical engineer is of the younger generation, ... and to him the utilitarian past is without interest beyond the lessons it holds for the present and for the future"; but it unavoidably recalls the caustic satire of a German writer: "Every 30 years a new generation comes into the world, which knows nothing and proposes to summarily assimilate the knowledge of all the ages and then know more than all past time put together. For this purpose the youngster betakes himself to the universities and goes in for the latest books. Nothing for him but what is short and new!—he is new himself. Then he lets loose his opinions on the subject."

The sentence just quoted from your editorial would, in fact, furnish a text for a sermon on our side of the question. It shows that the "utilitarian past" is just what you metricists completely lose sight of in your ethereal flights, which render so fitting the characterization of the system you extol as "a long chain having the solar system at one end and a quart measure at the other." Your exception of "the lessons it holds for the present and the future" is to you no exception, for it is these very lessons, stretched out over a hundred years of dreary and disappointing experience, of governmental convulsions, of foolish and frantic efforts, and all for a very trivial, purely theoretical and withal puerile object—a meddlesome intervention of mathematicians in a purely administrative matter—these very lessons, I say, which we, myself and many others, have laid before you, and to which you turn a deaf ear. It is incumbent on every one, as Gibbon trenchantly said in his "Vindication," to read before he attempts to write, but it is patent from your remarks that you have not read the writings which you presume to criticise. Had you done so, it is impossible that you could continue to so misrepresent our position, or be so utterly impervious to the overwhelming mass of evidence on our side.

Now as to the electrical units: If, as you claim, the watt is a metric unit, how does it come that it is related to the real metric unit of power, the kilogrammeter per second, in the ratio 0.1019 ± Is this one of the "beautiful correlations" of the metric system? It is admitted that the "ridiculous old unit" now used "is only perpetuated by electrical engineers . . . . . . *in order to meet commercial requirements.*" What superb condescension!—equaled only by that of the original system-mongers, who condescended to give their system to the world of commerce. The watt, then, does not meet commercial requirements—any more than the metric system and its units.

I venture to prophesy, and that, too, with confidence, that as soon as you can be prevailed upon to study our side—say five or ten years from now—your Editorships or your successors will be "on the fence" on this question, as many formerly metric papers are now; and that in ten or fifteen years you will be on our side of it—in other words, that you are only five or ten years behind the times in this matter. Meanwhile, all we ask is fair play, and may the best system win. Live and let live. Use the metric system all you want, and let others use theirs. Let the government alone—it is no "dog" to try nostrums on, as proposed by Mr. Southard, of the Coinage Committee. Remember, Congress has no power to enforce any system on the country—particularly an unwilling country. And finally, do not, while disavowing attempts at compulsion on the one hand, foster or promote compulsory laws on the other. The discussion of the past six months has had at least this good and profound effect, that it has wrung from metricists of all colors and degrees a unanimous disavowal of compulsory laws. This done, Mr. Southard and his committee find themselves suddenly high and dry, abandoned by their backers, and the whole agitation explodes in a farce.

Montreal, Canada. George W. Colles

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Non Synchronous Alternating-Current Generators.—Feldmann.—An abstract of a paper read before the Cologne Electrical Society. After discussing the action of such generators in practice, he states that they afford a possibility of running alternators in parallel and as boosters. When the Heyland collector is suitably furnished with the main current, besides the shunt excitation, the non-synchronous dynamos cannot only be compensated, i. e., made self-exciting, but can also be compounded to a quite constant potential, which even increases with the load. Such compound generators, as constructed by Brown, Schuckert, Lahmeyer, Siemens & Halske and the A. E. G., have less slip the greater the compounding is. They can, therefore, be employed in central stations in place of the synchronous machine necessary for maintaining the frequency. The running of such a central station would be comparatively simple, especially if the larger motors connected to it were also fitted with the compensating device so that they would not take any more wattless current from the mains. The author states that it would seem as if this new type of generator would become of considerable importance in practice in the near future.—*Elek. Rundschau*, June 1.

REFERENCES.

The Electric Motor as Traction Motor.—Niethammer.—An article the first part of which contains a condensed enumeration of the different kinds of motors used on surface lines, elevated railroads, suburban roads, mountain railroads and large railroads, with their uses and advantages. In the second part the author gives his reasons for preferring direct-current motors to triphase alternating-current motors and quotes other continental and American engineers in support of his views.—*Zeit. f. Elek.*, June 13, 21.

Care of Induction Motors.—Weeks.—An article on the inspection and care of induction motors in a large factory.—*Lond. El'ty*, June 12.

LIGHTS AND LIGHTING.

REFERENCE.

Alternative Connection of Triplex Arc Lamps in Three-Wire Circuits.—Miram.—The author gives a scheme for the connection of 5 lamps in a three-wire, 2 x 110-volt circuit, so that one group of two, 2 groups of two, and the fifth one may be connected and disconnected at will.—*Elek. Anz.*, May 28.

POWER.

Proposed Transmission for Power Purposes.—Hicks.—A long illustrated article on a proposition for the generation of power from the waterfalls of the Sierras flanking the San Joaquin Valley, Cal., and its utilization, through electric transmission, for pumping the irrigating water supply in the valley. Three pipe lines are designed to be 30 in. in diameter, of steel plates riveted in place, with full load velocities of 7 ft. per second and an effective head of 660 ft., requiring a flow of 100 cub. ft. per second to generate the rated output of the dynamos. The generators proposed, three in number, are of the three-phase, 60-cycle, alternating-current, revolving field type, with a normal capacity of 1,350 kw, or 1,800 hp. at 2,200 volts, at a speed of 200 r.p.m., and are on the shaft with the water wheel. The current is transformed up to 30,000 volts and transmitted to transformer stations. A detailed estimate of the cost is given. The author estimates that the annual amount of water available from the new supply would be 300,000 acre-ft., which will then be available for cultivation.—*Jour. of Elec. Power and Gas*, June.

Electric Cranes.—Head.—An abstract of a paper read before the recent London meeting of the Institution of Civil Engineers, dealing with the speeds of overhead and other cranes as a factor in economic handling of material in working. The author deals almost exclusively with electric cranes, and states that electricity is rapidly displacing all other forms of power transmission for cranes. Its advantages over hydraulic power are its greater economy, ease of transmission, flexibility and less liability to trouble from changes of temperature. The advantages of greater simplicity and precision possessed by hydraulic power, are being rapidly neutralized by improved electrical appliances and methods of manufacture. The most suitable form of energy is stated by the author to be direct current at 220 to 500 volts, this being superior to alternating current on account of the greater starting torque and acceleration. The operations of a crane involve a rapid succession of startings and stoppings; continuous running occupies an unimportant fraction of the time and loads are very variable. Series-wound motors, which automatically run faster with light loads, should be used, if they are coupled permanently to the gearing. They should withstand 100 per cent. overloading for short periods and much higher overloads momentarily, without damage, which conditions are fulfilled by motors of the ordinary tramway type. Where motors run continuously with clutch connections to the gearing, they should be shunt-wound. The author then considers in detail the best working conditions and electrical equipment for fixed jib cranes, fixed rotary cranes, overhead traveling cranes, gantry and cantilever cranes and locomotive cranes. A table of speeds for electric overload traveling cranes of various capacities is given, for hoisting, cross-traversing and longitudinal traversing.—Lond. *Engineering*, June 19, and Lond. *Elec.*, June 19.

Motor-Driven Turret Lathe.—An illustrated description. The motor is mounted at the rear of the bed and not on an extension formed on the cabinet or box leg, the motor shaft and spindle being connected through spur gearing. The motor is of the variable-speed type, with a moderate range of speeds varying from 1,150 to 1,850 r.p.m. A large proportion of the speed changes are obtained through the gearing in the head.—*Am. Mach.*, July 2.

Plate-Straightening Rolls.—An article, illustrated with drawings in the text and on a plate, describing a new heavy machine for straightening hot plates 1.6 in. thick, cold plates 1 in. thick and 13 ft. 7½ in. wide. Power is furnished to the machine by an electric motor of 85 hp. The bottom rolls are driven by a separate reversible motor of 30 hp. The vertical adjustment of the top rolls is effected by means of a screw, driven by a 25-hp motor.—Lond. *Engineering*, June 19.

Electric Drills in Mines.—A long editorial discussing the principles of the construction of and the objections against, electric drills. It is stated that there is the expression of an earnest hope among mining engineers, that the electric drill may become a practical success in mining, and that there are reasons for believing that it will be fulfilled. There is also a communication by a correspondent on this subject in the same issue pointing out the objections to the use of the Siemens & Halske drill and hoping that the electric drill will be perfected, as its field of usefulness is manifest.—*Eng. & Min'g Jour.*, June 27.

TRACTION.

Traction by Accumulators.—An article on traction by means of accumulators on the Meridional Railways of Italy. The cars have seating capacity for 64 passengers, and the body is mounted on two four-wheel bogies, one axle of each bogie being driven through spur gearing by a 50-hp electric motor. The two motors of each car are in series and the gearing is in the ratio of 1 to 6. The battery is carried under the car; it weighs about 3 metric tons and comprises 266 cells, arranged in three groups of four boxes, or 12 boxes in all. The 12 boxes can be withdrawn by two men in 10 minutes; they are only entirely withdrawn when it is necessary to renew the plates; for recharging and inspection they are only partially withdrawn. Each charge of the batteries corresponds to 4,410 km-tons (car weight complete, 52½ tons; distance on one charge, 84 km), and requires on the average 104 kw-hours. The consumption of energy at the power station is 23.6 watt-hours per ton-km. The energy efficiency of the battery on the Bologna-Modena line has been found to be 57 per cent.; the normal speed is 28 miles per hour and the maximum 33¼ miles. With regard to the life of the battery, it has been found that the positive plates last for an average of 6,875 miles, and the negatives for double that distance. The cost of plates works out at 24 cm per km, or .00456 cm per ton km. The inspection, electrolyte and repairs cost during the first year 12 cm per km, or .00228 per ton-km. --Lond. *Elec. Rev.*, June 12.

Notes on Sub-Station Practice.—An article in which the writer points out factors which must be considered in the construction and location of sub-stations, which must be an accompaniment of all roads where alternating-current distribution is employed until alternating-current motors are developed. The first point is central position with reference to the load distribution. This should not be based simply on the existing load, but the engineer should consider the distribution which will be required in the future, the possibility of double-tracking, etc. A careful calculation should then be made of first cost and operating economy for the different proposed locations, for several schedules likely to be adopted. The various considerations underlying the selection of the location, both for technical and administrative reasons are discussed. Concerning the design and construction, it is claimed that the station should be of brick, and fire-proof as far as skill can make it. Complications in wiring should be avoided, as also all possibility of moisture where the high-potential wires are carried down into the station. The insulators should be the same on the line and within the sub-station, and all low-tension wires should be kept away from high-tension wires. The high-tension wires should be run in plain sight, if possible, and the low-tension wires under the floor. It is usually possible to arrange the high-tension wiring so that a person standing in one place in the sub-station can see the wiring and machinery without leaving his position. If storage batteries are used, care must be taken that the acid fumes do not reach the electrical machinery. Arrangements should be made for making it possible to cut the sub-station out of circuit in case of an interruption of the supply. The sub-station should have a telephone in a sound-proof box, located so that the operator can see the switchboard instruments while using the telephone.—*St. R'y Jour.*, July 4.

Berlin-Zossen Railway Tests.—An editorial referring to some recently published results of tests on this railway. Figures given in a Belgian paper confirm the opinions and results which have already been published. The method of taking current, even at 100 miles per hour and at 13,500 volts, presented no trouble, so that current collection need not be considered among the material difficulties of working at very high speeds with high voltage. It is also to be noticed that the cars ran much smoother at about 130 km an hour than they did at 100 km an hour, showing that there is a marked steadying effect at high speeds that materially lessens the tractive resistance. The comment is made that the acceleration was very low and the tests would also indicate that the traffic problem will be a serious one at high speeds. The power required was satisfactorily low, showing that there is no difficulty in this particular. In other words, this latest report tends to confirm the opinion, justified by the earlier ones, that the electrical difficulties have been overcome, and that the only difficulties now in the direction of high speed are from a mechanical standpoint.—*St. R'y Jour.*, June 13.

Electric Railway for Freight and Passengers.—A long illustrated article describing the Lackawanna & Wyoming Valley Railway, which is noteworthy on account of the terminal facilities provided, the heavy track construction and other provisions in the equipment for high-speed and heavy traffic. The main line will connect Scranton with Wilkesbarre, and an extension will be built to Carbondale, passing through the most prosperous section of the anthracite district in Pennsylvania. The entire line when completed will be about 37 miles long. A general description of the engineering features of the road is accompanied by a number of illustrations.—*St. R'y Jour.*, June 13.

Improvements on the Cleveland & Southwestern Interurban System.—An illustrated article describing a railway property which is interesting, especially as an example of a system built up piecemeal to answer the demands made by thriving towns in the neighborhood of Cleveland for better communication with that city. Only one line enters Cleveland, but beyond the city it spreads out like a huge fan, touching all the towns in a southerly and westerly direction within a radius of 50 miles. At present there are 7 divisions or branches of this road, and extensions now building will make it one of the most extensive systems of interurban electric railways in the country. The roadbed and overhead work are of standard construction, and the rolling stock is all built especially for interurban service. The main power station is located at Elyria, and when this installation is completed will include two 1,000-hp Westinghouse turbines, directly connected to alternating-current generators. Additional units will be installed. Several sub-stations have been established, and others are now being equipped, the initial installation of each consisting of a 300-kw rotary-converter and three 200-kw static transformers, together with high-tension and low-tension switchboards, static interrupters and the usual equipment for this class of work. Pending the completion of the main power plant, current is furnished temporarily by 300-kw inverted rotary converters, which have been installed at the Elyria power house. Another interesting feature of the equipment is a combination freight car and snow plow. This car is designed so that the plows may be readily removed and the car can then be used as an ordinary freight car. A portable pneumatic jib-crane mounted on a single truck is used for general hoisting and handling trucks, wheels and other heavy material in the yards and repair shops. A comprehensive system of train inspection has been developed in connection with this property and the movement of cars on all of the 7 divisions is controlled by the dispatcher from the central office.—*St. R'y Jour.*, June 27.

Street Railway Power Plant.—Jackson.—An illustrated article describing the Boston & Worcester Street Railway power plant. The electrical installation consists of one 500-kw and one 1,000-kw generator, two rotary transformers of 250 kw, 500 r.p.m., 6 poles, alternating-current voltage 360, direct-current voltage 600, at 417 normal amp.; 6 transformers of 100 kw, three for each rotary connected in delta, reactive coils are inserted in the secondary for compounding. There are two 35-kw, six-pole exciters and one 4-pole, 50-kw exciter, all running at 125 volts.—*The Engineer*, July 1.

Motor Repairs in Car Shops.—An editorial on the advantages and disadvantages of making repairs in the pits of car houses. It was formerly considered essential that a car house should have pits so that the workmen could examine the motors and other parts from below. It is thought by some, however, that good work cannot be carried on in a pit and two companies, in Milwaukee and St. Louis, have recently built car houses in which there are no pits. Here the motors and trucks are run out from under the cars and examined from above. In Milwaukee a special motor has been designed so that it can be inspected from above.—*St. R'y Jour.*, July 4.

REFERENCES.

Transportation Facilities at the Soo.—An article describing the system of the International Transit Company and the Trans-St. Marys Traction Company, both of which are controlled by the Consolidated Lake Superior Company. The construction of the road, the equipment and rolling stock is discussed.—*St. R'y Jour.*, July 4.

Accumulators for Traction Purposes.—v. Winkler.—A theoretical article, in the first part of which the author proposes to answer the question to what extent the rate of discharge may be increased for the single plate, in order to obtain on the one hand the largest possible effect per discharge (light battery), and on the other hand the greatest total effect, which the battery can give during the total time it is in use. The question is treated with the help of diagrams. He then takes up the discussion of the most favorable number of plates for a cell and the arrangement of the whole battery, concluding with some observations on the motors for traction purposes.—*Zeit. f. Elek.*, May 31, June 7.

Electro-Physics and Magnetism.

Secondary Radiation from Gases Subject to X Rays.—Barkla.—The author describes in detail the apparatus used and the experiments conducted for the investigations of the above subject. He arrives at the following conclusions: 1. All gases subject to X rays are a source of secondary radiation. 2. The absorbability of the secondary radiation is (within the limits of possible error, which was about 10 per cent.) the same as that of the primary radiation producing it. 3. For a given primary radiation the intensity of secondary radiation is proportional to the density of the gas from which it proceeds—the temperature and the pressure being practically constant. 4. The secondary radiation is not due to the recombination of the ions. As the primary and secondary radiations differ appreciably in intensity only, the author thinks that we may reasonably conclude that the radiation proceeding from gases subject to X rays, is due to scattering of the primary radiation. As this scattering is proportional to the mass of the atom, it may be concluded that the number of scattering particles is proportional to the atomic weight. This would then give further support to the theory that the atoms of different substances are different systems of similar corpuscles, the number of which in an atom is proportional to its atomic weight.—*Phil. Mag.*, June.

Electrical Conductivity of Atmospheric Air.—McLennan and Burton.—The air, whose conductivity was to be measured, was confined in a cylinder 125 cm long and 25 cm diameter, composed of sheet iron coated with zinc. Measurements on the conductivity were made at intervals of a few minutes at first, and it was invariably found that a rapid decrease in the ionization took place, until a minimum value was reached. The conductivity then slowly increased and approached a limiting value in the course of two or three days. The authors also conducted a series of tests in which they confined the air under high pressures in a heavy rolled iron cylinder coated with zinc. They found in this case again the rapid decrease to a minimum followed by a gradual rise towards a limiting value. They explain these observed facts by the supposition that a radioactive emanation, probably having its origin in the earth's surface, was introduced into the cylinder with the air, the decay of this emanation being the cause of the decrease in the conductivity, and that the subsequent rise in conductivity is due to a radioactive emanation given off by the walls of the containing vessel. On this view the limiting value to which the conductivity curves tend, would represent a condition of equilibrium, where the rate of decay of the emanation was equal to the rate at which it was produced. To ascertain whether the conductivity of the enclosed air was affected by a change in the metal composing the walls of the receiver, linings of tin and lead were used. The curves for these metals were found to have the same characteristics; in each there is a rapid drop to a minimum and a gradual rise towards an ultimate limiting value. A considerable difference, however, was found in the minimum conductivities of the various metals and the final limiting values also varied. The authors state that, while these effects may be explained by supposing the ionization of the air to be caused by a radioactive emanation sent off from the metals, they have found that part of the conductivity cannot be accounted for in this way, but must be attributed to an active agent external to the receiver. The heavy cylinder mentioned above was filled with air to a pressure of about 400 cm of mercury and allowed to stand until its conductivity had become steady. It was then placed in an insulated galvanized tank, which was gradually filled with water. The initial conductivity before the water was admitted was 21.1. As the water rose in the tank, the conductivity decreased and fell to 13.3 when the tank had been filled. The values for the conductivity show that the loss was almost directly proportional to the rise of the water and the total fall in conductivity was about 37 per cent. The authors conclude from these results that the ordinary air of a room is traversed by an exceedingly penetrating radiation, such as that which Rutherford has shown to be emitted by thorium, radium and the excited radioactivity produced by thorium and radium.—*Phil. Mag.*, June.

The Wiedemann Effect in Ferromagnetic Substances.—Honda and Shimizu.—The authors conducted tests on nickel steel wires and ferromagnetic bars. The experiments were conducted in the following manner: 1. The circularly magnetizing current was kept constant, and the amount of twist due to varying the longitudinally magnetizing current was measured. 2. The wire was then stretched by different loads and the above processes repeated. 3. The longitudinally magnetizing current was kept constant and the amount of twist due to varying the circularly magnetizing current, was measured. Before each experiment the wire was carefully demagnetized by the passage of an alternating current of gradually diminishing intensity, which was found absolutely necessary to secure correct results. The results show that in nickel steel the amount of twist first increases until it reaches a maximum, after which it gradually diminishes. But the reversal of the twist is never observed, though the field exceeds 1,200 C. G. S. units. The tension always diminishes the amount of twist; the diminution is large in weak fields, and becomes gradually less as the field is increased. The diminution is approximately proportional to the applied tension. By varying the circular field it was found that under a constant longitudinal field the angle of twist at first increases at a constant, but later at a gradually diminishing rate. As the longitudinal field is increased, the curves approximate to right lines, according with Kirchhoff's theory. For iron bars the authors found that the general course of the curves is similar to that observed in a wire of the same metal. The direction of twist is opposite to that of nickel in weak fields and in strong fields the direction does not reverse. The direction of twist is the same in cobalt as in nickel, cast cobalt giving different results from annealed cobalt.—*Phil. Mag.*, June.

Conductivity and Dielectric Constant.—Eversheim.—A preliminary article, with diagrammatic curves on some results obtained by the author in the investigation of the conductivity and the dielectric constant of solutions and solvent in the critical state. Experiments were conducted with ammonia, copper nitrate solution, sulphurous acid solution and carefully purified ethyl ether. The apparatus and details are promised in a later article. The following conclusions are drawn by the author: 1. The resistance of solutions and solvent grows continuously from a certain temperature, situated below the critical temperature and seems to take a constant value above that; whether this is the "absolute gasifying point" of Traube, demands a further investigation. 2. Also, the change of the dielectric constant from the fluid to the gaseous states takes place without jump. 3. The peculiar changes at the critical temperature, which have been observed in all substances under consideration, give rise to the supposition that they may be of a general nature and perhaps stand in the closest connection with the critical state. 4. The critical state is not marked by equality of density in the space containing the gas and the liquid, because the latter depends on the circumstances, for, as was proved in this and other investigations, it is only beyond the critical point that there is a possibility of equal density.—*Phys. Zeit.*, June.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—Pochin.—An abstract of a short paper read before the recent meeting of the Institution of Civil Engineers in London, with the discussion. The paper contains a condensed statement of the methods proposed for the solution of the priblem of isolation. The syntonic and the optical methods are discussed. Attention is called to the possibilities arising from the use of two or more radiators in suitable phase relation, to reinforce waves in a particular direction, or from a corresponding arrangement in the receiver, the creation of stationary waves or nodal areas and the employment of the earth's period.—Lond. *Elec.*, June 19.

Electric Waves.—Morton.—A mathematical article on the connection between the speed of propagation and attenuation of electric waves along parallel wires. The author concludes that in systems which cause a given amount of retardation in the speed of the waves, the attenuation constant is proportional to the frequency; or, there is a constant logarithmic decrement in running a distance equal to the wave-length in free space, of oscillations of the same frequency. When the dissipation of energy in the wires is small the logarithmic decrement, on running the fraction $\frac{1}{2}\pi$ of a wave length, is equal to the fractional decrease of the speed of propagation. When the attenuation is rapid, it approaches the value 2π divided by the actual wave length along the wire.—*Phil. Mag.*, June.

In the Transmission of Photographs by Telegraphy.—Korn.—A note before the French Academy of Sciences, wherein the author gives a new method, based on the change in conductivity of selenium. The photographic film of the receiver turns before a small window in a blackened vacuum tube. Luminous radiations can be produced in the interior of this tube, which will produce, after having passed the window, photographic impressions on the sensitive film. The latter moves synchronously with the film carrier of the transmitter (a film with the photograph to be reproduced on it, rolled around a glass cylinder), which is traversed by a very small bundle of light rays and passes, line for line, before a selenium cell arranged in the interior of the cylinder. According to the different shades of the photograph the selenium receives more or less light and an electric current produced by a constant e.m.f, passing through the selenium and the telegraph wire to the receiver, will receive corresponding variations of intensity and will regulate the intensity of the radiations of the receiving tube in the following manner: The active electrode of the tube is connected with a point, placed at a small distance from one extremity of the needle of a galvanometer arranged in the line wire, and a second point, situated near the other extremity of the needle is connected to one of the poles of the secondary of a Tesla apparatus. A flow of sparks jump over between the fixed points and the needle and the intensity of this flow is the greater, the nearer the extremities of the needle are to the points. By this arrangement it is possible to make the intensity of the radiations in the receiving tube correspond to the intensity of the light, striking the selenium of the transmitter and thus to reproduce the photograph line for line.—*Comptes Rendus;* abstracted in *L'Eclairage Elec.*, June 13.

Automatic Signaling.—Cudworth.—An illustrated abstract of a paper read before the last meeting of the English Institution of Civil Engineers, with the discussion. The first part of the paper is mainly historical; the author then proceeds to describe the systems now being installed on the North Eastern Railway and the London and Southwestern Railway. The latter is an electro-pneumatic system, differing, however, from those commonly used in the United States in that air at a pressure of 10 to 20 pounds per square inch is used, instead of 80 to 90 pounds per square inch. One power station situated near the center will serve for a distance of 23 miles. Pneumatic pressure is conveyed thence in pipes the whole length of the installation, with branches to all signals. Each signal arm is worked by means of a rod connected with a piston actuated by pneumatic pressure. The pressure is admitted to or withdrawn from the piston by means of a pin-valve actuated by an electromagnet in circuit with a signal battery, which again is under the control of the track battery circuit. The system being installed on the North Eastern Railway is the Hall system. Its general lines are similar to those of the London and South Western system as far as the track and signal batteries are concerned. Special appliances have to be added to effect the pulling off of the signals. The source of power is liquified carbonic acid, stored at a pressure of 800 pounds per square inch in two remarkable steel cylinders at the foot of each signal post. Each cylinder will suffice for 6,000 to 7,000 operations of the signal, the working pressure being about 50 pounds.—Lond. *Elec.*, June 19.

REFERENCES.

The Real Inventor of the Mercury Coherer.—Guarini.—A note in which the author shows that Prof. Tommasina, of Genoa, was the first discoverer of the mercury coherer, which was used by Marconi for his first transatlantic experiments in December, 1901.—Lond. *Elec.*, June 19.

Improvements in Different Systems of Wireless Telegraphy.—Prasch.—The continuation of the article previously noted in the Digest. The system of Anders Bull and several improved receivers, are described.—*Dingler's Polyt. Jour.*, May 30, June 6.

Wireless Telegraphy.—De Segundo.—A popular discussion of wireless telegraphy as compared with submarine cables, the author concluding that both methods have their own particular field.—*Page's Magaz.*, London, April.

Miscellaneous.

Some Unsolved Problems in Engineering.—Maw.—A long abstract of the "James Forrest" lecture at the English Institution of Civil Engineers. The author dealt with the economical generation and distribution of power. Speaking about raising the efficiency of the steam engine, he thinks that the question of steam jacketing and especially the application of such jackets to compound or multiple expansion engines of modern types and of large powers, using steam at high pressures, deserves a much more thorough and systematic investigation. Another question is the extent to which our most advanced steam engine practice can, especially in the case of large power units, be improved by the use of superheated steam and the manner in which such improvement can best be realized. Equally desirable is the thorough investigation of the action of steam, both saturated and unsaturated, in the various types of turbine motors, in view of its great and rapidly growing practical importance. Attention is also called to various points connected with internal combustion engines, which also deserve investigation. Reference is also made to the new rapid tool steels, as being a series of materials, which promise to revolutionize a very important percentage of the machine work, and to necessitate very material alterations in the proportions of the machine tools.—Lond. *Elec.*, June 18.

REFERENCE.

Italian Machine Works.—A description of the Franco Tosi Works, Legnano, turning out engines and boilers. In the general machine shops electric driving is in use throughout, the total power being nearly 500 kw.—Lond. *Elec.*, June 19.

New Books.

The Utility of an Academic or Classical Education for Young Men Who Have to Earn Their Own Living, and Who Expect to Pursue a Commercial Life. An Investigation. By R. T. Crane. Chicago, 1903. 110 pages.

The world would be a dreary abode if all men held the same opinions, and decided dissent from the majority even though absolutely at variance with the spirit of age, is apt to be refreshing to the jaded reader. Doubtless much of the vogue that the controversial writings of Ruskin had in their day was due to the antipodal views he took on the bearings of modern civilization, the material influences of which he denounced with all the vehemence of a rabid reformer fighting a great public evil.

These reflections rise from a reading of this little volume, which in its sentiments is almost as much at variance with the spirit of the present age as was Ruskin's ferocious antipathy to railways and other material developments that made the last century the golden age of mechanics. We may remark at once that so far as the author would deny systematic intellectual training to the young American, his attitude can only be likened to that of some southerners, who would narrow the life of the negro to the plantation field behind a mule.

The book contains a number of letters from educators and college graduates, and from business men who, like the author, have accumulated great wealth. The replies of the former apparently proved irritating to the author, for he exclaims, "I leave it to the public to judge whether the heads of these institutions have the proper appreciation of the importance of making accurate statements on this subject." College men apparently did not take very seriously the circular letter sent to them by the author, for he complains that only 555 replies were received from 1,593 letters sent out. From the replies received, 65 were selected as "from the class of young men whom I particularly desired to reach," and the author points out in apparent amazement that, "it is evident that 60 out of the 65 believe that the intellectual advantages coming to them from a college education are more valuable than financial success."

Neither do the replies received from business men seem to have been very satisfactory to the author, for he says, "even the replies of business men, as shown in the following pages, are often so indefinite as to be of no value for our purpose. No dependence can be placed on any of them who fail to make their practice consistent with their theories." The application of these remarks appears to be that some of the successful business men without early education, while not stultifying themselves by acknowledging the advantages of such education, yet appear to have no personal objection to the educated employee. Of all men, however, from whom to obtain an unbiased opinion on the causes of success in life, the most hopeless subject is the successful man; for his view invariably appears to be that what was lacking from his personal career is not to be a factor of success for anyone entering a similar career, an irrefragible proof of which is the fact of his own success.

Such an inquisition, however, must necessarily be inconclusive when the testimony adduced is that of men whose success is rooted in the conditions of a past age. When the successful business men of the present day were young men, higher education was confined to those preparing for the professions and to the idle classes; and in those days the possession of a classical or academic education acted as a bar to the sympathy of employers and associates, while the methods of the day and all other conditions were against the young college man who would enter the commercial or industrial field. At the present day, however, to ask us to revert to those times is like asking the naval architect to lay aside his scientific knowledge, discharge his drafting force and henceforth proceed to whittle models out of wooden blocks. To those in the electrical field who have witnessed the rise to dominance of the college man in that field, not only in the technical but in the commercial and manufacturing departments, and who see his present control of every avenue of advancement to such positions of profit he does not yet occupy, the hopelessness of the author's tilt against the conditions of to-day is as obvious as would be the case in an attempt to reproduce the material conditions of a generation ago.

As a further illustration of the author's attitude, we give below his remarks on the value of technical education, and particularly direct attention to his opinion that the mechanical millenium has been reached:

"The importance of technically educated men in mechanical lines of work, aside from electricity, chemistry and mining, has, in my opinion, been greatly overestimated. Many people who are unfamiliar with manufacturing seem to feel that there is a great field for such men in this kind of business, apparently forgetting that almost all the success which this country has gained along these lines of industry was achieved before technical men were ever heard of. They should realize that practically all branches of manufacturing business have been brought to such a wonderful state of perfection that there is very little chance for further improvement in them even by practical men who possess a large amount of experience, combined with good common sense. This being the case, there surely is no opportunity for the technical man, who is notably lacking in this latter qualification, to accomplish anything new in the mechanical direction."

Directory of Electrical Societies, Etc.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

American Street Railway Association. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting Atlantic City, N. J., September 2, 3 and 4, 1903.

The Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Underground Telephone System for Mexico City.

An extensive underground telephone system is to be constructed in the City of Mexico. The Compania Telefonica Mexicana (the Mexican Telephone Company), which concern already controls some 1,400 miles of telephone lines in the federal district, has secured the concession. Samuel Hernando & Co., of Mexico City, whose New York house is Samuel Hernandos & Cummings, 97 Front Street, are primarily interested. J. Sitzenstatter, the company's engineer, is now on his way from England, where he recently went to purchase material, etc. The Samuel firm represent the interests of the British concern, W. T. Henley's Telegraph Works Company. The major portion of the material will be furnished by that company. The automatic signaling switchboard, etc., will very likely be purchased in the State.

S. K. C. Induction Motors.

The induction motor by reason of its simplicity of construction and operation and its high efficiency, is becoming more and more popular, not only as an adjunct in great transmission systems where alternating currents are necessarily employed, but also for local distribution of power in factories, mines and other industrial establishments, where in many instances it has been given the preference over the direct-current motor. To meet the wide range of conditions which induction motors encounter in actual service, the Stanley Electric Manufacturing Company, of Pittsfield, Mass., manufacture three distinct types, which are separately treated below.

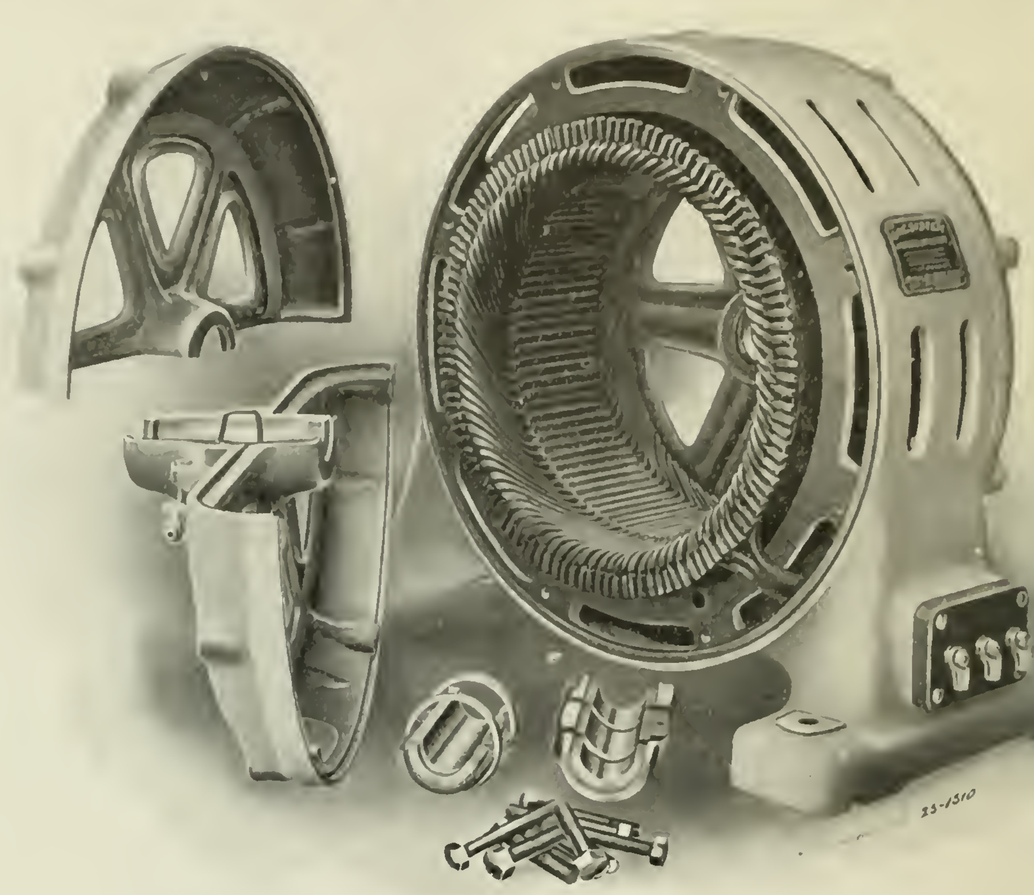


FIG. 1.—INDUCTION MOTOR WITH ARMATURE OR SECONDARY REMOVED, SHOWING PRIMARY WINDING AND BEARINGS.

The motor shown in Fig. 1 is the simplest type. The armature or secondary is of the "squirrel-cage" type, and consists of straight copper bars laid in partly closed slots, with practically no insulation, and short-circuited by means of heavy end rings, as shown in Fig. 2. Injury to the armature either by heating or by mechanical displacement of the parts is practically impossible, and the wear on the motor is reduced to that which takes place in the bearings. Owing to the extreme simplicity of armature construction, this type is the most desirable where the conditions admit of its use; namely, where

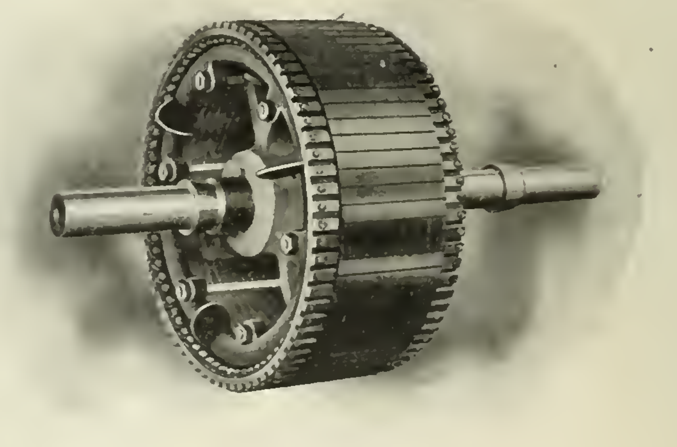


FIG. 2.—ARMATURE OF "TYPE A" MOTOR.

the motor is not required to start heavy loads, or where a large starting current will not injuriously affect the potential regulation of the system. It is possible to start the motor by simply closing the line switch, and this method is used with motors below 5 hp. But as the first rush of current, when so starting, amounts to several times the running current, it is advisable to use with the larger sizes of motors a device called a starting compensator to reduce the voltage impressed upon the motor, and thus decrease the current taken.

The starting compensator consists of a single coil transformer in each phase of the circuit, with taps brought out at various points of the winding in order that a number of potentials may be obtained. The compensator is provided with a double-throw oil switch, by means of which, after starting, the coils are cut out and the full voltage of the line applied to the motor. Fig. 3 shows diagrammatically the construction of the compensator and the method of connecting it to the line and to the motor.

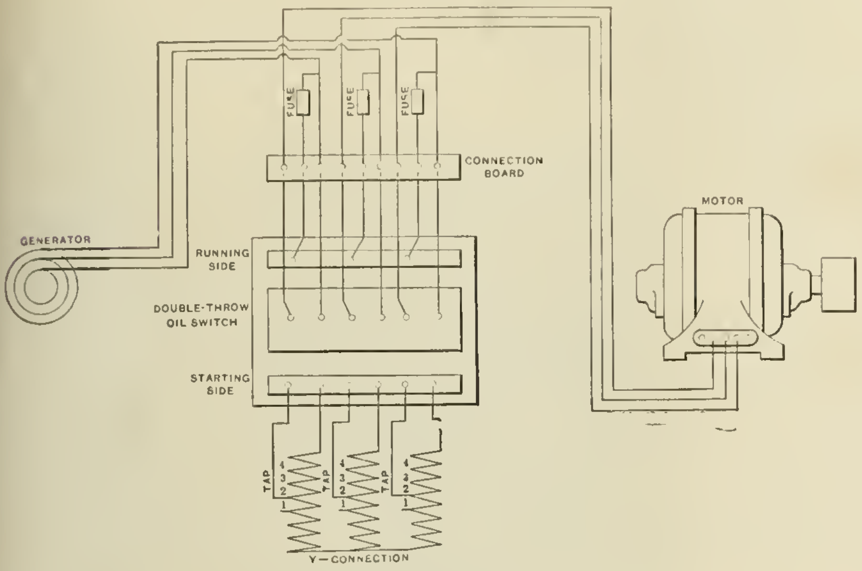


FIG. 3.—STARTING COMPENSATOR CONNECTED TO THE LINE AND TO THE MOTOR.

The point at which the compensator should be connected will depend upon the torque which the motor must develop on starting. The compensators are normally connected to the first tap in the winding, so as to give the minimum voltage and therefore the lowest current. Should the torque thus developed be unequal to that necessary, a proper adjustment of the connections of the compensator to secure a higher potential can readily be made. In the second type of motor the starting current is kept low by introducing starting resistance within the secondary circuit. This type does not possess the same simplicity of construction as the type just described, owing to the fact that the armature has a polar winding and a device for varying the armature resistance is necessary, but it has this advantage—it will start a given load with a current materially less than that taken by the other motor. Therefore, it is recommended where the motor must start heavily loaded and where a large current, such as the motor with short-circuited armature takes when starting at full load, would be objectionable.

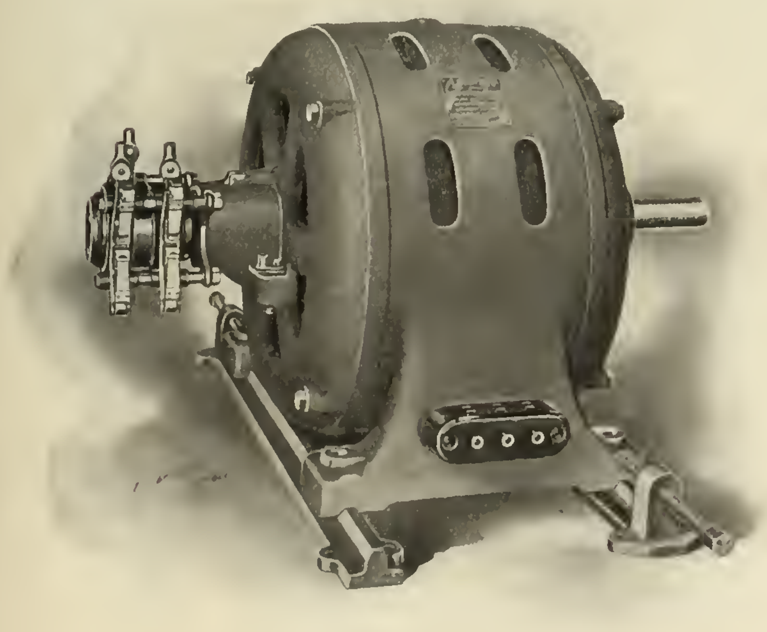


FIG. 4.—VARIABLE-SPEED INDUCTION MOTOR.

The starting resistance is placed within the armature spider, and leads are brought out from several points of the resistance to a set of contacts parallel to the shaft. A lever on the outside of the motor operates a sliding collar, which is arranged to pass over the contacts, so that the resistance, on starting the motor, can be short-circuited step by step.

In the third type of motor a variation in speed is secured by varying the resistance within the secondary or armature circuits. This resistance is located external to the armature so that the heat is generated at a distance from the motor and the resistance may be left continually in circuit if desired. The armature winding is similar to that of the motor just described. The leads from the winding are carried through a hollow shaft to the collector rings by means of which connection is made with a suitable controller for cutting in and out the external resistance. As is obvious, the controller constitutes a most satisfactory device for starting the motor.

The motors can develop a torque of at least 200 per cent. of their normal full load. Therefore, they are not liable to injury by temporary heavy overloads. The temperature rise of a motor of either of the three types on a continuous run at full load will not exceed 40° C. The speed of the two first mentioned types varies but slightly from no load to full load, the variation not exceeding 2 per cent. in the larger motors, and 5 or 6 per cent. in the smaller sizes.

Mexican Power Transmission Systems.

A syndicate composed of President Coffin, of the General Electric Company; President Hine, formerly of the Stanley interests, now head of the Guanajuato Light & Power Company, Limited; John Hays Hammond, the mining expert; the Bonbrights, of Denver, Colo.—in short the same group of Americans that is interested in the Guanajuato Light & Power Company, Limited, is to construct another important power transmission system in the Southern Republic.

An hydraulic plant capable of developing 10,000 hp, is to be built on the Rio de Valle for the purpose of generating energy for transmission to the El Oro mining district, one of the most important mineral regions in Mexico. The current will be conveyed about 45 miles. The volume of water available is 6,000 cu. m per second. The working head will be 269 m. Construction work is expected to begin in the early fall.

The Guanajuato Light & Power Company's plant at Zamora, on the Duero River, is rapidly nearing completion. It is anticipated that power will be conveyed to the Guanajuato mining district, 103 miles distant, by October 1. The plant is to be operated at the outset at 60,000 volts. The initial equipment will have a capacity of 4,000 hp. There will be two 1,500-kw General Electric generators, each direct-connected to two 1,000-hp Pelton wheels. The contract for the piping is being executed by Joseph T. Ryerson & Son, of Chicago, New York offices, 17 State Street. One of the several features of the system will be the use of galvanized steel towers for the transmission line. Twelve of these poles will be placed to each mile. The Aermotor Company, of Chicago, was awarded the contract.

Tobacco Factory Equipment.

The Blackwell's Durham Tobacco Company has recently placed an order with the Westinghouse Electric & Manufaturing Company for an alternating-current generator, 75-kw capacity, 250 volts, 25 cycles, 500 r.p.m., this being the third generator ordered by this well-known tobacco company for its factory at Durham, N. C. About two years ago the initial installation was made of a 150-kw, 25-cycle, 200-volt, belted type alternator, together with exciter and switchboard, and also about 150 hp in induction motors ranging in capacity from 3 to 20 hp. These motors are used to drive the various machinery used in the manufacture of this brand of smoking tobacco.

such as re-ordering machines, granulating machines and automatic picking machines, also elevator and other incidental machinery.

The original electrical installation proved so successful that last year the tobacco company decided to install an additional generator and ordered a Westinghouse 75-kw, 2-phase, 220-volt, 3,000 alternation, belted generator, complete with switchboard. This was arranged to run in parallel with the previous generator.

The factory has now been further enlarged and it was found necessary to increase the output of the combined plant which led to the placing of this recent order for 75 kw generator and new switchboard arranged for the control of all three generators, and also the necessary feeders.

The Martin Rocking Grate.

Many rocking grates have so many objections in the way of heavy depreciation by melting and warping of the bars, that there are a number of engineers who will have nothing to do with them. Some grates are so irregular that they do not permit a hoe or slice bar to be run over them, while others have fingers which interlock or engage with each other, and these fingers become burned off.

The Martin grate is evidently one upon which much thought and ingenuity has been expended in the design to overcome these objections. Fig. 1 shows one of these grate bars out of the furnace. Fig. 2 shows an assembled furnace with grate bars. They extend lengthwise of the furnace. The heavy part of the bar is so far below the fire that it does not become hot enough to warp. The principal part of the bar upon which the fire rests is provided with slots that allow of its expansion and contraction. The bar is only $1\frac{1}{2}$ in. wide, including the teeth, and is about $5\frac{1}{2}$ in. deep. All the bars rock in the same direction at the same time, and the space between the bars is not enlarged by the rocking. The clinkers, therefore, cannot clog the grate by dropping between the bars during shaking. The grate is heavy, weighing about 80 pounds to the square foot. The design, together with the weight, make it a very durable form. The grate bars rest like an inverted cone on the bearing bars, so that they rock very easily.

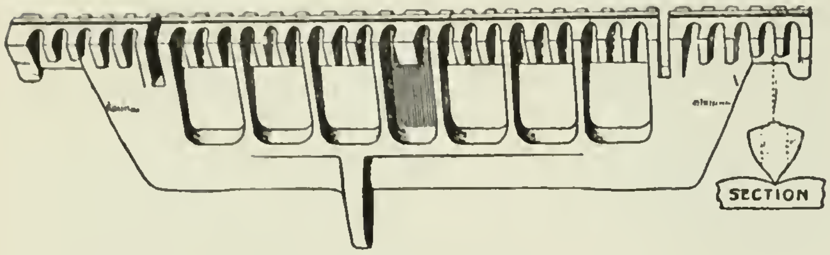


FIG. 1.—VIEW OF A GRATE BAR.

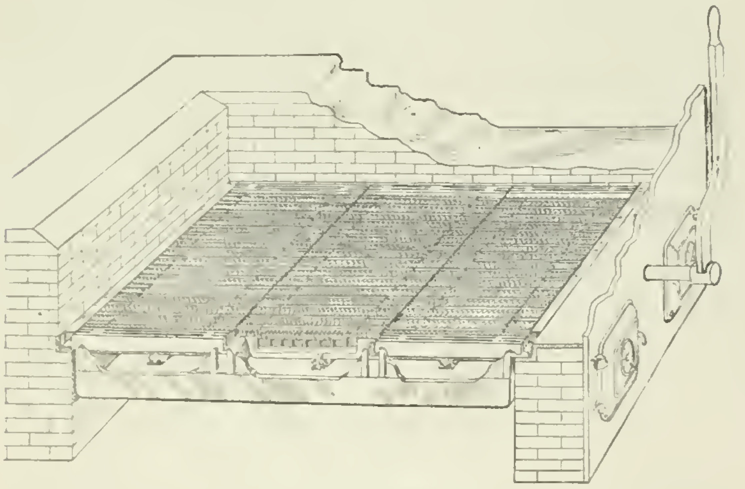


FIG. 2.—FURNACE.

The grate has been in use for a number of years in many well-known steam plants. Thomas W. Smith, chief engineer Crane Company, Chicago, says that "after four years' service these grates are in as good condition as when first put in." They are under twenty-two boilers at the Joliet mills of the American Steel & Wire Company. The Otis Elevator Company, the Citizens' Electric Light Company, of Altoona, Pa., and the Oshkosh Electric Light Company, of Oshkosh, Wis., are among a long list of users of this grate, only a few of whom have been mentioned here. The grate is made by the Martin Grate Company, 83 Van Buren Street, Chicago. It is fitted to burn any kind of coal, but is especially adapted for soft coal, slack and screenings, or in other words for cheap coal.

Battery Fan Motor.

In the season of hot waves, the fan motor is truly regarded as one of the necessities to human comfort, and where there is any system of electrical supply, its use is becoming universal. Taking the country as a whole, however, the offices and residences not having the benefit of electrical service are largely in the majority, and to these the battery fan motor offers itself as a substitute. One of the recent types of a battery fan outfit is shown in the accompanying illustrations, the source of current being a dry-battery. The manufacturers, Ewing-Merkle Electric Company, 1106 Pine Street, St. Louis, state that a $7\frac{1}{4}$-inch fan can be run with six cells of dry battery for 200 hours without renewal, thus bringing the cost to less than one cent per hour.

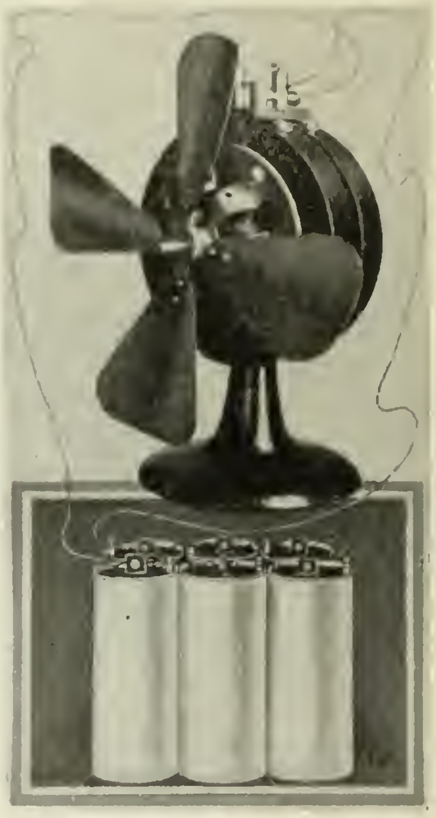
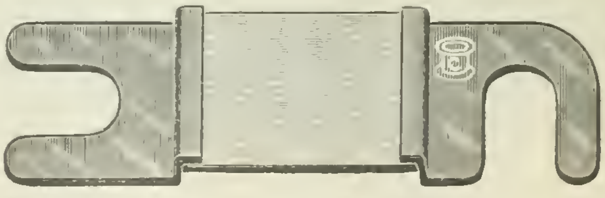


FIG. 3.—BATTERY FAN MOTOR.

New Link Terminal.

The accompanying illustration shows an improved form of terminals for copper-tipped fuse links, upon which a patent has recently been granted to the Chicago Fuse & Wire Co., Chicago, New York and Buffalo. The fuse shown is especially adapted for use in main cut-outs and for dynamo fuses. The special advantage claimed for these links is that a strong and reliable connection is secured between the fuse and terminal, there being, it is asserted, contact surface twice as great as that of the ordinary style of construction. The completed fuse is also very compact. The company has for some time been using this style of connection with the larger size of fuses, which are made from strip with satisfactory results.



FUSE LINK AND TERMINAL.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 3½@4 per cent. for 60-day loans. The stock market, although dull, was weak in tone, the principal unsettling factors being a decline in New York Central and the weakness in United States Steel shares. Favorable crop advices failed to stimulate any activity in Western railway stocks, although earnings continue to show large increases. The money market continued easy, although the shipment of over $6,000,000 of gold to Europe was among the unfavorable symptoms of the week. At the close of the week New York Central declined, with several other stocks, to the lowest point of the year. In the case of the United States Steel securities, the decline was based upon unfavorable reports about the character of the showing for the June quarter and the half-year ending June 30, while it was also suggested that there was some question about the declaration of the regular quarterly dividend on the common stock. This last report, however, proved altogether unfounded, since the directors have since declared the regular dividend. All of the traction and electric securities participated in the general downward movement and suffered losses. Brooklyn Rapid Transit lost 3⅛, closing at 55¼, after having reached 54¾. Metropolitan Street Railway closed at 120¼, being a loss of 2¾ points. This stock reached the lowest point of the year, viz., 119¾. General Electric closed at 173, which was the lowest point of the week, and a net loss of 4 points. Western Union closed at 83⅝—a loss of 1¾ points. American Telephone & Telegraph closed at 132, being a loss of 4 points. Following are the closing quotations of July 14.

NEW YORK.

	July 7.	July 14		July 7.	July 14
American Tel. & Cable......	80	77	General Electric.		170¼
American Tel. & Tel........	131	127	Hudson River Tel...........	..	..
American Dist. Tel..........	30	26	Metropolitan St. Ry.........	122½	118¾
Brooklyn Rapid Transit ...	57⅝	52	N. E. Elec. Veh. Trns........	..	..
Commercial Cable.	..	..	N. Y. & N. J. Tel............	..	..
Electric Boat.	17	15	N. Y. E. V. T. Co...........	5½	5
Electric Boat pfd............	40	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.. .	1	1	Western Union Tel...... ...	..	83
Electric Vehicle...	7¼	7	Westinghouse com....	..	..
Electric Vehicle pfd........	13½	13	Westinghouse pfd...........	..	..

BOSTON.

	July 7.	July 14		July 7.	July 1
American Tel. & Tel	152	128½	Western Tel. & Tel. pfd....	90*	90*
Cumberland Telephone....	..	..	Mexican Telephone.........	1⅝	1½
Edison Elec. Illum..........	..	242	New England Telephone ...	129	128½*
General Electric............	..	173	Westinghouse	..	..
Western Tel. & Tel.........	13	13	Westinghouse pfd.........	..	..

PHILADELPHIA.

	July 7.	July 14		July 7.	July 14
American Railways.........	..		Phila. Traction..	95¾	95¾
Elec. Storage Battery.. ...	60	60	Phila. Electric	6⅛	5⅞
Elec. Storage Battery pfd.	..	..	Pa. Electric Vehicle.........	..	..
Elec. Co. of America.	8⅞	8¾	Pa. Electric Vehicle pfd ...	..	..

CHICAGO.

	July 7	July 14		July 7.	July 14
Central Union Tel.	..	..	National Carbon pfd........	93	92
Chicago Edison........	..	147	Northwest Elev. com........	..	..
Chicago City Ry....	190	185	Union Traction	4	4
Chicago Tel. Co	..	..	Union Traction pfd.........	30	30
National Carbon.	23	23¼			

*Asked.

AMERICAN TELEPHONE & TELEGRAPH.—An additional $5,018,700 of the capital stock of the American Telephone & Telegraph Company has been listed on the New York Stock Exchange, making the total amount listed to date $109,700,100. This stock is, according to a statement made to the Stock Exchange, part of the capital stock for which admission to the list was requested in the company's application of June 18, 1901, of which 620,944 shares ($62,094,400) were admitted in September, 1901, and 321,431 shares were then withheld from the list. Of this amount (321,431 shares) 5 shares were then withheld from the list by reason of a clerical error in a letter of July 11, 1901, from the treasurer of the company to the secretary of the New York Stock Exchange, and 321,426 shares ($32,142,600) were then withheld because they were held by the American Bell Telephone Company, as set forth in the letter above named. Of the 321,426 shares ($32,142,600) above mentioned, then held by the American Bell Telephone Company, 50,182 shares ($5,018,200) have been released from the stipulations of any agreement and from any obligations arising therefrom, as also appears from the statement by the secretary of the American Bell Telephone Company. Since the date, January 8, 1903, of the previous application made by this company for the admission to the list of any of its capital stock the stockholders at a special meeting duly called and held on March 31, 1903, increased the capital stock from $150,000,000 to $250,000,000. The company is presently to receive subscriptions for a part of this additional stock, for the admission of which application is to be made hereafter with statement of the purposes to which the proceeds are to be applied when the amount of such subscription has been determined. The amount now issued is $136,826,600 (1,368,266 shares) of which $104,681,400 (1,046,814 shares) is now listed upon the exchange; $2,100 (21 shares) are presently to be notified as paid for; $5,018,700 (50,187 shares) are the subject of this application, and the remainder $27,124,400 (271,244 shares), are held by the American Bell Telephone Company.

ST. LOUIS POWER CONTRACT.—One of the largest contracts of its kind ever executed has just been closed between the St. Louis Transit Company and the Union Electric Light & Power Company for electric power. The contract in effect is a 10-year agreement with the traction syndicate, providing for the use of approximately 12,000 hp per diem. Delivery of this enormous current will commence on May 1, 1904, the contract having been made with an especial view to use at the beginning and during the World's Fair. Charles W. Wetmore, vice-president of the Union Electric Light & Power Company, estimates that the receipts under the deal with the Transit Company will amount to at least $600,000 per annum, or $6,000,000 for the ten-year period. The closing of this contract indicates the abandonment of the rather elaborate plans whereby the St. Louis Transit Company was to establish a power house on the East Side, presumably on the river front, for the generation of power, carrying the power under the Mississippi River by means of cables. It was even stated at one time that options had been secured on property in East St. Louis and that a site for a central transforming and distributing station had been selected in East St. Louis. Officials of the Union Electric Light & Power Company state that the power sold to the Transit Company, will be sent from the new central power station, being built at Levee and Ashby Streets, construction of which will be completed on April 1, 1904.

UNITED STATES STEEL.—At the monthly meeting of the directors of the United States Steel Corporation, held last week, the regular dividends were declared on both the preferred and common stocks, and a statement of its earnings, including those for the quarter ending June 30, 1903, was made. The net earnings for the quarter were $36,499,828, which is a decrease of 3 per cent. from the corresponding quarter of 1902, but an increase of 32 per cent. compared with the preceding quarter, ending March 30. The following table is a comparison of the first half of 1902 with the first half of the current year:

	1903.	1902.
Net earnings	$61,568,235	$64,407,153
Sinking fund	729,795	240,428
Balance	$60,838,440	$64,166,725
Depreciation and reserve fund	6,655,504	6,556,028
Balance	$54,182,936	$57,610,697
Interest and sinking fund U. S. Steel bonds...	9,120,000	9,120,000
Balance	$45,062,936	$48,490,697
Dividends	28,025,889	28,027,074
Surplus	$17,037,047	$20,463,623

AMERICAN DISTRICT TELEGRAPH EXPANDING.—The American District Telegraph Company of New Jersey has been engaged for several months in acquiring the stocks of district messenger companies throughout the United States. Some forty different companies in the larger cities, including Baltimore, Cleveland, Philadelphia, Chicago and Buffalo, have been secured by the New Jersey company and are now being operated by it. Three companies are still outside the combination. The latest offer of the American District of New Jersey was made last week for the Mutual District Messenger Company, of Boston, whose stockholders were notified that the New Jersey company had made a proposition to purchase its stock. The offer was on the basis of eight-tenths of a share of the New Jersey company stock for each share of the Mutual District Company's stock. The capital of the Boston company is $225,000. It is stated that the plan of the New Jersey company is to amalgamate and bring into close relations with it the messenger service of every city in the United States which is in any way identified with or dependent on the service of the Western Union Telegraph Company. The American District Telegraph Company of New Jersey is known as a Gould company, the Gould interests predominating in its directorate. It is capitalized at $10,000,000.

CLEVELAND ELECTRIC RAILWAY.—The consolidation of the two local street railway systems in Cleveland having been effected will control 200 miles of lines. Patrons will be given six tickets for a quarter. This was decided at a meeting of the directorate in Senator Hanna's office last week. The Cleveland Electric Railway Company has requested authority of the State to increase its capital from $13,000,000 to $23,400,000 to provide for the purchase of the Cleveland City Railway Company. The directors elected the following officers: President, Horace E. Andrews; vice-president, Christopher F. Emery; treasurer, George Russell; assistant treasurer, John Ehrhart; secretary, H. J. Davies; general manager, John J. Stanley; general superintendent, George G. Mulhern. Senator Hanna is chairman of the board of directors.

MEXICAN TELEGRAPH COMPANY shows results as follows:

March 31st, surplus after payment of April dividend	$1,242,164
June 30th quarter (partly estimated) gross	$117,500
Expenses (partly estimated)	22,500
Net	$95,000
Interest	13,371
Balance	$108,371
Mexican government's proportion	5,000
Balance	$103,371
Dividend	47,815
Surplus	$55,556
Total surplus	1,297,720

CENTRAL & S. A. TEL. COMPANY reports as follows:

March 31 surplus after payment of April dividend	$726,719
June 30 quarter (estimated) gross	$250,000
Expenses	103,000
Net	$147,000
Interest	5,000
Balance	$152,000
Dividend	115,884
Surplus	$36,116
Total estimated surplus	762,835

STOREY MOTOR COMPANY RECEIVERSHIP.—George R. Beach, of Jersey City, was appointed receiver for the Storey Motor & Electric Company, of Harrison and New York, by Vice Chancellor Stevens on July 7. The company was incorporated in October, 1901, with a capital of $500,000. The application was made by Frank T. McDermott, of Jersey City, and Frederick Weimer, of New York, counsel representing Henry E. Fanshawe, vice-president and general manager of the concern. The holders of a $40,000 mortgage and more than 75 per cent. of the bondholders concurred in the request for the appointment of a receiver, which, it is stated, is desired to prevent legal interruption to the reorganization plan. The concern's total nominal assets are stated to be $90,000 and total liabilities $70,000, including $34,000 due the bondholders.

MORTGAGE IN ST. LOUIS.—Four millions of first mortgage 5 per cent. thirty-year gold bonds are to be issued by the Union Electric Light & Power Company, St. Louis, Mo., through the Mississippi Valley Trust Company, N. W. Harris & Co. and Altheimer & Rawlings Investment Company. The present issue will be $2,000,000 and during the year a like amount will be issued. The proceeds will be used in part for the purpose of retiring existing liens, amounting to $1,552,000, on the properties of the Union Company; also for the purpose of greatly increasing its plant. The company has a ten-year contract to furnish power to the St. Louis Transit Company, as noted elsewhere.

ELECTRIC COMPANY OF AMERICA.—At the meeting of the board of directors of the Electric Company of America, in Philadelphia last week, the president reported that the full returns for five months show that in the net earnings there was a gain of over 19 per cent. over the same period of the previous year. The board passed a resolution unanimously advising that the par value of the stock be increased from $10 to $50 a share. A special meeting to vote on this question will be held in the Fall.

AMERICAN TELEGRAPH ELECTION.—At the annual meeting of the American Union Telegraph Company of New Jersey, in Jersey City last week, these directors were elected: A. R. Brewer, J. B. Bertholf, B. Brooks, R. C. Clowry and T. F. Clarke. The directors subsequently elected these officers: R. C. Clowry president, Thomas F. Clarke vice-president, and A. R. Brewer secretary and treasurer.

Commercial Intelligence.

THE WEEK IN TRADE.—The trade conditions in general are very much improved. The winter wheat crop harvest has about been completed with a considerably larger yield than last year, retail trade in summer goods has improved, and re-orders from jobbers are larger in volume. Confidence in a large fall trade grows as corn and cotton make up for their early backward start, clearings are in excess of a year ago at most centers; railroad earnings continue to show gains over all preceding years, and prices develop exceptional steadiness for a mid-summer period. Although money still remains easy, reports from Western centers indicate that the country has already begun to draw supplies for crop-moving purposes. The labor situation shows some improvement. On the Pacific coast the lumber trade is especially active at Portland, Ore. Business at the East is rather better as a whole, due partly to the improved outlook in labor matters. The iron and steel market is dull and unsettled as to prices. Inquiries are numerous, but new business in iron is scant. A good volume of orders for rails has been booked. The copper market was weak and low, and the official prices have been reduced to 14c. for Lake and electrolytic and 13½c. to 13¾c. for casting stock. It is reported, however, that Lake is obtainable at 13¾c.; electrolytic at 13½c. and casting at 13¼c. The demand is very small and there is less confidence than ever. The business failures for the week ending July 9, as reported by *Bradstreet's*, numbered 154, against 162 the week previous, and 195 the corresponding week last year.

EXHIBITORS AT THE STREET RAILWAY CONVENTION.—Following is a list of concerns which have taken space for exhibits at the convention of the American Street Railway Association, at Saratoga, September 2, 3 and 4 next: Adams & Westlake Company, Chicago; American Automatic Switch Company, New York; American Brake-Shoe & Foundry Company, New York; American Car Seat Company, Brooklyn; American Railway Supply Company, New York; American Steel & Wire Company, Chicago; Atlas Railway Supply Company, Chicago; Baldwin Locomotive Works, Philadelphia; Bemis Car Truck Company, New York; Berry Brothers, Detroit; E. W. Bliss Company, Brooklyn; J. G. Brill Company, Philadelphia; Harold P. Brown, New York; Bruck Solidified Oil Company, Boston; Brady Brass Company, New York; L. C. Chase & Co., Boston; Christensen Engineering Company, New York; Adam Cook's Sons, New York; R. W. Conant, Cambridge; Consolidated Car Fender Company, New York; Consolidated Car Heating Company, Albany; Continuous Rail-Joint Company, Chicago; Curtain Supply Company, Chicago; Dearborn Drug & Chemical Works, Chicago; Detroit Trolley & Manufacturing Company, Detroit; Duff Manufacturing Company, Allegheny; Electric Storage Battery Company Philadelphia; ELECTRICAL WORLD AND ENGINEER, New York; Electric Railway Equipment Company, Cincinnati; C. J. Field, New York; General Electric Company, Schenectady; Globe Ticket Company, Philadelphia; Gold Car Heating & Lighting Company, New York; Hale & Kilburn Manufacturing Company, Philadelphia; C. J. Harrington, New York; Heywood Bros. & Wakefield Company, Philadelphia; Howe Manufacturing Company, Scranton; International Register Company, Chicago; H. W. Johns Manville Company, New York; Kinnear Manufacturing Company, Columbus; C. S. Knowles, Boston; Le Valley Vitæ Carbon Brush Company, New York; Lorain Steel Company, Lorain; Ludlow Supply Company, Cleveland; Lumen Bearing Company, Buffalo; G. P. Magann Air-Brake Company, Detroit; National Carbon Company, Cleveland; National Electric Company, Milwaukee; National Ticket Company, Cleveland; National Lock Washer Company, Newark; F. H. Newcomb, Brooklyn; R. D. Nuttall Company, Pittsburg; Ohio Brass Company, Mansfield; Ohmer Fare Register Company, Dayton; Pantasote Company, New York; Peckham Manufacturing Company, New York; Pennsylvania Steel Company, Philadelphia; T. Raymond Pierce, Boston; Pittsburg Reduction Company, Chicago; Pittsburg Switch & Signal Company, Pittsburg; Railway Appliance Company, Albany; Railway Appliances Company, Chicago; Root Track Scraper Company, Kalamazoo; Rossiter, MacGovern & Co., New York; Railway Sander Company, Toronto, Canada; Sherwin-Williams Company, Cleveland; Standard Paint Company, New York; Standard Vitrified Conduit Company, New York; Star Brass Works, Kalamazoo; John Stephenson Company, Elizabeth; Sterling-Meaker Company, Newark; Sterling Varnish Company, Pittsburg; St. Louis Car Company, St. Louis; Stuart-Howland Company, Boston; *Street Railway Journal*, New York; *Street Railway Review*, Chicago; Taylor Electric Truck Company, Troy; Traction Equipment Company, Brooklyn; Uni Signal Company, Cambridge; United States Curtain Company, Newark; Van Dorn & Dutton Company, Cleveland; W. T. Van Dorn Company, Chicago; Wm. T. Watson, Newark; Weber Railway Joint Manufacturing Company, New York; *Western Elec-*

trician, Chicago; Westinghouse Electric & Manufacturing Company, Pittsburg; Wm. Wharton, Jr., Company, Philadelphia; Wheel Truing Brake-Shoe Company, Detroit. Exhibits may be placed four days before the opening of the convention. The exhibition will open September 1.

NERNST LAMPS.—The Pennsylvania Railroad Company is equipping more of its offices with Nernst lamps. The Philadelphia office of the Nernst Lamp Company reports that twenty-six six-glower and five three-glower Nernst lamps have recently been installed in the freight department of the Pennsylvania Railroad, at Broad and Washington Avenues, Philadelphia, this being one of the most important departments of the company. Several three-glower Nernst lamps have also been placed in the power house at Camden, N. J., and the lighting equipment at the new passenger station is about to be completed by the installation of twenty-three lamps of the three-glower type, which will be an addition to the six-glower Nernst lamps already in use. It is expected that the new shops of the Philadelphia, Baltimore & Washington branch of the Pennsylvania Railroad will be largely lighted by these lamps, the six-glower type being used.

THE GENERAL INCANDESCENT COMPANY ABSORBED BY GENERAL ELECTRIC.—A dispatch from Syracuse, N. Y., dated July 8, states that word has been received there that the General Incandescent Arc Light Company, which was to have moved to that city, has been absorbed by the General Electric Company and will go to Pittsfield, Mass., instead. The Chamber of Commerce of Syracuse had raised several thousand dollars to defray the moving expenses of the concern and the company had leased the Barnes, Cobb & Phoenix foundry buildings in that city. The *Wall Street Journal* states that an official of the General Electric Company confirms the report that his company is negotiating for the purchase of the General Incandescent Company, and that the plant will be moved to Pittsfield.

BROOKLYN RAPID TRANSIT IMPROVEMENTS.—The Brooklyn Rapid Transit Company intends to make extensive improvements during the present year and $14,008,719.73 has been appropriated for this purpose. Of this amount $6,000,000 is to be used for a new power house on Kent Avenue with a capacity of 80,000 hp; $3,124,962 is to be expended in the enlargement of other power houses; $1,821,500 for the improvement and equipment of the elevated and surface lines; $1,295,935 for miscellaneous work, including new tracks and new buildings; $1,153,823 for the construction of underground conduits for carrying feeder cables, and $612,500 for the purchase of real estate.

COPPER PRICES.—A large producer of Lake copper says that when the metal was reported to be selling at 15¼ cents per pound he was unable to make sales at 15 cents. He now declares that although the nominal price is 13⅞ to 14 cents, he can find no buyers who are willing to pay over 13⅝ cents. The manipulation of the United Metals Selling Co., he says, is hurting the market, because no one knows what a fair price is. Consumers were bearish when the market was advancing a few months ago, and now they are bullish when the market is steadily declining. Prices of finished goods are now considerably higher than they should be, with copper selling at 13⅞ cents.

THE EUREKA ELECTRIC COMPANY, of Genoa and Chicago, has recently supplied the Hoosier Telephone Company, of Salem, Ind., with a 300-line switchboard of its new bell style ringdown type. This company is making a specialty of this style of board, and anticipates a very large sale of it. It is very simple in construction and operation and combines many desirable features. The company has completed its new factory at Genoa, Ill., which gives it three times its former capacity. From the present outlook the company thinks that it will be necessary to enlarge the factory before another year elapses.

WESTINGHOUSE CANADIAN COMPANY.—The Canadian Westinghouse Company has been incorporated with headquarters at Hamilton, Ont. The names of the incorporators, as given in a dispatch from Ottawa, are as follows: George Westinghouse, Pittsburg; Henry Herman Westinghouse, New York; George Carson Smith, Pittsburg; Frank Hendrickson Taylor, Pittsburg; Loyall Allen Osborne, Pittsburg; Thomas Ahearn and Warren Young Soper, Ottawa; Paul Judson Myler, Hamilton.

TULA IRON WORKS, MEXICO.—A company styled the Tula Iron Company has been incorporated under the laws of New Jersey with a capital of $2,500,000 common stock and $7,500,000 of preferred stock to acquire the Tula Iron Works, near Guadalajara, Mexico. Mr. Ralph H. Beach, of the General Electric Company, is the principal party interested in the enterprise. Later on it is proposed to utilize water power of which there is abundance in the vicinity for the purpose of operating the works.

ILLINOIS TELEPHONE & TELEGRAPH COMPANY.—The Illinois Telephone & Telegraph Company has won its fight in the city council and secures practically all it asked for, says a Chicago dispatch. It secured a franchise for 20 years for its tunnels and the privilege of transporting "mail, newspapers, packages and merchandise" upon the payment to the city of a proportion of the gross receipts from all revenue and the turning over to the city of its tunnels at the expiration of the franchise.

CHICAGO TELEPHONE.—A Chicago dispatch says: "A fight has been begun in Chicago City Councils against an application by the United Telegraph, Telephone & Electric Company for a city telephone franchise authorizing a measured service, on the ground that the Chicago Telephone Company, which is a subsidiary concern to the American Telephone & Telegraph Company, is the real applicant seeking thus to obtain a satisfactory substitute for its present franchise which expires in 1909."

LIGHTING EQUIPMENT FOR JAPANESE WARSHIP.—The British electrical engineering and contracting firm of L. J. Healing & Co., Yokohama, whose New York representative is Francis A. Cundill, 90-96 Wall Street, has secured an order for a marine generating set for installation for lighting purposes in a Japanese warship. The equipment will consist of a multiple 25-kw, 450 r.p.m. General Electric generator, direct-connected to a tandem-compound engine.

TUERK FANS FOR THE FAR EAST.—E. B. Latham & Co., 39 Vesey Street, New York, report a substantial foreign demand for Tuerk alternating-current ceiling fans, the orders on hand showing an increase of more than 50 per cent. above those on the books up to a similar period last year. The foreign contracts at present come chiefly from the Far East. Good-sized orders have just been booked for shipment to both Shanghai and Manila.

SWITCHBOARD CONTRACTS.—The Stromberg-Carlson Telephone Manufacturing Company, of Chicago and Rochester, has recently closed contracts for switchboards for the following companies: Adena Telephone Company, Adena, Ohio; Vigilant Telephone Company, Dillonville, Ohio; Morrow County Telephone Company, Mt. Gilead, Ohio; also a large number of telephones to the last-named company.

THE SOUTH SIDE ELEVATED RAILROAD COMPANY, of Chicago, has recently purchased a Westinghouse 1,500-kw railway type generator of 600 volts, and running at 75 r.p.m., which is to be installed in its power house at the corner of Fortieth and State Streets. This power house already contains two Westinghouse generators of the same type and size, which have been in successful operation for some time.

OSAKA EXHIBITS.—A consular report from Kobe, Japan, says that in one of the departments of the Osaka Exposition a very creditable exhibit is made of American machinery. Among the American firms represented are the Niles-Bement-Pond Company, the Pratt & Whitney Company, the Rand Drill Company, Buffalo Forge Company, the Laidlaw & Fay-Egan Companies, Brown & Sharpe and L. S. Starret.

THE SWEDISH-AMERICAN TELEPHONE COMPANY has recently furnished complete exchange equipment for the following named independent telephone organizations: The New Telephone Company, New, Ohio; the Potosi Telephone Company, Potosi, Mo.; the Palo Telephone Company, Palo, Mich.; the Idaville Mutual Telephone Company, Idaville, Ind., and the Illiopolis Telephone Company, Illiopolis, Ill.

ELECTRIC COAL-CUTTING PLANTS FOR JAPAN.—Francis A. Cundill, 90-96 Wall Street, New York representative of the British electrical engineering and contracting firm of L. J. Healing & Co., Yokohama, is about to let contracts for electric coal-cutting plants for installation in two of the large Japanese collieries. The electrical equipment for the larger plant will be of 75-kw capacity.

JUNE BUSINESS FAILURES.—According to *Dun's*, the manufacturing concerns which failed during June showed liabilities amounting to $2,642,516, against $3,261,365 in June, 1902. The liabilities of trading companies that failed amounted to $3,443,456, against $5,728,300 for June, 1902. The liabilities of brokers and transporters was $2,240,682, against $1,184,252 in June, 1902.

COPPER.—Negotiations for the sale of 40,000,000 pounds of Lake copper at 13⅜ cents, it is stated, are pending. The prospective buyer is a large brass concern. Lake copper is now offered at 13¾ cents, but it is believed that a bid of 13½ cents would be immediately filled.

THE BARRIETT ELECTRIC COMPANY is the name of the reorganized Cincinnati Electric Motor Company. Mr. S. L. Barriett is president of the company. It will continue business in Cincinnati in the same establishment as before. The capital stock has been doubled.

GENERAL ELECTRIC BUYS A LYNN WHARF.—The General Electric Company has purchased the wharf property on Western Avenue at Fox Hill Bridge, Lynn, Mass., from the estate of William M. Newhall.

General News.

THE TELEPHONE.

CONGRESS, ARIZ.—The Arizona State Telephone Company connects with the Prescott Company's lines. It has a 50-drop board, 140 subscribers and 70 miles of toll line. A line into Phoenix is to be built.

OZARK, ARK.—The Home Telephone Company rents its switchboard and telephones from the Southwestern Telephone & Telegraph Company and connects with the latter's long distance lines. A 100-drop board, 100 subscribers and 60 miles of toll line are supplied by the Home company.

NEWMAN, ILL.—The Chapman Telephone Company has a 100-drop board, 135 subscribers and 25 miles of toll line.

FARINA, ILL.—The Farina & Vandalia Telephone Company has eight stations, 30 miles of toll line and the same length of rural line.

HOOPESTON, ILL.—The Hoopeston Telephone Company operates a 300-drop board with 450 subscribers and 50 miles of toll line.

JERSEYVILLE, ILL.—The Illinois Telephone Company is building a line from Carrollton to Kane, north of Jerseyville and will establish an exchange at Kane.

MONMOUTH, ILL.—The Monmouth Telephone Company has a 550-drop board, 630 city and 260 country subscribers. The rates are $1 and $2 for residences and business houses.

OLNEY, ILL.—The Richland County Telephone Company has all it can do to meet demands for service. A 400-drop board supplies 350 subscribers, and there are 250 miles of toll line. Business rates are $2 and $2.50; residences $1 and $1.50.

ALTON, ILL.—The demand for telephone connection was great in Alton during the recent flood. Men who desired to get word to their families offered as much as $5 and $10 for the privilege of immediate connection. The operators simply said: "Await your turn and you'll only pay 25 cents." Only one wire, that of the Central Union, was working to St. Louis during most of the time of the flood.

DENOTTE, IND.—The Halleck Telephone Company has a 150-drop board, 100 subscribers and 250 miles of toll line.

ELIZAVILLE, IND.—The Elizaville Mutual Telephone Company has a Eureka board of 100 drops, and 114 stockholders.

CUMBERLAND, IND.—The Cumberland Telephone Company is of recent formation, has a 50-drop board and 30 subscribers and 6 miles of toll line.

ROCKVILLE, IND.—The Parke County Telephone Company operates a 400-drop board, has 360 subscribers and 120 miles of toll line, with 50 more projected.

NEW PARIS, IND.—The New Paris Mutual Telephone Company has 160 subscribers. There is a fine outlook for rural lines, and 30 toll lines are already in operation.

SULLIVAN, IND.—The Sullivan Telephone Company operates a 450-drop board and has 405 subscribers. There are 100 miles of toll line. Rates are $1 and $2; tolls extra.

ROACHDALE, IND.—The Roachdale Union Telephone Company operates two boards of 100 drops each and has 310 subscribers. Recent growth has been most satisfactory.

SEYMOUR, IND.—The Seymour Home Telephone Company is growing steadily. It operates a 400-drop board, has 375 subscribers and 20 miles of toll line at $1.25 and $2.25.

SHANNONDALE, IND.—The Shannondale Company has a board of 100 drop capacity, fifty drops being installed. There are 142 subscribers, 20 toll lines and other party lines.

VEEDERSBURG, IND.—The Veedersburg Telephone Company has a switchboard capacity of 300 drops, 250 of which are installed. There are 300 subscribers and 7½ miles of toll line.

COLUMBUS, IND.—The Citizens Telephone Company has 1,000-drop switchboard capacity, 1,100 subscribers and 100 miles of toll line. There are numerous exchanges about the country.

FORT WAYNE, IND.—The Home Telegraph & Telephone Company has switchboard capacity of 8,000 drops, 2,700 of which are in service, with 2,700 subscribers. Large cable extensions are projected.

INDIANAPOLIS, IND.—The French Lick, Elon and Eckerty Telephone Company has increased its capital stock from $930 to $1,420. The company proposes to install two new modern switchboards.

BLOOMINGTON, IND.—The Bloomington Telephone Company operates a 700-drop board and has 635 subscribers. It is connected with several rural lines, but does not own any, and has free service all over this section.

BRISTOL, IND.—The Bristol Telephone Company has a 100-drop board, with 50 in operation. There are 50 subscribers, 17 miles of toll line and 20 miles of farmers' lines soon to be completed. Rates are $1 and $1.50.

WALKERTOWN, IND.—The telephone here is operated by Mr. C. A. Lemert, who proposes putting in an exchange at North Liberty. He operates a 100-drop board, has 65 subscribers and 20 miles of toll line.

TIPTON, IND.—The Tipton Telephone Company has switchboard capacity of 440 city and 30 country party line drops. There are 500 subscribers and 40 miles of toll line leased and owned. The rates are $1 and $2.

INDIANAPOLIS, IND.—The Converse Telephone Company, of Converse, has filed articles of incorporation. The capital stock is $12,500. B. F. Agness, W. J. Stillwell, J. J. Sumpter, George T. Randall and W. J. Castler are the incorporators.

NEW MARKET, IND.—The New Market Telephone Company has a 200-drop board, 90 installed, and 190 subscribers, who use 63 miles of line free. The company is co-operative, each stockholder paying $3.65 per year and 15 cents for service.

FAIRMOUNT, IND.—The Fairmount Telephone Company operates the common return system and has lately installed 100 country telephones at $1 per month. There is a 300-drop board, 250 city and 100 country subscribers and 45 miles of toll line.

KENTLAND, IND.—Mr. W. K. McCrary is the owner of the Home Telephone Exchange. Three hundred and ten subscribers are being afforded service from a 200-drop board. There are 50 miles of toll line and several farmer's lines are in course of construction.

WINCHESTER, IND.—The Winchester Telephone Company has increased its capital stock from $25,000 to $50,000 in order to make necessary improvements and extensions to accommodate the rapidily increasing business. Alonzo L. Nichols is president and J. A. Browne, secretary.

WEST LEBANON, IND.—The Cadwallader Telephone Company is now giving night service at State Line and at Marshfield. It operates two switchboards of 100 drops each, with 100 subscribers at the latter and 160 at the former place. It has 60 miles of toll line. Its rates from $1 to $3.

JONESBORO, IND.—The business of the Home Telephone Company of this city has increased to such an extent in this vicinity that the two exchanges controlled by the company, one here and one at Gas City, will be enlarged by the addition of switchboards capable of accommodating from 200 to 300 more subscribers.

RENSSELAER, IND.—The Jasper County Telephone Company has 300 miles of toll line all metallic. Farmers' lines are also metallic and have 10 subscribers on each line. The 800-drop board gives good service to 725 subscribers. Rates for business houses and residences are $2 and $1 respectively; farms $1.50 per month.

GREENSBURG, IND.—The Decatur County Independent Telephone Company has a central energy switchboard capacity of 500 line and 200 party lines. It has 1,100 subscribers. There are 1,475 miles of wire, of which 246 is toll line. The company's business is increasing rapidly and about half of the subscribers are stockholders.

BEDFORD, IND.—The Bedford Home Telephone Company has 480 drops installed, 250 subscribers and 60 miles of toll line. It has just completed a line to Mitchell which gives through connection with West Baden and French Lick Springs. In this way the company reaches Louisville and all long distance points in Kentucky and Indiana.

ROCHESTER, IND.—The Rochester Telephone Company has recently adopted the Stromberg-Carlson "lockout" system for its country lines which cover a radius of 10 miles. It is very satisfactory and the demand for telephones is increasing. The switchboard capacity is 600 drops, 400 of which are installed. There are 375 subscribers and 137 miles of toll line.

BROOKVILLE, IND.—The stockholders of the Brookville Telephone Company have elected the following directors: J. C. Shirk, W. A. Koehler, M. H. Irwin, J. H. Masters and James Beckley. In turn the directors elected J. C. Shirk, president; M. H. Irwin, secretary, and W. A. Koehler, treasurer. Steps were taken at this meeting to improve the plant and extend the lines.

WARREN, IND.—Mr. W. R. Lowe recently bought the exchanges at Warren and Van Buren and has combined the names in the title of his company. The towns are eight miles apart in the heart of the oil region. The switchboard capacity is 400 drops and there are 380 subscribers with 20 miles of toll line. Two thousand three hundred feet of cable are now being put in.

FORT WAYNE, IND.—The National Telephone & Telegraph Company has exchanges at Auburn, Kendallville, New Haven, Ind., and Sturgis, Mich. The general offices are at this place. It has 1,000 subscribers and about 1,000 miles of toll line. Rates are $12, $18 and $24. Cable extensions and toll lines are projected. The company reports a steady increase of business on all lines.

WABASH, IND.—The Central Union Telephone Company's franchise for this city does not expire until next March. It has been announced that the company's franchise had expired and that the company would be ousted. It is believed that the company will not ask for a renewal of rights to operate, but will be content to maintain a toll station, the Home company having pre-empted the local patronage.

LOGANSPORT, IND.—The Logansport Home Telephone Company has increased its capital stock from $150,000 to $350,000, and will issue bonds to be secured by mortgage on the property of the company. This step is for the declared purpose of making extensions and improvements of the company's plant, which is to be the central point for the consolidated lines of northern Indiana. Walter J. Uhl is secretary.

RIPLEY, IND.—The Farmers' Co-operative Telephone Company operates three boards of 10, 100 and 100 drops. It gives service to 300 subscribers and has 200 miles of toll line. Rates are $10 to stockholders, and $1 to $1.25 to subscribers per month. The company is building farmers' lines as fast as it can, placing ten on one line, and extending to two other counties. It connects with numerous cities and towns also.

FRENCH LICK, IND.—The Star Telephone Company has a 100-drop board, 90 installed, and 92 subscribers. Two new boards are to be put in, one at West Baden. This company has the contract to handle the independent long distance business for the two mineral spring resorts, and in view of the fact that little less than 100,000 people visit them every year, it is to be expected that there will be a prosperous season for the Star Company.

CAMBRIDGE CITY, IND.—The Citizens' Telephone Company has a 400-drop switchboard capacity of which 350 are installed. The apparatus used is of Kellogg, Monarch and Eureka make. There are 650 subscribers at $1 for dwellings, $1.50 for business houses, and 110 miles of toll line. With a population of 2,000, the city supports 240 telephones; the others are within a radius of six miles and the demand exceeds the company's ability to build.

GOODLAND, IND.—The Western Indiana Telephone Company uses Western Electric apparatus and has a 200-drop board with 250 subscribers. There are 32 miles of toll line and 63 of county lines. Business rates are $24; residences, $12; rural, $15. The company is now building on its own property and will equip the exchange with three 100-drop sections and toll board, with 1,500 feet of cable, probably underground. The toll board will carry seven Central Union circuits, four of its own and 12 rural circuits.

RICHMOND, IND.—The directors of the Home Telephone Company have instructed their superintendent to proceed to order the necessary cable, switchboards and other materials to increase the capacity of the plant to 5,200. There are now over a hundred contracts and applications on hand and others in sight awaiting these extensions which will be pushed as rapidly as possible. The company will also purchase some additional copper toll wire with a view to increasing long distance facilities in Western Ohio and northeastern Indiana.

FARMINGTON, IA.—The Farmington Telephone Company uses American Electric apparatus, has a 100-drop board and 60 subscribers.

SPRINGVILLE, IA.—The Springville Telephone Company operates an American 60-drop board and has 50 subscribers at $1 per month.

HEDRICK, IA.—The Hedrick Telephone Company operates a Kellogg 200-drop board and has 250 subscribers, with 50 miles of toll line. Farmers' lines are soon to be built.

PLEASANTON, IA.—The Pleasanton Telephone Company gives service to 60 subscribers from a 100-drop board. It has 80 miles of toll line and will build farmers' lines.

REDFIELD, IA.—The telephone line here has 20 miles of toll line and gives service to nearly all the farmers in the vicinity. Messrs. Nelson and Thornburg are the principal owners.

OAKVILLE, IA.—The Oakville Telephone Company has a 100-drop board, 325 subscribers and 66 miles of toll line. Connection is projected with independent lines of Illinois. There is a great demand for telephones.

WILLIAMSBURG, IA.—The Williamsburg Telephone Company has increased its capital stock from $10,000 to $25,000. It has a 250-drop board with 475 subscribers and 30 miles of toll line. Service costs $1 per month.

ROLFE, IA.—The Rolfe Telephone Company gives service to 195 subscribers in town and 156 on farm lines. The switchboard capacity is 193 drops. There are 20 miles of toll line and 50 farm lines have been put in this season.

ARLINGTON, IA.—The Arlington Telephone Company operates an 80-drop board and is about to build several farmers' lines for which there is a great field. From 300 to 400 telephones will probably be in operation before winter.

FAIRFIELD, IA.—The Jefferson County Telephone Company operates a Eureka 500-drop board and has 456 subscribers, with an expected increase. There are 75 miles of toll line. About 4,000 feet of cable will be put in soon.

IOWA CITY, IA.—The Johnson County Telephone Company, like most of the independent companies, is paramount in its own section. It has 810 subscribers and 210 miles of toll line. Rates are $18 and $30. Numerous improvements are projected.

WEST BRANCH, IA.—The West Branch Telephone Company operates a 100-drop board, with 110 town subscribers and 200 farmers. It has 35 miles of toll line. Extensions are projected. The lines have been practically rebuilt owing to the increased demand.

NEVADA, IA.—The Nevada Mutual Telephone Company's switchboard is of 500-drop capacity with 300 installed. It has 360 subscribers and toll lines of 75 and 60 miles respectively, also farmers lines, with more of the latter to come. Its rates are $2 and $1.25.

SHELL ROCK, IA.—The Shell Rock Telephone Company operates a 100-drop board with 80 subscribers. There are nearly 800 miles of toll line. Three new lines with 17, 14 and 12 subscribers are to be built. Three already in working order have 17, 14 and 8 subscribers.

WASHINGTON, IA.—The Washington Telephone Company operates a 500-drop board, has 385 subscribers and 80 miles of toll line. The company is installing 13,000 feet of cable and is doubling its capacity, besides putting in a new farmer and toll line board for 50 lines.

LA PORTE CITY, IA.—The La Porte Public Utility Company comprises water, electric light and power systems as well as telephone. The latter operates a switchboard of 300 central energy signals, 50 drops for farm lines, with 215 city subscribers and 200 farmers. Rates are $12 and $18.

STOCKPORT, IA.—The Union Telephone Company consists of four principal exchanges. Keosauqua, Bonaparte, Stockport and Birmingham, with drop boards of 100, 100, 40 and 65 respectively. There are five rural party lines with 300 connections and toll lines connecting all surrounding towns. Rates are $1 to $1.50 per month.

MANHATTAN, KAN.—The Wareham & Wood Telephone Company uses Sterling apparatus. It has a 400-drop board and 450 subscribers. There are 30 miles of toll line.

GALENA, KAN.—Messrs. Williams & Robinson are the owners of the Galena Telephone Company and report bright prospects for business in their section. They operate a 700-drop board, have 500 subscribers and 80 miles of toll line. An increase and a new exchange at Scammon are projected.

CARLISLE, KY.—The Carlisle Telephone Company is extending its lines and making good progress. It has a 400-drop board and 378 subscribers; also 28 miles of toll line.

VINEYARD HAVEN, MASS.—The Public Telephone Company operates a 260-drop board, has 117 subscribers and 175 miles of toll line. A large increase in capacity is projected. The company is holding its own in spite of keen competition.

CANTOR, MINN.—The telephone station here is managed and owned by Mr. J. Dunford. It has 300 subscribers and nearly 150 miles of toll line; also many farmers' lines with 18 to 24 on a line. Improvements and additions are projected.

THIEF RIVER FALLS, MINN.—The telephone station here is owned by Mr. H. Frant. It operates a 200-drop board and has 192 subscribers. A 60-mile toll line has been laid out, 10 miles of which are completed. Local lines are also to be built.

HARTVILLE, MO.—The Hartville Telephone Company uses a Stromberg-Carlson 50-drop board and has 43 subscribers. There are 64 miles of toll lines. The outlook for telephone business in this section is fine.

JULIAN, NEB.—The Julian Telephone Company operates a Eureka 100-drop board, has 50 subscribers and 20 miles of toll line.

NELIGH, NEB.—The Northwestern Telephone Company operates a 200-drop board here, has 170 subscribers and 15 miles of toll line. Its rates are $2 and $1, and 15c. for party lines.

CREIGHTON, NEB.—The Camp Dewey Telephone system is making rapid progress and has to enlarge its switchboard capacity. It now has 250 miles of toll line and is about building 75 miles more. There are 198 subscribers.

TUCKERTON, N. J.—The Atlantic Burlington & Ocean Telephone Company operates a 100-drop board, has 16 subscribers and 10 miles of toll line.

STAMFORD, N. Y.—The Stamford Telephone Exchange operates a 100-drop board with 60 subscribers. It proposes putting in a new switchboard and new cable.

WOODHULL, N. Y.—The Woodhull Telephone Company operates a few miles of toll line, but there is every prospect of every road in the district being utilized for telephone extensions.

ALDEN, N. Y.—The Alden Telephone Company has not been operating long, but expects to increase its sphere of work soon and to have long distance connection. It has a 100-drop board and 25 subscribers.

COHOES, N. Y.—The Cohoes-Waterford Home Telephone Company has been installed only two months, but is doing extremely well. It operates 800 drops of a board of 3,000 capacity and has 500 subscribers at $40 to $20 per year.

MARS HILL, N. C.—The Ivy Telephone Company, of Mars Hill, is contemplating several extensions.

SALISBURY, N. C.—The Salisbury Telephone Company is building a system in Spencer, about 100 telephones being installed in the new plant.

ASHEVILLE, N. C.—The Asheville Telephone Company and the Southern Bell Telephone Company have conditionally consolidated. A new corporation will be created provided the city grants the desired franchise. The consolidation will mean higher rates and the dismantling of the Bell system.

OXFORD, OHIO.—The Oxford Telephone Company will extend its system under the supervision of the county engineer.

NEWARK, OHIO.—The Newark Telephone Company has been authorized to increase its capital stock from $60,000 to $100,000.

JEFFERSON, OHIO.—The Jefferson & Warren Telephone Company has been making some needed improvements to its lines in this place. Considerable new cable has been stretched.

COLUMBUS GROVE, OHIO.—The village council has granted a franchise to the Mutual Telephone Company to enter this city. The company is made up mainly of farmers who desire connections with the city.

ST. MARYS, OHIO.—The stockholders of the St. Marys Telephone Company have decided to enlarge the plant to about twice the present size. The capital stock of the company will also be increased to $60,000.

DILLONDALE, OHIO.—The Vigilant Telephone Company at a recent meeting appointed a committee to solicit subscribers and also consider a proposition to combine with two other companies and build lines direct to Mingo Junction.

CANTON, OHIO.—The Stark County Telephone Company will expend about $80,000 during the next three months in enlarging its exchange in this city. Other large sums of money will be spent in extending the lines to all parts of Stark and adjacent counties.

FREMONT, OHIO.—The Fremont Home Telephone Company will soon increase its capital stock from $60,000 to $100,000. Part of the increase will be expended for a new switchboard to take care of the rapidly increasing business. The company has about 750 exchange subscribers and nearly 50 farm line subscribers. It has about ten miles of metallic circuit toll lines.

OTTAWA, ONT.—As soon as its charter is granted by the Dominion parliament, it is the intention of the Canadian Telephone Company to institute a special rural system in Canada, in an effort to make the telephone as popular as the post office. It is prepared to give a long distance service for about half the present rates charged by the Bell Company. Subscribers in cities like Montreal, Toronto and Ottawa will be given a 20-mile circuit without extra cost above that paid for their telephones.

CHESTER, PA.—The United Telephone Exchange was struck by a tornado on July 3 and set on fire, the loss being $5,000.

WAINSBURG, PA.—The South Penn Telephone & Telegraph Company will build a telephone line in Green County. Mr. M. R. Travis is one of the directors.

BALLINGER, TEX.—The Central Texas Telephone Company has a 210-drop board and 160 subscribers.

OGDEN, UTAH.—The Rocky Mountain Bell Telephone Company has begun the work of building underground conduits for its system and it will not be long before the city is free from overhead wires.

SALT LAKE CITY, UTAH.—The directors of the Rocky Mountain Bell Telephone Company have authorized the purchase of the plants of the Powder River Telephone Company and the Sheridan Telephone Company in central and eastern Wyoming, which will add 325 miles of line to the system.

CLAREMONT, VA.—The Claremont Telephone Company operates a 50-drop board and has 42 subscribers and 15 miles of toll line.

ELECTRIC LIGHT AND POWER.

CLIFTON, ARIZ.—Preliminary surveys are being made for the establishment of a large electric power and transmission plant, to be located on the Blue River. The survey is in charge of A. J. Johns, an engineer of San Francisco. It is stated that the actual work of construction will begin as soon as the preliminary arrangements can be made. The electrical energy is to be transmitted to Clifton and Morenci, where it will be utilized in the mines and smelters and for domestic purposes.

FT. SMITH, ARK.—It is stated that Col. Ira Oglesby is preparing an ordinance for an electric light plant.

PINE BLUFF, ARK.—Douglas C. Bell has recently bought the plant of the Citizens Light & Transit Company, of Pine Bluff, the consideration being $15,000. Chas. Senyard was the former owner.

SAN FRANCISCO, CAL.—It is stated that bids are wanted about August 1 for constructing the 10,000-hp water power of Kaweah River Power Company, at an estimated cost of $1,000,000. Leon M. Hall, 814 Hayward Building, San Francisco, is the engineer.

MACON, GA.—Twenty-five thousand horse power is being developed from the Ocmulgee River near Macon, to secure power for generating electricity for Macon and other towns. The cost will be about $500,000. Henry Horne, of Macon, is said to be interested. A dam is also being built near Milledgeville on the Oconee River.

ALTON, ILL.—The Alton City Council will consider at its next meeting a proposition for lighting the city with enclosed arc lamps in the place of the present system of open-arc lights. The company now lighting the city of Alton, the Alton Railway, Gas and Electric Company, will make the proposition for the new contract.

EDWARDSVILLE, ILL.—A controversy of several years standing was ended July 8, when the City Council of Edwardsville granted a franchise to the Edwardsville Electric Light & Power Company for a period of seven years, and entered into contract with the company to furnish the municipal lighting. The new franchise provides a rate of $75 a year for city arc lights, operated every night; commercial lighting at 12c. per kw-hour net on incandescent circuits, with no charge for meters or meter rental. A clause provides that the city may purchase the plant at the expiration of five years.

CONVERSE, IND.—The Converse Electric Company has been incorporated, with a capital of $12,500, by J. A. Henry, J. J. Sumpter, and others.

ANDERSON, IND.—The Westinghouse Electric & Mfg. Company has contracted to supply a turbine engine for the city electric light plant for $19,250.

COLUMBUS CITY, IND.—It is proposed to improve the electric light plant at a cost of about $5,000. There will be required one horizontal tubular boiler, one side crank engine of 150-hp; one 100-kw alternator, steam pipe fitting, etc.

LOGANSPORT, IND.—Bids will be received by the Electric Light Company of the City Council until August 31 for furnishing two high-pressure steam boilers having a capacity of 350 hp each. A. D. Fansler is City Clerk.

RICHMOND, IND.—Bertram & Storrs, of New York, have purchased the property of the Richmond Light, Heat & Power Company. The consideration is said to have been $100,000, the purchasers paying 50 cents on the dollar for the $200,000 worth of bonds of the local company, with the stock thrown in. The purchasers will be compelled to compete with the municipal plant, which will relieve the company of the street lighting next year.

BUHL, MINN.—The Northern Electrical Company, of Duluth, Minn., has secured the contract for constructing the electric light plant at Buhl.

ST. CHARLES, MINN.—The contract for constructing an electric light plant has been awarded to the American Electric Company, of St. Paul, Minn., for $9,990.

ST. LOUIS, MO.—The Union Electric Light & Power Company, formerly the Citizens' Electric Light & Power Company, has made application for a permit to erect a $500,000 power house on the river front between Ashley and Biddle Streets.

MEXICO, MO.—A company composed of S. M. Locke, president; J. W. Wooldridge, vice-president; F. A. Morris, secretary and treasurer, and E. R. Locke, has purchased the Mexico Electric Company's plant from Messrs. Thomas Waddell, Harry Rubey and W. E. McCully, of Macon City, for about $35,000.

CLAYTON, MO.—The Valley Park Electric Company has filed articles of incorporation. The incorporators are William W. Darley, W. J. Vance, Jas. H. Beal and R. T. Rossell, of Pittsburg, Pa.; George W. Easley, Lon O. Hocker and Edward T. Miller, of St. Louis. The capital stock is $50,000. The object of the company is to furnish current for light, heat and power in Valley Park (a suburb of this city) and the adjacent country.

GUILFORD COLLEGE, N. C.—The sum of $1,000 has been donated to Guilford College for the erection of an electric lighting plant.

MICAVILLE, N. C.—The Estatee Electric Company, of Micaville, has been chartered with $125,000 capital by Geo. D. Miles, of Chicago, W. W. Chapman, of Micaville, and others.

CHARLOTTE, N. C.—It is reported that Geo. W. Vanderbilt will build a model manufacturing town between Hendersonville and Brevard, N. C., with complete systems of electric lights, heating, power and water.

NEWARK, N. J.—Bids for lighting the city with electric lamps for two and five years were received from the United Electric Company on June 18, by the Board of Works. The company offered to furnish the standard type of open arcs for two years for $98.55 per lamp, and enclosed arcs for five years at $95 each.

FREEPORT, L. I., N. Y.—The citizens voted to expend $3,000 to extend the municipal lighting system and $6,000 for extending the water works. A. P. Ehlers is Village Clerk.

VALATIE, N. Y.—James I. Snyder, of Valatie, and John Snyder, of New York, have purchased the Valatie electric light plant. It is reported that they will install an entirely new plant and give the village all-night service.

POTSDAM, N. Y.—W. H. Walling and H. B. Batchelder are ready to receive bids for material for a new concrete dam which is to be built by the city. This work is preparatory to the construction of a municipal electric light plant.

SANTA FE, NEW MEX.—It is announced that the Capital Light & Power Company will begin the construction of its large electrical generating plant, to be located on the Pecos River about August 1. The stockholders of the company are for the most part residents of Toledo, Ohio. J. H. Webster, of Denver, Colo., is connected with the enterprise. The company proposes to build transmission lines to Santa Fe, Las Vegas and Albuquerque.

BRILLIANT, OHIO.—The Steubenville Traction & Light Company is preparing to furnish electric light in Brilliant.

COLUMBUS, OHIO.—The State will install an electric lighting plant at the State encampment grounds near Newark.

CLEVELAND, OHIO.—The Board of Public Service has been authorized to expend $5,000 in having plans prepared for the proposed municipal lighting plant which will be operated in connection with the new water works pumping station.

SPRINGFIELD, OHIO.—The lighting plant of the American Railway Company, of Philadelphia, which is located in this city, has been purchased by the Springfield Light, Heat & Power Company for $350,000. The works will be enlarged.

DILLONVALE, OHIO.—The village will vote on a proposition to issue $35,000 of bonds for the purpose of building an electric lighting and water works plant. The measure will probably pass. Twenty-five arc lamps will be installed, together with the necessary generating equipment.

BAKER CITY, ORE.—It is announced that the General Electric Company has been awarded the contract for all the necessary machinery for the Rock Creek Power & Transmission Company's power plant near this city. The plant will furnish electrical power for transmission to this city.

PORTLAND, ORE.—The Portland General Electric Company is stated to have secured the contract for lighting the streets and city buidlings for one year. The contract calls for 850 street arc lights, which will be maintained for $4,500 a month. Additional lights will cost $5.30 each a month.

BAKER CITY, ORE.—The Baker City Gas & Electrical Company is making rapid progress in the re-establishment of its power plant. The engine is now being installed, and the plant will be in operation by August 1. Many manufacturing enterprises will be started as a result of the installation of the plant, including flouring and woolen mills. Work is also being pushed on the power plant will be in operation by the end of the present year.

M'KEESPORT, PA.—It is stated that the Altmyer Light & Power Company is to install an electric light and power plant in McKeesport, at a cost of $150,000.

ROCK HILL, S. C.—The Catawba Water Power Company, of Rock Hill, has increased its capital stock from $250,000 to $650,000.

WINNSBORO, S. C.—Bids will be received by the Town Council for a municipal lighting plant, of 35 arc and 600 incandescent light capacity. W. B. Smith, Whaley & Co., Columbia, are the engineers.

DICKSON, TENN.—It was voted June 23 to construct water works and an electric light plant.

GRANDVIEW, TEX.—W. B. Head is stated to have secured a franchise for an electric light plant.

LAREDO, TEX.—Local capitalists contemplate erecting an electric power plant on the Rio Grande at a point about 25 miles above here. C. C. Pierce, of Laredo, can probably give information.

MARLIN, TEX.—Prof. T. U. Taylor, of the engineering department of the State University at Austin, has made an examination of the Brazos River at a point near here with the view of determining the amount of water power available for an electrical generating plant which Captain J. A. Martin, B. C. Nettles and other citizens of Marlin contemplate establishing. It is stated that Prof. Taylor's report is very favorable and that further steps towards carrying out the project will soon be taken.

SPRINGVILLE, UTAH.—The $20,000 bonds authorized to be issued by this city for the installation of an electric plant have been sold to E. H. Rollins, of Denver, Colo.

PROVO, UTAH.—The Telluride Power Company is making improvements in its plant which will increase the capacity from 1800 to 3000 horse power. The work involves the construction of a flume a distance of eight miles to the mouth of Provo canyon, where a second power plant will be installed.

SPOKANE, WASH.—The Washington Water Power Company has begun surveys for the proposed electric plant to be constructed at Post Falls, which will cost $500,000.

SEATTLE, WASH.—The City Council has granted to F. A. Pieplow, of La Junta, Col., a franchise for electric light plant and a telephone system. The plant will be in operation by the end of the present year.

KILBOURN, WIS.—The Village Trustees are reported to be considering the question of constructing an electric light plant.

LA CROSSE, WIS.—The Council has passed an ordinance ordering all electric wires in the brick paved district underground.

THE ELECTRIC RAILWAY.

HUNTSVILLE, ALA.—A. B. Coryell, superintendent of the Huntsville Electric Railway, Light & Power Company, announces that the company will install a new $25,000 plant to be completed within six months.

TUSCUMBIA, ALA.—The power house to furnish power for the new interurban line of the Tuscumbia, Sheffield & Florence Street Railway in Alabama is now being erected and the line will probably be started up by November 1.

HARTFORD, CONN.—The Manila Electric Railroad & Power Company has been organized under the laws of Connecticut, with an authorized capital stock of $6,000,000, par value of shares $100 each. A holding company of similar name was incorporated in New Jersey last spring, but the present company, formed under the more liberal laws of Connecticut, owns the franchise and rights in Manila.

CARTERSVILLE, GA.—The Everett-Moore Syndicate, of Toledo, O., has agreed to build an electric railway from Athens to Cartersville, Ga., if the people along the route will give $30,000 and the right of way. A preliminary survey will be made.

ATLANTA, GA.—The Atlanta Interurban Railway Company has been incorporated with a capital stock of $100,000 to build the proposed electric railway between Atlanta and Marietta. Interested in the company are Georgia Railway & Electric Company interests. The incorporators of the company are: P. S. Arkwright, G. W. Brine, T. K. Glenn, W. H. Glenn, H. N. Hurt, S. E. Simmons, S. J. Bradley, R. E. Cullinane, W. B. Stoval and F. M. Fisk.

SPRINGFIELD, ILL.—The articles of incorporation of the Springfield & Southwestern Railroad Company have been filed. The capital stock of the company is $25,000. The incorporators and first board of directors are: J. W. Maunts, G. D. Chaffee, Max Kleeman, T. F. Dove, of Shelbyville, and C. Weekley, Obed, E. D. Kerr, Brunswick, and R. P. Smith, of Moweaqua, all citizens of Shelby County.

FT. WAYNE, IND.—The Ft. Wayne and Springfield Railroad Company has been incorporated. The capital stock of the company is $300,000. The promotors are: William H. Fedderjohann, John H. Koenig, Henry J. Happel and others.

INDIANAPOLIS, IND.—The French Lick & West Baden Electric Railway Company has filed articles of incorporation, with a capital stock of $30,000. The incorporators are Thomas Taggart, William A. Holt and B. J. T. Jeup. Thomas Taggart is president and Maurice Donnelly secretary.

ANGOLA, IND.—The Goshen & Indiana Traction Company, incorporated to build a line from Goshen to Angola, Ind., has changed its name to the Northern Indiana Railway Company, and filed a mortgage to the Colonial Trust Company, of Pittsburg, as trustee, to secure $3,500,000 of fifty-year bonds.

INDIANAPOLIS, IND.—The capital stock of the Indianapolis & Cincinnati Traction Company has been increased from $1,500,000 to $2,000,000. The stockholders at the same time ordered a bond issue of $4,000,000. The entire stock issue and $2,000,000 of the bonds have already been sold to Indianapolis capitalists.

LAFAYETTE, IND.—The directors of the Lafayette Street Railway Company have voted to turn the road over to the Fort Wayne, Logansport & Lafayette Traction Company. Superintendent C. D. Emmons, of the Lafayette Company, will become general manager of the Traction Company, with headquarters at Fort Wayne. This is the beginning of the merger system.

DES MOINES, IA.—The articles of incorporation of the Western Iowa Interurban Railway Company have been filed. The capital is $100,000. President, J. A. Nash; secretary, C. R. Benedict.

DES MOINES, IA.—The Illinois & Iowa Railway Company, of Clifton, has given notice of increase of its capital stock to $1,500,000. The increase was made necessary by the intention of the company to complete the interurban line between Clinton and Davenport at once. This is the company which has heen promoted by Thomas Wilcox, of Des Moines. The road is now under construction.

LOUISVILLE, KY.—Articles of incorporation of the Louisville & Cincinnati Interurban Railway Company have been filed in Indianapolis. The step is the culmination of plans formed quietly by capitalists of Louisville, New Albany and Jeffersonville, the intention being to operate a direct interurban line to Cincinnati. It is announced that all arrangements have been made and the work of construction will begin shortly. The capitalization has been fixed at $50,000, this being, of course, a nominal sum for temporary use. The directors are: George B. Lewman, president of the First National Bank; John F. McCulloch, of New Albany, Ind.; John C. Zulauf, of Jeffersonville, Ind., and Louis Hartman, of New Albany.

WORCESTER, MASS. The new trolley line between Worcester and Boston was opened for traffic on July 1.

NEWTON, MASS.—The Newton Street Railway Company has petitioned the Railroad Commissioners for authority to issue $185,000 additional capital stock for improvements and additions.

BOSTON, MASS.—The Worcester & Holden Railway Company has petitioned the Railroad Commissioners for authority to issue $100,000 5 per cent. twenty-year bonds, and $50,000 stock to fund floating debt and to purchase new equipment and real estate.

BOSTON, MASS.—The Boston & Worcester Street Railway Company has petitioned the Board of Railroad Commissioners for authority to issue $1,000,000 4½ per cent twenty-year bonds and $250,000 stock for the purpose of building and equipping its road.

WHITINSVILLE, MASS.—The Selectmen of Northbridge have voted to grant a franchise to the Uxbridge & Blackstone Street Railway Company for an extension of its track to connect at Whitinsville with the Linwood Street Railway.

BATTLE CREEK, MICH.—The Grand Rapids & Southern Michigan Traction Company has been incorporated, with a capital stock of $1,300,000. The stockholders of the company are: Arthur J. White, Edward F. Pangborn and Alfred E. Poulsen, of Battle Creek.

JACKSON, MICH.—Articles of incorporation have been filed by the Jackson, Ann Arbor & Detroit Traction Company, with a capital stock of $2,500,000. The stockholders are: William Halls, Jr., Summit, N. J.; U. S. Potter, Jackson, Mich.; Leonard H. Hole, Montclair, N. J.; William N. Color, Jr., Newark, N. J.; W. A. Boland, Yonkers, N. Y.; Henry R. Carse, New York, N. Y., and George W. Mechem, Battle Creek, Mich.

HAGERSTOWN, MD.—The Chambersburg, Greencastle & Waynesboro Electric Railway Company has purchased the electric plant of the Waynesboro Electric Light & Power Company. A mortgage for $300,000 against all the property of the former company has been put on record. Bonds amounting to $250,000 only are to be issued against the mortgage.

BELVIDERE, N. J.—The Easton (Pa.) & Belvidere (N. J.) Street Railway Company has awarded the contract to build its railway to the Railway Construction Company of America, with offices in the Exchange Building, Boston, Mass., and work will begin at once. The directors are: W. S. Reed, Leominster, Mass.; Charles A. Shipper, Milford, Mass.; Michael J. McGawley, Boston; John McGawley, Lowell; E. B. Fullen, Haverhill, Mass., general counsel; Charles A. Richardson, Boston, general manager, and Howard Mitchler, of Easton, Pa.

BROOKLYN, N. Y.—The Postoffice Department has issued a fraud order against the American Street Car Transportation Company of Brooklyn. The company advertised to sell for one cent each, tickets good on any electric and elevated street car in the United States. This it did by an "endless chain" scheme, whereby, in order to obtain 25 cents worth of one-cent tickets, it would be necessary for the applicant to sell three "introducers" at 25 cents each to his friends, and for each of the three friends to return their "introductions" to the company with 75 cents, with which to supply in turn three of their friends, with "introductions." The company operated in many cities, and by its methods caused street railway managers much annoyance.

JOHNSTOWN, N. Y.—The extension of the trolley system of the Fonda, Johnstown & Gloversville Railroad Company from Amsterdam to Schenectady, has been formally opened for traffic.

NEW PALTZ, N. Y.—The property of the New Paltz & Poughkeepsie Traction Company has been sold under foreclosure to Charles J. Rowe, of New Jersey, representing some bondholders, for $200,000. The Franklin Trust Company was the trustee under a $100,000 mortgage.

ONEONTA, N. Y.—On the application of attorneys for Oneonta creditors of the Oneonta, Cooperstown & Richfield Springs Railway Company, Judge Mattice has appointed Herbert T. Jennings receiver. Liens aggregating $100,000 have been filed in Otsego and Herkimer counties.

NEW YORK, N. Y.—E. Hanson, president of the Havana Electric Railway Company, announces that financial arrangements have been completed in London for a very considerable extension of the Havana electric railway system. It is stated that in due course the Havana Railway will have 100 miles of track.

NEW YORK, N. Y.—The Brooklyn Rapid Transit Company broke all previous big traffic records on the Fourth of July. Two million passengers were carried on the surface and elevated roads. Although the cars and trains were run without any regular schedule, there was not a single casualty, and only a few minor mishaps and delays. Sunday, July 5, was another big record day.

KINGSTON, N. Y.—The property and franchises of the New Paltz & Poughkeepsie Traction Company, which operates over the Poughkeepsie Bridge, has been sold at auction under foreclosure of a mortgage by the Franklin Trust Company, of New York, to Charles J. Rowe, a New Jersey lawyer, for $20,000. The mortgage was for $1,000,000. Rowe is believed to represent the Franklin Trust Company.

UTICA, N. Y.—A report has been received in this city to the effect that as soon as the electric railway from Johnstown to Schenectady has been completed it will be transferred to the New York Central. It is said also that the franchise held by the electric line will permit the use of steam power as well as electricity. The line runs through the streets of Amsterdam. The Johnstown-Amsterdam line is already in operation and the section from Amsterdam to Schenectady is nearly completed.

ITHACA, N. Y. The Ithaca & Cortland Traction Company has filed papers of incorporation. The capital stock of the company is $200,000. The road will be 20 miles in length. The directors for the first year are: Howard L. Chandler, Philadelphia, Pa.; Curtis J. Harrington, New York; Ogden Armstrong, Philadelphia, Pa.; Francis S. Howell, of Philadelphia, Pa.; James D. Staley, of Philadelphia, Pa.; George F. Archer, of Camden, N. J.; E. H. Chandler, of Atlantic City, N. J., and C. Taylor Leland, of Philadelphia, Pa.

CONNEAUT, OHIO.—The capitalists who are building the Conneaut & Erie Electric Railway have decided to lay a branch line from Girard south to Albion, Pa. Work will be started soon after the main line is completed.

MARION, OHIO.—The Marion Railway, Light & Power Company has been incorporated, with a capital stock of $500,000. The incorporators are: John G. Webb, W. A. Black, O. T. Martin, T. Troupe and W. S. Rabbits.

CINCINNATI, OHIO.—The Cincinnati, Milford & Loveland Traction Company has purchased the privileges and interest of the Cincinnati, Milford & Eastern Traction Company. The purchase price was said to be between $60,000 and $70,000.

DAYTON, OHIO.—The capitalization of the Southwestern Traction Company has been increased to $150,000. The capital stock will be increased later to $600,000, when there will be a bond issue in that amount. The road is to be built from Dayton to Camden. Among the prominent Dayton capitalists interested is M. L. Mowrer.

CINCINNATI, OHIO.—Council has decided that the franchises of the Cincinnati Street Railway Company, which are expiring, are not subject to public sale, and cannot be altered in view of the litigation which is pending in connection with the validity of the Rogers law, under which the company holds a 50-year franchise.

COLUMBUS, OHIO.—Charles H. Kumler, of Dayton, Ohio, attorney for the Lebanon & Franklin Traction Company, has filed a certificate of increase of capital stock with the Secretary of State. He stated that the line, which will be 11 miles in length and will run between Franklin and Lebanon, will soon be started. Power will be furnished by the Cincinnati, Dayton & Toledo Traction Company.

FREMONT, OHIO.—The County Commissioners have granted to the Kerlin Bros. Company an extension of franchise for their proposed Tiffin-Fremont electric line. The franchise expired about a year ago, but the Kerlins, by agreeing to repair some of the work already done, have had their grant extended until January 1, 1905. It is intimated that some work may be done on the line this summer.

COLUMBUS, OHIO.—At a meeting of the directors of the Columbus Railway Company and the Columbus Railway & Light Company Robert E. Sheldon resigned as president of the Columbus Railway Company and was elected president of the Columbus Railway & Light Company, of which L. S. Steward was chosen vice-president. Butler Sheldon, son of R. E. Sheldon, was elected to the presidency of the railway company.

ZANESVILLE, OHIO.—The Ohio Power Company, of Zanesville, has filed articles of incorporation, with a capital of $50,000, to operate an electric railway in Zanesville and through the counties of Muskingum, Coshocton, Washington, Perry, Licking and Franklin. The company is also authorized to supply electricity for light, heat and power. F. A. Durban, T. F. Shangley, Charles T. Atwell, W. B. Cosgrove and W. A. Gibbs are the incorporators.

ALLENTOWN, PA.—The charter of the Trexlertown & Alburtis Street Railway Company has been filed. The capital stock is $18,000. H. E. Ahrens, of Reading, is president. The directors are: G. B. Schaeffer, of Fleetwood; John Barbey, John L. Bowman, John R. Miller, Ferdinand Gratz, James R. Mercer and H. E. Ahrens, of Reading.

ALTOONA, PA.—A charter has been applied for in New Jersey for the Johnstown & Cumberland Railways, Light & Power Company, which is to take over a score or more of street and suburban railway and electric light plants in Central and Southern Pennsylvania, between Johnstown, Pa., and Cumberland, Md. The capital stock of the company is $6,000,000. The line will have a mileage of 150 miles.

PITTSBURG, PA.—A new street railway is to be built from Hays Borough south to Currys Station, a distance of about 6 miles. The new line will connect with the Pittsburg Railway Company's lines and with that of the new line to Charleroi. The right of way was secured by E. W. Curran, of Homestead. The capital of the new company is $36,000. The officers elected are: President, F. H. McKinney, of Pittsburg; secretary, E. W. Curran, of Homestead; treasurer, Daniel McSweeney, of Hays.

CHAMBERSBURG, PA.—A resolution of the directors of the South Middleton Railway Company has been entered for record at the Court House. The line is to run from Burnt House to Chambersburg. This line is said to be a part of the system formerly known as the Baltimore, Westminster & Gettysburg Electric Railway, and which will extend from Westminster, Md., to Harrisbug, Pa., between Chambersburg and Cumberland, Md., completing all the gaps between the lines, which would give a total of 150 miles and a direct line from Johnstown to Cumberland, a distance of 72 miles. It will connect thirty or more mining towns that are now practically isolated. Among the companies whose stock and plants will be taken over by the new corporation are the Cumberland & Westernport Street Railway Company, the Lonaconing, Midland & Frostburg Railway Company, which lines are now built and in operation; the Meyersdale & Salisbury Street Railway Company, which is now nearly completed; the lines, stock and rolling equipment of the Johnstown Passenger Railway Company, which includes about 43 miles of railway in operation, and a score or more of electric lighting plants. The Robert W. Hunt Company, of Pittsburg, which designed the $1,000,000 plant of the Pittsburg, McKeesport & Connellsville Street Railway Company, located near Connellsville, has been retained as engineers for the company, and is now drawing up plans for an immense power plant.

NASHVILLE, TENN.—The deed to the property of the Nashville Railway has been transferred to the new owners by Charles C. Trabue, the commissioner appointed by the Federal Court to sell the property. The name of the new company will be the Nashville Railway & Light Company. Percy Warner has been elected president and J. H. Fall, vice-president. The new company will operate both the street railway and the Cumberland Electric Light & Power Company. The Nashville Railway & Light Company will authorize a bond issue of $5,000,000. The Nashville Railway Company, for which a receiver was appointed, had bonds outstanding amounting to about $6,500,000. Of the new issue $2,000,000 will be held in reserve to secure the underlying bonds of the several companies of which the Nashville Railway was composed.

SALT LAKE CITY, UTAH.—The Consolidated Railway & Power Company, it is announced, will soon establish its own electric power plant.

WHEELING, W. VA.—The Fairmount & Clarksburg Traction Company has been incorporated, with a capital stock of $2,000,000. The incorporators are: S. L. Watson, L. L. Malone, C. Powell, Walton Miller and M. L. Hutchinson, of Fairmont. This company is said to be the successor of the Fairmont & Clarksburg Electric Railway Company.

CHARLESTON, W. VA.—The Kanawha Water & Light Company has been granted a franchise for an interurban railway. It plans to connect Charleston with the towns up and down the Kanawha River. The principal stockholders in the company are Senator Elkins and ex-Senator H. G. Davis.

MILWAUKEE, WIS.—The Withee & Maplehurst Electric Railway & Light Company, of Milwaukee, has been incorporated with a capital stock of $50,000. The incorporators are W. J. McElroy, F. C. Eschweiler, and E. H. Naber.

NEW INDUSTRIAL COMPANIES.

THE LIQUID AIR AND X-RAY INSTITUTE, of New York, has been incorporated with a capital of [illegible]. Directors: R. H. Jaeger, F. L. Thompson and Fenton Moore, New York.

THE NATIONAL ELECTRIC COMPANY has been incorporated in New York City with a capital stock of $10,000, the incorporators being Messrs. Augustus Noll, O. C. Braun and J. C. Corlan.

THE SOUTHERN CAR COMPANY, of High Point, N. C., has been chartered with a capital of $60,000 paid in, and [illegible] authorized. The company will manufacture cars for steam and electric railways.

THE AMSTERDAM ELECTRICAL MFG. COMPANY has been incorporated at Amsterdam, N. Y., with a capital stock of $50,000. The incorporators are Charles D. Austin, Edward McDonnell and Morris Cohn, Jr.

LEGAL.

WESTERN UNION-PENNSYLVANIA.—Judge Morris, at Baltimore, has granted a preliminary injunction restraining the Philadelphia, Baltimore & Washington Railroad from removing from its lines the Western Union poles and wires.

TREE TRIMMING.—The Court of Civil Appeals of Texas, in a suit decided May 16, 1903, held that a telegraph or telephone company which enters on premises abutting a street along which its wires are strung and without the consent of the owner, removed the branches of trees which interfere with its wires, thereby causing the trees to wither and die, makes itself liable for the damage done. It was held that the plaintiff had no right to enter the premises of the defendant without his consent and to injure his trees in the manner that was done.

THE WASHINGTON, BALTIMORE & ANNAPOLIS ELECTRIC RAILWAL COMPANY has been placed in the hands of receivers by Judge Morris, of the United States District Court at Baltimore. This action was taken upon the application of the Cleveland Construction Company, which alleges that it is creditor to an amount of $93,000, and that the railroad company is unable to meet the payment of this amount and its other liabilities. The answer of the railroad company admitted the allegations set forth, and assented to the appointment of receivers. James Christy, Jr., of Akron, O., and George W. Williams, of Baltimore, were appointed receivers.

FAILURE TO DELIVER TELEGRAMS.—In a suit decided in the Court of Civil Appeals of Texas, May 20, 1903, it was held that the defendant, a telegraph company, was not guilty of negligence in the non-delivery of a telegram addressed to "Marvin Cox, traveling picture man," who did not stop in a hotel or boarding-house, but camped in a wagon yard. On June 11 the Court of Appeals of Kentucky rendered a similar decision in the case of a message intended for "an obscure colored woman." It was held that since the woman lived outside of the free delivery limit it was the duty of the sender of the message either to prepay or guarantee the extra delivery fee. In the Supreme Court of Monroe County, Conn., it was held in a suit on appeal that the addressee of a telegram could not recover the penalty for neglect to deliver a telegram, such right being by the statute expressly limited to the sender of a dispatch.

OBITUARY.

CHARLES C. MARTIN, formerly chief engineer of the Brooklyn Bridge, was found dead in bed on the morning of July 11 at the home of his son, Kingsley Martin, in Far Rockaway, L. I. Death, it is stated, was due to apoplexy, superinduced by heat. The deceased was 72 years of age. He was born in Springfield, Pa., and received his technical education in Rensselaer Polytechnic Institute at Troy, N. Y., from which institution he graduated in 1853. Mr. Martin's body was interred at Pittsfield, Mass.

PERSONAL.

MR. J. M. ANDERSON, treasurer of the Albert & John M. Anderson Company, of Boston, Mass., is about to sail for Europe on an extensive trip.

MR. JOHN HAY KUHNS, of Omaha, Neb., is on a short visit to the East on professional business. Mr. Kuhns was assistant electrical engineer of the Omaha Exposition of 1898.

PROF. FRANK W. SPRINGER, of the University of Minnesota, is making a professional tour of inspection of Eastern electrical works and new or enlarged operating plants previous to entering on his vacation.

MR. CHARLES CLEGG, general manager of the Mexico City Electric Traction system, which is controlled by Wernher, Beit & Co., of London, has left for the Southern Republic, after a short visit to the States.

MR. A. A. KNUDSON presented at the recent Detroit Convention of the American Water Works Association a paper entitled "Some Recent Effects of Electrolytic Action upon Underground Mains and Other Metals."

MR. ROBERT L. WARNER, in a paper read before the New England Railroad Club, entitled "Electrically-Driven Shops," gave an excellent discussion of direct-connected shop tools, illustrated by references to specific tools for various uses.

MR. ASA M. MATTICE has been appointed chief engineer of the Westinghouse Machine Company, but will retain a connection in a consulting capacity with the Westinghouse Electric & Mfg. Co., of which company he has for several years been chief engineer. Mr. B. G. Lamme will take up the former duties of Mr. Mattice with the title of Acting Chief Engineer.

MR. GEO. H. GIBSON has resigned as manager of the advertising and publication department of the B. F. Sturtevant Company, of Boston, Mass., to accept an appointment with the International Steam Pump Co., having offices at 114-118 Liberty St., New York City. Mr. Gibson was formerly connected with the Westinghouse Companies' publishing department, of Pittsburg, Pa., and was for two years a member of the editorial staff of *Engineering News*.

PROF. R. B. OWEN, of McGill University, Montreal, in view of the proposed operation of the horse, steam and cable tramways in Melbourne and vicinity and the conversion of surburban lines of the steam railroads in that part of the world, has been invited by the Victorian Government to prepare a report on the subject. He will visit the General Electric works, and will also gather data regarding suburban railway and tramway services in New York and Boston.

MR. EDWARD GUINLE, together with Mr. A. Aschoff, have purchased the business and assets of the electrical engineering firm of James Mitchell & Co., of Rio Janeiro and San Paulo, and will conduct the same with offices at both of the above-mentioned places under the firm name of Aschoff & Guinle. Both Mr. Aschoff and Mr. Guinle have many acquaintances in American electrical circles, the latter having taken a course of instruction in the Schenectady works of the General Electric Company.

MR. RALPH H. BEACH, head of the railroad department of the General Electric Company, left New York July 11 for Mexico. His visit to the Southern Republic is made for the purpose of determining what equipment is required for doubling the capacity of the Tula Iron Works, which are located in the Sierra Madre range of mountains in the State of Jalisco, district of Sayula, about 60 miles south of the City of Guadalajara. Mr. Beach expects to be back in New York about the first week in August.

Trade Notes.

THE SILLS-EDDY MICA COMPANY has established its main office at its Newark factory, the mailing address being box 135, Newark, N. J.

REMOVAL.—Richard Lamb, C. E., has removed his office to the Electrical Exchange Building, 136 Liberty Street, New York City, where he will continue a general engineering practice.

LAVITE.—The D. M. Stewart Mfg. Company, Chattanooga, Tenn., has issued a booklet under the title, "Mechanical and Electrical Properties of Lavite." This publication will be found of value and interest.

EUREKA FLEXIBLE CONDUIT.—The Rittenhouse Miller Company, Witherspoon Building, Philadelphia, has issued a circular pointing out the advantages of "Eureka" flexible conduit, and including a price list.

PASS & SEYMOUR, INC., in a little pamphlet entitled "Little Gem Rosettes," show in excellent half tone illustrations, printed on a good quality of paper, a line of rosettes for cleats, mouldings and concealed work.

NERNST LAMPS.—The Chicago office of the Nernst Lamp Company reports that Nelson, Morris & Co., of Chicago, are making tests of the Nernst lamps for office use, with a view to replacing their desk lights with these lights.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, of Rochester, N. Y., and Chicago, Ill., has recently sold a special type dispatcher's desk with telephones to the Interurban Railway & Terminal Company, of Cincinnati, Ohio.

STORAGE BATTERIES.—The Gould Storage Battery Company, New York City, has issued a bulletin on the subject of "Line Batteries." It describes the uses and advantages of line or "floating" batteries on feeder lines, and contains illustrations of installations, curves, etc.

GAS BLOWERS AND EXHAUSTERS.—The Buffalo Forge Company, Buffalo, N. Y., has issued a 24-page pamphlet describing and illustrating in detail its line of gas blowers and exhausters. The final pages contain illustrations of the Buffalo high-speed automatic engine.

THE NATIONAL WIRE CORPORATION, New Haven, Conn., has just issued to the trade a special price list of galvanized telegraph and telephone wire and wire strands. The price list contains valuable information, and any one interested can obtain a copy by addressing the company.

METERS AND TRANSFORMERS.—In a pamphlet issued by the Westinghouse Electric & Manufacturing Company, entitled "Some Facts about Meters and Transformers," an interesting account is given of the experience of a central station in reducing its meter and transformer losses.

MR. C. HUDSON MACHEN, sales engineer representing the Cutter Company, of Philadelphia, is prepared to submit blue prints and give any information required relative to I-T-E circuit-breakers and Keystone measuring instruments. Mr. Machen's office is at 120 Liberty Street, New York City.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, announces the change in address of its New York Exide Battery Depot, which was formerly located at No. 148 West Eighteenth Street. It will hereafter be operated by the New York Transportation Company, at Forty-ninth Street and Eighth Avenue.

THE CINCINNATI CONSTRUCTION COMPANY, which has done much work in consulting engineering on steam and electrical traction enterprises, will take up as a specialty the reconstruction of traction properties, which are run down through bad construction originally, or incompetent management. The officers of the company are W. P. Deppe, president and treasurer and E. Jarrow, secretary and chief engineer.

MOBILENE.—The H. W. Johns-Manville Company, 100 William Street, New York, in a postal card folder, points out that "mobilene" was a factor in the recent automobile record-breaking feat of B. E. Oldfield, at Indianapolis. The folder reproduces from the New York *Herald* an account in fac-simile of the record-making run, and also a letter in fac-simile from Mr. Oldfield, saying that the machine was packed with "mobilene."

MR. F. C. MOTT, recently associated with Mr. G. M. Gest, the conduit contractor, has been placed in charge of the New York office lately opened by the American Conduit Company, manufacturer of the electrolysis proof bituminized fiber conduit. This is in addition to its offices at Philadelphia, Chicago, and Los Angeles. The demand for this material during the past season has been very great, running into many millions of feet.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out illustrated and descriptive circulars of the new cartridge fuse ("The McBride Arkless" fuse), for which it is selling agents. This fuse is adapted for every fuse connection, and is made in 125 and 250 volts in any capacity from 3 to 30 amperes. It takes the place of link fuses, or fuse wire, and no change is necessary to adapt it for cutouts, switches, panel boards, switchboards, etc.

ENCLOSED FUSES.—The Chicago Fuse Wire & Manufacturing Company, of Chicago, New York and Buffalo, is putting on the market the "Union" line of enclosed fuses. These fuses are designed to fit all styles and sizes of bases in common use. The "Union" enclosed fuse embodies a number of orginal features, among them being an independent cartridge filling secured within the case. Inquiries may be addressed to any of the company's offices above named.

THE EUREKA ELECTRIC COMPANY dedicated its new factory at Genoa, Ill., on July 4, the ceremony being part of the town's official Fourth of July programme. Responses to toasts were made by President I. J. Kusel, Hon. Charles E. Fuller and others. The factory was christened by Mrs. Kusel and six young ladies, a bottle of Genoa artesian water figuring in the ceremony. In the evening a dedicatory ball was held in the building. Mr. A. L. Funk was chairman of arrangements.

THE ELECTRIC APPLIANCE COMPANY, Chicago, states it is meeting with great success in introducing the new "Zenith" Packard lamp. This lamp is made in two sizes, 25 to 55 cp, the latter in two efficiencies, 1.9 and 2.18. The lamp is ornamental, and while it consumes less current than a 32-cp lamp, it produces a much greater light. Its success is due, according to the claims of the selling agents, to the fact that it has the Packard label, and it is therefore a "dependable" intermediate between an arc and incandescent lamp.

L. B. ALLEN COMPANY, INCORPORATED, Chicago, has just issued for distribution to its patrons a set of four handsome three-color display boards. These hangers show the Allen soldering stick, paste, salts and the large and small size sticks of Allen commutator lubricant—in actual size and colors—cleverly grouped about an illuminated centerpiece, which is a true copy in colors of a masterpiece of modern art. These sample boards are 18 by 14 inches, and are all ready for hanging, and are at the service of dealers in Allen products.

ELECTRICITY IN A SUGAR REFINERY.—In its latest bulletin the D'Olier Engineering Company, Philadelphia, Pa., gives a well written and well illustrated description of a very complete electrical installation which that company has installed in the works of the Pennsylvania Sugar Refinery at Philadelphia. This is the first large manufacturing plant in America completely equipped with steam turbine apparatus, the De Laval steam turbine being employed where electric motors are not used. One illustration shows steam turbines driving pumps for boiler feed. The pumps for raw sugar, sugar liquids and syrups are all electrically driven, as are also the numerous centrifugal machines.

MAGNETO MULTIPLE TELEPHONE SWITCHBOARD.—The Ericsson Telephone Company, 296 Broadway, New York, has recently installed one of the handsomest and most efficient multiple switchboards in the South. It is built for the magneto system, and fitted with new combination indicator jacks that have been recently patented. The board is installed for 1,200 numbers, and has a capacity for 3,000. The main distributing rack for 1,200 numbers is fitted with carbon lightning arresters and heat coils; also a monitor desk with visuals for calling and clearing, and jacks for listening were installed. The woodwork on this board is made of mahogany with heavy piano finish, giving it a very fine appearance.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., have recently added their extensive curriculum, a course in advertising. The "know-how" necessary for preparing a course in advertising comes from the best possible source, viz., successful practical experience, for it is a well-known fact that the International Schools are among the best advertisers in the country. The new course is written and conducted by Mr. George Frank Lord, the manager of the advertising department. Mr. Lord has prepared an attractive prospectus, giving full particulars about the course, and illustrating it of a number of the School's own advertisements, in reduced size, as well as advertisements on other subjects. The prospectus can be obtained by any one interested in this modern art.

JEFFREY OUTING.—The eighteenth annual outing of the employees of the Jeffrey Manufacturing Company, Columbus, Ohio, was held at Olentangy Park on June 27, and was a very elaborate and entertaining affair. The programme of amusements included races of all sorts, ladies' thread and needle race, swimming contests, prize waltzes, etc., and there was dancing afternoon and evening and a baseball game in the afternoon. There was also a play in the theatre both afternoon and evening, the piece presented being "The Senator." A rather interesting note is made in the programme to the effect that the company employs so many persons that none of the railroads out of Columbus would undertake to carry them all to a more distant point. Mr. J. A. Jeffrey, president of the company, states that the number of employees would require 65 to 75 coaches to transport them. For the various games first and second prizes were given, and judging from the excellent programme no doubt everybody present had a very enjoyable time.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 7, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

732,699. ELECTRIC SWITCH, Charles F. Antenrieth, Brooklyn, N. Y. App. filed Aug. 2, 1902. A cord connects with a ratchet on a ceiling switch so that successive pulls on the former will alternately open and close the circuit.

732,701. ELECTRIC ARC LAMP; Robert Broderick and Frank W. Gordon, Cleveland, Ohio. App. filed Jan. 6, 1903. Details.

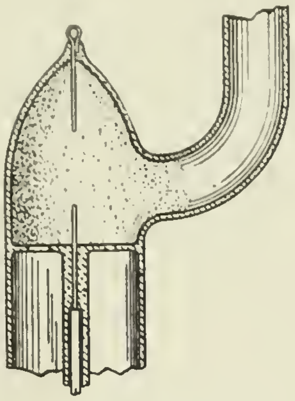
732,737. ALARM SIGNAL FOR ELEVATORS; Edward L. Hail and George Hail, Providence, R. I. App. filed July 30, 1902. Signals and circuit controllers are arranged at the various floors in such a manner that while the car is moving, one signal is always in operation, but while the car is standing at a landing, the signal is quiet.

732,745. ELECTRIC SWITCH; John D. Ihlder, Yonkers, N. Y. App. filed May 5, 1902. A reversing switch particularly applicable to polyphase alternating current circuits.

732,753. ELECTROLYTIC MANUFACTURE OF CHLORATES AND PERCHLORATES; Pierre Lederlin, Chedde, France. App. filed July 11, 1902. (See page 101.)

732,768. LOCOMOTIVE; Seward N. Mighell, Chicago, Ill. App. filed Dec. 15, 1902. A mining locomotive provided with a take-up device for the flexible trolley conductor.

732,811. GALVANIC BATTERY; Edward L. Anderson, St. Louis, Mo. App. filed July 9, 1902. A carbon vessel having a cover at the bottom held in place by a flange on the surrounding zinc element.



732,823.—Adjustable Vacuum Tube.

732,813. ELECTRICAL SIGNAL FOR ADDING SECURITY TO SAFES; Wilber E. Arnold, Madisonville, O. App. filed May 1, 1902. Alarm circuit closers are arranged at various places in the neighborhood of a safe to indicate when the latter is approached.

732,822. ALTERNATING-CURRENT INDUCTION MOTOR; Charles S. Bradley, Avon, N. Y. App. filed Oct. 7 1895. (See Current News and Notes.)

732,823. ADJUSTABLE VACUUM TUBE; Mark H. Branin, Newark, N. J. App. filed Mar. 8, 1898. The tube contains a chemical capable of giving off a gas by the action of current flowing in the tube, to lower the vacuum.

732,842. SECONDARY BATTERY; William Gardiner, Chicago, Ill. App. filed Jan. 23, 1902. (See page 101.)

732,843. METHOD OF PREPARING ELECTROLYTES; William Gardiner, Chicago, Ill. App. filed Jan. 23, 1902. (See page 101.)

732,851. SOLENOID MAGNET; George T. Hanchett, Hackensack, N. J. App. filed March 19, 1901. Details of construction whereby the pulling power of the magnet can be adjusted and balanced against springs or weights attached to the armature.

732,875. CONTROLLER FOR ELECTRIC MOTORS; Frank A. Merrick and Emmett W. Stull, Johnstown, Pa. App. filed May 7, 1901. A switch controlling two motors adapted to throw them into series or parallel and for cutting one out of circuit and establishing a working circuit through the other in both the series and parallel positions.

732,888. ALTERNATOR; Charles A. Persons, Newcastle-Upon-Tyne, England. App. filed Oct. 6, 1902. Consists in employing two or more rotating elements and one or more fixed elements combined differentially in such a way that their relative speeds of rotation give a low frequency.

732,890. PUSH BUTTON ELECTRIC SWITCH; Charles G. Perkins, Hartford, Conn. App. filed Jan. 19, 1903. Details.

732,943. CLUTCH MECHANISM; Camille Jenatzy, Fils, Brussels, Belgium. App. filed Dec. 16, 1902. A magnetic clutch in combination with a rheostat for controlling the clutching power.

732,944. TRANSMISSION DEVICE FOR MOTOR VEHICLES; Camille Jenatzy, Fils, Brussels, Belgium. App. filed March 17, 1903. The engine drives a small dynamo which supplies the power to operate an electromagnetic clutch between the engine and traction wheels, a rheostat being introduced in the dynamo circuit for controlling purposes.

732,967. TROLLEY POLE, Ernest Schlicker, Pittsburg, Pa. App. filed Feb. 21, 1903. Details.

733,015 TROLLEY; Arthur S. Deem, Reading, Pa. App. filed July 9, 1901. Two trolley wheels mounted in a frame pivoted upon the arm, with which are used a pair of fingers capable of being thrown over the wire to retain the trolley in place.

733,028. ELECTROLYTICALLY COATING IRON WITH ZINC; Emanuel Goldberg, Moscow, Russia. App. filed April 17, 1902. (See page 101.)

733,035. MEANS FOR VARYING THE SPEED OF OVERHEAD ELECTRIC CARRIERS; Henry M. Harding, New York, N. Y. App. filed Aug. 22, 1902. A rheostat automatically operated by the carrier at grades to vary the power.

733,040. ELECTRIC FURNACE; Paul Louis Toussaint, Héroult, La Praz, France. App. filed March 27, 1902. (See page 101.)

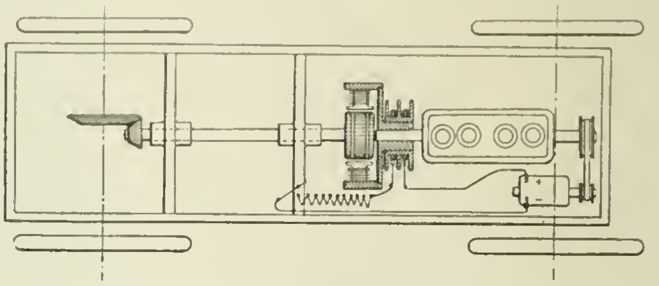
733,064. CABLE HANGER; Eugene S. Marsh, Bridgeport, Conn. App. filed Oct. [illegible]0, 1902. Details.

733,097. ELECTROMAGNET; Isaac G. Waterman, Santa Barbara, Cal. App. filed Aug. 4, 1902. An iron clad magnet in which the heads of the magnetic circuit have sleeve projecting inward and outward.

733,135. ELECTRIC ARC LIGHT; Frank Buchanan, Dayton, O. App. filed Jan. 2, 1903. Details.

733,146. SWITCH FOR ELECTRICAL APPARATUS; Eugene R. Carichoff, East Orange, N. J. App. filed Aug. 1, 1901. Details.

733,149. METHOD OF CHANGING THE FREQUENCY OF SINGLE PHASE INDUCTION MOTORS; Penrose E. Chapman, St. Louis, Mo. App. filed April 15, 1902. The invention consists of two or more "phase" or "teaser" coils, one placed within the other and main coils wound around one or several polar projections and connected in series with each other, such phase coils being of higher resistance than the main coils and leading the latter in phase.



732,944.—Transmission Device for Motor Vehicles.

733,159. ELECTRIC CLOCK; Ulysses L. Collins, St. Louis, Mo. App. filed May 12, 1902. Details.

733,169. TROUGH OR CONDUIT FOR UNDERGROUND ELECTRIC CABLES; Thomas E. Devonshire, Chislehurst, England. App. filed Nov. 8, 1902. The trough or conduit is built up of cement in which wire net work is embedded.

733,178. DRY BATTERY; Eugene M. Fishell and Marcus H. Moffett, Cleveland, O. App. filed April 14, 1902. Relates to the construction of a box for a number of cells of dry battery.

733,184. THERMOSTAT; John E. Gould, New York, N. Y. App. filed Feb. 7, 1902. A cable having a fusible and a non-fusible wire normally insulated, is provided with a terminal which insures the electrical connection of the two wires when the fusible conductor is melted.

733,188. ELECTRIC LIGHTING DEVICE; Henry C. Graybill, Altoona, Pa. App. filed Oct. 22, 1902. Details of a switching apparatus.

733,225. ELECTRIC BELL RINGER; Tiodolf Lidberg, Chicago, Ill. App. filed Nov. 20, 1901. Details.

733,232. WINDING FORM; Julius W. Lundskog, Lynn, Mass. App. filed June 21, 1901. A winding form for armature coils.

733,233. METHOD OF WINDING COILS; Julius W. Lundskog, Lynn, Mass. App. filed June 21, 1901. A method of winding coils composed of a number of separate wires whereby the conducting leads may be brought out at the outside of the coil without objectionable crossing.

733,234. METHOD OF FORMING COILS; Julius W. Lundskog, Lynn, Mass. App. filed June 21, 1901. Pieces of insulation which soften under high temperature are inserted between the layers of winding, which are then subjected to heat and pressure.

733,252. MOTOR CONTROL SYSTEM; William O. Mundy, Schenectady, N. Y. App. filed Jan. 2, 1902. In a multiple unit system, the arrangements are such that the operation of the circuit controlling switches in all operations of the master controller will be dependent upon the proper operation of the reversing switch.

Electrical World and Engineer

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HONEST WORK.

It is with deep regret that we record this week the death of Luther Stieringer, for many years past one of the most interesting men connected with the development of electric lighting, and one who has in many ways left a deep impress upon the early practical stages of the art. It is very much to the credit of Mr. Stieringer's courage and foresight that at the very beginning of electric lighting, although then highly successful in the field of gas lighting, he recognized the importance of the new illuminant and extended to it a warm welcome rather than opposing it as so many prominent gas engineers did. He not only gave his earnest support to Mr. Edison and others, but himself was instrumental in effecting some of the most valuable improvements in fixtures and details that were necessary to render electric lighting by the incandescent lamp possible and successful. In addition to this, while lending his energies to promote the merely commercial development of the art, Mr. Stieringer was one of the first to realize and seize upon the superior plasticity of the new illuminant as an element in decorative lighting, and some of the most brilliant and memorable work in the field of spectacular effects, especially at exhibitions, was due to his skill and good taste.

Over and above all, the quality that must be most commended in the work of this pioneer is his energetic insistence upon the necessity of honest work. He fought tooth and nail against everything which pointed in the direction of defective insulation and danger to life or property; and while this sentiment carried him sometimes to extremes and blinded him to the real value of great advances, as, for example, alternating-current development, it enabled him to do a great deal that was permanently valuable in perfecting the modern system of incandescent illumination. Possibly had Mr. Stieringer been a man of less violent likes and dislikes, and more politic and considerate in his dealings with some of his fellow men, he might have gone further as a champion of that which is best and permanent in the art; but after all is said and done, his influence was always for good, and his departure from among us deserves more than ordinary recognition. It was, we are glad to know, a matter of pleasure to him as he passed away that in addition to many of the other medals and awards conferred upon him for his work in illumination, he had just been granted one of the medals of the Franklin Institute specifically for his improvements in the field of electric lighting.

THE STREET RAILWAY INDUSTRY.

In our recent issues considerable space has been given to the interesting and valuable data presented in the recent bulletin issued by the United States Census Office on the statistics of the street railway industry of the United States. The totals which are presented in this report are truly imposing, revealing tremendous advances in the last ten years, with consequent benefit to the public without a single drawback worthy of the slightest consideration. It is interesting to note that the total capital obligations of the industry represented at the time the figures were compiled last year, a total of not less than $2,300,000,000, with 22,589 miles of track and over 60,000 passenger cars. One of the most interesting figures which emerges is that of earnings, the companies showing gross receipts from operation of $247,553,000, of which all but $14,000,000 was received from passengers. The total receipts from passenger earnings of the steam railroads of the country for the same annual period were only $393,-

000,000. Upon the basis of the population of 1900, the average number of street car rides per inhabitant was 63 in 1902, or just double what it was in 1890. It appears upon this basis and upon the figures of earnings, that the average expenditure per head in the United States for street railway service is just about $3, and that the enormous number of 4,809,554,438 fare passengers were carried in 1902.

It is needless to say that this enormous expansion of traffic and utility is wholly due to the introduction of electricity. It is also interesting to note that the system for the 797 companies reporting the figures, out of 817, showed 133,641 wage earners, whose income amounted to $80,000,000. It is altogether inconceivable that but for the aid of electricity the street railway system of the country would have been able to give employment to so many men of a higher grade, and under better conditions, than those who once drove horse cars. Equally interesting are the figures which we have quoted with regard to motive power, car equipment, etc., showing a total power house capacity of 1,204,238 horse-power of dynamos, and a daily kilowatt-hour output of 6,249,910, representing roughly a total operation of about five hours daily of all the apparatus reported. And yet great as these figures are, it is evident to the most casual observer that ten years hence the statistics are likely to show as great an increase as those of 1902 have shown over those of 1890 in the application of electricity to the transportation of the traveling public in cities, as well as outside city limits.

Engineering English.

A paper on this subject was read by Mr. T. J. Johnston at the Niagara Falls convention of the American Institute of Electrical Engineers, which criticises the English of many engineers. As some facetious gentleman has remarked on the same subject: "Much engineering English is Dutch." The criticism is no doubt valid to a large extent. Engineers often write inelegant English, and sometimes write incorrect English. It is desirable that their attention should be called to a fact, which, however patent to senses cultivated in this direction, is often completely concealed from the subjects. A man who may speak and write very defectively in English, often fondly imagines himself to be quite superior to criticism in such matters. The only hope for improvement lies in free criticism, and in requiring that students in engineering shall pass adequate examinations in English prose composition. On the other hand, however, more excuse exists for imperfections in the language of those who express themselves in deeds rather than in words, on metals rather than on paper. It is undoubtedly desirable that an engineer's English should be good, but of yet greater importance is clearness and lucidity of statement.

Lightning Protection.

Of the several discussions at the Niagara Institute meeting, the most notable and by far the most extensive, was that on the group of high-tension transmission papers—or more correctly, on the introductions prepared by specialists with a view to exciting discussion on the several topics thus brought before the meeting. Much credit for this successful issue is due to Mr. Ralph D. Mershon, to whom the preparation of this part of the programme was confided, and who at the sessions was indefatigable in prompting thorough discussion. The discussion on these topics alone would fill a small duodecimo volume, and owing to the lack of precise statement natural in extemporaneous speech, as well as much repetition by different speakers, its value when published in the transactions would be much enhanced by a most liberal use of the blue pencil on the part of the Editing Committee—a hint which moreover applies to Institute discussions in general.

The remarks on Mr. Mershon's paper on lightning protection brought into prominence the very great need of a thorough study of this most important problem. The data are at present so ragged that it is quite impossible to draw valid conclusions from them. Even in so simple a matter as the advantage derived from a grounded guard wire, engineers of experience seem unable to reach any consensus of opinion. Lightning is one of the comparatively few things which cannot be made the subject of experimental study on an adequate scale, so that the somewhat meager information that is gathered comes to us in unrelated scraps. Hence it is particularly hard to generalize upon the subject. This much, however, seems certain, that in protecting a long line, four classes of disturbances must be dealt with: direct strokes, electrodynamic induction, electrostatic induction, and finally atmospheric charges independent of thunderstorms as such. As to the first mentioned, it is happily rare, and by common consent cannot be successfully dealt with by means of guard wires, or certainly even by the most cunningly contrived lightning arresters. Discharges of this sort generally show localized effects upon the line and are also accompanied by very violent phenomena at other points on the system. Because a line is struck, it does not follow that service will be interrupted, for the discharge sometimes passes to ground via the poles without even damaging the insulators, but the effects in the station may be disastrous. A good bank of lightning arresters will often prevent serious damage even under these conditions, but cannot be implicitly relied on.

To the second and third classes belong probably nineteen cases out of twenty of so-called lightning. What part of the general result must be charged to electrodynamic and what to electrostatic induction it is almost impossible to tell. We are inclined to think, with Mr. Thomas, that the electrodynamic action may often be a very serious factor in the total result. The energy represented in a lightning discharge of the first rank corresponds to a prodigious rate of output, and the primary voltage, if one may so call it, is counted in millions of volts. A horizontal flash between clouds may readily reach a mile or so in length and the electrodynamic effect on a line in the vicinity is necessarily something terrific. The electrostatic stresses are of corresponding magnitude, and the total result is adequate to almost any mischief. One feature of the case which is often forgotten is the immense size of the bodies which take part. We have a huge cloud perhaps half a mile in air and several miles broad, acting as one terminal of the condenser. Compared with these dimensions, the lines concerned are at the general level of the earth's surface and we have grave doubts as to the adequacy of the ordinary considerations in figuring out the effect of guard wires a few feet nearer or further from the earth. That their position above or below the line has little influence on their efficacy, we are quite prepared to believe, and we are also disposed to think that as regards both electrostatic and electrodynamic actions on a serious scale, they are of very limited value. It is all very well to theorize on shielding, but we may remind our readers that in the summer of 1898 two submarine mines near Ft. Monroe were exploded by inductive effects of the same thunderstorm, each being in a different group and on a different cable.

As to "static" in the common use of the term, the guard wire is at least of some service. Charges due to shifting potential of the air accumulate as a rule rather gradually and seldom represent any large amount of energy. They are common enough as we all know, and the potentials are often reckoned in thousands of volts. Disconnected lines are usually thus loaded, and we have no doubt that "static" often makes the proper adjustment of spark-gap arresters very troublesome and causes other unpleasant phenomena, but the term is very loosely used and covers everything from resonance to surface leakage due to dirt. There is little doubt that a guard wire near the main line tends to reduce these atmospheric, and we might almost say, normal charges, very considerably. Where the difference in the height of various parts of the line is considerable, static effects may be of unusual magnitude and a guard line should be fairly effective as an equalizer. But lightning on a big scale is a very much more troublesome customer. Nevertheless we hope that "static" properly so called will receive serious attention from engineers. It is certainly true that on transmission lines there may usually be found symptoms, some very grave ones, of potentials greatly in excess of those pertaining to the normal operation of the system. It is of really great importance to locate the cause of these rises of potentials, so that one may know how they should be treated. If they are purely static, they require one treatment, if resonant quite another. Nothing but careful and persistent recording of the phenomena, and cautious experimenting wherever it is possible, will give us the facts regarding abnormal violent causes. The action of the Transmission Committee in making a determined effort to gather data is the best possible step toward a knowledge of the real facts of the case.

THE STORAGE BATTERY IN SUB-STATIONS.

An interesting paper on this subject was read by Messrs. W. E. Goldsborough and P. E. Fansler at the recent Niagara Falls convention of the American Institute of Electrical Engineers. It deals with tests made on the storage battery system of the Union Traction Company of Indiana. This company has a power house at the central point of Anderson, and transmits power along the lines of track to a maximum distance of 34 miles, employing eight sub-stations and a total track length of 160 miles. The average working load at the central station was about 2,000 kw, and the total storage battery power installed, about 250 kw, on the basis of a four-hour discharge. These batteries are installed at the sub-stations in connection with converters.

A new term is employed in the paper, viz.: the "efficiency of equalization" of the storage batteries. It is virtually defined as the ratio of the abnormal input to the abnormal output of energy. If the storage battery at any sub-station performed its functions perfectly, the power input from the high-pressure line to the sub-station would never deviate from the mean input, no matter how the load on the sub-station varied. Consequently, a measure of the power equalizing value of a storage battery is obtained by taking the amount of energy delivered to a station in excess of its average load, and dividing this by the amount of energy delivered by the sub-station in excess of its mean load. This is the quantity referred to as the efficiency of equalization. In the case of one of the batteries tested, this efficiency was determined to be about 12 per cent. It is evident that the property thus designated and defined is an important criterion of the commercial value of a storage battery in a distributing system. There are three main purposes that a storage battery subserves, viz.: (1) the reserving of power in case of breakdowns; (2) the regulation of pressure on the system; (3) the regulation of activity in the central station. The last item is one of prime importance. If the storage batteries on the system had sufficient capacity, the station could be operated continuously under unit load-factor. The less the capacity of the batteries, the more variable the demand on the central station may become, the smaller the load factor, and the greater the amount of idle machinery in reserve at the station. To a certain expenditure on machinery, or on batteries, pertains, at least in theory, the maximum economy.

Owing to the fact that pressure regulation is one of the functions of the storage battery, it seems desirable to change the name "efficiency of equalization" to "efficiency of power equalization," since a similar definition could be made for the efficiency of pressure equalization. The data accompanying the paper elicited the facts that in the distributing plant the efficiency of the high-tension system, including high-tension lines, transformers and converters, was approximately 75 per cent., and that the efficiency of the low-tension system, or 500-volt conducting network, also averaged about 75 per cent. This represents a larger absolute loss of power in the high-tension than in the low-tension system, although the percentages are alike. No particular conclusion seems to be forthcoming from this coincidence, that can be applied to systems generally. The case is a special one. There is urban traffic in half a dozen towns and interurban traffic over long lines connecting them. From generator terminals to cars, the joint efficiency is slightly over 50 per cent., so that for every kilowatt-hour delivered to the cars, nearly two kilowatt-hours have to be delivered at the central station switchboard. No doubt the relative economy of this distribution has been carefully considered in view of the low price of coal and the high efficiency of the generating apparatus. Moreover, an efficiency which might seem unduly low in an urban system with no feeder exceeding say five miles in length, would be very reasonable over an extended system in which copper would have to be poured in like water in order to raise the line efficiency in any marked degree. The average energy efficiency of the five storage batteries in the system appears to have been 89 per cent. This is an unusually high efficiency in central station work, 75 per cent. being about the average. It seems as if the conditions under which the tests were made must have favored the batteries to some extent. There is scarcely any test so difficult to carry out as an efficiency test of a storage battery under working conditions. A large number of cycles must be measured before much reliance can be placed upon the results, for the reason that it is so difficult to bring the battery at the end of the test to the condition it had in the beginning.

The same authors also contributed a paper on "Central Station Economies." In this paper the fuel records are tabulated for three successive days' operation of the power station. The coal and the water consumed were recorded and compared with each day's output at the switchboard. The mean result obtained was 4.28 pounds of coal per switchboard kilowatt-hour. It is pointed out that the consumption includes that of the auxiliary engines. If 15 per cent. be allowed for the auxiliary engine consumption, then the mean consumption per switchboard kilowatt-hour becomes 3.64 pounds of coal. Since, however, the auxiliaries must be fed, the former rate is the standard of reference, except where all the auxiliaries are electrically driven, and then the latter result becomes important. It is often very difficult to estmiate the consumption of the auxiliaries, and in some cases they are more wasteful than is suspected. The proverb—deliver us from our friends—becomes applicable to auxiliaries. The mean water consumption per switchboard kilowatt-hour was 36.8, including all auxiliary consumption. The efficiency of the furnaces and boilers in the three-day test was nearly 80 per cent. The efficiency of the engines was about 88 per cent. The total thermal efficiency was 6.4 per cent., reckining from the potential energy in the coal down to the switchboard. The efficiency of the transmission system was about 50 per cent. Allowing 70 per cent. for the efficiency of the motors and gears, only about 2½ per cent. of the energy of the coal becomes available at the motor shafts for driving the cars. Although such a condition, which is the ordinary state of affairs, is very regrettable, yet with coal at $1.35 per short ton, the cost of the energy for driving the cars can only be a small fraction of the total expense of the car mile. Or, stating the matter in a different light, if some process could be devised whereby the total electro-thermo-dynamic efficiency of the system could be raised from 2.5 to 40 per cent., the total cost of operation per car mile would not be very markedly reduced.

Death of Luther Stieringer.

Luther Stieringer, in 1902.

THE whole electrical fraternity in the United States is poorer by the death of Luther Stieringer, on Friday, July 17th, at Pasadena, Cal. Although Mr Stieringer was only in his fifty eighth year at the time of his death, his originally vigorous constitution had been showing signs of breakdown since the fall of 1900. Dyspepsia, accompanied by nervous hypochondria, then began to manifest itself, and many of Mr. Stieringer's old friends assumed somewhat hastily that the absence of his characteristic optimism was due to business worries, though it was in reality a well-recognized result of the malady from which he was suffering. In the summer of 1902, a heavy cold settled upon his chest, which failed to yield to the remedies prescribed by his New York physician. Acting under medical advice, he went South and West in November, 1902, resting for some weeks at El Paso, Tex., and going thence to Los Angeles, Cal. He then stayed for some months at Nordhoff, a quiet health resort in the foothills of Southern California. Some weeks ago his illness took a more serious turn and he went to Pasadena, where he was attended with unremitting care by a physician and a trained nurse. He was in touch with the outer world through Mr. A. W. Ballard, of Los Angeles, who kept Mr. Samuel Insull, of Chicago, Mr. Edward Clark, of Schenectady, and Mr. C. A. Coffin, and, through them his many other friends, fully informed by letters and telegrams of Mr. Stieringer's condition. The immediate cause of his death was consumption complicated with Bright's disease. His body has been cremated, in accordance with his dying wishes. The funeral was held at Los Angeles.

Luther Stieringer, though he achieved prominence in many different parts of the field of incandescent electric lighting, will be longest remembered for his marvellous power of mentally visualizing effects with artificial light before actual trial with the lights themselves. It was this quality that gave his services such an unique value to the projectors of expositions in this country. Next to Mr. Edison, to whose inspiration and fecundity of suggestiveness and analysis he was always proud to acknowledge his early successes were due, Mr. Stieringer was the first to grasp the enormous increase in striking effects in decorative or fête lighting made possible by the substitution of the electric incandescent lamp for gas, candles or oil. Exterior decorative lighting, with the elimination of wind and rain as limiting factors, assumed a new phase. Interior artificial lighting, both ordinary and decorative, was no longer trammeled by the need of a clear flame area with its attendant fire risk and blackened ceilings to be kept in mind. From this point on, the differentiation of artificial illumination into decorative and non-decorative proceeded rapidly.

In decorative lighting the objects sought were the outlining of structures; the artistic massing of lights; form, variety, color, contrasts. In non-decorative lighting, a perfectly uniform distribution of light was aimed at, the actual source of light being either concealed or rendered as inconspicuous as possible. Mr. Stieringer's reasoning upon this latter point was that the effect of light upon the human eye was purely relative, so that very bright points in the field of vision by contracting the pupil of the eye made other objects seem badly lighted by contrast.

Of Mr. Stieringer's success in Exposition lighting, for decorative purposes, etc., it is almost needless to speak in the columns of the ELECTRICAL WORLD AND ENGINEER, which has enjoyed so many admirable articles from his pen, or has itself described his excellent work. Though already under the shadow of his last illness, he conceived and laid down the lines upon which the brilliant success of the night illumination of the Pan-American Exposition, at Buffalo, was achieved, and this was fated to be his last monument in the field of decorative lighting. Mr. Stieringer contributed several valuable papers, to the various societies of which he was a member, on the growth and development of decorative lighting by means of the electric incandescent lamp, as well as on other features of electrical construction.

Mr. Stieringer's boyhood was passed in New Jersey, where his father lived in a house between Jersey City and Bayonne. He attended the public schools in New Jersey, and then served a short apprenticeship as a gas fitter in New York City. He had a keen, inquiring mind, and was always an omnivorous reader, so that he was soon recognized by his employers as a workman of superior calibre. While yet a very young man, he was placed in charge of the choice pieces of work in his line in all parts of the country. Thus he was responsible at various times for the installation of gas fixtures at the Capitol, the White House, the Treasury Building, the State, Army and Navy Building, and other public buildings in Washington. He also did work in the residences of many of the prominent families in New York City, such as the Astors, the Vanderbilts, Mr. J. P. Morgan, the late A. T. Stewart, and others. During this period, covering the later sixties and all the seventies, his mind was not idle. He analyzed lighting effects wherever he saw them, and his reputation was sufficiently well established in the middle seventies to have had him called in on many occasions to arrange the scheme of lighting for large oil paintings.

Mr. Stieringer joined Mr. Edison at a very early stage at Menlo Park. His first work there was the adaptation of incandescent lamps and their connections to existing gas fixtures, and while doing this Mr. Stieringer took out several patents. His subsequent work lay largely in the exploitation of the incandescent lamp. As a pioneer in this field he had hardly an equal, and his reports, at once graphic and succinct, left nothing to be desired.

Mr. Stieringer has left behind him hosts of warm friends scattered through the United States, Canada and Europe. His rich mental storehouse was always placed freely at their disposal, and his vivid recollections of the early difficulties and triumphs of electric lighting constituted an unfailing source of interest to younger men. Mrs. Stieringer's death in 1897 was a great blow to him, from the sorrow of which it is doubted if he fully recovered. He leaves no family. After this sad event, he gave up housekeeping, and stacked up the relics of the art and the valuable technical literature and memorabilia to the enthusiastic collection of which he devoted a great deal of his leisure through many years. It is indeed to be hoped that his collections may not be dispersed, but handed over to some such trustee as the Institute, and bearing his worthy name.

Returning to Mr. Stieringer's technical work, it is difficult, of course, to determine its lasting value, but no doubt can exist as to its importance. He was a pioneer in the electric illuminating art, and successfully introduced many fundamental inventions, of his own, of which three systems of interior wiring are now in universal use, as disclosed in the patents, to wit: combination lighting fixtures, electroliers, and a system of distribution and control for interior conductors, commonly known as the "cabinet system." This system is now the standard wiring system in all countries. He also invented and introduced the hard-end fuse and incombustible base and other useful inventions now recognized as standard devices required in light installations. He was a pioneer in the application and distribution of electric light more especially in large areas, such as expositions. The illumination for the Louisville Exposition of 1883 was planned and installed by him, this being the first exposition entirely lighted by incandescent light. The 1893 Chicago Columbian World's Fair illumination and electric fountains, as well as other prominent expositions since, including the Omaha Exposition of 1898, and the recent Pan-American, were designed and installed by him, he also holding the position of consulting electrical engineer in most of them. Medals and diplomas were awarded to him for many of these illuminations. He first introduced the outlining and accentuation of the buildings on a large scale with incandescent lamps at the Chicago Fair of 1893. The further development reached its climax at the Omaha Grand Court and surrounding buildings, the lighting being effected by small incandescent lamps. A specially minted gold medal and a diploma were awarded to him, this being the highest award made. He may justly claim to have, by persistent effort, introduced and demonstrated the value of a small unit of light as exemplified on a large scale at the recent Pan-American. Just before his death he was awarded the John Scott medal by the Franklin Institute for this work, but unfortunately did not live long enough to be a recipient of the award in person.

The Rateau Steam Turbine.

A TYPE of steam turbine which has come into considerable prominence abroad is that invented by M. A. Rateau, of Paris, and which is now being manufactured in France by Sautter-Harlé & Cie, and in Switzerland at the Oerlikon Works. Through the courtesy of the inventor we are enabled to give an account of the principles of this turbine, which we preface with a description of the construction of the machine.

In Fig. 1 are shown two of the bucket wheels, and in Fig. 2 several guides. Fig. 3 shows a turbine with the upper half of the casing removed and containing only the bucket wheels. Referring in general to the latter figure, live steam is admitted in a chamber to the left, and passing through ports or nozzles in a diaphragm, has its pressure transformed to jet velocity. The jets then strike the blades of the first wheel, then enter the first guide, passing thence to the second wheel, and similarly with respect to the remaining guides and wheels of the first stage. At the end of this stage the velocity of the steam jets is reduced approximately to zero. It then passes through ports or nozzles and starts on its second stage. In these nozzles the pressure, that is, the difference between the first stage pressure and exhaust pressure—is transformed into jet velocity as previously, and the same process follows that took place in the first stage.

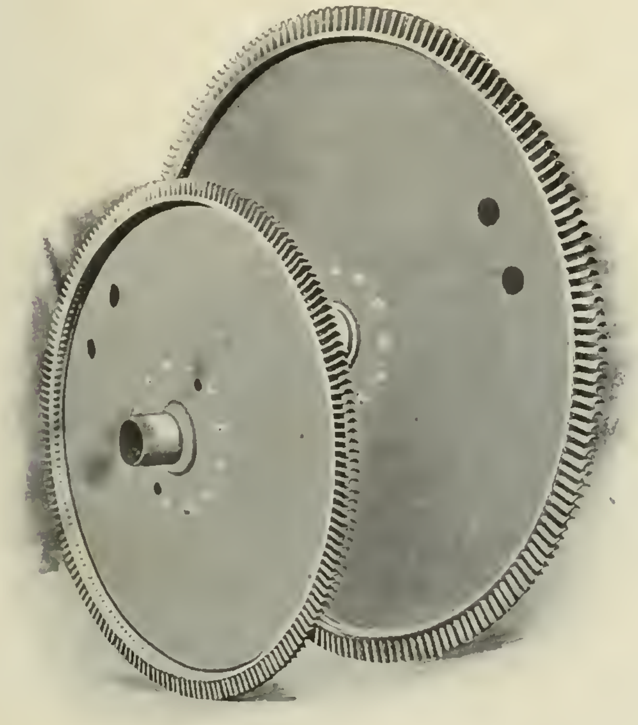


FIG. 1.—TWO BUCKET WHEELS.

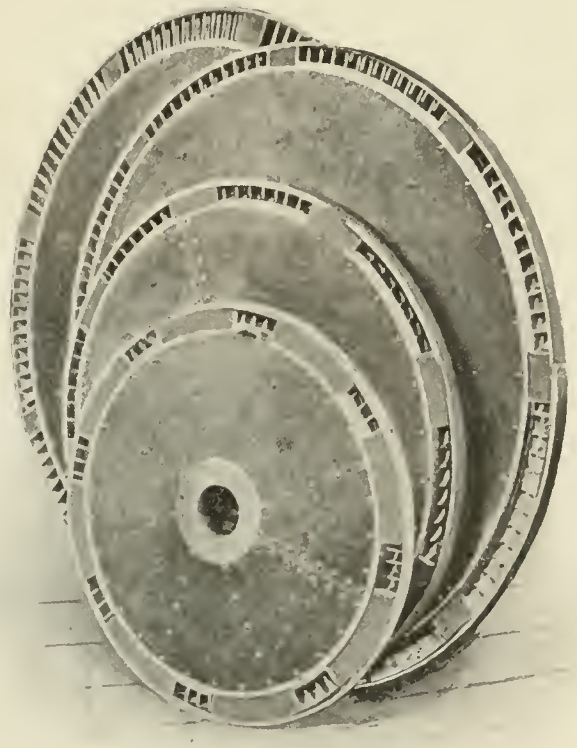


FIG. 2.—GUIDES.

The wheels of the second stage have a greater diameter than those of the first stage in order to reduce the depth of the buckets and also to maintain a proper relation between jet and peripheral velocity. The steam ports and nozzles only take up a portion of the circumference of the stage diaphragms; and in each stage the first guide plate has the least guide openings, each succeeding guide having a progressively increasing number.

The peripheries of the guide plates are fitted and secured steam tight to the turbine casing, but a clearance of from 5/32 to 6/32 in. is left between the shaft and the edge of the shaft opening in the plates. The clearance between the bucket and guide plates at the working portions is about 1/8 in. M. Rateau admits that there is a loss through friction between the surfaces of the bucket and guide plates which is absent in the Parsons system of steam turbine construction.

Regulation is obtained by means of a centrifugal governor acting on a valve in the admission steam pipe. In the case, however, of machines which are rarely called upon for full load, the width of the openings of the first stage nozzles is varied by an appropriate mechanism. When a machine may for a short time be called upon for a large overload, as in electrical generation, or when the exhaust is diverted from the condenser to the atmosphere, provision can be made for maintaining normal speed by an auxiliary supply of live steam at some intermediate point, such as at the beginning of the second stage.

Among the claims made for the Rateau turbine are: 1. High mechanical efficiency combined with the lowest possible angular velocity of bucket wheels. 2. Sufficient clearance between moving and fixed parts to allow for any possible wear of bearings and for shaft flexure. 3. Great lightness as a whole and particularly of the rotating parts, thus reducing gyroscopic effect to a minimum—this latter point being one of importance in turbines for marine use. As illustrative of the second statement, a machine of 1,000 to 1,200 hp does not exceed 1,100 pounds in weight.

For the following discussion of the theory of the Rateau turbine and account of tests, we are indebted to M. Rateau.

Before giving the figures obtained in the tests, it is convenient to define exactly efficiency, as that term is used by M. Rateau. Too often manufacturers or designers are satisfied by measuring the steam consumption either per indicated horse-power, or per effective horse-power, on the shaft, without giving the figures for the initial pressure of the steam and the exhaust pressure. This method of describing performance of a machine is not sufficient; one might just as well give for a hydraulic turbine only the quantity of the water without the height from which it falls.

In the tests from these turbines, M. Rateau determined the efficiency from the ratio of the theoretical steam consumption of an ideal perfect machine to the real steam consumption, referred to the power available at the shaft. In the case of electric generating sets, it is preferable to refer this real steam consumption to the electric power measured at the terminals of the dynamos. The theoretical steam consumption is defined as corresponding to the maximum work which the steam can produce under the conditions under which it is delivered to the machine, by expanding adiabatically and without losses from the initial pressure, P, to the exhaust pressure, p. This method presented some difficulty in calculation, but a diagram may be plotted from which the theoretical consumption can at once be found for saturated dry steam. Such a diagram shows how extremely important it is for economical operation, to have as perfect a vacuum as possible in the condenser, in order to diminish the exhaust pressure, p. The expansion is better and the steam consumption is considerably improved by better vacuum, as may easily be seen from the following example:

If a machine is using saturated steam at a pressure of 213 pounds per square inch and by exhausting into free air, the diagram shows that the theoretical steam consumption is 12.85 pounds per hp-hour; if we provide the same machine with a condenser which reduces the exhaust to 27 in., the theoretical steam consumption is only 7.82 pounds, i. e., 39.3 per cent. smaller than before.

Data will first be given of a turbo-generator of 540 electric hp, which is one of three similar machines, made in the Sautter Harlé works for the Penarroya mines in Spain, where they have just been installed. These consist each of two turbines of high and low pressure direct coupled to direct current dynamos, giving each at normal load 830 amp. at 220 volts. The normal speed is 2,250 r.p.m. These turbines operate with condensation which is effected by ejector condensers of the Rateau type. As the boilers give steam under pressure of from 140 to 210 pounds, a reducing valve maintains the pressure of admission at 140 pounds per sq. in. as maximum. The consumptions and the efficiencies are given in the following table.

	¼ full load.	½ full load.	Full load.	Over load.	Over load at [illegible]
Electric hp produced (measured at the brushes)	135	259	525	627	641
Pressure in lbs. per sq. in. of steam admitted (gage)	31	61	121	141	141
Pressure in lbs per sq. in. of exhaust steam (lbs.)	1.247	1.34	1.64	1.82	1.82
Theoretical consumption in lbs. per hp-hour for a perfect machine	10.01	9.77	8.82	8.71	8.71
Consumption found in tests per electric hp-hour measured at the brushes	21.3	18.0	15.74	15.31	14.86
Combined efficiency of generating set	0.513	0.540	0.560	0.569	0.586

This table shows that the combined efficiency, i. e., that of turbine and dynamo together, varies between 51 and 58.6 per cent., while the steam consumptions per electric horse-power may be as low as 14.86 pounds. If the data are plotted it will show that the combined efficiency is practically constant, its variations being not more than 8 per cent., between overload and ¼ full load.

It has recently been claimed that with respect to efficiency and steam consumption, the turbines are economical only when operated at full load. The above example shows that this criticism is unfounded. In fact, the curve of steam consumption shows that the consumption at no load, with excited dynamos, is only about 10 per cent. of the consumption at full load (tests of other Rateau turbines have given figures varying between 8 and 12 per cent.). On the other hand, for an electric generator driven by a piston engine, the consumption at no load is between 15 and 25 per cent. of the consumption at full load, and these figures refer to the better types of machines of this class.

In the case of a turbine driving a four-wheel centrifugal pump working at from 90 to 140 hp, the combined efficiency of turbine and pump together was as high as 36 per cent., and did not fall below 31 per cent.; this corresponds to an efficiency of about 67 per cent. for the pump and 54 per cent. for the turbine.

By the use of condensing and by producing a vacuum of 24 to 27 in. in the condenser, it is possible to utilize steam at low pressure for the operation of turbines and to obtain quite satisfactory figures for steam consumption and efficiency. This is a considerable advantage of turbines over piston engines. In fact, if a machine of the latter type was to be operated with steam of a pressure of about 14 pounds' pressure, one would get an excessively cumbersome machine, too expensive to install, and of an efficiency which would be low for several reasons, the main reason being the very important condensing losses which would take place in the cylinders. This advantage of steam turbines has permitted Prof. Rateau to utilize the enormous quantities of steam which so far were wasted in mines and in plants equipped with powerful machines exhausting into the atmosphere and running at intermittent load. This is the case with hauling machines in mines, with machines in rolling mills, and with steam hammers. With these machines neither compounding nor condensing can be used, and the efficiency is, therefore, rather low. In any case it was very difficult to utilize the exhaust steam of these machines. They furnish an intermittent flow of steam, while a continuous jet is to be supplied to the turbine. M. Rateau has solved this problem by inventing an apparatus which he calls a "regenerative accumulator of steam." It consists of sheet iron cylinders, containing a series of cast-iron plates. This plays the same rôle for heat as a fly-wheel for kinetic mechanical energy; that it stores it up, the steam being condensed at its arrival and being formed again later when the exhaust from the primary machine stops. The pressure of the exhaust steam is nearly constant, about 3 pounds. An adjustable valve, regulated by hand, permits to vary within certain limits, the pressure of the steam leaving the accumulator; in general this pressure is 2.8 to 5.2 pounds.

A very interesting application of this principle has been made at the Bruay mines at Pas de Calais. The exhaust steam of the hauling machine is fed to a turbo-generator of 300 hp. The tests showed that the machine gives 1 electric hp at the terminal of the dynamo with a steam consumption of 39.68 pounds per hour, the steam being admitted at atmospheric pressure and the vacuum in the condenser being 24.8 in., hence relatively bad. This figure could be reduced to 28 pounds per electric hp-hour with a better vacuum in the condenser, which is perfectly obtainable in practice.

Under these conditions the low-pressure generating set would perform about three times more useful work than the hauling machine; and even with a steam consumption of 39.68 pounds per hour,

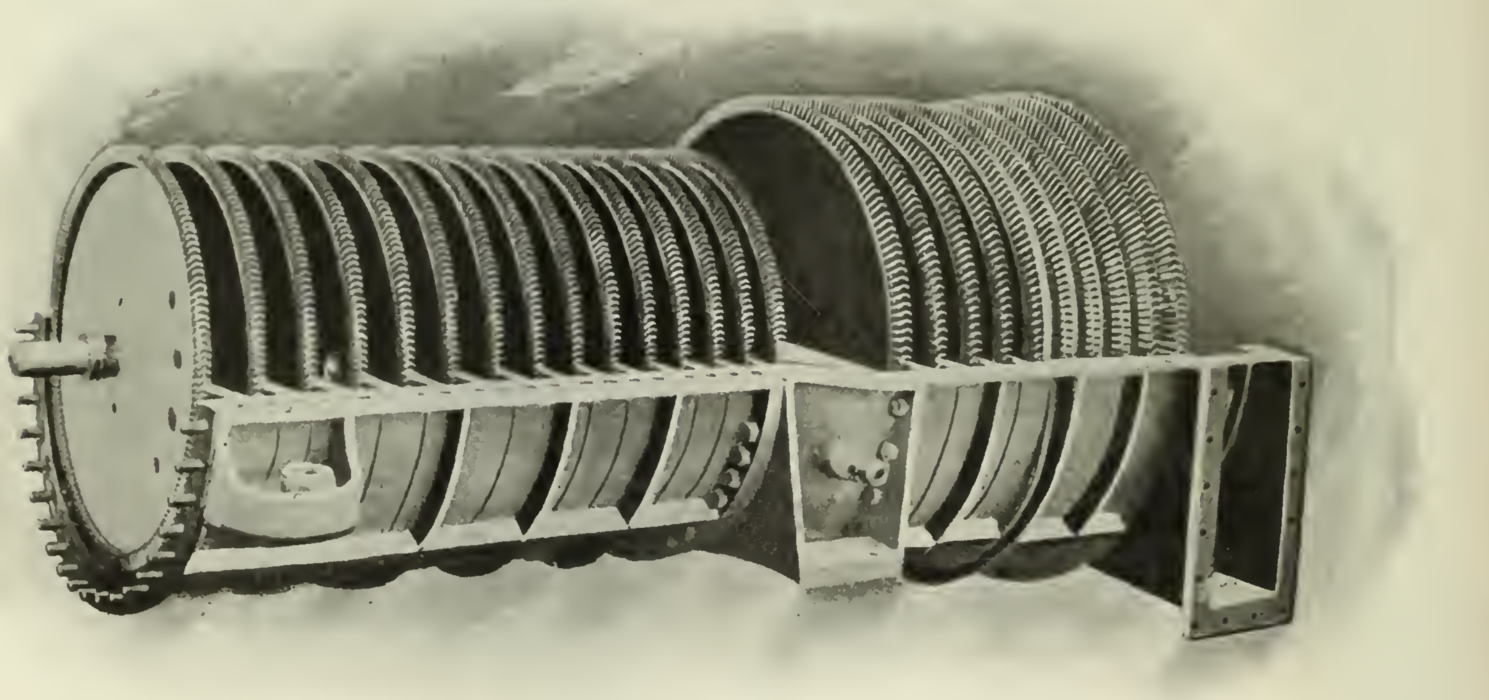


Fig. 3.—Steam Turbine with Upper Half of Casing Removed.

the work performed by the turbine set is nearly three times that of the hauling machine, for the latter consumes generally 100 pounds of steam per useful hp-hour, this very high figure for consumption being normal for a non-compound hauling machine, exhausting into the atmosphere.

These are considered to be results of great importance, and the employment of low-pressure machines for the utilization of the exhaust steam of machines running at intermittent load, has apparently a great industrial future.

So far turbine-driven dynamos and turbine-driven pumps have been discussed, but it may be added that the turbine is equally applicable for driving ventilators, and, in fact, at present numerous turbo-ventilators of the Rateau system are in practical use. In view of the high speed of rotation of these ventilators, it is possible to supply the speed directly to the ventilator by mounting its wheel on the shaft of the turbine itself, and thus to obtain a turbo-air compressor. This construction gives machines much less cumbersome and less expensive than piston compressors. The Sautter-Harlé works have supplied such turbo-compressors to the French Navy and the British Admiralty, and at present they are building a turbo-compressor for use in the blast furnace of the Châtillon and Commentry Works. This apparatus will give 88.3 cu. ft. of air per minute at a pressure of 4 pounds.

A turbo-ventilator when running at a speed of 20,200 r.p.m., has given a back pressure of more than 7 pounds per sq. in.; this pressure was obtained with a mechanical efficiency of about 60 per cent.

The figures given for the steam consumption and efficiency of the turbines show that these machines have now reached a remarkable degree of perfection and that their efficiency is superior to that of compound machines and even comparable to that of the better types of triple-expansion machines. From day to day they become of greater industrial importance, being gradually substituted for piston engines on land, while for some time there has been a tendency to substitute them for the latter even on board ship.

Interesting Features of American Electric Railway Work.

Note has already been made in these pages of the leading data presented in the United States Census Office bulletin on American street railways, just issued. The report contains a variety of interesting figures and information, full of suggestion and guidance as to what has been done in the art and as to its present tendencies. The whole report is a most remarkable exemplification of what electricity can do in stimulating an industry, for it is inconceivable that any such growth as is manifested in the figures already quoted last week could have taken place with animal power, while the limited applicability of the cable would also have been against such universality of use as has characterized the electric current. Moreover, it is noteworthy that other once competitive powers with electricity, such as gas and compressed air, have quite disappeared from the scene. The recent statements in regard to the cost of compressed air trials on the New York Metropolitan Street Railway system, give the reason why.

As regards the gains in the period or decade under the electric régime, the total reported cost of construction increased $1,778,276,788, or 456.7 per cent., as compared with an increase of $1,830,046,142, or 382.7 per cent., in the combined par value of the capital stock and funded debt. While the percentage of increase for the capital stock, 355.1, is smaller than that for funded debt, the actual increase in the par value of the stock was $1,026,514,827, as compared with an actual increase of $803,531,315 in the amount of funded debt. The increase in both capital stock and funded debt is due very largely to consolidation of independent roads and the operation of roads under the lease system, where the stock of the constituent and underlying companies is not retired.

The increase in earnings from operations was $156,936,788, or 173.2 per cent.; the increase in operating expenditures was $80,301,412, or 129.5 per cent. The percentage that operating expenditures formed of the total earnings from operations was 68.43, in 1890, as compared with 57.49 per cent. in 1902. A special table in the report gives information concerning the percentage of operating expenses to earnings from operations for the companies in the different States and Territories.

The increase in the number of passenger cars amounted to 27,785, or 85.5 per cent. In connection with the increase in the number of cars, the increase in size, made possible by the introduction of electrical power, should be taken into consideration. This is doubtless indicated by the increase in the number of passengers carried per car. The number in 1890 was 62,237, and 1902, 79,774, an increase of 17,537. The number of employees, exclusive of salaried officials and clerks, increased 62,877, or 88.9 per cent. The report in giving detailed accounts of this kind, states that the decrease in the length of line operated by animal, cable or steam power has been attended in every instance by more than a corresponding increase in the trackage operated by electricity. As to the use of the service by the public, it appears that in the United States in 1890 the average number of rides per inhabitant was 32 and in 1902 was 63, a gain of 31 per head. But in some sections of the country the gain was much greater than that, as, for example, in the North Atlantic States, where it rose from 66 to 124, or just again doubled itself. For the whole country the traffic earnings in 1902 were $247,553,999, and the number of fares was 4,809,554,438. This income from operation is not, however, wholly from passengers, that amount being $233,821,548, with enough from chartered cars to make it just over 234 millions. As this amount includes all the interurban traffic, the average fare is obviously less than 5 cents. Looked at in another way, on the basis of the population of 1900, or just 76,000,000, the average expenditure per inhabitant of the United States for street car travel is just over $3 per head. In the report published last year on electrical apparatus and supplies by the present writer, who has also been engaged as expert on the street railway census, the amount per head derived from the public by the traction companies, it was predicted "would reach not less than $3 per head."

Other figures of income and expenditure have already been noted, and need not be again referred to here. As to the employees, some interesting data can be gleaned from the report. Of the total number, 133,641 employees, 80,144, or 59.97 per cent., were conductors and motormen, who received $48,642,359, or 60.22 per cent. of the total amount paid in wages. The next largest group of employees is road and track men, which includes laborers employed in reconstruction and repair of the road. The 11,474 employees reported for this group were 8.59 per cent. of the total and their wages amounted to $5,511,425, or 6.82 per cent. of the total wages. The number of employees reported includes, however, employees working in electric light and power plants, operated by railway companies, and, as such employees are engaged indiscriminately in the two branches of work, the total number cannot be accepted as the number employed exclusively in the operation of street and electric railways.

The reports for 669 electric railways located in different sections of the country include also 94,874 wage-earners, or 70.99 per cent. of the total for all companies. The distribution of this large proportion of employees at the different daily rates of pay indicates very closely the prevailing rates of wages in the industry. For all classes taken together the prevailing rate of wages is from $2 to $2.24 per day, 39,678, or 41.8 per cent. of the total, being paid at this rate. It appears that 65,297 wage-earners, or more than two-thirds of the total, receive from $1.75 to $2.49 per day. More than half of the conductors and motormen receive from $2 to $2.24 per day. The prevailing rate for road and track men, which includes a large number of laborers, is $1.50 to $1.74 per day, nearly one-half of the total number being reported at that rate.

Turning now to line construction, it is interesting to note that of the 21,920.07 miles of single track operated by electric power, 21,302.57 miles, or 97.18 per cent., obtain the current by means of an overhead wire. The methods of supporting this wire are shown in Table 27, from which it appears that, of 15,857.26 miles of construction reported, 10,220.07, or 64.45 per cent., is supported by span-wire construction; 5,223.08 miles, or 23.83 per cent., by side bracket, and 414.11 miles, or 2.61 per cent., by center pole. Wooden poles were used for 80.27 per cent. of this mileage, and steel or iron poles for 19.63 per cent. There were 15.92 miles of line having wires supported by elevated railway structures and by buildings and bridges. The average number of poles on each mile of line ranges from 30, reported for the Salem Electric Railway Company, of Salem, Ohio, to 85, reported for the Duluth-Superior Traction Company, of Duluth, Minn. There were 24,754.29 miles of feeder wire construction reported, and of this mileage 22,343.22 miles, or 90.26 per cent., was overhead and 2,411.07, or 9.74 per cent., underground —a very small proportion. This form of construction was used by 27 companies. The statistics for the conduit system are intended to cover only the conduit system employed by the street railway companies for the reception of their mains and feeders. The schedule called for miles of duct, and the inquiry was designed to ascertain the number of miles of separate pipeway, each pipeway receiving one cable of wire. One mile of street laid with conduit of 6 holes would thus represent 6 miles of duct. There were 6,546.9 miles of duct laid ready for use, occupying 589.3 miles of street. Of this, 3,905.1 miles of iron pipe and 600.4 miles of wood or other material. The use of underground construction predominates in Washington, D. C.; Chicago, Ill.; New York, N. Y.; Boston, Mass., and Philadelphia, Pa.; these 5 cities, containing 5,462.3 miles, or 83.43 per cent. of the total for the United States.

As to the cars employed, some details were given in these pages last week concerning motor equipment, lighting, heating, etc. There were 66,784 cars of all classes reported. The largest number—3,612—reported for a single company is given for the Boston Elevated Railway Company, of Boston, Mass., which includes cars operated on both surface and elevated tracks. There were 60,290 passenger cars and 6,494 cars used for express, work or other purposes. Comparing the number of passengers carried and the passenger-car mileage with the number of cars, it appears that each car carried on the average 79,774 passengers and traveled 18,001 miles during the year, or nearly 50 miles every day in the year. Of the passenger cars, 32,658 were closed and 24,259 open. Combination closed and open cars were reported by 106 companies, the total number being 3,134, of which 1,203, or 38.38 per cent., were used by 22 companies in California. Combination passenger and express cars were used by 99 companies, the number being 239. Cars used for more than one service were enumerated only once; for instance, cars carrying passengers as well as material and mail were classified as passenger cars. The use of express, freight or mail cars was reported by 206 companies, the largest number being shown for the St. Louis & Belleville Electric Railway Company, of Belleville, Ill., an interurban freight line operating between East St. Louis, Ill., and Belleville, Ill. The 1,727 snow plows reported do not include snow plow attachment, but only snow plow cars. Similarly the 790 sweepers include only sweeper cars. Cars used both as sweepers and as snow plows were counted only once, either as plows or as sweepers. There were 50,699 cars provided with electrical equipment; and as the roads operated either in whole or in part by electric power reported a total of 64,618 cars of all classes, the number having equipment of this character was 78.46 per cent. of the total.

Of the total car mileage, 1,099,256,774, the passenger cars traveled 1,085,397,802 miles, or 98.74 per cent., and freight, mail, or other express cars 13,858,972, or 1.26 per cent. In computing the car mileage and the car hours, where a road operated one or more trailers, or, in some cases, a train of cars, the entire combination was considered as one car. The total, therefore, contains a certain amount of train mileage, and allowance should be made for this fact in considering the average fare passengers per car-mile and car-hour. The fare passengers per car mile for all companies averaged 4.43 and ranged from 0.01 for the Chicago General Electric Railway Company, of Chicago, Ill., to 69.15 for the Monongahela Incline Plane Company, of Pittsburg, Pa. It was impossible to obtain information concerning car-hours from a large percentage of the companies. However, 389 companies furnished this information. Their total car-hours for the year amounted to 65,869,342, of which passenger cars formed 65,403,287, or 99.29 per cent., and freight, mail, express and other cars 466,055, or 0.71 per cent. The fare passengers per car-hour for the companies reporting both factors averaged 33.28, the highest figure being 89.24 for the Worcester & Southbridge Street Railway Company, of Worcester, Mass. No fewer than 286 companies reported that they were carrying mail, and the companies in the aggregate reported the owning and operating of as many as 350 pleasure parks.

The following statement reproduces the totals concerning the number of persons killed and injured in the United States:

Class.	Killed.	Injured.
Total	1,216	47,429
Passengers	265	26,690
Employees	122	3,699
Others	829	17,040

"Others," referred to in the above statement, include persons on foot or riding in vehicles other than street cars who were killed or injured in collision with street cars. The number of persons reported as killed, 1,216, and injured, 47,429, form only an inappreciable percentage of the total number of passengers carried, and present electric traction in that respect also in a very favorable light.

Proceedings of Niagara Meeting of the American Institute of Electrical Engineers. *(Concluded.)*

THAT part of the Niagara Institute programme which elicited by far the widest discussion was the group of papers on high tension transmission subjects. These contributions, in fact, were prepared in such form as to serve specifically as introductions to discussions, and thus departed somewhat from the usual character of Institute papers. The preparation of the programme was confided to Mr. Ralph D. Mershon, chairman of the Committee on Collection of Data on Transmission, and it was largely through his efforts that the discussion at Niagara was so successful. At his suggestion an adjourned meeting for continuation of discussion was held on the afternoon of the day when the papers were read, and all of those particularly interested in the subject of the papers were asked to forego a trolley ride on the regular programme and attend this meeting. The large number who accepted that invitation and the great interest shown at the meeting, rendered it one of the most successful of any the sessions held during the week.

Mr. C. E. Skinner, in a paper entitled "Methods of Bringing High-Tension Conductors into Buildings," discussed the general requirements for bringing high-tension conductors into buildings. The requirements which must be met are the maintenance of proper insulation of the circuit, the prevention of the entrance of rain, snow, cold air and dust, the proper mechanical fastening of the line wire, reliability and simplicity of construction. In general, wires are best brought through the walls of the building. The simplest form of construction consists merely of an opening in the wall sufficiently large to allow the proper air insulation between the wire and the wall, this opening being suitably protected from rain either by means of a large pipe set in the wall, sloping outward or by a sufficient extension of the roof above, or both. The wire must be at a sufficient distance from the pipe. The pipe should always be considered as "ground." The cross arms holding the wire inside and outside of the building should be sufficiently near and so braced that the wire will remain central in the pipe. With potentials of 15,000 volts or lower a disc of glass or other fire-proof insulating material is placed over the wire at the inner end of the pipe. The tube must be sufficiently large so that the surface insulation over the insulating disc used will be ample to prevent trouble under the worst conditions. When there is any danger of condensation of moisture due to differences of temperature inside and outside of the building two discs a little distance apart should be used. Their surface insulation should never be less than that of the line insulators. For voltages above 15,000 volts, a long insulating tube of small diameter and very heavy wall may be placed over the wire and passed through a slab of insulation set in the wall of the building, the whole being protected from driving rain by an extension of the roof. The insulating tube should slope outward in all cases. Some form of drip point should be provided on the wire just outside the end of the tube. The insulation slab holding the tube should be large enough to prevent actual break-down even though the tube is broken. Both tube and slab should be of fire-proof material. This form of construction has been successfully used for potentials as high as 50,000 to 60,000 volts.

Mr. Skinner read a communication by Mr. Floy, who considers that the use of glass plates or of conductors insulated for a portion of their length (as in the two schemes advocated by Mr. Skinner for bringing the wires into a station) is objectionable, because of the constant menace of leakage and grounding of the system through the wall of the building. Mr. Floy believes there is nothing quite equal to a plain but generous hole in the wall through which the wire rigidly supported may pass; he gave a sketch of a construction in which the wire first passes vertically through the floor of an overhanging gallery which is an extension built on the side of the building; the wire then passes horizontally through a hole in the wall into the building; the gallery is used as a place for the lightning arresters. All water drips from the wires before the latter turn vertically to pass through the floor of the gallery; and the two apertures being at right angles to one another, prevent any large amount of cold air entering the building.

Mr. Skinner then read a communication by Mr. O. H. Ensign, chief engineer of the Edison Company, of Los Angeles, Cal. He uses for 30,000 volts plain open 12-in. sewer pipe. He does not believe that any sort of closed plate insulation would do.

In a brief communication by Mr. A. L. Mudge the writer suggests that the terra cotta pipe, mentioned in Mr. Skinner's paper, should be closed at the outer end to prevent birds and insects getting into and building nests in the pipe.

Mr. F. C. Pierce, of Philipsburg, Mont., does not believe in allowing the wall of the building to take the strain of the line; the last poles of the line should be guyer. He gave some details of construction, used by the Montana Water, Electric Power & Mining Company.

Dr. Louis Bell thinks that a mania for compactness has been responcible for more trouble in high voltage-systems than any other cause. Wire towers for high-potential lines should be avoided. The high-voltage wires themselves and all their connections should be so placed that their whole arrangement is evident at any time from a cursory glance.

Mr. J. Harisberger, of Seattle, Wash., states that the Snoqualmie Power Company, adopted at the very beginning the second arrangement suggested in Skinner's paper, and with all of its high-tension troubles it has yet to experience its first trouble with this style of construction for entering buildings. In some of the buildings where the wires enter with the first construction, suggested by Skinner, in every instance when the high-tension lines became grounded for one reason or another, there was a discharge across the glass plate to the terra cotta pipe.

Mr. H. M. Gerry, Jr., gave a review of various methods used in practice, and said there can be no one method of entering high-tension wires; it is always a question of engineering detail which should receive special treatment in each particular case.

The foregoing were all written communications. In the oral discussion of Mr. Skinner's paper which followed, Mr. Mershon said that by experience he had come to feel somewhat afraid of the use of glass tubes. The climatic conditions determine details of construction.

Mr. R. F. Hayward described some methods used in Utah; on account of the climatic conditions they have to keep their wires much further apart than in the East. Good glass tubes may be had and have proven satisfactory, but porcelain tubes are better. He thinks that people do not appreciate how effective in practice a simple piece of plate glass is. On 16,000 volts he used a piece of 12-in. plate glass with a ¾-in. hole drilled in it with wires passing right through, and has never had the slightest trouble, in spite of frequent storms in winter. The most important thing in outlets is to provide much space and not to cumber the outside of the building with any extra structure.

Mr. V. G. Converse criticised some special points in Mr. Skinner's suggestions. Porcelain tubes are much preferable to glass tubes. A rain shed should be provided. Mr. P. H. Thomas concurred in the latter proposal; he also suggested mounting the true high insulating inlet in an insulating panel. Mr. P. M. Lincoln recommended that the line end strain should be taken up by a strain insulator inside.

Some of the transmission lines of this country have installed upon them as a protection against lightning one or more wires strung parallel to the power wires and grounded at intervals. As there is a difference of opinion amongst electrical engineers as to the efficacy of this device, Mr. Ralph D. Mershon, in a paper entitled "The Grounded Wire as a Protection Against Lightning," discussed the problem of its advisability. He first gives the theory of the subject and calculates the "shielding action" of the ground wires for a special numerical case. If each wire of a transmission line 20,000 ft. in length, the conductors of which consist of No. 00 wire, has stretched parallel to it and at a distance of 12 inches, a grounded wire equal in size to the line wire, the potential of the line wire due to a charged cloud could not rise to exceed 30 per cent. of the value to which it would rise if the grounded wire were not present; this is given only as a rough example to show the magnitude of the effect of the grounded wires. The author refers briefly to the material and dimensions of ground wires and to their method of installation, and gives some results obtained in practice in various plants. In one plant as the result of a number of years of operation, those in charge feel sure that the grounded wires furnish a reliable and effective protection against lightning. In some of the other plants those operating think that the grounded wires furnish more or less protection, but are doubtful as to the amount. In still other plants those in charge feel sure that the grounded wires are of no value whatsoever and constitute a muisance and menace because of their liability to break and fall across the power wires. In some of the cases of doubtful success or failure the trouble may have been due to poor grounds or to the wires not having been grounded frequently enough, as in some of these cases the wires were not grounded at every pole. In all of the doubtful cases lightning arresters which were installed in addition to the grounded wires received more or less discharges during thunderstorms.

In the discussion of Mr. Mershon's paper which followed, Mr. R. S. Kelsch gave an account of a careful record undertaken in Montreal, when a great many light and power wires of a company were constructed below the wires of other companies; it was found that the greatest amount of trouble, such as transformer burn-outs, etc., caused by lightning, occurred on the circuits that were built under the lines of other companies.

Dr. Perrine discussed the use of barbed wires for grounding. When a cloud has discharged in the neighborhood of a line, and the line and its accompanying guard wire have reached a stationary condition, the points on the grounded wire tend to aid the release of the charge. The trouble is, however, that in practical operation the barbs form points of mechanical injury, as the wire may be twisted and kinked around the barb.

Mr. C. O. Mailloux referred to a three-conductor line in Arizona, 25 miles long, with only three lightning arresters, one at the transmitting end, one at the receiving end, and the third at a second power plant about 8 miles from the receiving end. This line was started last fall and has worked without interruption; although there were many lightning storms, they had never any trouble from lightning. There were discharges over the lightning arresters, but the operation of the line was never interfered with.

Mr. A. J. Wurts looks on the entire situation as a cloud and the earth forming the two terminals of a huge static machine. He considers the lines over the earth's surface, electric lines, grounded lines, railroad rails, gas pipes, water pipes, all a part of the one terminal of the machine. He does not believe that a grounded wire in the neighborhood of an electric line will materially protect that line; they will all discharge.

Mr. Thomas stated that the data at hand concerning lightning protection are still very poor. We have no decisive experience yet as to whether a grounded wire really affords any protection. Besides the electrostatic induction, there is also electromagnetic induction. He thinks there should be an appreciable loss due to the grounded wire. The problem is very complex and one should go very slow in putting too much at stake on grounded wires.

Dr. Perrine pointed out that there are several things to protect against. One is the gradual charge and discharge of the line due to conditions of the atmosphere. The line may gradually acquire a charge from the wind blowing over the line when there is no lightning in the neighborhood; it is against this form of trouble that the guard wire is intended to guard. On the other hand, it is not of any great advantage where there are lightning discharges of severe character.

Dr. Kennelly referred to the long years of experience on this question in the protection of telegraph and telephone lines; among telegraph men it has always been a popular impression, derived from long experience, that the presence of other wires protects the neighboring wires against direct lightning effects. The tendency in a working wire is to carry the earth up over that wire or in the vicinity of that wire and to produce partially that effect which a completely grounded wire produces more thoroughly. If we only have enough parallel wires above and around a working wire, we carry immunity to the latter. Whether it is worth while to do so is a very important question. When some years ago he collected information of this character from the representatives of local stations, he found the evidence to be in favor of protection by means of a guard wire.

Mr. F. S. Woodward referred to a case in which barbed wires had been used and remained in good condition for about two years; at the end of that time they broke and there were a number of short circuits owing to the wire falling over the line. On this same line there were some lightning arresters and an investigation of them at regular intervals showed that they were very frequently acted, so that the barbed wires themselves did not prevent the lightning stroke from striking the line wire.

Mr. Rushmore referred to the effect on a transmission line, due to differences in altitude between different parts of the line. This effect is evidenced by injury to the insulation at the lower altitude. He referred to a case in which one part of the line is about 7,500 ft. above sea level and the other part about half that altitude; the insulation remains good on the higher part and does not hold up at the lower part. Guard wires may protect the line against this effect.

Mr. John F. Kelly believes that the main protective effect of the grounded wire is not against lightning discharges, but principally against the ordinary atmospheric electricity. He referred to troubles due to the latter, experienced on an old telegraph line. The most important point in Mr. Mershon's theory is that the wire should be equally effective if placed below the line, as if placed above. The great danger heretofore has been that it was above and in breaking would fall on the transmission wires. He believes that there may be some protective effect from the grounded wire, but it does not pay for the complications.

Mr. Hayward stated that the Committee on High-Tension Transmission has sent word to every operating engineer, asking that every one of their engineers be made an observer; in the case of a breakdown from lightning, the engineer is to go right to the spot as if it were a fire, and collect all the evidence. In this way it is hoped that in a year or two a large amount of exact data will be collected. He believes that the locality has much to do with the nature of the discharges. He thinks that overhead grounded wires, such as telegraph and telephone wires, are a protection; they have never lost a transformer in their business section, which is the most thickly covered with other wires; but they are not a complete protection by any means. If one would absolutely surround the transmission wires with a grounded network, they would be protected, but this method is absolutely impracticable. The transmission line must be easily accessible. They have made careful records of their troubles from lightning; their troubles always come at the moment when the lightning discharges. Troubles due to the raising of the potential of the line when there is a dust storm, or wind storm, or a thunder cloud, are taken care of by the lightning arrester. Every single occurrence that has given them trouble has been at the moment of the lightning discharge. In recent times, while they have had arresters in connection with spark-gaps, they never had any trouble with the lightning arresters themselves.

President Scott remarked that Mr. Hayward has duly emphasized the point that the men in the laboratories, the men who are building apparatus, need the co-operation of the men who are experiencing difficulties on the ground; the two must work together.

Mr. Waters suggested another method of calculating the conditions, different from that used by Mr. Mershon. He gave some results of his experience on European mountain lines of short length, the voltage being between 5,000 and 1,000. Troubles arise there usually from violent lightning storms and from heavy sleet and snow storms. The universal opinion of the operating engineers there is that the grounded wire is more trouble than it is worth.

Prof. D. C. Jackson expressed the opinion that the numerical example in Mr. Mershon's paper does not represent the commercial conditions in a long transmission line. Instead of estimating the protection from the guard wire at something like 70 per cent., as Mr. Mershon does, he thinks 7 per cent., or one-seventh of 1 per cent. would come nearer the truth.

Mr. Mershon, in his reply, said that his numerical example was not so far off from the actual conditions in some lines. In his paper he did not deal with electromagnetic, but only with electrostatic action. He agreed that the ordinary guard wire cannot furnish much protection against electromagnetic action.

Mr. N. A. Blanck stated that in most cases on recent Italian lines, as also on the German lines, the lightning arresters are used in the stations, never on the line itself, and the use of iron wires for protecting the line itself has been abandoned.

Dr. Perrine said he had tried to measure the loss due to the grounded guard wire, but was unsuccessful in his attempt.

"Y or Delta Connection of Transformers," was the subject of a paper by Mr. F. O. Blackwell, which discussed the comparative advantages and disadvantages of the two alternative methods of connecting transformers to a three-phase system. The comparison is made under the following headings: Size of transformers required; grounding the neutral; unstable neutral; rise of potential. The selection of Y and delta connection of transformers for long-distance transmission should only be determined after a careful consideration of the conditions in each case. There is little choice between Y and delta without a grounded neutral. In small installations, the cheaper cost of transformers for Y with a grounded neutral will be a determining factor. Larger plants will be guided by the greater importance of giving uninterrupted service and will not employ a grounded neutral unless demanded on the score of safety. Where the amount of power is great and the system extensive, delta connection will be generally preferred on account of its avoiding the possibility of rises of potential from any cause. Many plants can have advantageously a mixed system with both Y and delta transformers, each installation of transformers being considered by itself.

Mr. J. S. Peck, in a paper entitled "Grounded and Underwound Transmission Circuits," discussed the problem of grounding a transmission system with reference to Mr. Blackwell's paper. By the grounding of the neutral point it is sought to limit the strain from line wires to ground and to limit the strain between high-tension and low-tension windings of the transformers, also between high-tension windings and iron case. The author discusses in detail with the aid of diagrams the effect of grounding on the various possible polyphase systems and sums up his results in a long table. In many cases the grounding of the neutral points of a transmission system limits the voltage strain to ground and the voltage which may be obtained across any transformer, and in such cases grounding would seem advisable. This is notable in the case of the star system with grounds on transformer and generator neutrals. There is, however, the danger arising from this grounding that in case of trouble on the circuits current may flow through the ground to the neutral; in thus flowing it will naturally take the path of least resistance, so that if telephone or telegraph lines, which have normally low resistance to ground, parallel the transmission circuit, the current will flow along these wires, often with disastrous results to the circuits. Two cases of trouble are particularly liable to occur: First, where the neutral points of the high-tension windings of raising and lowering transformers are grounded, the opening of one or two of the three transmission wires will cause currents to flow through the ground; second, a high-resistance ground on a transmission wire will partially short-circuit a transformer and cause current to flow through the ground to the neutral. Some plants have been able to operate satisfactorily with grounded neutrals; with others this grounding has caused great disturbance on telephone circuits, and in one plant it is reported that the blowing of a fuse on one of the high-tension wires put out of service the telephone systems in "ten counties." Thus, while grounding of neutrals may be permissible in certain localities, it may not be allowable in others; and in laying out a plant it would seem to be advisable so to arrange the apparatus that it may be safely operated without grounding the neutrals. An examination of the tables given by the author indicates that the delta system is the one giving the minimum chance of trouble. Under certain conditions, however, the star and star-delta systems will give satisfactory service.

The discussions of the papers of Mr. Blackwell and Mr. Peek was opened by President Scott, who called the attention to the fact that the question of grounding or not grounding the neutral is not at all settled yet; there are diametrically opposite opinions held by practical engineers concerning it, neither one with full reason or the ability to answer the position of those who operate in the other way. It is a peculiar fundamental question, partly theoretical but largely practical.

Mr. Haywood who has operated his 17,000-volt lines without grounds, said his experience was, of course, that one may have a short circuit on one wire, and with the wire down, one could still keep running. Yet he believes that when one gets up to any very high voltage it is better after all to ground the neutral and keep them grounded everywhere. The lines must be made so that they will not break down. The conditions worked out theoretically by Mr. Blackwell and Mr. Peck for possibility of troubles, are not merely theoretical, they will and do occur in practice.

Mr. Gerry believes one may get perhaps equally good results by the use of either delta or a Y-connection on a transmission line. The points, brought out by Mr. Peck are very real, but means can be taken in the construction of a plant and in the arrangement of the transformers to void practically all the serious conditions outlined by him. It is possible to so connect the transformers in star that one transformer cannot be cut out without practically all three coming out at the same time; and when transformers are connected in that way, with the neutral grounded, it should always be done. The star connections of the transformer should be permanent and fixed, so that one transformer cannot be cut loose from the other two, and a reverse can be arranged with reverse apparatus. On the other hand, it is a question whether the star connection is desirable; while one gains something in the design of the transformer, yet this is a small advantage. He discussed some secondary operating advantages of the delta connection.

Mr. Nunn described the troubles which his company has had. The most severe accident was, when operating its 40,000-volt system the current once jumped from the conductor eight feet to the steel frame work of the roof; he knows the fact, but not the conditions which caused it. Many of the troubles were due to the peculiar local conditions of the plant. He gave a great many details concerning its operations and the construction of insulators, and concluded by stating that he cannot better sum up his decision after his five or six years of experience with 40,000-volt work than to say that he does not know, and that there is a lot about it that he does not know and cannot even guess at.

Mr. Thomas analyzed in detail the conditions of resonance at normal generator frequency and at very high frequencies. Mr. Lincoln referred to a contribution by Pupin in which he showed how very difficult it is to maintain resonance with iron in the circuits; he showed that when there was no iron in the inductance coils, resonance was very marked, but as soon as iron was introduced into the coils, it was very difficult to obtain resonance conditions.

Mr. Junkersfeld referred to moderately high voltage transmission lines, such as used in our large cities. In Chicago they have been operating a four wire, three phase, 60 cycle overhead system with a grounded neutral for about three years; the generators are star connected, and the common point is connected to the ground. It has been very successful from the start. They ground in the station only and do not ground any other point of the primary system. The neutral of the secondaries is also grounded. In their underground system, which is operated at 9,000 volts and 25 cycles, they likewise operate now with the grounded neutral. For the first four or five years, while the voltage was only 4,500, they had step-up transformers with delta connections; the next step was to double the voltage and install line voltage generators which are operated with the grounded neutral with very satisfactory results. He emphasizes the necessity of doing away with single-pole switches and fuses. They have had very few transformer troubles. With the increase in the number of transformers, they have come to the conclusion that the advantage of having delta-connection transformers—in order to be able to cut out one of the bank and operate with two—is not very great. They have now gone over to Y-connection and are installing three-phase transformers, the idea being that with these accidents occur very rarely, and when they occur, one can afford to have a whole unit shut down.

Mr. Gerry thinks there is some advantage in using a delta-connected system; one may use single phase switches and one avoids the excessive potentials mentioned by Peck. When satisfactory and reliable swithches are on the market for opening all three legs of a circuit, one may go over to star connection but whether he shall then desire to do so, is another question.

Mr. Woodbridge, in a written communication takes up the special case of high-tension power distributed for the operation of rotary converters. In distributions of this kind the secondary voltage of the step-down transformer is so low that there is no advantage in a Y-connection of the secondary coils; in fact, this would prove a positive disadvantage. For this reason a delta-connection of the secondary windings is to be preferred for three-phase converters. With the primary windings connected Y and and the secondaries delta, in operating synchronous machinery there is no instability of the neutral. After a detailed discussion of the various points which must be taken into consideration, he reaches the conclusion that extra high voltage systems, i. e., those with a working pressure between wires of over 25,000 or 30,000 volts, should have the high-tension windings of their step-up and step-down transformers Y-connected and with the neutrals grounded.

Dr. Louis Bell, in a written communication, concurred with Mr. Blackwell's conclusions. The Y systems, which are immensely valuable in saving copper, also entail some additional care. In practice he has found that mixed delta and Y converters are desirable and tend to to steady the regulation. He believes in the grounded neutral as a safety measure, but sources of accidental grounds should be followed up rigorously and carefuly eliminated.

Mr. P. H. Thomas, in a paper entitled "The Testing of Electrical Apparatus for Dielectric Strength," pointed out that while the only practical method of testing high-tension apparatus is by means of over potential tests, yet the latter involve dangers, and great care should be taken to avoid injury to the apparatus, and excessively severe tests, especially long-time tests at high potential, should be avoided. A disruptive test fails partially of its object in testing the fitness of the apparatus for actual service, because the conditions of the test do not approximate closely the conditions of the service, either normal or emergency conditions. In general, electrical apparatus is never in a condition so poorly adapted to stand dielectric strains as when first installed. Insulation tests require special testing apparatus and expert and experienced direction which are very often not available and without which great risk is run in attempting such tests; as an exception it may be mentioned that some simple types of apparatus, such as high-tension series transformers, high-tension bus-bar insulation, etc., may be readily tested without great danger.

Among the specific practical suggestions, made by the author, for tests of dielectric strength are the following: In high-tension apparatus, e. g., 20,000 volts and above, only moderate, short-time, over-voltage tests should be specified in contracts. Such tests should be used once for all when the apparatus is known to be in good condition, preferably at the factory, by experts, to give assurance that the specification has been met. Such tests should not be made a second time. After installation, a considerably lesser test should be made upon the apparatus, which will detect any serious injury in transportation and installation. Any moderate deterioration due to absorption of moisture, etc., will right itself with service, provided no abnormal deterioration has occurred. It is preferable to make high-potential tests by increasing the voltage upon the apparatus as it is designed to operate, one terminal at a time remaining grounded, rather than making a high break-down test by voltage from an external source. On tests of very high-tension apparatus, such as generators and transformers, no break-down gap should be used in connection with the determination of voltage. Any error in the voltage of test, provided precautions as to the proper size of testing apparatus are used, will be comparatively unimportant. In some cases the voltage of the testing device may be determined by means of a spark-gap before the apparatus to be tested is connected to the circuit.

In the discussion of the paper of Mr. T. H. Thomas, Mr. Terk was the first speaker. A piece of apparatus is in its weakest condition just after it is installed. During transit it is liable to absorb moisture. While it goes on continually drying out, it improves in quality and will ultimately be in as good a condition as it was when it was tested at the works. But before it has been thoroughly dried out, a strain may occur, and is most likely to occur at this time, as the plant is new and the men are not yet experienced.

Mr. Stott considered the tendency of Mr. Thomas's paper to be to discourage tests and thinks this is not good tendency, as we have no factor of safety to depend upon without an over-potential test. In all structural material for mechanical purposes we insist upon strength and we also insist upon a factor of safety ranging all the way from three to ten. For the same reason cables should be tested at an over-voltage. Concerning the effect of moisture on insulation, he had recently made some tests in an atmosphere of steam at atmospheric pressure; he found that steam had apparently no influence whatever on the surface leakage; the only thing that has any influence is the presence of dirt. The moment dirt of any description is introduced on the surface—such as particles of oil or carbon dust, or anything of that nature floating in the air—the insulation broke down immediately in the presence of the moisture.

Mr. Lincoln said that Mr. Stott's analogy between the testing of mechanical apparatus and the testing of electrical apparatus would hardly hold. In the former case one takes a test piece of the material, puts it into the testing machine and breaks it. Mr. Thomas called attention to the concluding paragraph of his paper in which he does not recommend abolishing high-tension tests, but distinctly recommends them, only urging that they be made with reason.

Mr. Waters recommended testing apparatus at a high voltage for only a few seconds; and when it is installed and is just going into operation, to apply a less severe test, say at 50 per cent. over-voltage. Mr. Skinner said that break-down tests are made first to determine the strength of the insulation and second to determine the workmanship. Every piece of electrical apparatus for any considerable load whatever should receive numerous tests during the process of manufacture to determine this second point.

Mr. Mershon said that a one-minute test at a double potential is not any too severe. In a certain transformer test, a water rheostat caused some mysterious troubles which were avoided after a metallic wire rheostat had been substituted. Tests should be made of apparatus after they have been installed; what is wanted to be known is the condition of the apparatus at that place, not how it was in the factory.

Mr. Dunn said insulation tests are necessary to see whether the mechanical pressure applied for instance in putting the conductors in the slots, has not damaged the insulation. But no strain above its elastic limit should be applied to an insulation. He urged the collection data concerning the elastic limit of insulation. Mr. A. S. Langsdorf suggested insulation tests analogous to those which are made with metal, and recently with cement, to determine the effect of fatigue, i. e., repeated tests. Mr. H. Pickler called attention to the fact that in tests we sometimes have no sine waves, but a distorted e.m.f. wave highly peaked.

Dr. Perrine referred to the question of the proper subdivision of long lines for their protection from interference. The problem of constructing perfect high tension switching apparatus is one which must be solved in order to obtain satisfactory long-distance transmission. This problem solved, the multiplication of switching points is feasible and this implies that, with long lines, where two or three duplicate transmission circuits are established, it will become necessary to establish switching sub-stations for no other purpose than the cutting out of sections in the line when repairs become necessary, thus obtaining satisfactory regulation. Such switching apparatus should not be more distant than 25 miles and their location at 15 or 20 miles would be more practical. While the use of automatic switching apparatus would be very advisable, yet the main problem of switching has not been solved so satisfactorily as to permit the consideration of automatic apparatus.

President Scott said that in an electrical machine there are three principal factors: One is iron, which is pretty substantial and determinable from a mechanical standpoint, though it does have its magnetic eccentricities. Then there is the copper which is pretty certain and reliable, both mechanically and electrically. Then there is the insulation, which is a combination of paper, rags and varnish. Now the insulation engineer has a very different and a very difficult problem to handle. With low voltages it is fairly simple. When we get up to the higher voltages, then we have a new order of affairs. One of the things to guard against particularly is that we do not encounter a new kind of phenomena. For example, when we test at two or three times the normal voltage, at high voltages, we are doing this to determine the breaking-down strength. Some phenomena like dielectric hysteresis may come in to make heat, and in suddenly applying the voltages there may be some sudden rises of voltage. It is things of this kind, these incidental and unexpected things, which we must guard against particularly.

Mr. Thomas, in closing the discussion of his paper, repeated his warning that every precaution must be taken to remove intense strains and avoid doing damage where we do not know of it. In a transformer test a spark may occur between two layers inside and the insulation be punctured, and if the apparatus is not in a position to be supplied with current to the full capacity of the system, one may think it is all right; a little later a strain of much less magnitude may come along when conditions are favorable for the fault to be developed and then the apparatus will break down. Concerning fatigue tests, he remarked that time tests are fatigue tests in a sense. A time test with alternating current is the application of recurrent strains and the longer that is carried on the more fatigue tests one has. Concerning the elastic limit of insulating materials, this is a question which he is afraid will never be settled.

There were three communicated discussions of Mr. Thomas's paper, by Mr. L. A. Hawkins, Mr. H. Gerry, Jr., and Dr. Louis Bell.

Mr. Hawkins does not consider of much importance the objection that the weakest point is the only one which is tested; in practice it is the weakest point alone that is of importance. On tests of very high-tension apparatus no spark-gap should be used in connection with the determination of the voltage.

Mr. Gerry recommended more tests of samples of the insulation and less testing under severe strains of the finished product. The effect of temperature on insulating material should be taken into careful consideration. The deposit of moisture during transit may permanently injure the qualities of the insulation. Shipments of such material should be made in hermetically-sealed cases, under oil, or in a manner to prevent contact with moist air at varying temperatures. This is a matter of importance especially in connection with the shipment of large high-tension transformers.

Dr. Louis Bell does not think it wise for a purchaser of apparatus to place much reliance on over-voltage tests set forth in contracts, save in case of line insulators and other simple apparatus. In other cases such tests ought not to be long continued and should not be made until the apparatus has successfully stood a full load test and recovered therefrom. He does not think that a disruptive test is unfair because it may subject to severe strain parts of the insulation which normally receive in commercial working only a moderate strain; the disruptive test ought to try out these very points. He attaches some value to an overload test at a voltage somewhat greater than will ever be demanded in practice, with careful insulation measurements before and after.

In a paper with the title "Choice of Frequency for Very Long Lines," Mr. P. M. Lincoln discussed the question which of the two standard frequencies—60 or 25 cycles per second—is the better frequency for a very long line, if the matter is considered purely as a transmission problem. In his discussion the author assumes a three-phase line 200 miles long. He first takes up voltage regulation and gives a table showing the limits of transmission of low capacities; if the voltage at the receiving end is 20,000, the power which can be delivered with 20 per cent. inductance volts is 500 kw for 60 cycles and 1,250 kw for 25 cycles; for a voltage of 80,000, the power is 8,000 kw, and 20,000 kw for 60 or 25 cycles respectively. If the amount of power to be transmitted is large, the multiplication of lines necessary at 60 cycles unduly increases expense both of pole lines and of right of way for the same; this point is evidently in favor of the lower frequency. The author then discusses the effect of the charging current and shows that in a 60-cycle installation it is necessary either to operate the generators on such a line at about full current output all the time, no matter what the load, or to compensate for the charging current in part or in whole by the installation of choking coils, either horn of which dilemma is not pleasant to consider. The author discusses finally the danger of resonance; the lower the fundamental frequency, the less is this danger. While no actual trouble has ever been experienced in existing plants from this source even in the longest lines and highest frequencies in use, yet it constitutes an advantage for 25 over 60 cycles that cannot be dismissed with a scoff. In spite of these advantages of the lower frequency, it is a fact that the longest transmission line in the world (Bay Counties) and the highest voltage line (Missouri River Power Company) are both operating at 60 cycles.

In the discussion of Mr. Lincoln's paper Mr. Mailloux said that as electrical energy is used mainly for lighting the frequency must be chosen accordingly; he himself has found a frequency of 40 to be unsatisfactory for lighting; he thinks a frequency of 50 might perhaps be a satisfactory compromise.

Mr. Stott said that incandescent lighting becomes impossible at about 20 cycles, as shown by experiments which he carried out. Twenty-five cycles, with a low-efficiency lamp, taking about 4 watts per candle, at voltage of 110, were found quite satisfactory; they made the experiment of having direct-current lighting in the draughting room and then without notice threw it over on the alternating current, and no one knew anything about it. About 30,000 incandescent lamps in the elevated stations in New York are run now on 25 cycles and very few people notice the fluctuation. He thinks it depends a good deal upon the voltage regulation and also upon the fact that low-efficiency lamps are used.

Mr. Mershon said that in most transmission plants the condition to be met first is that of delivering power at a high frequency of 60 cycles. Then the question comes down to whether or not it is better to transmit at 25 cycles and use frequency changers for 60, or whether it is better to transmit at 60 cycles and use synchronous motors to raise the power factor of the load. If one considers the question of the investment in both cases, the 60 cycles show up much more favorably. Concerning the lowest frequency suitable for lighting, the personal element is to be taken into account; the majority of people cannot notice any effect from 30 cycles.

Mr. Rushmore said that with relation to the self-induction and capacity of the line, one must also take into account the apparatus in the circuit. The higher the voltage is which is applied, the more care must be taken that the generator e.m.f. wave should have the form of a sine wave. Messrs. Lincoln, Mershon and Perrine discussed the possibility of obtaining regulation be means of synchronous motors placed at the end of the line. Mr. Lincoln believed that the scheme of Mr. Mershon would not work. Dr. Perrine referred to a successful regulation of a line effected by Mr. Baum by means of an automatically excited synchronous motor.

Mr. Stott referred to experiments made some time ago in Columbia College and which showed that 20 or 21 was about the highest frequency at which any man could detect a flicker of incandescent lamps regularly; in fact, the majority could not detect with certainty a flicker at a frequency of 20. He also referred to a case in which arc lamps are said to have been operated quite satisfactorily at a frequency of 30.

There were presented two communicated discussions of the paper of Mr. Lincoln, the one by Mr. B. A. Behrend, the other by Prof. F. G. Baum.

Mr. Behrend pointed out that in considering the question whether a frequency of 25 or 60 cycles is preferable for power transmission, one should not confine the attention to the line itself, but should take into consideration the generating plant, the transformers, and the sub-station as well. In regard to the generating plant and the transformers, a frequency of 25 is without doubt lower than desirable. In regard to the sub-station apparatus, a frequency of 25 is as high as desirable for rotary converters, while it is too low for lighting.

Prof. Baum also said it is not right to confine the discussion of the choice of frequency to the transmission line, because the frequency effects every part of the system, including generators, transformers and receiving apparatus. If one would take the effect on the transformers alone into account, the higher the frequency, the better. The best frequency for the generators depends on the speed at which they are driven, and on their capacity. If a system were to be laid out entirely new, including receiving apparatus, it is very probable a lower frequency than 60 would be chosen; but if the power is to be used for a mixed load of lights and motors, the frequency would be limited by the periodicity at which the flickering of lamps can be noticed, i. e., about 30 cycles. If the lines are to increase in length to 300 and up to 500 miles, it will be necessary to operate at less than 60 cycles in order to reduce the reactance volts and also on account of coming into resonance with the line.

In a paper entitled "The Operation and Maintenance of High-Tension Underground Systems," Mr. Philip Torchio gave some notes on moderately high-tension underground systems as installed in large cities in the last few years. Concerning independent vs. parallel operation of feeders at sub-stations, he remarked that independent operation has in most cases the disadvantage of not allowing the full use of the copper investment at light loads; but has the following advantages: The short-circuit current fed back from the sub-station bus-bars into a faulty feeder is limited by the reactance of at least two sets of transforming apparatus, which will materially help the final clearing of the short circuit. Further in rotary converter sub-stations the independent groups of transforming apparatus can be fed from different bus-bars or from different generating stations, thereby increasing the reliability of service. The author made some brief remarks on testing of cables and gives in a table the record of all cable faults of a New York company for a period of five years, the voltage of operation being 6,000; of the 9 faults manifested there were 5 due to extraneous mechanical causes and 4 to defective installation.

Ground detectors with annunciator relay and drop-signal are considered as desirable features of a high-tension switchboard equipment. Grounding of the neutral of high-tension generators has apparently given satisfaction wherever it has been tried; the objection to the heavy short-circuit current from one leg to ground has been overcome by the suggestion of grounding through a non-inductive resistance, thereby limiting the short-circuit current to a pre-determined amount. It seems impossible always to guard against the appearance of high voltages due to sudden change of load, grounds, short-circuits, etc., and, especially in the latter case, spark arresters will greatly increase the safety. These devices are preferably connected delta on systems without grounded neutral and installed at the generator end as well as sub-station end of every cable and at every other place where the cable is looped into a sub-station or joins an overhead line.

"The Use of Automatic Means for Disconnecting Disabled Apparatus," was the subject of a paper by Mr. H. G. Scott, in which he gave some notes on this subject, dividing it into three sections: generating apparatus, transmission apparatus, receiving apparatus. He states as a general proposition that no overload device should be used in the generating plant to disconnect disabled apparatus. On each generator a suitable circuit-breaker should be installed which will operate only when the direction of flow of energy through it is reversed. As an additional precaution in large plants, a second reverse-current relay should be installed which will merely light up a letter or number in front of the operator so that in the event of the failure of the first automatic device the faulty machine may be quickly disconnected by hand. These reverse-current relays should have a time element and current-limit attachment, which should be set for not less than three seconds, so that a slight reverse current, or one of momentary duration, such as is liable to occur at the moment of multiplying, will not operate the circuit-breaker.

For transmission lines the author recommends to run the feeders entirely separate at the receiving end, only putting the direct-current end of rotaries in multiple; or in cases when low-tension alternating current (2,000 volts or less) is supplied, putting the secondaries in multiple. If under these conditions, reverse-current relays are installed at the receiving end of the feeders they will operate very satisfactorily as the reactance of the rotaries and transformers will be sufficient to limit the reverse current in the faulty cable, thus allowing the reverse-current relays to operate, as there has been no serious fall of potential. The greater the number of feeders between the generating station and the sub-station, the better this method becomes.

With the title "Electric Cables for High-Voltage Service," Mr. Henry W. Fisher gave some notes on the manufacture of cables. Since paper-insulated cables have been improved, some engineers prefer paper to rubber, the life of paper cables being assumed to be longer than that of rubber cables. On the other hand, the ability of a rubber-insulated cable to withstand high voltages depends upon the ingredients entering into the composition of the rubber compound. The dielectric strength to resist electric pressure becomes greater within certain limits with increased percentages of pure Para or other high-grade rubber, and there is good reason for believing that when lead-covered cables are employed the life of rubber-insulated cables is lengthened with increased percentages of such rubber. In the manufacture of paper-insulated cables for high voltages, great care has to be exercised in selecting the right kind and quality of material, and also in the methods of construction and impregnation of the paper with the insulating compound. Cables saturated with oily compound can better be handled without injury to the dielectric, and also resist better high voltages. The use of oily compound is, however, accompanied with lower insulation resistance, and consequently many engineers who think they are adopting the best practice by specifying several hundred megohms per mile, are in reality inviting bids on an undesirable type of cable.

The carrying capacity of cables as frequently recommended is entirely too great when many cables are in the same duct system. In this case the middle and top one, although carrying normal currents, are apt to become very warm. Under no circumstances should the temperature of the conductor be allowed to reach 90° C.

The three papers by Messrs. Fisher, Torchio and Stott were discussed together. Mr. W. C. Carlton contributed a written discussion of Mr. Torchio's paper. The experience of the Chicago Edison Co. with its high tension three phase cables has been similar to that of the New York Company, mentioned by Mr. Torchio. At present they are operating about 45 miles of three-conductor cable at 9,000 volts. The first of these cables was installed about five years ago. The voltage used at first was 4,500, but about a year and a half ago it was changed to 9,000. There have been seven cases of trouble on these cables; four were caused by mechanical injuries to cables in manholes; one by a burn out on an adjacent cable; one by a defective joint and one by electrolysis causing a hole to be made in the lead sheath of the cable. With the exception of the defective joint, none of these troubles would have been avoided by using high pressure tests in the cables. The neutral points of the high tension generators are grounded direct, no resistance being used to limit the flow of current. Two of the cases of trouble, one due to mechanical injury and one to electrolysis, resulted in one conductor of the cable burning to ground, the other two being left in good condition. Very little damage was done, but he believes that if they had been operating without a grounded neutral, the chance would have been greater for more serious trouble, owing to the displacement of the neutral that would have occurred.

Mr. W. P. Wells contributed a written discussion of Mr. Stott's paper. He states that his recent experience with 6,600-volt, revolving-field apparatus in central station practice, has convinced him that automatic disconnecting devices are not necessary in order to insure reliable operation of the system to which current is supplied, and that capable operators with good judgment can handle any cases that may arise. During the two years that his station has been in operation it has always been the practice to run the high tension feeders on what Mr. Stott refers to as the safest plan, i. e., entirely separate at the receiving end, only putting the direct current ends of the rotaries in multiple. But as practically all the sub-stations are equipped with large storage batteries, which are also in multiple with the rotaries, it has been found best to operate without reverse current relays, but depend on the operator in the sub-station opening the circuit-breakers when necessary. On the entire system there are in use no automatic disconnecting devices except those operated by time overload relays on the feeders in the generating station and by a centrifugal speed limit device on the rotaries in the sub-station.

In the oral discussion which folowed, Mr. Schwartz was the first speaker. He agreed in general with Mr. Stott and made some remarks on the reverse current relay for the generator circuit. For the transmission line he thinks that at the generator an overload relay with a time limit device will be generally sufficient.

Mr. Eglin said that with the growth of the size of generating stations and with all the feeders run in parallel on a large generating station, some means must be provided for limiting the amount of energy that can be put into any short circuit of a high tension cable. Their practice has been to subdivide the feeders at the sub-stations these not being tied together there. Their operation has been very successful.

Mr. Mailloux said that in many cases automatic devices are undesirable, and referred to the experience which he had with isolated plants in large hotels, where they depend on the operators entirely; the principle thing in such a hotel is to avoid a panic.

Mr. Mershon, and Mr. Mailloux asked several questions to which Mr. Wells replied. It is the practice of the New York Company, mentioned in Mr. Torchio's paper, not to make any over-voltage tests on cables or, in fact, on any electrical apparatus. Cables and apparatus are thoroughly tested before being put into service. A test of a light over-voltage, of 20 or 30 per cent. is enough to determine whether the work has been properly done or not.

Mr. Stott said that it is the practice of his company to make a 30-minute test at 100 per cent. over-voltage. They have found that a joint which is comparatively poor will stand up as long as 18 minutes and then break down. They have in operation over 120 miles of 11,000-volt three-phase underground cable. Out of that 120 miles they have had only one fault in the cable itself. All the others were due to inferior work in the joints. Since they went into operation 20 months ago, they have had a total of four break-downs while operating. He believes that a great deal of the underground troubles which have occurred were not due to faults in the insulation, but to faults in the lead sheath, stray currents from other properties passing through the same. They have now decided to re-insulate the lead sheaths of their cables all the way through in the man holes. The condults are very good insulators themseves.

Mr. Fisher gave an account of cable tests recently made at Niagara Falls. He stated that cables are now working at 22,000 volts in this country, being guaranteed for that voltage. A communicated discussion by Mr. E. P. Burch dealt with the very successful operation of two 12,000-volt, three-phase cables, of 9.5 and 7 miles length respectively, in Minneapolis. Most cable faults are due either to mechanical injuries or to chemical deterioration of the sheath from electrolysis; in both cases moisture finally works through the paper insulation. Mr. R. S. Kelsch contributed a written discussion on the use of automatic means for disconnecting disabled apparatus. Reverse current relays should be set to operate at 5 per cent. reverse current.

Recent Electrochemical Developments.

REMOVING SILICA FROM COKE.

In the manufacture of aluminum and other metals by electrolytic processes, the carbon used in the electrodes must be free from silicon compounds and particularly silica; otherwise when the electrodes are consumed in operation, the silica originally contained in the same is taken up by the aluminum, thus yielding an impure product. In order to avoid this, it has been proposed to use in the electrodes petroleum-coke, because it is practically free from silicon, but such coke is more expensive. Mr. Charles M. Hall, the inventor of the Hall aluminum process, has now devised a method which has just been patented to him, for removing silica from the ordinary and cheaper kinds of coke.

This method consists in mixing with the pulverized coke a metallic fluoride which will react with the silica, giving a fluoride of silicon, which goes off as a gas during the process of baking the electrodes. Sodium fluoride, cryolite and fluorspar give good results. The powdered coke and fluoride is then mixed with pitch or an other suitable binder and formed into blocks or whatever form of carbon is desired.

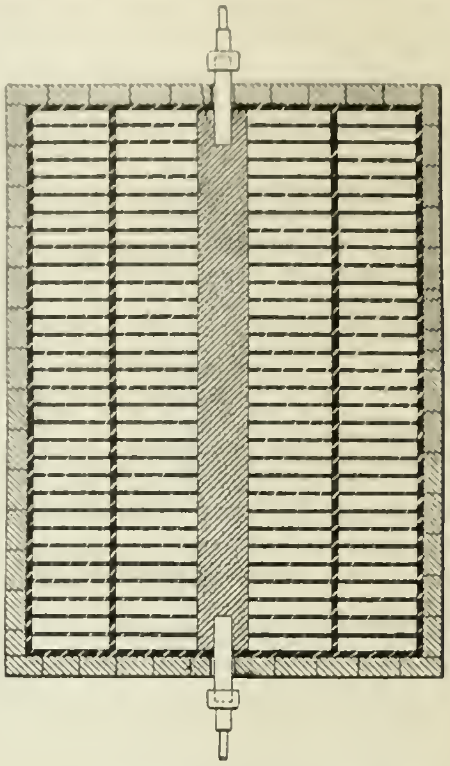


FIG. 1.—REMOVING SILICA FROM COKE.

These are then baked in a furnace of the form shown in the adjoining diagram. The wall of the furnace is built of brick, and in it the carbon blocks are placed, insulated from each other. In the center of the furnace a core of a suitable material is provided which can be heated to an adjustable temperature by means of an alternating current supplied through the binding posts, indicated at the top and the bottom of the figure. The temperature should be somewhat higher than in the ordinary baking furnace, in order to facilitate the chemical reaction between the fluoride and the silicon.

Instead of mixing the coke, fluoride and pitch and forming them into the desired shape before baking, thereby combining in one process both the purification of the coke and the manufacture of the electrodes therefrom, the purifying step may be carried out separately by heating the mixture of coke and fluoride alone. The operation of the process in two steps has one advantage; namely, that the material then receives two heatings, thus insuring the completion of the desired chemical reaction.

ANODES FOR ELECTROPLATING.

A patent was granted on July 14 to Mr. Harry E. Starrett, of Chicago, for the use of metallic (especially nickel) anodes of elliptic cross-section instead of the usual rectangular form. Flat anodes of rectangular cross-section are corroded and dissolved more readily at their edges and corners than at other places on their surface, and cathodes suspended opposite such anodes receive the deposits of the metal of the bath more rapidly at those points which are nearest the edges and corners of the anodes, thus producing a coating of unequal thickness.

A recent investigation by Prof. C. F. Burgess and Carl Hambuechen (published in *Electrochemical Industry*, June) gives point to this patent. They determined the variation of the current density over the various places of the anode surface, with electrodes of oval and of rectangular cross-section, and found that it is quite constant over the whole surface in the former case, but not in the latter. This has the effect that with an oval electrode, the corrosion takes place in such a manner that the electrode retains its original shape, although, of course, decreasing in size, the corrosion continuing until the electrode is reduced to a very thin rod or slip; the necessary waste or scrap from such electrodes is, therefore, only 5 per cent., against about 15 per cent. with electrodes of rectangular cross-section.

OZONIZING APPARATUS.

The construction of ozonizing apparatus for the sterilization of water has been undertaken with considerable energy by various electrochemical inventors in Europe, and apparatus of various types are operated on a commercial scale in different cities of Germany and Holland. A patent, granted on July 14 to Dr. Marius Otto, of Paris, France, is especially interesting at the present time in view of the fact that an exhibition of his ozonizing and sterilizing apparatus was recently given in Niagara Falls. The feature of the present patent is the method by which the cooling of the glass plates and the insulation in the ozonizer is effected.

The adjoining diagram shows the Otto ozonizer, in which a sheet of iron, *a*, provided at its upper end with an air chamber, *b*, and an exhaust pipe, *c*, is suspended between two plates of glass, *d*, held at a suitable distance by insulating clamps made of glass. To the exterior surface of each of these two plates of glass is fixed a metallic conducting surface, *e*, covered with a layer of felt, *f*. The whole arrangement is firmly secured by screws to the metallic support, *g*. Two perforated metal tubes, *h* and *i*, allow of the felt layers, *f*, being continuously sprinkled with water. The two exterior electrodes are connected to earth at *t*. Only the metallic sheet, *a*, is insulated and is connected by means of the wire, *l*, with one pole of the high-tension winding of a transformer, *m*, the other pole of which is connected to earth. When the apparatus is in working order the electric sparks leap the interval between the sheet, *a*, and the interior surface of the dielectric, *d*. Air flowing in the direction indicated by the arrows intersects these sparks and is thus ozonized, to be led to the sterilization tower. *P* is a spark-gap, to act as an automatic protecting device should the potential reach a limit dangerous to the security of the apparatus.

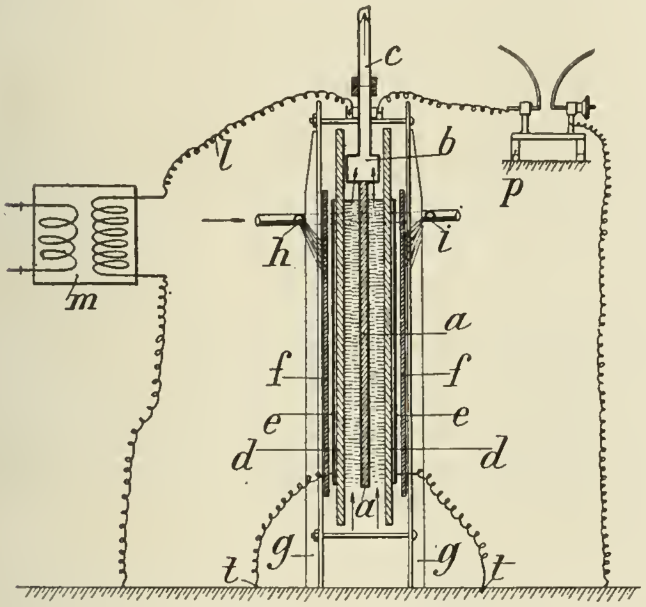


FIG. 2.—OTTO ATOMIZER.

REDUCTION OF METALS IN THE ELECTRIC FURNACE.

A patent, granted to Mr. Georg Egly, of Charlottenburg, Germany, refers to a well-known difficulty experienced in the reduction of metals in the electrical furnace, especially in the preparation of nickel by reduction of protoxide of nickel in presence of carbon. This difficulty is that the molten metal easily takes up carbon from the electrodes, thereby appreciably diminishing the value of the product. Mr. Acheson, in a recent patent, avoids this difficulty in an electric furnace heated by means of core of carbon, by covering the carbon core with a refractory heat-conducting sheath of a carbide.

The furnace has two electrodes, and the lower horizontal one, which in the case of continuous current is the cathode, is covered with a layer of about 2 cm thickness, of a scoria which protects the metal formed in the reduction process against the absorption of carbon from the lower electrode. This scoria is formed over the lower electrode previous to the reduction process, and magnesia is said to be a substance especially well fitted for the formation of such a coria.

Wireless Telegraphy in Guadaloupe.

Consul Ayme, of Guadaloupe, reports on June 10 that the wireless telegraph system in operation between that island and Martinique has been thrown open to the public. Messages are transmitted to the station at Gosier by telephone. The tariff of rates is practically that of the French Cable Company, the lines of which were broken at the time of the eruption of Mont Pelée, and have not yet been repaired.

New Telephone Patents.

REDUCTION OF SIDE TONE.

With common battery systems the production of an ideal talking circuit for sub-station instruments has been a considerable problem. Both clearness and volume are obtainable in many ways, but their accomplishment has involved a volume of side tone such as to bring the resultant efficiency below the desirable limits. An improvement in the standard circuit of the Bell Company, having for its object a reduction of side tone, is the subject of a patent recently granted to A. B. Stetson.

In the Bell Company's standard circuit the transmitter is inserted in that portion of the circuit numbered 8, 9 in Fig. 1. The present invention consists in transferring it to the position shown, isolated from the local receiver circuit. This change eliminates from the receiver circuit any "series" or direct effect from the transmitter, and it has been found to materially reduce the side tone. On the other hand, the change in the circuit is evidently such as to have little effect upon its transmitting and receiving qualities.

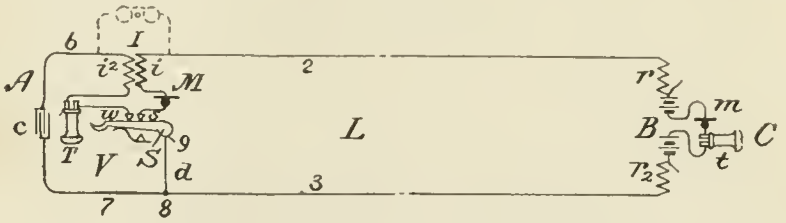


FIG. 1.—STETSON SUB-STATION TELEPHONE CIRCUIT.

ANTISEPTIC DEVICE.

After a considerable period of quiet the antiseptic mouthpiece has again broken forth, appearing in a patent granted to S. J. Ballard, of Los Angeles, Cal. This device is of the "sheet of paper" type and is adaptable to both receiver and transmitter. A rather neat metal clamping device holds a pad of paper sheets near the mouthpiece of the instrument in a position such that a single sheet may be conveniently inserted between the mouthpiece and the user. It is suggested that such paper sheets be used for advertising as well as for antiseptic purposes. The chief merits of the device lie in its simplicity.

NEW EXCHANGE APPARATUS.

In Fig. 2 is shown in detail the magnet and coils of a receiver which has been patented by Mr. J. S. Goldberg and assigned to the Stromberg-Carlson Company. The object in view is the production of a receiver which can be disassembled quickly and easily, and the inventor seems to have succeeded excellently in accomplishing this result. The mounting of the pole pieces and pole spacer are self-evident, but this is scarcely true of the coil retainer, which is arranged as follows: After the coils are slipped upon the pole pieces, a punched metal washer, shown in plan at the left of the figure, is slipped down above them. Over the retaining washer the clamping plate is placed. This plate is shown at the right of the figure. The clamping plate has a central projection which registers with the small central hole in the retaining washer and serves as a pivot. By the aid of the spanner wrench, the ears of the clamping plate are turned into slots in the poles. In this position the plate becomes locked,

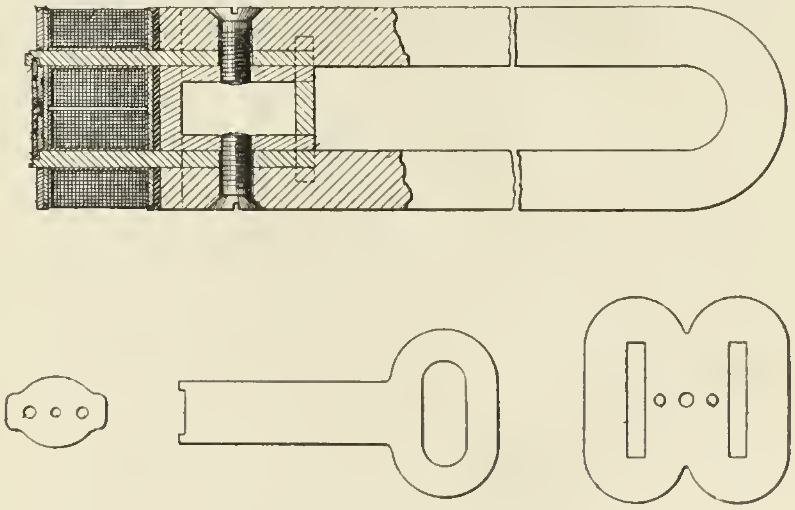


FIG. 2.—GOLDBERG RECEIVER.

because the wrench holes drop over light projections rising from the retaining washer. It is claimed that with this construction, which is not expensive, receiver coils may be replaced at subscribers' premises in a very few minutes.

A circuit switch of the type commonly used with the hand microphone of foreign practice has been applied to receivers by Mr. Benj. O. Fox, of Milwaukee. The side of the receiver body is slotted to receive the switch piece of hard rubber, as shown in Fig. 3. This handle is mounted directly upon the swinging switch member, which projects into the cup-shaped end of the receiver and swings between the other contact springs. These springs are bent to clear the receiver coils and magnet.

A second circuit switch, this of the ordinary hook variety, has been patented by E. H. Strauss, of Chicago. In this switch the contact springs are arranged beneath the switch lever and are assembled in groups after the manner of switchboard keys. Rubber projections from the switch lever engage the upper springs and thereby control the contacts.

Mr. J. S. Gemmill, of Cleveland, Ohio, has designed and patented a new call bell ringer in which the distance between the armature and the polarizing magnet is kept constant. Adjustment is accomplished by providing the operating magnet cores with slidable centers. These may be adjusted to alter the air-gap, without changing the position of the armature.

COMBINED JACK AND DROP.

Combined jacks and drops have received a good deal of attention from the independent manufacturers, many different kinds having been produced. The latest of these is described in a patent granted to Charles E. Egan. In this the jack is placed directly in front of the drop to economize space. The drop shutter is perforated to clear the jack body sufficiently to allow of its falling just far enough to display a satisfactory signal. Self-restoring features are contemplated, but these and the details of construction are not disclosed in the present patent. Mr. Egan has assigned his patent to the Western Telephone Manufacturing Company.

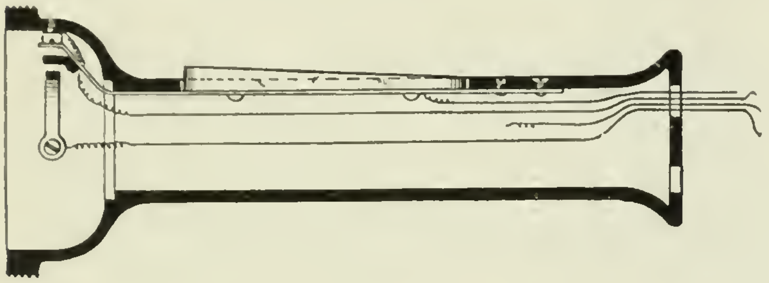


FIG. 3.—FOX TELEPHONE.

AN AUTOMATIC CENTRAL OFFICE.

A new automatic exchange system of German origin forms the basis of a patent issued to Friedrick Merk, of Berlin. This system provides a selector switch at the subscriber station and a switching machine for each line at the central office. The apparatus at the subscribers' station is remarkably simple, requiring but one extra electrical contact, and but one electromagnet, this controlling an escapement. The central switches are also fairly simple, this simplicity being made possible by the use of a continuously rotating commutator. One commutator performs the current switching functions for the whole exchange, its various brushes being connected to eight bus-bars, which tap all the switching machines. The commutator carries four independent rings connected to batteries and thus continuously sends out upon the associated bus-bars the sequence of current impulses necessary for completing a connection. It thus only remains for the sub-station selector switch to start its central office connecting switch and to stop it, all intermediate switching functions automatically taking place through the agency of the commutator.

The connecting switch arm passes over a series of contacts to which the several lines are connected in the proper sequence, the number of steps made by the switch arm determining the particular line with which connection is established. Provision is cleverly made to prevent interference with busy lines, to automatically send all signals and to restore all parts to the zero position upon the return of the receivers to the switch hooks. The apparatus in its present form is unfortunately adapted for a few lines only, but the ideas involved seem worthy of further development.

CURRENT NEWS AND NOTES.

TELEGRAPHERS' UNION.—The Commercial Telegraphers' Union of America is now holding in New York its first annual convention. Delegates are in attendance from Philadelphia, Chicago, Boston, St. Louis and other large cities, and several from Canada.

LIGHTNING IN A COAL MINE.—During a thunder storm at Frackville, Pa., July 15, a lightning bolt descended into a mine, following the steel rails into the slope to the bottom, a distance of about 400 ft. Several miners received shocks, but none was seriously injured.

TELEGRAMS ABOUT THE POPE.—Some idea as to the immense amount of telegraphic traffic caused by the illness of His Holiness, the Pope, may be found from the following cable dispatch from Rome, of July 15: "Yesterday the number of dispatches inquiring about the Pope's condition which have been received at the Vatican reached 26,000, including some lengthy cablegrams from half round the world. The total cost of these telegrams is estimated at $36,000. This enormous deluge taxes to the utmost the resources of the Vatican administration. A large force of priests and seminarians is temporarily aiding the officials in making responses, which bear the signature of Cardinal Rampolla." This, of course, is wholly exclusive of the enormous quantity of cable news and special cable correspondence from all parts of the world.

INSULATION FOR HIGH-TENSION CURRENTS.—A patent was granted on June 30 to M. K. S. Lemström, of Helsingfors, Finland, for an insulator for use in connection with influence machines generating high-tension current, and in which it is desirable to provide against the loss of any portion of the current. A porcelain insulator of the ordinary bell form is employed, but is not fastened to an iron support, as is usually done, but to the upper end of a vertical rod of highly polished ebonite. If the surface of the porcelain bell should get moistened, the current which might escape by way of it, is interrupted by the ebonite support, to the polished surface of which water does not adhere. On the other hand, the porcelain bell protects the ebonite from the deteriorating effects which are usually caused in the polish of ebonite by exposure to the weather.

TESLA AT WARDENCLIFFE.—Some startling things have been taking place at Wardencliffe, L. I., according to a press dispatch from that place. The dispatch reports that "all sorts of lightning were flashed from the tall towers and poles" in the grounds where Mr. Tesla is at work. It is understood that Mr. Tesla has driven a deep well beneath the tower and that the electric waves are sent underground as well as through the air. "It is true," Mr. Tesla is reported to have said, "that some of them (the experiments) have had to do with wireless telegraphy, and that in addition to the tower and poles there is a hole dug in the ground. This is 150 ft. deep and is used in these experiments. If the people about there had been awake instead of asleep, at times they would have seen even stranger things. Some day, but not at this time, I shall make an announcement of something that I never once dreamed of."

NEWS ALL THE VOYAGE.—The Cunarder *Campania*, on her arrival last week, attested a remarkable development of Marconi wireless telegraphy at sea. She was never "out of touch" the whole way over and back. By her log it is shown that going to the eastward she held converse with the Marconi wireless stations at Babylon, Sagaponack, steamship *Umbria* coming west, and Nantucket Lightship. These dialogues were on a Saturday. Sunday the Atlantic Transport steamship *Minnetonka*, proceeding for London, was the link; Tuesday the sister ship *Carpathia*, from Liverpool, bound this way; Tuesday and Wednesday the *Lucania* and the *New York* were picked up; Thursday the Cunarder *Ivernia*, bound for Boston; Friday and until the stage was reached at Liverpool, *Crookhaven*, *Rosslare*, *Holyhead*, *Seaforth* and the *Etruria*, leaving port. Returning this way the *Saxonia*, a Boston Cunarder, *Seaforth*, *Holyhead* and the *Umbria* were "on the wire." Sunday *Rosslare*, *Roche's Point* and *Crookhaven;* Monday the *Carpathia*, steaming in the other direction, was on the list of correspondents; Tuesday and Wednesday the *Lucania* was the connecting link; Thursday the *Philadelphia*, also steering eastward, and Friday and until arrived at her pier Saturday, the *Campania* talked with Nantucket Lightship, Sagaponack, Babylon and the *Etruria* in the North River about to sail for home. The *Cunard Bulletin*, published Friday, July 17, had the news transmitted through the air from Nantucket Lightship of the Pope's condition; the death, in London, of William E. Henley, the author; the execution of Dougal, the Moat House murderer, and confession on the scaffold; the death of Mrs. James G. Blaine; the record of the Great Western Railway train from London to Plymouth, which covered 240 miles in 233¾ minutes; entertainment of the American fleet at Portsmouth; the government crop report, and market reports.

WIRELESS TELEGRAPHY IN THE NAVY.—Rear Admiral Bradford has ordered twenty sets of wireless telegraphy for installation on the flagships and scouts which will participate in the summer manœuvres. The *Topeka* and *Prairie* will soon install wireless telegraphy sets for experimental purposes.

PAPAL CANDIDATURE.—The Marquis de Castellane, discussing in a New York newspaper the prospects of the various candidates to succeed Leo XIII, says of one of them: "Cardinal Ferrari, Archbishop of Milan, is not favored, for the apparently trivial reason that he uses a motor car, which is not considered dignified in a Prince of the Church."

TELEGRAPHS IN EAST AFRICA.—The telegraph system in the East African British Protectorate of Uganda now extends to the shore of the Albert Nyanza. The trunk line from Mombasa, with its branches, is over 1,034 miles in length, and the charge over the whole distance is 4 cents a word, with a minimum of 33 cents for a message of eight words. There is also a telephone service along the whole distance, which may be used at 33 cents a conversation. The pole line consists of living trees.

NOTABLE ITALIAN STORM.—A fierce electrical display occurred recently in Northern Italy and residents near Lake Como were treated to an extraordinary exhibition of lightning pyrotechnics. Thunderbolts fell in every direction, and the ground seemed to shake from the terrific roar of the thunderclaps. One thunderbolt fell into a cabin where ten peasants and a dog had sought shelter. Five of the peasants and the dog were killed outright. It is said, however, that some one had presence of mind enough to secure some good photographs, which will be very interesting.

NEW RUBBER SUPPLY.—In a report to the Department of Commerce and Labor Consul-General Guenther says that a Liverpool firm, which does a large trade with West and Southwest Africa, recently received a species of plant, hitherto unknown, that produces rubber. The plant grows underground and will probably be found in English West Africa. The rubber is directly beneath the bark and is of unsurpassed quality. Ordinarily the roots, when about one month old, contain from six to six and one-half per cent. of rubber. If the bark is removed the percentage is higher.

EXTENSION OF PACIFIC CABLE.—It is now stated from San Francisco that the Pacific Commercial Cable Company will proceed immediately with its cable from Manila to Shanghai. R. Lucas, the engineer who has charge of the laying of the cable from Honolulu to Manila, has arrived there. In discussing the project, Mr. Lucas said: "The cable undoubtedly will be extended from Manila to China, for such was the intention when I left England to begin the work of connecting Honolulu with Manila. The port of Shanghai has been selected by the company as a terminus of the wire. The steamers *Anglia* and *Colonia* will return home, and one will then be sent out with the cable, which is to connect Manila and Shanghai."

NEW INVENTIONS OF MARCONI.—The London correspondent of a Montreal paper announces that new inventions have been made by Mr. Marconi which will greatly facilitate the transmission and reception of long-distance wireless telegraph messages. It is stated that Mr. Marconi is expected to arrive on this side about the middle of August, when the new system will be placed in operation at Table Head and Wellfleet. It is reported that these inventions are of a very radical and revolutionary character. According to the statement of a gentleman authorized to speak for the American Marconi Company, poles and towers for use in the transmission of transatlantic messages will be unnecessary, the entire operation being conducted at the sea level. Further than this, it is stated, instruments have been devised which wholly neutralize the effect of atmospheric electrical disturbances upon the apparatus used in wireless telegraphy. Syntonism, this gentleman further states, has advanced beyond the experimental stage and has entered the realm of practical certainty.

A CURIOUS THIRD-RAIL DISPUTE is exhibited in the following item from Scranton, Pa.: "Grand Master Morrissey, of the Brotherhood of Railroad Trainmen, telegraphed the local lodge of the Brotherhood to accept the application of the employees of the Laurel Line, a third-rail electric road, for membership in the brotherhood, despite the protest of the Amalgamated Association of Street and Electrical Railroad employees, that these men come under its jurisdiction. A boycott was placed on the road when it was opened in May because the employees were not unionized. The company declared its willingness to have the men join a union and the men made application for membership in the brotherhood. National Organizer W. B. Fitzgerald, of the Amalgamated Association, declares that unless the men join his organization the boycott will not be lifted. The fight is the opening of what promises to be a bitter war between these two organizations for jurisdiction over the employees of this new kind of railroad, a line which is operated and disciplined the same as a steam railroad and runs over a private right of way between distant places, but which uses electricity for motive power."

SPEEDY DEEP SEA CABLE LAYING.—In speaking of the recent work of the *Anglia* in laying the Commercial Pacific Cable, the Honolulu correspondent of the *New York Herald* says: "In the actual work of laying the final section of cable the *Anglia* had a very remarkable trip. She started soon after noon on June 26 to pay out the section from Midway to Honolulu, and came right along without the slightest hitch or delay, taking the courses surveyed by the *Hero* several years ago. The deep sea cable ended about ten miles south of the Island of Oahu, about eighteen miles from the place where the shore end was landed. The *Anglia* laid exactly 1,315 knots of cable from Midway to this point, and with the additional eighteen miles of shore end the actual amount of cable laid is 1,333 knots. There was about eight per cent. of slackage. The cable force was very proud of the making of a new record for continuous use of the wire log, which registers the distance traveled. This log is on reels of 140 knots each, which have to be renewed as fast as they are run off. Heretofore the transfer of the reels has necessitated vessels slacking. The greatest run ever made before without a stop was 840 knots. The *Anglia* ran the entire distance of 1,221 miles without a single break or stoppage or slacking of speed. The greatest depth encountered on the trip from Midway was about twenty-seven hundred fathoms."

TROLLEYS AND AESTHETICS.—With regard to trolley extension in Paris it is stated that the controversy over the matter has brought out many harsh criticisms about the way the authorities are gradually but surely "uglifying" *la ville lumière*. One interview in the *Figaro* which has attracted considerable attention is with Victor Binet, the well-known decorator. He asks what is the use of bothering with overhead wires—for trolleys must be endured whether they are ugly or not—when so many other misdeeds against art are being committed. The so-called new art has so stultified the public that no trace of taste remains in France. These new art people have been working for years to make Paris ugly. They were allowed to devastate the Esplanade des Invalides and the Champs d'Elysées. The new monuments and ornaments in the squares and parks are ridiculous—gingerbread and cardboard monstrosities altogether devoid of decorative effect. The new houses are hideous with their absurdly unornamental facades, which will harmonize well with the trolley wires, the gibbets stuck all over the city, and the yellow asparagus stalks fixed up over the entrances to the stations of the underground railway, called for brevity the "Metro." "Let us pray," says M. Binet, "for power to stand all this mercantileism, Americanism and utter ugliness." But why "Americanism"? New art is decidedly a European production, French or German, perhaps both.

INTERNATIONAL EXPOSITION AT MILAN.—The completion of the Simplon tunnel will be marked by an international exposition, to be held in Milan in 1905. A fund of $600,000 has already been raised, half of which was contributed unconditionally.

TO STUDY AMERICAN TRANSPORTATION SYSTEMS.—According to a London dispatch dated July 15, the Royal Commission which was appointed to examine into the question of London street traffic has decided to send a sub-committee to the United States in the fall to study American systems of transportation. Mr. H. H. Vreeland, president of the Interborough Rapid Transit Company, New York, is now in Europe and will appear by special request before the Royal Commission in London.

RIOT OVER TELEPHONE FACTORY STRIKE.—Riots and disturbances continue to result from the strike of workmen employed in the factory of the Kellogg Switchboard & Supply Company, of Chicago. In our issue last week reference was made to the strike and some acts of violence committed. The lawlessness has attained such proportions that Mayor Harrison issued a proclamation on July 17 warning all persons from lounging or gathering together at any place within the city where there is disturbance or riotous conduct of any persons. The business of the Kellogg Company has been conducted under police protection. A squad of police was attacked on July 17, but quickly scattered the mob. Judge Holcom's injunction restricting the picketing of the Kellogg factory has been upheld by the Appellate Court.

WIRELESS TELEGRAPHY IN THE AMERICAN NAVY.—Information comes from Washington to the effect that the Slaby-Arco system of wireless telegraphy will probably be adopted for use on the American warships. Experiments have been conducted for over a year by the Bureau of Equipment to determine the best system of wireless telegraphy for use, and, according to the dispatch, it is a foregone conclusion that the officers in charge of the tests will select the Slaby-Arco system. It is stated that twenty sets of Slaby-Arco instruments have arrived from Germany. These will be installed on the battleships *Kearsarge, Illinois, Maine* and *Texas;* the cruisers *Olympia* and *Baltimore*, and the training ships *Topeka* and *Prairie*. It is also stated that wireless telegraph shore stations will be established at Cape Elizabeth, Me.; Cape Ann and Cape Cod, Mass.; Montauk Point, L. I.; Newport, R. I., and the Atlantic Highlands, N. J.

LETTER TO THE EDITORS.

Steam Turbines.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with much interest the various articles recently published in your paper on the subject of the Curtis steam turbine, and especially that by Mr. W. L. R. Emmet, in your issue of April 11, from which the following is extracted: "All improvements in prime-movers are of great importance to the engineering world. The steam turbine is destined to effect the first really great improvement since the days of Watt, and the forms of Curtis turbine here described make the first great stride in advance of other steam engines."

Now, it is very easy to make such a statement, but I have vainly tried—as regards at least the second part of the above passage—to find out how it could be proved to be correct. If the steam turbines of De Laval and Parsons had not been in existence before the Curtis turbine appeared, or even if I were not acquainted with the fact that Parsons turbines of larger size have been built than the holders of Curtis's rights appear to contemplate building now, I would have nothing further to say; but as it is, the writer of the article in question will allow me to state that I do not agree with him.

Speaking of the Laval and Parsons turbines, the author of the articles continues as follows:

"Both of these turbines have attained some (!) success, but neither as thus far developed affords sufficient advantages over the steam engine to cause any very rapid or radical change in engineering conditions."

He generously admits that the predecessors of the Curtis turbine have had "some" success. That is something. But as regards the second half of the sentence, I again beg to differ. On the European continent, at any rate, the steam turbine has already—that is, before the appearance of the Curtis turbine—caused quite a revolution "in engineering conditions," and it is this very fact to which the Curtis turbine no doubt owes its acceptance as a power generator.

But the Curtis turbine, it will be objected, is an improvement on the Parsons system. Of course, the author of the article, at any rate, thinks so, since he claims that the Curtis turbine has the advantage of "*lower speed, less weight, fewer and simpler parts, higher economy, less cost and other important advantages.*" Permit me to make these claims the basis of a short comparison between the Curtis and Parsons turbines, and I will endeavor to show how far they go. I take the Parsons system, because I am better acquainted with it, and also because it is the only one of which large sets are now running.

First, as regards speed: If this word were replaced by number of revolutions, then the Curtis turbine might be said to run at lower speeds, provided the data published by the manufacturers can be relied upon. But it must be observed that the aspect of the case changes entirely if you compare the two systems on the basis of circumferential speed of the blades, which in the Curtis turbine is double and treble the *highest*, or about six times the *average* circumferential speed of the blades of the Parsons turbine. If the lower number of revolutions can only be attained at the cost of such a startling difference in the circumferential speed, then I fail to see where the advantage of a reduced number of revolutions lies.

Second, as to weight and cost, no data are published with reference to the Curtis turbine, and I am unable, therefore, to make an exact comparison of figures. Taking, however, the average dimensions of Parsons turbines and those stated for the Curtis system, I think that the Curtis turbine can hardly be lighter and less costly than the Parsons.

Third, fewer and simpler parts are the next advantages claimed for the Curtis turbine. If it were called more complicated, I would at once endorse the author's statement. Let us compare the rotating part of a Parsons with that of a Curtis turbine. It will be found that a simpler device than the former cannot well be imagined. It consists of a shaft or hollow drum carrying the blades, which are fixed to the drum by the simplest of means, and ample clearance is provided both axially and radially. The Curtis rotating part, on the other hand, consists of two or more complicated wheels with blades cut out of the solid, and the axial clearance, i. e., the clearance between running and fixed blades is, according to diameter, only 0.03 to 0.05 in., which any practical man would condemn. As another instance of the paucity of parts, the governing of the Curtis turbine appears to be entrusted to a very complicated and elaborate device, which will in practice prove proportionally unreliable, whereas the Parsons governing gear, consisting mainly of a single valve, is the very pattern of simplicity.

Fourth, as regards economy, the consumption curves given for the 600-kw Curtis turbine are very good indeed, but the same results can be attained with the Parsons. The figures given for steam consumption of large sets, especially at full load, are, on the other hand, poor, and for big units, unless these figures can be greatly improved upon, I consider the Curtis turbine to be a decided step backward. In fact, the consumptions given are 20 to 30 per cent. inferior to those attained with the Parsons system under same conditions.

Finally, as to other important advantages: I presume that by these is meant that the Curtis turbine is a vertical shaft turbine. The idea of arranging steam turbines with vertical shafts is quite an old one, but has not hitherto been resorted to by competent engineers because of the many disadvantages involved. If we consider that with the vertical turbine the floor space is not less than with the horizontal one, owing to the space that has to be provided for the condensers, which can be placed entirely underneath the horizontal turbine; that the height to the crane of the engine room is the same as for large vertical engines, as against a height of 10 ft. for the largest horizontal units; that all repairs to the internal parts of the turbine other than to minor parts arranged for detachment through lateral openings, necessitate the dismantling of the set one asks—Where are the advantages of this much-prized vertical arrangement?

The horizontal arrangement allows the dismantling of any part without affecting the whole, and the attendance is obviously simplified and made more efficient by being restricted to one plane, and avoiding the necessity of climbing all over the machine.

The present practice in modern electrical and hydraulical engineering bears out the above, for although till quite recently vertical water turbines coupled direct with dynamos were used on an extensive scale, the horizontal arrangement is now being largely reverted to again, the vertical arrangement becoming obsolete.

It is with reluctance that I have taken up the pen to write the above, but I noticed with surprise that no one else tried to reduce to the limits of reality the somewhat exaggerated statements made in the article referred to. Being intimately connected with the steam turbine business, I thought it but right to establish the facts as they are, because the said statements might give rise to the belief that the turbines first in the field were inferior machines, and that the Curtis turbine might really be what the author of the article calls "the first great stride in advance of other steam engines." My view is that the people connected with the Curtis turbine will find a good lot of hard work to do before they may call it, not "superior," but "equal" to the Parsons turbine. One important fact not to be overlooked is that there are in a turbine many points which can only be pronounced sound after the full test of time.

Baden, Switzerland. C. E. L. Brown.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Reference.

Induction Motors with Commutators.—Blondel.—The continuation of his long article on the theory of these motors, previously noted in the Digest. This installment contains the development of an algebraic theory.—*L'Eclairage Elec.*, June 27.

Power.

Italian Installation for Power Transmission.—Riccardi.—An illustrated description of the works of the Societa delle Forse Idrauliche del Moncenisio, which are in course of construction, and which are interesting on account of the exceptionally high waterfall used and of the high potential of transmission. Power is obtained from the River Cenischia, utilizing a fall of 859 meters, with a total of 11,700 hp. The construction of the hydraulic arrangements is described. The power station is situated at Novalesca, and contains at present 3 groups of turbo-alternators. The turbines are of 1,600 hp each for a useful fall of 436 meters at 500 r.p.m., with a flow of 360 liters per second. There are also installed two groups of turbo-exciters, of 110 hp each, with a speed of 600 r.p.m. The alternators are of the triphase type, with rotating magnet wheel and fixed armature, of 1,400 kw. They have 12 poles, and furnish 50-cycle current at 3,000 volts. They receive 12.3 kw for excitation, at 125 volts. The exciters are direct-current dynamos, 6-pole, 75 kw each, at 125 volts, directly coupled to their respective turbines. There are four monophase transformers of 1,100 kw each, oil-cooled, three of them united in star connection, the fourth being in reserve. They step the voltage up from 3,000 to 30,000. They are designed to stand 25 per cent. overload for 2 hours without heating more than to 50°. A description of the switchboard arrangements is also given, as also the construction of the transmission line, which is 60 km long. The sub-station is situated in Turin, and contains at present 3 triphase oil transformers, with air cooling, of 1,000 kw each, which transform the high-tension current to 3,000 volts. It is proposed to use the current mostly for furnishing power for industrial establishments, but it will also be utilized for traction, lighting and electrochemical purposes. The plant at the power station, when completed, will consist of 10 groups of turbo-alternators, 16 monophase transformers and 4 groups of turbo-exciters.—*L'Elettricista*, July 1.

New Power Plant in Livet, France.—A note describing the installation, now in course of construction, of the Société Electrochimique de la Romanche, the power for which will be obtained from the River Romanche. Current will be transmitted at 26,000 volts for 35 km to the city of Grenoble. Turbines of 375 r.p.m. are directly coupled at the central station to two triphase alternators, furnishing current at 3,500 volts, which is stepped up by transformers to 26,000 volts, at which it is transmitted.—*Echo des Mines et de la Met.*; abstracted in *Centralblatt f. Accum.*, etc., July 1.

Power Transmission Plant.—An illustrated description of the power transmission installation of the Apscheron Electric Company in the Russian petroleum district of Baku. The company furnishes motive power for drilling the oil wells, which has been formerly performed by small steam engine plants; 1,500 hp is available for distribution, furnished by steam boilers and engines. Current is generated by two triphase alternators of 700 kw, at 6,500 volts and 100 cycles per second. The current is stepped down to 1,100 volts in transformer stations. The motors are built for 1,000 volts pressure and furnished with 2 armature windings. One of them, which only serves to start the motor or running without load, consists of bronze rods with hard-soldered short-circuit rings, while the working winding proper is constructed as in normal motors. The ends of this last coil, however, do not lead to collecting rings, but to metallic contacts, which after starting the motor and reaching a certain speed, are automatically short-circuited. The contacts are enclosed air-tight, to avoid ignition of any gases which might be present. On account of their simplicity and the freedom from danger of fire, these motors are preferred to the steam engines.—*Zeit. f. Beleucht.*, June 20.

Electrical Equipment of the New Orleans Drainage System.—Venable.—An illustrated article describing the installations for pumping the drainage. Only a small amount of power is required constantly and the larger portion of the plant is idle except during and after storms. An economy over steam is, however, effected by being able to concentrate the steam plant at one central station instead of distributing it at several pumping stations. The current used in this equipment is distributed on the three-phase system at 25 cycles per second and 3,150 volts. The motors at the various pumping stations are of the three-phase synchronous type, and are direct-connected to the shafts which carry the moving parts of the centrifugal or screw pumps.—*Elec. Rev.*, July 4.

Transmission and Distribution by Single-Phase Alternating Current.—Monkhouse.—A paper read before the recent engineering conference in London. The author points out the greater simplicity of the single-phase system as compared with the polyphase in power transmission and railway work; the chief features which he brings out are well known in the art. He concludes with the statement that the advantages of transmission of power by single-phase alternating current are so apparent that it only remains for a suitable motor to be produced which will give as good results, both as to regulation and efficiency, as are given by the best continuous-current motors, to insure the system being used for long-distance power transmission in the future. In the discussion following the paper, Alexander Siemens pointed out that the whole question of the transmission and distribution of single-phase alternating current hinged on the last difficulty, as the complicated devices necessary for starting single-phase motors and bringing them up to synchronism, did away with all the advantages gained beforehand.—Lond. *Elec.*, June 26.

References.

Cost Price of Motive Power.—Saint-Martin.—A long article, in which the author first discusses in detail the conditions obtaining when electric energy is generated by private central stations, in the case of stations exclusively for the transmission of power and of private electric light stations. The second part of the article is devoted to a calculation of power costs for steam engines, non-condensing and condensing, gas engines and compressed air engines, the single items of which are discussed and tables are given. Then follows a comparison between the power produced by the thermal machines and by electric energy, and several typical cases are described where electric motors took the place of steam or gas engines and the economy effected by their use is set forth.—*Bulletin Technologique de la Société des Anciens Eleves des Ecoles Nationales D'Arts et Metiers*; reprinted in *L'Eclairage Elec.*, June 6.

Large Electrically Driven Punch and Shear.—A note, with illustration, of a large machine, driven by a 20 hp direct current, slow-speed motor. It has a capacity of punching a 2 in. hole into a 1¾ in. steel plate and weighs about 100,000 pounds.—*Am. Mach.*, July 9.

TRACTION.

Project for Electric Traction on the Swedish Railways.—DAHLANDER.—An abstract of a report made by the author to the Swedish Government, by which he had been commissioned to study the advisability of changing the motive power on the Swedish Government railways from steam to electricity and thus enable the government to make use of the water powers and turf deposits of the country, instead of importing coal. Continuous-current transmission is excluded on account of the length of the railroad system and the small density of population. Polyphase currents with high-voltage transmission and transformer sub-stations also appear unsuitable. The single-phase alternating-current systems are in their present form also unsuitable for application on the Swedish railways. A calculation of costs was made on the supposition that the whole system, of 4,332 km, was operated by electricity. Power was to be furnished by 22 power stations, 17 at waterfalls and 5 at peat bogs. These stations are to furnish single-phase alternating current of 40,000 volts and 25 periods, which is stepped down by transformers along the line to 7,500 volts for the contact cable, the rails to be used as return circuit. The locomotives are furnished with rotary transformers. The speed regulation of the motors is effected by changing the direct-current voltage at the rotary transformer. For passenger and freight trains the locomotives must have 700 hp. The cost of the whole undertaking, including copper, poles, rail connectors, protective devices and installation of the lines, is calculated to average about $2,716 per km. The necessary power is calculated at 120,000 hp, of which 80,400 would be furnished by water power and 21,600 by burning peat. A calculation shows that the expenses for electric motive power would be higher than for steam, but for reasons of political economy the Swedish Government has given its assent to the change to electric traction. Previously, however, the installations in other countries are to be exhaustively studied and an experimental line is to be installed, to work out a suitable system. An article on the report appeared in ELECTRICAL WORLD AND ENGINEER, March 21, 1903.—*Elek. Zeit.*, June 25.

Railroad Motors with Compound Winding.—HOBART.—An article illustrated by a number of diagrams giving the results of tests with a single compound motor having two commutators, and for a combination of two motors arranged on a street car. The single motor is of 35 hp and its construction is described in detail. Under normal conditions the motor runs at 569 r.p.m. with 500 volts, and commutators connected in parallel. The current is taken off by 2 brushes, between which are arranged 172 windings in series. The controller for a street car, provided with 2 of these motors has 9 positions, and curves are plotted giving the characteristic motor curves for all these positions and for all values of the current up to 200 amp. It is stated that from very few experiments it is, therefore, possible to follow the working of the motors and their behavior in the different connections. It is only necessary for this purpose to determine the magnetization curve, and to measure approximately the iron and friction losses, as well as the resistances. If the constructive data of the motors are then known, the determination of the curves is not difficult. Several values for the speed have been determined experimentally and agree well with the values found by calculation. Curves are also given in the article for the efficiency, the speed, the tractive force and the work of the motors for all 9 controller positions. Data and tables on the heating of the motors are also given.—*Zeit. f. Elek.*, June 28.

Return Circuit of the Electric Street Railways in Hamburg.—V. GAISBERG.—A paper read before the recent annual meeting of the German Electrotechnical Society in Mannheim. The author describes the damages which had been discovered in wrought iron and lead water supply pipes, which crossed the street railway tracks. Most of the wrought-iron pipes were perforated by the action of the tramway return currents, while the lead pipes showed an even oxidation. Cast-iron pipes were not affected at all. It was tried to protect the pipes by coating them with tar and also with a mixture of pitch, which was poured upon a shirting ribbon, wound spirally around the pipe. It was found that the tarred pipes resisted better, while the other pipes were especially attacked at the places where the spirals overlapped and their destruction was hastened. It was ascertained that the surfaces which send out destructive currents were comparatively small and they were found only immediately below the tracks or quite near to them. In spite of the electrolytic destruction of the pipes, which was very energetic at some places, only a very small percentage of the 3,000-amp. current can have found its way over the pipe lines. The means adopted to prevent this destruction of pipes consisted in the laying of isolated return cables of about the same thickness as the feeders. In order to ascertain the right current distribution on the return cables, the differences of potential are measured from time to time, and this distribution can be changed by resistances, inserted in the return circuits. The author states in conclusion that the state of the return circuits of electric railways can be watched without much trouble by tests made from time to time. From the experience in Hamburg, where no destruction of pipes has taken place since the requisite measures were taken, he concludes, that any apprehensions on the part of the proprietors of pipe lines in regard to the destruction of pipes by earth currents of electric railways, may now be considered as done away with.—*Elek. Zeit.*, June 25.

REFERENCES.

Urban Railway Traffic.—COTTRELL.—A paper entitled "The relative advantages of overhead, deep-level and shallow subway lines, for the accommodation of urban railway traffic," read before the recent Engineering Conference in London. The author assumes that the operation of these various lines would be by electricity and considers the several systems for conditions obtaining in England. The discussion following the paper is also given.—Lond. *Elec.*, June 26.

Motor Car for Railways.—An editorial discussing the various types of motor cars. The conclusion drawn therefrom is that from a careful study of the whole question, it does not appear that self-contained motor cars, whether steam, petroleum, electrical, or worked on some combined system, are likely to prove serious competitors to electric haulage on urban, suburban or interurban lines carrying a heavy traffic. Their best sphere of action would seem to be in short country branch lines, where high average speeds are not required.—Lond. *Elec. Rev.*, June 26.

Applications of Electricity to Driving Carriages in Towns.—CROMPTON.—A paper read before the recent Engineering Conference in London. The author discussed various points, such as the transmission gear, the storage batteries and the tires. He advocates the standardization of storage batteries and the establishment of charging depots, where the standardized accumulators can be supplied to the owners of electrical vehicles.—Lond. *Elec.*, June 26.

Cost of High-Tension Lines.—A preliminary calculation on the cost of building a line 30 miles in length to carry 15,000 kw at 40,000 volts. The total cost is $163,000.—*St. R'y Jour.*, June 20.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

New Electricity Works of the Manchester Corporation.—The first part of a well-illustrated article. The plant, with its present output of 26,550 kw, is already the largest electric power distribution undertaking in Great Britain, and with the completion of sets now under construction, the total capacity will be brought up to 34,000 kw. The load is at present divided as follows: About 400,000 lamps are connected to the mains, while over 1,000 motors, of about 4,000 hp, and tramways comprising about 130 miles of single track, with 400 motor cars, are supplied from the stations. The Stuart street station, described in detail in the present issue, supplies three-phase alternating current at 6,500 volts at 50 cycles. This is transmitted through underground cables to sub-stations, where it is converted by means of motor generators into direct current, at 500 to 550 volts for traction, and at 205 and 410 volts for light and power supply. Power is furnished by 24 water tube boilers, each capable of evaporating 12,000 pounds of water per hour at a pressure of 200 pounds per square inch, but working normally at 170 pounds. They are supplied with mechanical stokers of the chain grate type, driven by four motors. There are six main generating sets, each consisting of a 2,500-ihp vertical cross-compound engine, driving direct a polyphase generator of 1,500-kw capacity at 94 r.p.m. The engines and regulating governors are described in detail. The generators are of the stationary armature type, mounted between the high and low-pressure cylinders of the engines, the 64 magnet poles being carried on the periphery of the fly-wheel. Two large slip rings of gun metal, each provided with four brushes, serve to convey the exciting current into the field magnet winding. The armature is of tie-rod construction, the usual massive frame being replaced by cast-iron cheeks clamping the core laminations together. The structure is strengthened by means of nine tension rods round the circumference, the topmost rod being horizontal and the two lowest rods meeting at a point vertically beneath the shaft. The frame is divided in the horizontal plane. The winding is disposed in the usual way, in two holes per pole per phase. There are also three auxiliary generating sets, each consisting of a three-crank compound engine running at 350 r.p.m. and coupled direct to a 200-kw shunt-wound dynamo of 220 volts. These sets are used for supplying power for lighting the station, and for driving the various motors working the pumps, barring gears, stokers, etc. They can also be used for exciting the main generators. The latter are normally excited by two motor generators, each consisting of a three-phase induction motor fed from the 6,500-volt bus-bars, direct-coupled to a shunt-wound, six-pole dynamo, generating at 220 volts. Each of these sets is provided with three bearings, and the rotor of the motor is fitted with a device to prevent the brushes from being lifted before the rotor is short-circuited, when the machine has been run up to speed. The remaining running machinery consists of two mains chargers, each comprising a direct-current motor coupled to a comparatively large three-phase generator, the latter having to be large in order to carry the capacity current when charging the feeders. There is also a portable motor air compressor, for cleaning the machinery. The switchboards are also described in detail and illustrated. The speed of the engines is controlled by an ingenious electrical device, consisting in effect of a small controller on the switchboard platform, and a small motor mounted on a lever in connection with the governor of each engine. The motor is worked by direct current, and is so arranged that it reproduces exactly the motions of the hand wheel on the platform, thus screwing itself in or out on the lever arm, and varying the effective weight on the governor spindle. Another noteworthy device is a telephone and battery circuit, used for the purpose of synchronizing the engines, not only electrically but also mechanically. The circuit is carried to the valve gear of each engine, which momentarily closes it at a certain point in each revolution of the crank shaft. The make and break is short-circuited in an engine which is at rest. Unless the contacts are made simultaneously on each engine which is running, the telephone circuit will not be complete; hence it is only when the engines are running not only at the same speed, but with their cranks in steps, that the telephone responds.—Lond. *Elec. Rev.*, June 26.

REFERENCES.

Electric Heating Appliances.—Reyval.—An illustrated description of the appliances in use on the electric line of the Chemin de Fer de l'Ouest, from Paris to Versailles.—*L'Eclairage Elec.*, June 6.

The Charging Tariff Question for Electricity Works.—Schwabach.—The author discusses the question of the principle of distributing the fixed charges on the power users, and gives several graphical charts to arrive at the costs.—*Elek. Zeit.*, June 25.

Electro-Physics and Magnetism.

Radium.—Curie.—An abstract of a lecture delivered by the well-known French scientist before the Royal Institution, London. The lecture was illustrated by many experiments. Prof. Curie demonstrated that radium emitted heat, by noting the difference in temperature between two small cylinders of equal size, one of which contained 7 decigrams of radium. This difference was 3° C. A piece of radium was lowered into a glass vessel containing liquid air, to show that its radiations persisted even at that temperature, and the light emitted by the radium appeared equally bright whether the metal was in the liquid air or not. The discharging action of radium was also shown by approaching it to the knob of a charged gold leaf electroscope. The emission of three different classes of rays by radium was discussed. The deflection of the B rays was shown by the accelerated discharge of the leaves of an electroscope, when the rays were deflected by an electromagnet on the knob of the instrument. Induced radioactivity was also illustrated. A piece of cardboard was made radioactive by the radiation from a solution of a radium salt and then taken near to an electroscope, which it discharged. A still more striking experiment showed that the radium emanation could be condensed by liquid air, and again allowed to diffuse in a manner analogous to a gas. Two bulbs, one above the other, were used, both containing sulphide of zinc. The upper one was first made radioactive, and by means of liquid air the emanation was condensed into the lower bulb, which became more brilliant. On being left alone, however, the upper bulb again increased in brilliancy, while the light from the lower bulb decreased. Another experiment showed how radium rays facilitate the passage of the spark from an induction coil. Two spark-gaps were connected in parallel, and when radium was approached to either one of them, the sparking in the other ceased. A very striking demonstration of the fact that radium emanations possessed heat energy was the boiling of liquid air through its agency. The remarkable property of radium of altering the coloring of crystals and other solid bodies was also touched upon, as sodium chloride becoming blue, and glass violet under the influence of the rays. It was also pointed out that in these researches the electroscope was 10,000 times more sensitive than the spectroscope. In conclusion, Prof. Curie touched briefly on the hypotheses put forward to account for these phenomena, without, however, expressing his own opinion as to the probability of these hypotheses being correct.—Lond. *Elec.*, June 26.

Coherers.—Hurmuzescu.—A long article, in which the author, after a thorough historical exposition of the work done on the coherers and the attempts to formulate a theory of their action, describes experiments undertaken by him with a view to ascertain whether the variations of the resistance of the coherers under the action of the waves, depend upon the time during which the latter act. He therefore measured the time of action and the variation of resistance during this time. From the experiments made with a number of coherers and various dielectrics the author deduces the following conclusions: 1. In a general way, metallic filings become good conductors of electricity under the action of electric waves. 2. All coherers present a minimum in the value of their electric resistance relative to the time during which the electric wave acts. 3. This change of resistance is permanent for most of the systems. There are, however, a number of cases, where this modification ceases at the same time as the cause which has brought it about. These are the systems, carbon-carbon, metal-carbon, iron-mercury, etc., or the coherers with spontaneous decoherence. 4. But all these systems lose the property of spontaneous decoherence on account of a feeble oxidation or of a too rapid fatigue of the coherer by employing electric waves of too great intensity. These phenomena of auto-decoherence have been obtained for a great number of systems, in the first period, at the beginning of each experiment. 5. For certain systems, such as iron-manganese, silver-manganese, the action of the waves diminishes their resistance at first; then, when the waves are allowed to act again, an increase of the electric resistance of the coherer is found. These systems, therefore, behave in the first phase like ordinary coherers, in the second phase like anti-coherers. 6. A large number of ordinary coherers, when their contact surfaces are moist or dip into a dielectric containing water, present the two above phases, that is, by the first action of the waves, their resistance diminishes, to increase towards its original value by a subsequent action. According to different conditions, the first phase is more or less abbreviated and it can even disappear in some of the systems. In this latter case one deals with anti-coherers. 7. All these phenomena depend upon a layer between the contact surfaces; the intervening dielectric influences this layer, be it through the interval, or through the oxide or through gas condensed on the surfaces themselves. The author offers the following explanation of his results. The existence of the minimum of variation of the electric resistance of the coherers, relative to the time during which the electric wave acts, leads to a common explanation for the coherers and anti-coherers. For the former the action of the electric waves would be simply to diminish the resistance down to the vicinity of the minimum. This minimum would correspond, for a system, to the maximum coherence; that is to say, the formation of chains between all the grains following the direction of the current. For the latter, these metallic chains, formed by the small sparks jumping over between different grains, would find themselves interrupted on account of the introduction of new resistances into the path owing to the oxidations due to the sparks themselves. These oxidations depend on the nature of every metal and the dielectric with which it is in contact. If, according to the nature of the metal and the surrounding dielectric the oxidation is produced very quickly by the first spark, the first phase of the phenomenon (the fall of resistance) can escape us; this is the case of the anti-coherers.—*Annales Scientifiques de L'Universite de Jassy*; reprinted in *L'Eclairage Elec.*, June 27.

Electric Conductivity of Selenium.—Van Aubel.—A note presented to the French Academy of Sciences, on the electric conductivity of selenium in the presence of bodies treated with ozone. The author subjected a leaf of red caoutchouc to the influence of a current of dry ozone during twelve minutes. Some selenium, the resistance of which was 500,000 ohms, was allowed to be acted upon by the radiations sent forth from the caoutchouc, and after 15 minutes the resistance of the selenium fell to 550,000 ohms. A brass screen was then introduced and after one hour the resistance had gone up again to 503,000 ohms. The next morning the selenium had arrived at its former conductivity. Similar results were obtained with pieces of camphor.—*Compt. Rendus*; abstracted in *L'Eclairage Elec.*, June 13.

Changes in Length of Ferromagnetic Substances.—Honda and Shimizu.—The authors carried out experiments on the change of length of ferromagnetic substances under the influence of magnetization at high and low temperature. The temperature was raised to 1000° C., and tests were also made in liquid air. The substances experimented upon were nickel, soft iron, tungsten steel, cast cobalt and annealed cobalt. Curves are plotted for each of these materials. The authors come to the following conclusions: In comparing the results for soft iron, tungsten steel, cast and annealed cobalt, the curious fact is observed that the changes of length of these metals, which are so different at ordinary temperature, take an extraordinarily simple character at high temperatures, in so far as they tend to become proportional to the magnetic force, a fact which has without doubt an important bearing on the theory of molecular magnetism.—*Phys. Zeit.*, June.

REFERENCE.

Notes on X-Light.—Rollins.—The continuation of notes on this subject, dealing mainly with small versus large induction coils for exciting X-light tubes.—*Elec. Rev.*, June 27.

ELECTRO-CHEMISTRY AND BATTERIES.

Manufacture of Sodium by Electricity.—Becker.—A description of the processes of Becker and of A. H. Cowles. The Becker process depends on the decomposition of sodium chromate, tungstate, etc., and carbon in an electric distillation furnace, the sodium being distilled off and being condensed afterwards, while metallic chromium remains. By treating mixtures of different salts and oxides, it is possible to produce alloys. The Cowles process depends on the reduction of sodium aluminate with the production of aluminum carbide and metallic sodium, which distills off and is condensed as above. If iron or copper is added to the sodium aluminate, ferro-aluminum or cupro-aluminum is obtained instead of aluminum carbide.—*L'Industrie Electrochimique*, June.

Production of Metallic Calcium by Electrolysis.—A description of the process of the Electrochemische Werke. The calcium is obtained by electrolysis of fused calcium chloride, in a furnace with carbon walls as anode and a small rod of iron inserted through an insulated bottom, as cathode. The main point in the process is that the electrolysis is conducted at a temperature below the fusing point of the calcium. The latter, therefore, separates on the anode in a spongy mass, containing about 50 per cent. of metallic calcium. This spongy mass is compressed, while still in the electrolyte, with tongs or in any other suitable manner, and removed from the electrolyte. It presents a metallic fracture and contains nearly 90 per cent. of metallic calcium.—*L'Industrie Electrochimique*, May.

The Thallium Accumulator.—Jonas.—An article in which the author investigates the reactions taking place in a thallium cell, as they are of considerable theoretical interest, in so far as the battery is only composed essentially of a metal and water. One electrode is metallic thallium and the other consists of oxide of thallium, while a solution of thallium hydroxide serves as electrolyte. The author first investigates the deposit obtained upon the anode by the electrolysis of thallium hydroxide, and finds that it is not a hydrate, but after drying at 200° corresponds approximately to thallic oxide. Reactions are calculated according to which the discharge of a storage battery consisting of thallium, thallium peroxide and dilute thallium hydrate solution, takes place, and the theoretical value of the capacity of such an element is determined as 235.2 amp.-hours per kgm of thallic oxide, and 131.4 amp.-hours per kgm of metallic thallium, differing from former values given by Marsh as 117 amp.-hours per kgm of the oxide. The author also gives measurements of the potentials with a number of different solutions.—*Zeit. f. Electrochem.*, June 25.

Electromotive Behaviour of the Oxides of Cerium.—Baur and Glaessner.—A theoretical investigation with measurements of the oxidation and reduction potentials of various cerous and ceric salt solutions against a normal electrode; such cells appeared to offer a means for obtaining energy from the cold combustion of organic materials. The work was undertaken, as Auer von Welsbach is said to have patented an accumulator consisting of a cerous and a ceric electrode. The authors also investigated cells made of ceric and cerous salt solutions, with different depolarizers in the cathode and anode compartment. They conclude that the probability appears small; that with the employment of watery solutions, elements of such type with a practical efficiency could be produced.—*Zeit. f. Electrochem.*, June 25.

Sulphides of the Alkaline Earths.—Brochet and Ranson.—An article dealing with the electrolysis of barium sulphide, in order to find what reactions are taking place. The authors found that the electrolysis takes place substantially in the same manner as that of the alkali sulphides, particularly sodium sulphide. In a dilute solution sulphur, sulphite, hyposulphite and sulphate are formed, which being mostly insoluble separate at the anode. In concentrated solutions, sulphur, barium hydrate and hydrogen are obtained. Electrolysis had to be performed at an elevated temperature, because the sulphide, and especially the hydrate of barium, are very difficultly soluble in the cold.—*Comptes Rendus.*, Vol. CXXXVI, p. 1195.

REFERENCES.

Electrochemical Reduction of Aromatic Nitro Bodies.—Elbs and Stohr.—The authors discuss the increase of resistance, which gives rise to disturbances when their method of reducing aromatic nitro bodies with the production of azo and hydrazo-bodies and benzidines, is carried out. They give directions for overcoming this disturbance.—*Zeitsch. f. Electrochem.*, June 25.

Utilization of Nitrogen of the Air.—Frank.—A description of the authors' experiments for the absorption of nitrogen of the air by calcium carbide and barium carbide.—*Zeitsch. f. Carbidfabrikation*, June 12.

Electric Smelting Furnace.—An illustrated description of a recent construction by Harmet.—*L'Industrie Electrochimique*, June.

UNITS, MEASUREMENTS AND INSTRUMENTS.

REFERENCES.

Potentiometer for Thermocouple Measurements.—Lehfeldt.—A description of an instrument which the author has constructed for the above purpose with a view of not introducing a high resistance into the circuit of the couple and galvanometer and also avoiding accidental thermoelectric forces. The only metals used in the measuring circuit are copper and manganon.—*Phil. Mag.*, June.

Packing of Electrical Instruments for Export to India.—Bruehl.—An abstract of a paper read before the Calcutta Local Section of the English Institution of Electrical Engineers. The author recounts his experiences with the deplorable state of scientific instruments upon their arrival in India. The suggestions contained in the article should prove interesting reading to manufacturers of electric instruments and machinery, exporting to the tropics.—Lond. *Elec.*, June 26.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Electric Signal for Railroad Crossings.—A note containing a description of a new signal installed at the crossing of a German electric road with a steam road. The apparatus consists of an electric motor driven from a power circuit; it actuates a bell, and at the same time furnishes current for 4 incandescent lamps. Three contacts are arranged, two of which are 500 meters in front and back of the crossing respectively and one at the crossing. The train, when it strikes the first contact, starts the motor which in turn actuates the bell and lights three of the incandescent lamps, which are set in a lantern, bearing the inscription, "Train comes." When the train strikes the contact at the crossing, the bell and glow lamp circuit is disconnected again. The fourth lamp is a control lamp at the railroad station, which is disconnected, when the train strikes the third contact. This simple device is stated to work very well.—*Dinglers Polyt. Jour.*, June 27.

Telephone Exchange.—An illustrated description of the equipment of the Geneva Telephone Company, at Geneva, N. Y.—*Elec. Rev.*, July 4.

New Books.

Dies: Their Construction and Use for the Modern Working of Sheet Metals. By Joseph V. Woodworth. New York: Norman W. Henley & Co. 384 pages, 505 illustrations. Price, $3.

This is a very practical and useful manual devoted to the subject of working in sheet metal for the production of the stamped articles that have now become so familiar and useful an appliance. Mr. Joseph V. Woodworth, the author, is said to be a skillful and experienced workman in this department, and these pages give every indication of his thorough familiarity with the design, construction and use of the necessary tools and appliances, as well as with the handling of the raw material in such manner as to secure the largest amount of output with a minimum of cost and waste.

There are a dozen chapters in the book devoted to the various kinds of dies for bending, forming, perforating, etc.; to coining processes, drawing, annealing steel tools, etc.

Hardening, Tempering, Annealing and Forging of Steel. By Joseph V. Woodworth. New York: Norman W. Henley & Co. 280 pages, 200 illustrations. Price, $2.50.

The author of this book is also the author of the kindred work itself, both of them covering to some extent the same ground. The present work is one which should prove of great usefulness to all who desire to become thoroughly acquainted with the modern processes of heating, annealing, forging, welding, hardening and tempering steel, and there is no doubt that workers in this field will also derive considerable benefit from its practical directions and suggestions as to the manner in which work can best be done. A number of simple and successful processes are described, and the twelve chapters of the book deal in succession with the steel itself, with its treatment in the form of sheet, tools, dies, etc.

Chapter II is devoted to miscellaneous kinks, and throughout the book abounds in data of extremely practical character.

The Story of a Grain of Wheat. By W. C. Edgar. New York: D. Appleton & Co. 40 illustrations.

This is a very interesting book on a most important subject, written by a man thoroughly competent to deal with his subject. A vast amount of information is brought together, within these pages, Mr. Edgar, as editor of the *Northwestern Miller*, being able to supplement purely historical data with the observations and conclusions of a trained observer dealing with current facts every day, and aiming to understand the tendencies of the industry with which he is so closely associated.

In one respect, perhaps, and that by no means of minor consideration, Mr. Edgar is more optimistic than some people we could quote. The very day before writing this review of his book, we noted in one of the serious newspapers a statement to the effect that wheat stores are now about as low as they ever were, and that the farmers might count confidently on steadily better prices for their product because of growing demand and a supply that does not keep pace with it. But Mr. Edgar remarks: "In wheat production nature keeps ahead of man's requirements." There is certainly a clash of authority on that point. So far as general discussion of the subject goes, we need only refer the reader to Sir William Crookes' discussion of the problem, and his insistence on the point that in order to secure the wheat supplies needed in the near future, nature's exhausting reserves of fixed nitrogen must be supplemented by those of the atmosphere. Such work as this, it is well known, Mr. C. S. Bradley has been doing successfully at Niagara with the aid of electricity, and it seems to us that by such work rather than by unaided nature, the nations are likely to be furnished with their daily bread—but they may have to pay more for it, as they are already beginning to do for their daily fuel.

Directory of Electrical Societies, Etc.

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

American Order of Steam Engineers. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York.

American Street Railway Association. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, Indianapolis, Ind., third Wednesday in June, 1904.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., 1904.

Engine Builders' Association. Secretary, F. P. Ide, Springfield, Ill.

Electrical Contractors' Association of New York State. Secretary, Wm. J. Davis, Ithaca, N. Y.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September 2, 3 and 4, 1903.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, Utica, N. Y.

New York Electrical Society. Secretary, G. H. Guy, 104 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association. Secretary, E. W. Pichardt, Huntingburg, Ind.

The Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

The Central Union Telephone Company in Indiana.

The Central Union Telephone Company is moving its headquarters from Chicago to Indianapolis and in a few days will have its large office force in good working order. In view of the fact that it is generally believed that the Central Union is losing ground in Indiana, a synopsis of its annual report just filed with the State Tax Board may prove of interest. The report shows that the company had in use in the State on the first day of April 40,224 business telephones and 74,773 residence telephones, at an average rate charge of $2.10 per month for business, and $1.23 for residence, against 46,336 business telephones and 61,422 residence instruments at an average charge of $2.05 and $1.19 respectively during the previous year. The gross earnings for the year were $3,004,103.03 and the net earnings $173,706.63, while for the year previous they were $2,584,789.42 gross and $224,526 net respectively.

The company has 4,159½ miles of poles in Indiana and 55,808¾ miles of wire, an increase during the year of 117 miles of poles and 12,691½ miles of wire. The original cost per mile of the line is given at $160. Iron, steel and copper wire is in use and there is an average of four wires to each line of poles. The average height of the poles is 30 ft. and 25 poles are set to the mile. The cost per 100 of these poles is given at $100. The company owns real estate in Indianapolis assessed at $52,000. The capital stock is given at $3,587,100 and the number of shares 35,871 of a par value of $100, and market value of $30. The bonded indebtedness is given as $6,000,000. For officers' salaries $303,159.32 were paid out and $446,566 for labor. The expense of offices and stations amounted to $835,309, and $587,499.89 was expended for materials, etc.; for royalties and interest, $611,895.49, and for taxes, messengers and miscellaneous, $219,672.

Dry Battery.

The Electric Contract Company, 202 Centre Street, New York, is making a dry cell that is particularly recommended for automobile and gas engine ignition work. In designing this cell the object sought was a high discharge rate compatible with long life, and this desideratum, it is claimed by the manufacturer, has been notably realized.

Each cell is tested before being sent out, and if it is not up to the standard it is not shipped. This care bestowed upon the goods enables the company to guarantee a high efficiency for the cell.

These cells are made in four sizes of the following dimensions: 5 in. x 2 in.; 6 in. x 2½ in.; 7 in. x 3 in., and 8 in. x 3½ in.

Detroit Convention of the National Electrical Contractors' Association.

The third annual convention of the National Electrical Contractors' Association took place at Detroit, Mich., July 14, 15, 16 and 17. The enthusiasm shown and the large attendance were a revelation even to those who have watched the progress made by this important body in its existence of only three years. It was an indication of the prominent position occupied in the electrical industry by the electrical contractor to-day, and while the meetings are not yet taken up with the discussion of papers on technical subjects, practical affairs are talked over and the general interests of the contractors are safeguarded thereby. They are brought together, and the result is beneficial to the contractor, his employee and the public.

On the opening day the arrival of the Eastern delegation in the early morning was attended by some amusing exercises and a mock parade. An executive session of the directors was held at 10 o'clock, at which a nominating committee was selected. At 2 o'clock the convention went into open session and the delegates were formally welcomed to the city by Mayor Maybury. The mayor, in his customary happy manner, extended the freedom of the city to the delegates, and called attention to the fact that the greatest electrician of the age—Thomas A. Edison—was once a Michigan lad, who took his first lesson in the craft as a messenger boy between his home, Port Huron, and Detroit.

President Charles L. Eidlitz responded, declaring that the welcome given to the members of the association, and the treatment accorded them by the citizens of Detroit, will always live in their memory.

Immediately following the speeches, the convention again went into executive session and all the proceedings were conducted in executive session, so that no report can be given of the transactions.

The officers elected were Earnest McCleary, Detroit, president; first vice-president, W. I. Gray, Minneapolis, Minn.; second vice-president, W. C. McIntyre, Philadelphia, Pa.; treasurer, J. R. Galloway, Washington, D. C.; secretary, W. M. Morton, Utica, N. Y.; sergeant-at-arms, J. C. Stearns, Buffalo, N. Y.

The Detroit Light Guard Armory, large and commodious as it is, was none too large for the exhibit of electrical apparatus put in use by the electrical contractor, and over fifty manufacturers took advantage of the opportunity to display their various lines. The exterior of the building was handsomely decorated with electric signs and flags put up by the Elblight Company, of New York, which also did all of the interior decoration in illuminating effects with great skill and success.

EXHIBITS.

Marshall-Sanders Company, Boston, had a very interesting exhibit of its specialties, and Mr. L. W. Kittman was most affable and painstaking in showing the line.

"Hylo" Lamps will be long remembered through the efforts of W. J. Phelps, W. E. Phelps and J. Wiley Phelps.

The old house of Partrick, Carter & Wilkins, Philadelphia, sent along W. W. Winship to display their annunciators and some of their house goods specialties.

The Nungesser Electric Battery Company, Cleveland, Ohio, was represented by H. G. Robbins, who gave out a handsome little button as a souvenir.

Western Electric Company had adequate representation in Major R. Edwards, Jr., C. W. Cobb, E. R. Field and L. J. Baldwin.

Manhattan Electrical Supply Company, in its exhibit showed only a few of its products, the Mesco batteries, a line of sockets, receptacles and other specialties for contractors. Mr. J. W. McDowell, of New York, attended to all visitors and inquirers and gave away the most valuable souvenir at the convention.

John A. Roebling Sons Company.—Visitors to the booth of John A. Roebling Sons Company were cordially greeted by Frank W. Harrington, W. F. Richardson, W. P. Bowman, W. W. Affleck, G. W. Swan, C. B. Cushing and J. W. Brooks.

The National X-Ray Reflector Company exhibited a line of its silver-plated glass reflectors, Mr. E. L. Haines, general manager, of Chicago, representing it.

Valentine Clark Company, Chicago, sent Mr. Ernest E. Clark to talk about its poles, ties, cross arms, etc.

The Peru Electric Manufacturing Company was somewhat delayed in getting its exhibit in shape, but it was pushed through. It was represented by R. H. Bouslog and George S. Searing.

George F. Porter, ex-secretary of the National Electric Light Association, was in active attendance in the interests of the Atlantic Insulated Wire & Cable Company. Even this veteran of conventions opened his eyes at the attendance and display.

Michigan Bolt & Nut Works booth was in charge of Mr. H. MacLean and Frank S. Bigler.

Pass & Seymour, Solvay, N. Y., made a splendid exhibit of their well known specialties, and through the untiring efforts of Mr. W. Brewster Hall, of New York, and J. W. Brooks, Chicago, it was made most interesting. Souvenirs were given away.

Crocker Wheeler Company, Ampere, N. J., was represented by Mr. F. S. Blackall, of New York.

Mr. M. B. Austin was there in person for the M. B. Austin Company, Chicago.

American Electrical Heater Company was out in force, B. H. Scranton, president; John Scudder, secretary-treasurer, and George J. Schneider, superintendent, being very much in evidence.

Alphaduct Manufacturing Company had an interesting exhibit of its flexible conduit, Mr. W. M. Porter, Western manager, meeting all his friends and incidentally distributing a smoking pipe made of the conduit.

Crouse-Hinds Electric Company.—A most elaborate exhibit was made by the Crouse-Hinds Electric Company, of Syracuse, N. Y.. As one came down the main isle the first thing that greeted the vision were lightning flashes radiating from a blaze of light in the booth, the center having a wreath which formed the trade mark of the company. The center of the trade mark contained a Syracuse changeable electric head light, one of the company's many products. Directly above this wreath was the sign "Norbitt" made of changeable monograms. The booth was surrounded by railing made of heavy quartered oak and supported on ornamental brass pedestals, the top of the railing being utilized for exhibiting the Norbitt moulding and conduit receptacle all electrically connected. At the entrances to the booth, of which there were two, were four cut glass aquariums supported on pedestals, similar to the railing. In the interior of each aquarium was placed a Norbitt temporary decorative socket with a 16-cp lamp. Two of the aquariums contained battery fluid and two water with gold fish, showing the waterproof qualities of the appliances. To the left of the entrance of the booth was the red room, devoted to the display of switchboard and panel boards. The decoration consisted of over 400-cp ruby lamps, each embedded in a flower-shaped shade, festooned about the walls and ceilings in good taste. Extending the entire length of the exhibit was an enormous electric sign, reading "Crouse-Hinds." The entire equipment consisted of over 1,100 8-cp lamps. The various circuits feeding these lamps were controlled from a marble panel enclosed in an oxidized copper-trimmed metal cabinet. Around the walls of the booth were many different designs of panels enclosed in cabinets of oak, maple, mahogany and cherry. The "Quick Put Up" Norbitt appliances were in great demand by exhibitors for decorating their booths. Mr. Hawkins, Mr. Norden, Mr. Hills and Mr. Crofoot certainly deserve credit and are to be congratulated for the fine display they made of their company's product. In keeping with their custom in the past, they distributed a souvenir in the shape of a very handsome leather bill folder for pocket use.

EXHIBIT OF CROUSE-HINDS ELECTRIC COMPANY.

The Michigan Electric Company was represented by Mr. Henry F. de B. Cameron, R. J. Thorne, E. Bullock and Joseph E. Lockwood.

Kuhlman Electric Company, of Elkhart, Ind., had its transformers talked about by Mr. K. Kuhlman.

McBride Manufacturing Company "Arkless" fuses were spoken for by Mr. B. D. Horton.

The Gould Storage Battery Company had Mr. E. L. Draffen, of the Chicago office, in attendance.

The Jewell Electrical Instrument Company, Chicago, had Manager Edward M. Jewell on the scene.

The Anderson Porcelain Company, East Liverpool, Ohio, sent Mr. Howard H. Balliett.

J. H. McGill, secretary and manager of the Crescent Company, Chicago, distributed neat little souvenirs advertising its soldering sticks.

The Adams-Bagnall Company had Mr. J. G. Pomeroy in attendance talking the merits of A. B. arc lamps better than ever.

Fostoria Incandescent Lamp Company was represented by Chas. J. Wells from the home office.

Transportation.—Mention should be made of the great comfort secured to the Eastern delegation and inconvenience avoided, through the efforts of Alex. Henderson, master of transportation of the Association. The trip was made most pleasant and excellent accommodations were provided for all at Detroit by Mr. Henderson. Such service went far to make the convention a success, and means hard work for the man thus aiding his fellows.

M. B. Wheeler Electric Company, Grand Rapids, Mich., was represented by Mr. M. B. Wheeler, who added greatly to the convenience of all those attending the convention by having a printed list distributed of those attending the convention under three classifications—members, exhibitors and visitors. This enterprise was much appreciated, and Mr. Wheeler received profuse thanks from delegates and exhibitors.

The Thos. E. Clark Wireless Telegraph-Telephone Company made a striking display of its latest designs in wireless instruments. The company was ably represented by the inventor of the apparatus, T. E. Clark, assisted by Ackland Stilling and Gustave I. Riefstahl.

The De Veau Telephone Manufacturing Company showed a line of telephones. Its switchless telephone and the new push button telephone attracted considerable attention. Mr. A. S. De Veau and V. C. Gilpin, sales manager, looked after the interests of the company most pleasantly.

The Dale Company exhibit of electric lighting specialties was a most attractive one, so much so that the entire exhibit was sold and removed by the purchaser at the close of the convention. Many orders were booked for portables and half-shade reflectors, and through the efforts of J. H. Dale and O. J. Bryan, who represented the company, many new customers were won. Handsome souvenirs were distributed by the Dale Company.

Holtzer-Cabot Company, Boston, had a very interesting exhibit in charge of E. R. Harding, Chicago, whose acquaintance amongst the delegates and visitors kept him busy.

Flexduct.—A very handsome exhibit was that of "Flexduct," the product of the Osburn Flexible Conduit Company, New York. The success of the display was enhanced by the presence of C. E. Corrigan, who greeted warmly all his old friends and all visitors. He was ably assisted by C. B. Roulet.

Hart Manufacturing Company, Hartford, Conn., showed a full line of "Diamond H" switches. Two well-known representatives—Wm. Taylor, New York, and W. P. Crockett, Chicago—greeted a host of friends.

The Johnson & Morton Exhibit was one of the centers of attraction. It was in charge of W. H. Morton, the popular secretary of the National Electrical Contractors' Association, whose untiring efforts have gone so far to make the association the success it is.

National Carbon Company had on display its dry batteries, brushes, etc. It was represented by Edmund J. Climo and F. J. Kysela, Cleveland.

Bissell.—The interests of the F. Bissell Company, Toledo, Ohio, were looked after by Fred Bissell and M. S. Walker.

Frink Reflectors were not forgotten, through the presence of Mr. Frank Stout.

Carleton-Chase Electric Company, New York, made a most unique and novel exhibit in the form of a miniature reproduction of its entire building in New York. The model, about 6 ft. high, 2½ ft. x 5 ft., was illuminated, and made a very pretty effect. J. A. Vaughan and Percy R. Frost looked after the interests of the Company in a most painstaking way and handed around a very pretty souvenir.

National India Rubber Company, Bristol, R. I., showed samples of its goods from raw rubber to the finished product. P. F. Lyons was in charge of the display. Orla White was also in attendance.

A. R. Hussey showed a line of telephones, the product of the Allen-Hussey Company, Chicago.

The Norden-Bittner Electric Company, of 1402 Broadway, New York, was represented by Mortimer Norden, who explained the company's changeable electric signs to the various contractors, a number of whom desired to handle it in their cities.

J. A. Maltby came on from Bay City to take charge of the exhibit of the Maltby Lumber Company and greet his many friends.

The Seidler-Miner Company had a worthy exhibit, and were represented by B. F. Seidler and Frank J. Miner, the latter gentleman being mostly responsible for the great success of the entire Armory exhibition.

The Sprague Electric Company exhibit was in charge of Alex. Henderson, New York, assisted by E. B. Kittle, Chicago.

Fort Wayne Electric Works showed a line of arc lamps, meters, etc., in charge of H. L. Searles, assisted by Frank Ross.

The Elblight Company's exhibit, as at all conventions, attracted great attention. Its display showed many new features and designs, and Russell Spaulding and E. H. Abadie were assiduous in their attention to all visitors. Mention should be made of their superintendent, J. C. Schaeffer, who was in attendance and looked after the fine Elblight decorations throughout the building.

R. B. Corey talked for his several lines made by Hart & Hegeman Manufacturing Company, Bossert Electric Construction Company and American Circular Loom Company.

United Electric Heating Company, Detroit, made a splendid display of electric heating and cooking apparatus, Mr. Robert Kuhn representing.

Detroit Signal Company exhibit was in charge of Capt. Holmes and H. Fessenden.

The Westinghouse Electric & Manufacturing Company received visitors in a handsomely decorated booth through Charles F. Medbury, W. C. Armstrong, R. L. Rathbone and C. S. Jennings—the latter of the Sawyer-Man forces in New York.

Nernst Lamp Company had on hand T. H. Bailey Whipple, Pittsburg, and A. E. Fleming, Chicago, to talk the merits of the lamp.

Electric Appliance Company, Chicago, was well represented by S. A. Rall and W. P. Upham. Its booth was tastefully arranged with a large line of its supplies.

Fuller Electric Company.—Among the interesting things was one of the very first direct-connection high-speed dynamos ever constructed in the United States. It was built in 1882 by Rodolphus Fuller, present secretary and manager of the Fuller Electrical Company, of Detroit, and was installed in Chicago. This dynamo was used in lighting a railroad train by electricity for many years by the Grand Trunk, between Chicago and Port Huron. By its side on the platform stood a machine of the same power and speed built according to the latest plans. Another unique exhibit by the Fuller Company was a ventilating fan six feet in diameter, said to be the largest fan ever built with a direct-connected motor, and capable of handling 120,000 cubic feet of air a minute. This company also manufactures all sorts of marine lighting devices, many of which were exhibited in their booth. Mr. R. Fuller and F. Vollmer were in charge.

American Circular Loom had a handsome exhibit and an army of handsome representatives, in H. B. Kirkland, Jas. L. Kirkland, R. B. Corey, T. H. Bibber and T. G. Grier. Circular loom was well exploited. Handsome buttons were distributed, as well as Mr. Grier's latest literary effort, "Advice to young men."

American Push Button Telephone Company displayed its new types of telephones through the efforts of W. F. Van Benthuysen and W. V. Sweeten, the latter having just returned from a successful trip to the Pacific coast.

Electric Gas Lighting Company, Boston, had a large display of its various products such as bells, annunciators, etc., as well as the long-established Samson batteries. Great pains were taken by Chas. E. Lee and T. H. Sherman to explain the merits of the goods.

The Bossert Electric Construction Company, of Utica, had a considerable display in charge of F. T. Foxenberger, of Utica.

Chase Shawmut Company had an elaborate exhibit of some of its specialties which attracted great attention. Mr. Harry P. Moore, of the Boston office, was kept busy describing their merits and giving away as a souvenir a cigar cutter made in the exact shape, in miniature, of the Shawmut fuse.

H. L. Walker Company, Detroit, showed a line of supplies, H. L. Walker, W. J. Hartwig and J. R. McNaughton being in charge.

Browning Manufacturing Company, Milwaukee, showed a line of dynamos and motors. They were well advocated by S. A. Bean, of the head office, and H. B. Wilkins.

S. B. Condit, Jr., & Co., Boston, sent Fred W. Nason, who kept busy talking the merits of Elden circuit-breakers, and explaining the good points of their new laminated type, which is fully described in their July bulletin just issued. Only the most important business elsewhere kept Mr. Condit from attending the convention.

Electrical World and Engineer was represented by Messrs. J. V. S. Church, of Chicago, and G. W. Elliott, of New York. It had a booth in the Armory to receive callers and distribute papers.

Benjamin Electric Manufacturing Company, Chicago, made an exhibit of its wireless specialties, which elicited favorable comment. Mr. R. B. Benjamin, manager of the company, was in charge.

Ball & Wood Engine Company were represented by Mr. J. H. Parshall, of Detroit.

Among Those Present were C. A. Glack, American Conduit Manufacturing Company; W. C. Osborne and C. D. Goss, Sterling Electrical Manufacturing Company; D. B. Scarborough, Vallee Bros. Electric Company; H. W. Cook, John Toler Sons Company; G. L. Crosby, The Cutter Company; H. E. Wronk, W. R. Ostrander Company; G. W. Rodormer, Chicago American Electric Fuse Company; A. S. Hatch, Municipal Lighting Commissioner, Detroit; Prof. W. E. Goldsborough, St. Louis Exposition.

ATTENDANCE AT THE CONVENTION.

The following were the members registered in attendance:

Baltimore, Md.—H. K. McCay, F. G. Boyd, John K. How.

Boston, Mass.—Seth B. Witherbee.

Buffalo, N. Y.—F. P. Jones, F. H. Williams, W. Allan Gardner, J. C. Sterns, E. D. McCarthy.

Chicago, Ill.—C. R. Kreider, C. E. Browne, H. H. Deenis, H. T. Lounsbery, Arthur Frantzen.

Cincinnati, Ohio.—E. M. Lawton.

Columbus, Ohio.—J. C. McMaster, John Ryan, Mark Simonton.

Davenport, Iowa.—J. N. Butterworth.

Dayton, Ohio.—Charles P. Gutin.

Des Moines, Iowa.—Edward Kunkel.

Detroit, Mich.—E. McCleary, Jos. E. Lockwood, H. Colquitt, H. Cameron, Thos. E. Clark, Wm. H. Sheldon, Jr., B. F. Seidler, Hiram Marks, F. C. Teal, Geo. F. Kearney, A. Miller, F. J. Miner, E. W. Haines, Chas. A. Schmidt, D. A. Britten, Dan. L. Shoebottom, D. Donahue, James Rathbun, Geo. H. Jacobs, R. J. Thorne, Edward Bullock, J. D. Templeton.

Duluth, Minn.—Wm. Burgess.

Grand Rapids, Iowa.—M. B. Wheeler, H. A. Roseberry.

Hartford, Conn.—Harvey E. Paige.

Indianapolis, Ind.—W. A. Royse, F. W. Cheyne, G. M. Sanborn.

Jacksonville, Fla.—A. A. Kind.

Kalamazoo, Mich.—Henry M. Desenberg.

Minneapolis, Minn.—G. M. Jones, W. I. Gray, W. J. Chapman, L. L. Saunders.

New York.—Charles L. Eidlitz, F. S. Blackall, P. C. Haviland, J. S. Hatzel, E. S. Keefer, James R. Strong.

Philadelphia, Pa.—H. A. Loeb, Frederick W. Meyers, Gilbert P. Smith, Walter C. McIntyre, T. Carpenter Smith, Edwin R. Keller.

Pittsburg, Pa.—Geo. R. Mathieu, Robt. A. M. Steel, J. M. G. Fullman, W. I. Patterson, W. J. Snyder, Jr.

Port Huron, Mich.—D. J. Stevenson.

Rochester, N. Y.—Rudolp Schmidt, T. H. Green.

Schenectady, N. Y.—James F. Burns.

St. Louis, Mo.—Edw. T. Cooke, F. E. Newberry, Chas. J. Sutter, F. B. Adam, Wm. Hand, Wm. A. Corrao.

Syracuse, N. Y.—Jas. Hilton.

Toledo, Ohio.—H. W. Christian, Emil Grah, F. D. McCall.

Troy, N. Y.—Marshall L. Barnes.

Utica, N. Y.—W. H. Morton.

Washington, D. C.—E. C. Graham.

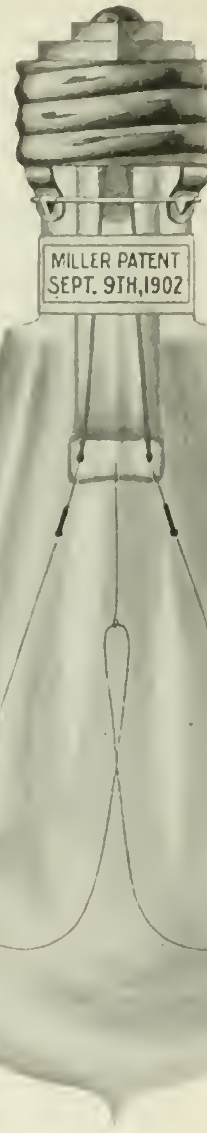
Worcester, Mass.—F. P. Coghlin.

A Large Electric Locomotive.

A dispatch from Schenectady states that the General Electric Company has completed an electric locomotive which is said to be the largest in the world. It was built for the Baltimore & Ohio Railroad Company for use in the Baltimore tunnel. The locomotive weighs 180 tons and is designed to haul freight trains weighing 1,500 tons up a 1½ per cent grade. Its capacity is 2,000 hp, and it is fitted with the multiple unit system of control, there being a controller at each end of the cab. The locomotive is made up of two units each weighing 80 tons, and is so arranged that any number of units may be coupled together. Each unit has eight 42-in drive wheels, making 16 wheels in all.

The Miller Incandescent Lamp.

The accompanying illustration shows an incandescent lamp which is being placed upon the market by the Missouri American Electric Company, St. Louis, Mo., one of the features of which is a detachable base. The base consists of a porcelain insulating button and a cap or sleeve with the usual socket thread. The sleeve has three ears, and a wire passing around these, as shown in the illustration, securely fastens the base to the bulb. By this means the base is held against lateral rotation, and against longitudinal withdrawal by the wire strapping the lugs below a moulded shoulder of the bulb. When the filament is burned out, the neck of the lamp is cut below the sleeve, thereby enabling the stem which carries the filament to be pulled out. A new filament may then be mounted and the neck fused together at the point of cutting. The original bulb may be used or a new bulb fused on, as desired.



INCANDESCENT LAMP WITH DETACHABLE BASE.

Among the advantages of this base is that the removably attached sleeve does away with the use of cement or plaster of paris; and not only is a much stronger attachment made to the bulb, but there is no porous material present to gather dirt and moisture.

New Canal for Boston Edison Company.

At a hearing held before the Massachusetts Harbor & Land Commission on July 15, President C. L. Edgar, of the Edison Electric Illuminating Company, of Boston, outlined a plan for taking cold water from Boston Harbor by the construction of a new canal 10 ft. deep and about 500 ft. long, for the company's new South Boston station. The new plant is to be equipped with ten or twelve large steam turbines at the outset and will be the principal central station in the entire Boston district.

Mr. Edgar stated that in order to bring in this water cold it will have to be taken from the nearest deep channel, which is that reserved, off the company's land at L and First Streets, South Boston. The canal will be from 30 to 75 ft. wide, and the amount of dredging will vary from 6 to 10 ft. The company plans to adopt a bulkhead line for its whole water frontage on the line of the section filled in during 1902. The canal will extend from the present line of the reserved channel to this bulkhead line, and from there three tunnels, two of 8½ ft. diameter and one 10 ft. in diameter, will extend to a point beneath the station. These tunnels will be set in concrete and their mouths will be protected from floating rubbish by coarse racks of wood. There will be two openings for each tunnel in the proposed sea wall. Two of these tunnels will be for the intake of cold water, the duplication being intended to forestall any shut-down of the plant for repairs or cleaning; and the third will be for the outlet of water heated by condensation. To separate the outflowing water, which will have a temperature of about 90° Fahrenheit, from the incoming cold water, a wall will be extended diagonally outward between the mouths of the inlet and outlet tunnels in such a way as to divert the outflow.

Large screens for removing dirt and rubbish from the intake will be located at a short distance inside the sea wall. These will be in duplicate for removal without interrupting the work of stoppage of foreign substances. Manholes will be located still further within the sea walls. The tunnels are to be set in concrete, and cost from $200 to $300 per running foot. The level of the water will be artificially reduced at the station end of the canal, and will flow in from the harbor by gravity.

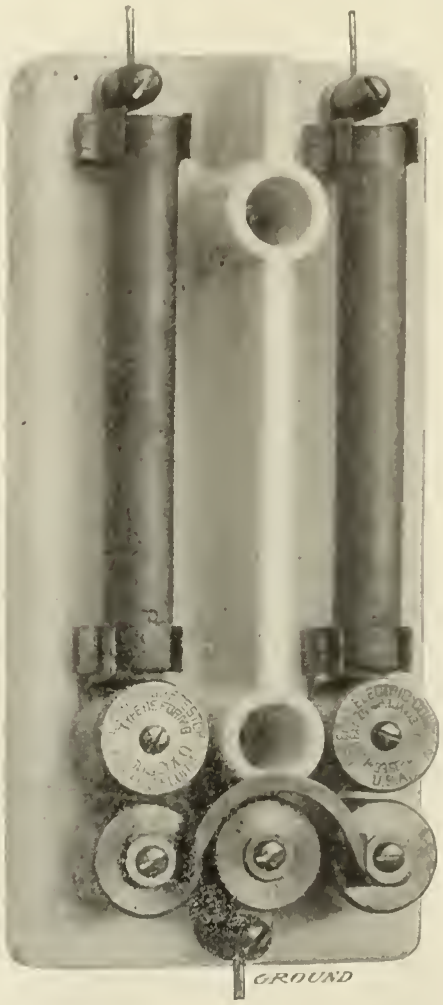
A New Development in Lighting Arresters.

Whenever alternating-current circuits contain both inductance and capacity in appreciable quantities, high voltages are likely to exist which endanger the insulation of the whole system. Such abnormal voltages are especially likely to occur in lines containing a combination of underground and overhead circuits.

The General Electric Company is now supplying alternating-current lightning arresters so designed as to protect against lightning and at the same time to act as a safety valve with reference to high voltages due to causes other than lightning. These high-voltage conditions in a great many cases may not be recognized by the central station manager unless they are brought to his attention by the frequent breaking down of insulation, and even then the troubles are often ascribed to other causes. The strains very often produce pin-hole punctures in the insulation of underground cables and thus relieve themselves temporarily; they may, therefore, remain unnoticed for a number of months until the insulation becomes very much impaired, ultimately resulting in a complete break-down.

It is very difficult to detect the existence of these excessive voltages with switchboard instruments commonly in use. In the first place, most voltmeters are installed on potential transformers. When these abnormal pressures exist, the wave is of enormous high frequency and will not appear on the secondary side of the transformer due to the fact that the eddy current set up in the iron by the high frequency is so great as to dampen out the wave and prevent its reappearance on the secondary side; but it is difficult to measure this pressure even with such instruments as electrostatic voltmeters installed directly across the high-pressure wires. This is because the wave is of short duration and its integrated value is so small and the time element of the moving mechanism of the instrument so large comparatively that the instrument will not record the disturbances. Practically it has been found that only spark-gaps of some form of wavemeter which records instantaneous value is of any service whatsoever for such measurements.

The new lightning arrester known as the "Bultiplex" performs the multi-function of protecting against lightning, resonance or other high-voltage disturbances on the line. The arresters are installed directly across the lines, the center of the arrester being connected through an additional installation of arresters, so proportioned that there are the same number of gaps from either line to line as from line to ground.



Alternating-Current Lightning Arrester.

Letters for Electrical Signs.

Metal letters for electric signs have the great advantage of taking a fine, glossy surface when coated with enamel colors that reflect the light from the lamps distributed about the letters. With a given number of lamps, a much larger and more effectual display may be made by using metal instead of wooden letters, and the former are not objectionable to fire underwriters. The letters keep their good appearance and finish quite a long time, and unlike wooden letters, do not crack, warp or shrink. Their advantage over the fire-enamel sheet steel signs is that the enamel colors do not chip and crack like fire-enamel does, when changing the temperature; moreover, they can be re-coated any time, while a fire-enameled surface, when once chipped, can never be repaired. The coated galvanized sheet steel signs are, although rigid, light in weight, thus saving transporation cost, and can be hung with less trouble and expense.

The Haller Machine Company, Chicago, manufactures as a specialty, metal letters for electric signs in sizes from 6 inches to 15 feet in height. The face of the letters is finished usually in white; the sides in red or other colors. The complete signs of the Haller Machine Company have a metal back ground, finished in smaltz. A raised metal frame around the sign and embossed metal ornaments in gold leaf finish, make a sign also very attractive in the day time.

The same company has introduced a new appliance for electric signs, consisting of an automatic sign dimmer which changes the sign or part of it, alternately or in rotation, from bright light to dark, and back again. This device may be used in connection with any existing sign of any size and shape, without necessitating a change of wiring.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was firmer than for sometime past, the closing rates being 4½@5 per cent. for 60 days and 5@6 per cent. for 90 days to six months. There was liquidation on an extensive scale in the stock market early in the week, and weakness developed which at times showed more or less demoralization. The public did not seem to be attracted by the lower level of prices. In the middle of the week, however, the heavy liquidation ceased, and there was better support and prices rallied somewhat toward the close. There was a severe drive at Amalgamated Copper, which carried it down to the lowest price on record and arrested the improvement in the general market. The reduction in the dividend of Amalgamated Copper resulted from the demoralization in the copper trade, which followed the abandonment by the Amalgamated Company of its attempt to maintain the price of the metal at 17c. per lb. All of the tractions and electric stocks suffered heavy declines in sympathy with the general market, and all, with the exception of Western Union, reached the lowest figures of the year. Brooklyn Rapid Transit lost 3½ points, closing at 51⅛, and Metropolitan Street Railway closed at 118½, being a loss of ⅝ point, 117 being the lowest figure of the week and of the year. General Electric dropped to 157, but rallied and closed at 165½, this being a net loss of 7½ points, while Westinghouse common closed at 170½, a net loss of 19½ points, and preferred at 176, a loss of 21⅞ points. Western Union was quite steady throughout the week, closing at 83½, a loss of ⅛ point, and American Telephone & Telegraph after dropping to 129¾, closed at 130, this being a loss of 2 points. Following are the closing quotations of July 21:

NEW YORK.

	July 14.	July 21		July 14.	July 21
American Tel. & Cable	77	77	General Electric	170¼	162
American Tel. & Tel	127	130½	Hudson River Tel	..	..
American Dist. Tel	26	25	Metropolitan St. Ry	118¾	115⅝
Brooklyn Rapid Transit	52	46½	N. E. Elec. Veh. Trns	.	..
Commercial Cable	.	.	N. Y. & N. J. Tel	..	..
Electric Boat	15	15	N. Y. E. V. T. Co	5	4¾
Electric Boat pfd	35	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1	1	Western Union Tel	83	82½
Electric Vehicle	7	5	Westinghouse com	..	170
Electric Vehicle pfd	13	13*	Westinghouse pfd	..	170

BOSTON.

	July 14.	July 21		July 14.	July 21
American Tel. & Tel	128½	130¼	Western Tel. & Tel. pfd	90*	85
Cumberland Telephone	..	..	Mexican Telephone	1½	1⅝
Edison Elec. Illum	242	239	New England Telephone	125½*	123
General Electric	173	162	Westinghouse	..	85
Western Tel. & Tel	13	12	Westinghouse pfd	..	88½

PHILADELPHIA.

	July 14.	July 21		July 14.	July 21
American Railways	..	..	Phila. Traction	95¾	95¼
Elec. Storage Battery	60	55*	Phila. Electric	5⅞	5¾
Elec. Storage Battery pfd.	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	8¾	8¼	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	July 14	July 21		July 14.	July 21
Central Union Tel	.	..	National Carbon pfd		92
Chicago Edison	147	..	Northwest Elev. com	..	..
Chicago City Ry	185	185*	Union Traction	4	3½
Chicago Tel. Co	..	..	Union Traction pfd	30	30
National Carbon	23¼	23			

*Asked.

LOUISVILLE RAILWAY EXTENSIONS.—It is noted from Louisville, Ky., that arrangements have been completed for raising $3,000,000 for new lines and betterments of the Louisville Railway and to capitalize the equities in the common stock. To do this a holding company will be incorporated in New Jersey under the title of the Louisville Traction Company. It will have common capital stock to the amount of $12,000,000 and $2,500,000 5 per cent. non-voting preferred stock. Of the common stock, $7,000,000 will be exchanged for the $3,500,000 of Louisville Railway common stock and $500,000 will be distributed as a 20 per cent. bonus to the holders of the $2,500,000 old preferred stock. The new preferred stock will be exchanged for the old, share for share. When the holding company is organized, about September 1, $3,500,000 of common stock will be offered to the common stockholders of the old company at $55 per share, the first payment being $25. The remainder of the $55 will be called for as needed, the money being loaned to the street railway for extensions and betterments. The remaining stock will be sold from time to time as required. The stockholders are requested to deposit their stock, and will be given negotiable receipts until the new stock is issued. After the 5 per cent. dividend is paid on the $2,500,000 of the new preferred, all the road's net earnings above the fixed charges will go to the holders of the common stock. It is believed that dividends will be begun at the rate of 3½ or possibly 4 per cent. The road is earning 12 per cent. on the old stock now.

SECURITY OF TROLLEY BONDS.—With regard to the effect of franchise conditions on long trolley enterprises, the New York *Commercial Advertiser* makes some interesting and pertinent remarks as follows: In considering electric railroad securities, and in particular electric railroad bonds, it should be carefully noted whether the franchises and rights of way are perpetual or whether they are terminable. If the franchise is perpetual, then the same rules apply as apply to steam railroads, but if the franchises and rights of way are terminable a new element is introduced which must be considered when applying the income of the property to the capital account to determine the value of the securities. As an illustration we may consider the figures submitted for the Columbus, Delaware and Marion Electric Railroad, a trolley line forty-five miles long, connecting the three cities mentioned. This is an excellent property, viewed from a physical consideration of the plant, its roadbed, power and equipment complying with the best standards of the most modern practice. Its prospective earnings for the year 1903, based on the actual results of the last quarter of the calendar year 1902, are estimated by a conservative engineer to be as follows:

Gross receipts	$157,283
Operating expenses and taxes	86,506
Net earnings	$70,777
Interest on bonds	50,000
Surplus for stock	$20,777

On the face of things these bonds, which, by the way, amount to $1,000,000, for the forty-five miles of road, should be a fairly good bond; but if we consider the franchises we find that the company is limited to twenty-five years in Columbia, in Worthington, in Delaware and in Marion. It owns sixteen miles of right of way from Worthington to Delaware and about twenty-two miles from Delaware to Marion. At the end of less than twenty-five years from the present time the company will find itself owning two detached pieces of road sixteen and twenty-two miles long, and without terminals at either end, unless it is enabled at that time to have its franchises renewed. It is respectfully submitted that it is perfectly proper for stockholders to assume these speculative chances of renewing franchises at the end of twenty-five years. But the bondholders have a right to expect that the property be so financed as to earn interest on the bonds and sinking fund sufficient to retire the bonds within the limits of the franchises. According to the estimated income of this property, as given above, the earnings at the present time are at a rate sufficient to pay the interest on the bonds and retire one-half of the principal within the expiration of the franchise. In this respect, and in the respect that this company will actually own perpetually thirty-five to thirty-eight miles of operative railroad, this trolley line is in a much stronger position than many others in the Central West.

BOSTON EDISON CAPITAL INCREASE.—The Massachusetts Gas and Electric Light Commission has approved the petition of the Edison Electric Illuminating Company, of Boston, for permission to issue 20,000 shares of new capital stock for the purpose of adding to the equipment of the company and purchasing electric lighting plants located in Milton, Dedham, Canton, Natick, Framingham, Woburn, Somerville, Chelsea, Newton and Needham. In its decision the board states that it is of the opinion that the Edison Company would supply the entire district now covered by the several companies operating independently, with greater economy and efficiency; also, that the purchase of these companies by the Edison Company will place additional advantages at the disposal of the public, and insure a more satisfactory service than these districts have heretofore enjoyed. The par value of the shares is to be $100 each, and the market value of the new stock is fixed at $200 per share. If any shares remain unsubscribed for by the stockholders entitled to take them they may be offered at public sale.

DIVIDENDS.—The Minneapolis General Electric Company has declared a regular semi-annual dividend of 3 per cent. on preferred stock, payable August 1. There is talk that the dividend rate on Cincinnati Gas & Electric stock will be increased to 5 per cent. Three of the directors say that the change will occur within a year. The United Traction Company, of Albany and Troy, has declared its usual quarterly dividend of 1¼ per cent. The American Light & Traction Company has declared a regular quarterly dividend of 1½ per cent. on the preferred stock, covering the quarter ending June 30. The dividend is payable August 1. The Consolidated Traction Co. of New Jersey has declared a dividend of 1½ per cent., payable as registered June 30. The Chicago Edison Co. has declared a regular quarterly dividend of 2 per cent., payable August 1. The Western Telephone & Telegraph Company has declared a semiannual dividend of $2 on the preferred stock, payable August 1, to stock of record July 18.

THE UNION TRACTION COMPANY OF INDIANA merged with the Indianapolis Northern Traction Company with nearly 300 miles of interurban lines in operation, and with a capital stock of $8,500,000 and a bond issue of the same amount, was on June 30 leased for 99 years to the Indiana Union Traction Company, which has a capital stock of $5,000,000, an authorized bond issue of the same amount, with $1,000,000 issued. Dividends on the stock of the leased company are graduated from ½ to 6 per cent., increasing 1 per cent. a year.

DEAL OFF.—It is reported that the proposed deal between the American Light & Traction Company and the United Gas Improvement Company, of Philadelphia, has been abandoned. Under the deal, the American Company was to have been leased to the Improvement Company on a 6 per cent. guarantee on the stock of the former.

ALBANY AND HUDSON BONDS.—Permission has been granted by the State Railroad Commissioners to the Albany & Hudson Railroad Company to issue $150,000 additional bonds for improvements.

Commercial Intelligence.

THE WEEK IN TRADE.—In reviewing the trade conditions *Bradstreet's* states that the prevailing summer weather helps crops, increases confidence in fall trade, and stimulates retail business. Speculation droops, but on the whole the tendency is in the direction of improvement. The money situation promises well, though predictions of higher rates in the future point to conservatism in the use of funds. The returns of railway earnings for six months, two-thirds of the country's mileage being represented, show a gain of more than 13 per cent. over the best on record, while roads thus far reporting for the first week of July show a gain of nearly 16 per cent. These figures confirm the claim that present business is the largest ever handled during a mid-summer period. The principal feature in trade reports is the better tone of advices from the Southwest. The reports from Texas are notably more favorable than they have been in recent years. From the Northwest the tone of advices is very good, and wholesale trade in the South is of good volume for the present stage of the season. Unprecedented activity is noted in the anthracite coal trade, and the shipments for six months are 68 per cent. in excess of a year ago, being nearly 32,000,000 tons. As to the crops, the outlook still favors next to largest recorded yields of wheat, corn and oats. The iron trade is quiet on the surface, but production and consumption are alike enormous, though pressure of the latter tends to ease in quotations from iron and steel. Copper is lower on alleged overproduction. Official prices were cut twice during the week, the last quotations being 13⅝ to 13¾c. for Lake and electrolytic and 13¼ to 13⅜ for casting stock. The business failures for the week ending July 16, as reported by *Bradstreet's*, aggregated 173 against 154 the week previous, and 174 the corresponding week in 1902.

GENERAL INCANDESCENT DEAL WITH GENERAL ELECTRIC.—An important step has been taken recently, as noted briefly in this department last week, by the General Electric Company in acquiring during the present month, or about three weeks ago, the control of the General Incandescent Arc Light Company, which under the vigorous direction of Mr. Samuel Insull and the efficient management of Messrs. Martin and Joseph Insull, has been brought to a commanding position in the field of electric light and power. It would appear that the opening arose out of the purchase by the Pennsylvania Railroad Company, on very advantageous terms to the sellers, of the splendid real estate of the General Incandescent Company, at the Thirty-fourth Street ferry of the Long Island Railroad. Mr. Insull had felt for some time that this was rather expensive property in the heart of a big city for factory purposes, but with wonted courage and foresight he held on, until now the big railroad system had to take it at a very high price for its tunnel and terminal developments in the vicinity. Meantime the General Incandescent Company, which has built up by steady work a big business in arc lamps, dynamos, motors, fans, meters, switchboards and other specialties, had to cast around for new quarters, but again a tempting proposition coming from the General Electric Company, Mr. Insull and other interests determined that it would be best to accept the proposition. The General Incandescent Company will be continued as heretofore, and its admirable specialties will be marketed under its name. It is reported that the factory will be removed to Pittsfield, but not much is being said at present on that point. The real estate goes into the hands of the Pennsylvania road on August 15. An interesting item of news that may be added here is the fact that the Cincinnati system has just awarded to the General Incandescent Company a further contract for its 4-amp. arc lamps, which have created so much interest during the past year. This will make a total of no fewer than 5,700 General Incandescent, or Hallberg 4-amp. arcs on the Cincinnati network.

BELL TELEPHONE INSTRUMENT STATEMENT.—The American Telephone & Telegraph Company's instrument statement for the month ended June 20 and since December 20 compares with previous years as follows:

	1903.	1902.	1901.
Gross output	87,608	96,653	96,300
Returned	42,189	41,741	34,221
Net output	45,419	54,912	62,079
Since Dec. 20:			
Gross output	600,064	589,109	469,923
Returned	235,141	226,267	194,569
Net output	364,923	362,842	275,354
Total outstanding	3,515,243	2,888,854	2,228,170

Many persons look upon the monthly instrument statements of the American Telephone & Telegraph Company as affording one of the best indices of trade conditions. To these the June statement, it is said, was a disappointment, being the poorest for the corresponding month in the past three years. A change in the system of collecting rentals from sub-companies was a factor contributing to the poor statement, since under the new system a large number of instruments held in stock by the several companies were returned to the lessors. Another adverse influence was the check of the canvass for new telephones in sections of the country where cheap telephones are being installed by the active and energetic independent companies. It is stated that for the year ended December 31, 1902, the parent company received less than $1 rental for each instrument against $14 a decade ago.

THE YEAR'S FOREIGN COMMERCE.—The foreign commerce of the United States for the fiscal year just closed aggregated $2,445,610,417, being the highest on record and an increase of $160,570,068 over the previous year. The increase over the fiscal year 1901 was $134,673,261; 1900, $201,186,151; 1899, $521,438,626, and 1898, $598,078,433. Imports in the year last named were valued at $616,049,654 and for the year just closed at $1,025,619,127, an increase of $409,569,573; the volume of exports in the meantime increasing only $188,509,960, or from $1,231,482,330 to $1,419,991,290. Compared with last year the value of the imports shows the enormous increase of $122,298,179, and the total, $1,025,619,127, for the first time in history, exceeds the billion-dollar mark. In the exports there was an increase of $38,271,889, but the greater increase in imports left a balance of trade in favor of the United States of but $394,372,163 aaginst $478,398,453 for the previous fiscal year. The growth in importation, which is the most striking characteristic of the year's commerce, is very largely in materials for use in manufacturing. Only eleven months' figures are yet available in such detailed form as to show the increase by great groups, but the figures of the eleven months ending with May show that articles in a crude condition for use in manufacturing, increased sixty-two million dollars or about 20 per cent. as compared with the corresponding months of last year; articles partially manufactured for use in manufacturing increased four million dollars or about 5 per cent.; articles manufactured and ready for consumption increased eighteen million dollars or about 13 per cent., and articles of voluntary use, luxuries, etc., increased fourteen million dollars or about 12 per cent., while articles of food and live animals increased fifteen million dollars or about 8 per cent.

MORE EQUIPMENT FOR SYDNEY POWER PLANT.—Because of the Sydney City & Suburban electric traction system, operated by the New South Wales government, having lately been operated with but little reserve of power, the State Cabinet has given authority to the railway commissioners to expend $500,000 in securing further equipment for installation in the Ultimo central power station. The conversion of the various lines will have to wait until the new machinery arrives. The first installation in the power house consisted of four 1,200-hp Allis engines, direct-connected to General Electric generators. These were supplemented August last by three 2,000-hp engines, also of Allis build, and direct-connected to General Electric generators. At the same time the foundations were built for three more engines and generators of the latter capacity. These are now urgently required. Two of them will be held in reserve. The boilers installed in the plant are of Babcock & Wilcox build. The structural steel for the power house was shipped by the American Bridge Company. It was the first contract ever let for steel frame construction in Australia. The specifications now issued call for reciprocating or turbine engines. Full details can be secured by addressing the agent general for New South Wales, 9 Victoria Street, London, S. W. Tenders will be received in Sydney up to September 12.

CONCHOS RIVER POWER TRANSMISSION SCHEME.—Further particulars are to hand regarding the Conchos River power transmission scheme, to which some reference has already been made in these columns. The Conchos River Power Company has appointed as consulting engineers the John F. Kelly Engineering Company, 140 Broadway, New York. The contracts for equipment, etc., will be awarded through this firm. George F. Hardy, 300 Broadway, is the hydraulic engineer. William Stanley, of the Stanley interests, and Frank H. Wright, president of the Stanley Investment Company, are primarily interested in the project. The latter gentleman is president of the Conchos River Power Company. About 3,200 hp is to be transmitted from the plant to be built at La Joya, on the Conchos River, to the City of Chihuahua, 80 miles distant, and 40 miles to Parral. The energy will also be utilized for the supplying of light and power to several mines in the vicinity. A dam of rip-rap construction will be built. The power house equipment will include four turbine water wheels to operate under a head of 125 ft. The wheels will be of 800 hp each and are to be direct connected to 600 kw, three phase, 60-cycle alternating-current water turbine type generators. Direct current exciters of 2,400 kw will also be installed. The transmission line is to operate at 40,000 volts. Contracts are expected to be awarded next month.

THE ARKANSAS VALLEY INTERURBAN RAILWAY COMPANY has been chartered to build an electric railroad from Wichita, Kan., southeasterly to Oxford, thirty-seven miles, thence east to Winfield, ten miles; west to Wellington, fourteen miles, and south to Geuda Springs, twelve miles, and to Arkansas City, ten miles farther—a total distance of eighty-three miles. The main power station will be at Oxford, where it is believed there is sufficient water power to run the whole line, unless it may be a month or two in summer when they will possibly need a small steam plant as an auxiliary. The water power is to be taken from the Arkansas River, which is estimated to furnish 2,200 horse-power at ordinary low water, and 1,500 horse-power is the amount estimated to run the road. The company is capitalized at a million, and most of the stock is subscribed. Local capital alone is interested so far. O. A. Boyle is president; William Allison, vice-president; J. E. Howard, secretary; C. L. Davidson, treasurer, all of Wichita. The headquarters of the company is Wichita. They expect to carry both passengers and freight, and to furnish electric light and power for the towns along the line. Mr. Boyle is general manager, and is pushing preparations as fast as possible toward completion of specifications, which it is hoped will be ready in a few weeks.

THE HELENA LIGHT AND TRACTION COMPANY is building a new power-house at Helena, Mont., which will be equipped with Westinghouse apparatus throughout, a portion of which has recently been ordered from the Westinghouse Electric & Mfg. Co., the remainder having been in use for some time. The electrical equipment consists of two 75-kw, direct-current generators, each to be direct-coupled to a 100-hp, type C induction motor; two 15-hp, motor-generator sets; nine 10,000-volt transformers—six of 150 kw and three of 125-kw capacity; also two 175-kw rotaries. Three 150-kw and three 125-kw transformers will be equipped with a face plate for obtaining different voltages from the transformers, this dial being connected to the low tension circuit in such a manner as to give variation of voltage between 2400 an 2050. Seventeen low tension leads are brought out from the secondary winding, one lead directly connected into the line and another lead connected to the spark gap, the remaining fifteen connected to the regulator face plate outside of the transformer case. This allows the purchaser to secure proper voltage regulation for extreme variation in load without changing the voltage at the Missouri River Company's station, fourteen miles distant.

ST. LOUIS FAIR INTRAMURAL RAILWAY.—A contract has been closed with the General Electric Company for fifty-one complete car equipments, each equipment to consist of four motors of 40-hp each, and each to be supplied with the latest train control apparatus. The train control is to be similar to that in use on the Manhattan Railway in New York City, the elevated roads in Chicago, and New York's underground electric railway. The trains for the Intramural Railway are to consist of three cars each, making seventeen trains in all for the road. They are to be equipped with air brakes by the National Electric Company, of Milwaukee, and will be of the well-known Christensen type especially adapted for train control service. The first ten trains are to be in operation on or before September 1 next. The contract with the General Electric Company was made through Mr. George D. Rosenthal, the St. Louis representative of the company, and the contract with the National Electric Company by Mr. J. D. Maguire.

ELECTRICITY IN HOISTING.—A new plan for gradually eliminating the horse is an application of electricity for the hoisting and conveying of dirt where excavations are made for the foundation of a building. A recent device carries a platform or carriage suspended on a stout cable, there being mounted on the platform a motor with two sets of frictional gearing, trolley wheels and the necessary apparatus for controlling the current. One of the friction gears propels the carriage on the cable or wire, the other raises and lowers the buckets of earth. It is a pretty operation and does away with the old method of backing a dump cart down a steep incline into the excavated place from which the carts were loaded by hand. In operation the new plan, as shown in Brooklyn, N. Y., empties the buckets as fast as four laborers can fill them.

SALES OF STREET RAILWAY APPARATUS.—Among recent sales of street railway apparatus, the Westinghouse Traction Brake Company reports an order from the Los Angeles Railway Company for 80 street car air brake equipments with motor driven compressors, to be fitted to new high-speed cars built by the St. Louis Car Company. The Company has also lately closed contracts for the following motor-driven compressor air brake outfits: 16 to Oakland Transit Company, Cal.; 17 to North Shore Railroad Company, San Francisco, Cal.; 12 to Indianapolis & Northwestern Traction Company; 16 to Indiana Railway Company, South Bend, Ind.

MICHIGAN TELEPHONE.—At Detroit, Mich., on July 15, Judge Swan, in the United States Circuit Court, ordered the sale of the plant of the Michigan Telephone Company to satisfy a mortgage held by the Old Colony Trust Company, of Boston. The property will be bid in by a syndicate representing the bondholders of the company, and it is understood that they have made arrangements to take care of a claim of $600,000 held against the Michigan company by the Central Trust Company, which is the trustee of the bonds of the Detroit Telephone Company, which was absorbed by the Michigan company. No date was set for the sale.

MEXICAN CAR BUILDING PLANT. Construction work is to begin immediately on the Mexican Car & Foundry Company's plant in Mexico City. Isaac M. Hutchison, of Mexico City, who represents the interests in the southern republic of the St. Louis Car Company, A. L. Ide & Sons, etc., is president of the enterprise. The company will build electric cars as well as those suitable for steam roads. The initial buildings, equipment, etc., will call for an expenditure of $1,000,000 Mexican currency. It is anticipated that the plant will be ready to commence building cars before the end of the year.

INTERNATIONAL STEAM PUMP.—The report of the International Steam Pump Company for the year ended March 31 shows a surplus of $506,154 after dividend payments, $262,402 increase over 1902. Arrangements have been made to extend the company's business in Europe by consolidating the European company with other companies and factories. This consolidation has opened up an important outlet for the production and has practically solved the difficulties arising from tariff conditions.

THE NEWCASTLE FORGE AND BOLT COMPANY, of Newcastle, Pa., is installing in its plant the following electrical apparatus, which has been purchased from the Westinghouse Electric & Manufacturing Company: two engine-type generators, of 75 and 100 kw capacity respectively, which will be operated by engines furnished by the Erie City Iron Works; seven 30-hp, direct-current motors, complete with rails and pulleys, and a three-panel switchboard with the usual auxiliary apparatus.

THE NERNST LAMP COMPANY, of Pittsburg, Pa., through its Portsmouth, N. H., agents, Messrs. W. T. Trafton & Son, has recently closed a contract with H. C. Hewitt & Co., of Portsmouth, N. H., for a number of six-glower Nernst lamps. These lamps have been installed in Hewitt & Co.'s business house and are giving entire satisfaction.

CHICAGO EDISON COMPANY.—An official of the Chicago Edison Company says that the company is supplying its limit in electric power. The company has about twenty stations, among which are eight generating plants. Business was never better. Marshall Field is the company's best individual customer.

CHICAGO TELEPHONE.—The Chicago Telephone Company's net gain of telephones in the city and country during June was 2,649, making the total in use 90,729. President Wheeler says the company will have 100,000 in use by the end of the current year.

LIGHTING PLANT FOR JAPAN.—The Kinshu Railway Company, of Japan, is about to let contracts for the complete equipment of an electric lighting plant to be erected at Wakatmatsu. The equipment will be purchased in this market.

General News.

THE TELEPHONE.

PRESCOTT, ARIZ.—The Prescott Electric Company operates a Eureka switchboard of 450 drops and gives service to 425 subscribers at Prescott and 100 at Jerome. It also has 250 miles of toll line, which reach small towns and mining camps throughout the country.

GRANGEVILLE, IDAHO.—The telephone system between this city and Buffalo Hump has been completed, and is now in operation.

ROSEVILLE, ILL.—The Roseville Telephone Company has recently increased its switchboard capacity and now operates a 200-drop board, with 300 subscribers and 15 miles of toll line. A large addition to the subscriber list is expected.

SARDINIA, IND.—The Sardinia Telephone Company has a 25-drop board and 45 telephones in use; with 11 miles of toll line.

SHELBYVILLE, IND.—A wire of the Mutual Telephone Company fell across one of the wires of the traction company on July 1, and a switchboard, containing 200 lines, was burned out.

WHITESVILLE, IND.—The Whitesville Co-operative Telephone Company has a 50-drop board and 90 subscribers, with 24 miles of toll line. The system consists mainly of farmers' lines.

INDIANAPOLIS, IND.—The New Long-Distance Telephone Company has completed and opened a long-distance line to Louisville, Ky., and also to French Lick, St. Louis and other points in the South and West.

VINCENNES, IND.—The Farmers' Mutual Telephone Society has organized to build a line from Russellville to Vincennes. The company will arrange for the Knox Telephone Company to handle its business in Vincennes.

MT. VERNON, IND.—The Posey County Home Telephone Company has a switchboard capacity of 1,500 drops using 400 at present; has 300 subscribers and 30 miles of toll line. Construction work is not yet completed.

NEWTON STEWART, IND.—The Newton Stewart & Paoli Telephone Company started business on a small capital two years ago, and has twice increased it. A 100-drop board gives service to 75 country subscribers, and 50 in town. More are daily coming in.

ELWOOD, IND.—Conditioned on the sanction of the transfer by the Union Central Telephone Company, E. C. Van Auker, of this city, has purchased the telephone system. The company secures long-distance connection through the Central Union, and for this reason the purchaser desires the sanction of that company.

LOGANSPORT, IND.—At a meeting of the stockholders of the Home Telephone Company on July 10 George W. Seybold was elected president of the company to succeed Theodore Thorwood, resigned. George W. Seybold, J. A. Seybold, Engnihardt Schmidtt, M. F. Mahoney and J. G. Powell were elected directors. H. W. Porter, F. B. Wilkinson, Solomon Brandt and Engnihardt Schmidtt were elected directors of the Cass County Telephone Construction Company.

INDIANAPOLIS, IND.—The Central Union Telephone Company makes the following report to the State Tax Board for the year ending April 1: Capital stock, $3,587,000; 4,159.5 miles of poles, against 4,042.5 miles last year; 55,808.75 miles of wire, against 43,217.25 for last year; 40,224 business telephones, against 46,336 for last year, a decrease of 6,112; 74,773 residence telephones against 61,422 for last year, an increase of 3,251. The net earnings are given at $173,706, against $224,526 for the previous year.

BEDFORD, IND.—The Union Home Telephone Company has been organized and incorporated to build lines and operate a number of exchanges in Lawrence and Jackson Counties. The company has a capital stock of $25,000, and will endeavor to extend and develop rural telephony to its greatest point of utility and perfect service in this field. Two rural systems have already been purchased by the new company. These will be combined and will give the company nearly 200 miles of rural lines. John A. Hartman and Frank Vance, J. C. Monteith, Seymour; W. H. Brown, Hintonsville, and G. C. Dudley, of Ohio, are promoters.

MUNCIE, IND.—The four-month strike of the Electrical Workers' Union against the Central Union and the Delaware and Madison County Telephone Companies at points throughout Madison County was formally declared off on July 11. It is given out that the companies agreed practically to all the demands of the strikers except the discharge of non-union men now in their employ, but agreed that all men hired in the future shall be union men. Superintendent Cline, of the construction department of the Central Union held out against any compromise with the strikers, but the absolute necessity of immediate repairs and improvements and the inability to secure sufficient non-union men for the purpose rendered prompt action necessary.

KOKOMO, IND.—The City Council has granted a forty-year extension of franchise to the Citizens Telephone Company on condition that all be laid underground and the poles removed from the streets. The company has accepted. The Citizens' Company operates a 3,000-line board and has 2,500 subscribers while the Bell Company has 400 subscribers. During the year ending June the company increased its capital stock from $25,000 to $100,000; increased its pole line from 26.5 miles to 56.5 miles; its wire from 77 to 141 miles; the number of its business telephones from 350 to 371; its residence telephones from 650 to 1,179; its gross earnings from $13,500 to $24,341, and its net earnings from $4,486 to $11,446. The company charges $2 per month for business telephones and $1.25 for residence telephones.

INDIANAPOLIS, IND.—The regular quarterly distribution of prizes for the long-distance operators of the New Telephone Company has been made. Hilda Canady was winner of the $25 prize; Addie Temple of the $15 prize, and Alice Milton of the $10 prize, in the competition for the highest average of efficiency and application to work during the last quarter. The cash prizes are awarded each quarter on the records made by the operators in attendance, lost calls, efficiency and deportment, the highest record possible being one hundred. By the lost call record is meant the number of long-distance calls that the operator is forced to abandon on account of inability to find the person called. It is stated that the more efficient operators will search by wire for a person called all over a town in order that a lost call may not be registered against her. It has been found that the efficiency of the long-distance operators of the New Company has been increased since the eight-hour order, and the plan of awarding prizes went into effect.

EVANSVILLE, IND.—The filing of a suit in the Superior Court by ex-Judge R. D. Richardson, to enjoin the City of Evansville from taking stock in the proposed Municipal Telephone Company, or from exercising any rights as stockholder under the subscription already made to the municipal telephone company, has produced quite a sensation. Richardson seeks also to enjoin all city officers as well as directors of the Municipal Telephone Company from taking any steps pursuant to orders or contracts made by or between the city and telephone company, on the ground of invalidity of any such transaction between the city and the municipal company. The complaint alleges the scheme to be illegal; that it would entail a heavy debt on the city by making it liable financially for all indebtedness if the company fails, and contends that the franchise to the streets in time would be bought by outside parties for little or nothing. The estimated cost of the municipal plant is $300,000 and the money to be paid in is $175,000. The city is not able to advance the money, he alleges. The officials of the municipal company claim that the Cumberland Company is back of the suit, and the plan is to hinder the letting of the contract for the new plant.

SCHALLER, IA.—The Schaller Telephone Company has a 100-drop board with 10 extra for country lines; 190 subscribers, 100 being in the country.

SLOAN, IA.—The Sloan Telephone Company has one of the largest exchanges, using a Clark Automatic system, and finds it very satisfactory. With a 75-drop board it gives good service to 79 subscribers.

MARINE CITY, MICH.—The Marine City Telephone Company operates a 200-drop board and has 100 subscribers.

MORRICE, MICH.—The Union Telephone Company uses 25 drops of a 100 board and has 25 subscribers at $12 and $15 per year.

MEMPHIS, MICH.—The Michigan Telephone Company, the only one doing business here, intends to have a rural exchange with about 50 subscribers. It now has a 15-drop board with five subscribers and six miles of toll line.

NORTH BRANCH, MICH.—The Michigan Telephone Company contemplates a large increase of business and extensions in many directions in the farming districts. It has an 80-drop board and 60 subscribers, besides eight miles of toll line.

KALAMAZOO, MICH.—The Citizens' Telephone Company, whose capital is $250,000, has 1,400 subscribers. The lines are all copper metallic and extend over the whole country, keeping the company in close touch with the outside world.

ZUMBRATA, MINN.—The Zumbrata Telephone Exchange has 200 switchboard capacity and 183 subscribers. There are 20 miles of toll line, and an increase is projected.

VERNDALE, MINN.—The Verndale Telephone Company operates a 100-drop switchboard, of which 60 are installed, and 60 subscribers. Rural lines are to be extended considerably in the near future.

COLUMBIA, MO.—The Columbia Telephone Company operates a 600-drop board and has about 800 subscribers, with 50 miles of toll line. The company will build 50 miles more of farmers' lines.

ABERDEEN, MISS.—The Citizens' Long Distance Telephone & Telegraph Company has reached the ultimate (220 drops) capacity of its switchboard and is having another installed to meet the demand of waiting subscribers. There are now 239 subscribers and about 200 miles of toll line. A line to Memphis, Tenn., is projected. Rates are 25 cents for five minutes; $18 and $24 per annum. The offices of this company are at Columbus, Miss.

ALBANY, N. Y.—The State Line Telephone Company has been incorporated with a capital of $1,000,000. No principal business office given. It is to connect New York and Buffalo by telegraph as well as telephone. Directors are Wm. Engert, George Engert, Chas. W. Andress, Robert P. Lyon, Daniel A. Nesbitt, Egbert A. Reynolds, of New York City and Henry N. McKay, of Brooklyn.

ASHEVILLE, N. C.—The proposed merger of the Bell and Asheville Telephone companies at Asheville is creating a great amount of discussion, and a committee has been appointed to see if another company will take the field at the present rates.

RALEIGH, N. C.—The retail grocers' association of Raleigh, in an effort to reduce the cost of telephone service, has adopted the Bell and Raleigh telephones, excluding the Interstate service. The matter, however, seems to be still unsettled.

CLARKSVILLE, TENN.—The Home Telephone Company, of Clarksville, has completed its line to Guthrie, Ky. Other extensions are also being made.

JEFFERSON, N. D.—The Jefferson Telephone Company reports quite a bright outlook, as subscribers are coming in. At present there are 30 with a 9-drop board. The company also has 25 miles of toll line.

HECLA, S. DAK.—The Social Telephone is exactly what its name implies. Each subscriber becomes stockholder on payment of $35, and has free use of the line; outsiders pay 25 cents for five minutes' use. The switchboard capacity is 12 drops, but is to be increased. There are 200 subscribers and 75 miles of toll line

PENDLETON, ORE.—The plant of the Pendleton Telephone Company has been purchased by John Endicott of this city. It is his intention to immediately extend and improve the system. The line at present extends from here to Pilot Rock, Alba, Ukiah, and Lehman Springs.

ELECTRIC LIGHT AND POWER.

SYLACAUGA, ALA.—The Sylacauga Water & Light Company has been incorporated with a capital of $25,000 by L. T. Yoder, of Pittsburg, Pa., and other citizens of Sylacauga.

CLIFTON, ARIZ.—A. F. Johns, of San Francisco, Cal., is making a survey for the construction of a power plant to be located on Blue River, for the transmission of electrical energy to Clifton and Morencia.

FT. ROSECRANS, CAL.—Bids are wanted Aug. 6 for an electric plant at this post. Address Maj. J. H. Willard, Corps Engineers, U. S. A., 518 Bradbury Building, Los Angeles, Cal.

CORONA, CAL.—The Corona Gas & Electric Company has been organized with a capital of $50,000, by M. W. Findlay, F. Cooper, M. Terpenning, and others, to construct a gas and electric light plant.

WASHINGTON, D. C.—The Norfolk Industrial Company and the Montgomery Power Company, the two companies which have franchises to develop power at Great Falls, have consolidated, and the new concern is now known as the Potomac Power Company of Maryland and Virginia; capital $110,000. Horace G. Williams, president; Clifford L. Pullen, vice-president, and William E. Stokes, secretary.

ST. AUGUSTINE, FLA.—The Council is negotiating with a company to establish an electric plant, at a cost of $50,000.

ASHLEY, ILL.—The city council has passed an ordinance calling for the issuance of municipal bonds to the amount of $5,000, the proceeds to be used in erecting a city electric plant.

ALTON, ILL.—The Alton City Council, at its meeting July 11, entered into a ten-year contract with the Alton Railway, Gas & Electric Company, for the lighting of the city. The city will be allowed 32 more arc lights at the old price.

RICHMOND, IND.—Bertrom & Storrs, of New York, N. Y., have purchased the plant of the Richmond Light, Heat & Power Company, and will make extensive improvements.

INDIANAPOLIS, IND.—Joseph McWilliams & Co., of Indianapolis, have secured the contract for the construction of a power plant, at a cost of $78,000, for the Central Indiana Hospital for Insane, at Indianapolis.

PRINCETON, IND.—The Princeton Lighting Company has purchased the Oakland City Electric Light Company plant, paying $10,000 for it. Extensive improvements will be made and some new machinery installed.

WABASH, IND.—The citizens of this city are strenuously opposing the municipal light proposition and the council will likely reject it. An estimate furnished by an electrical expert places the original expenditure at $41,000, and the expense of operating and repairs at $7,000 annually. Adding to this depreciation of property with $2,000 interest on bonds, makes the question of such serious import as to warrant the citizens in opposing the scheme.

HARTFORD CITY, IND.—The three dynamos to be used in the American Window Glass Company's factory have arrived and are being installed. They will be belted to the shaft of a gas engine of 150 horse power. The dynamos are of 25, 75 and 220 volts and will furnish power and light for the immense plant. The factory is being equipped for electric power, because it is the intention to operate the blowing machines by electricity as well as all other departments.

NOBLESVILLE, IND.—The Noblesville Hydraulic Company has been incorporated, with a capital of $100,000, to construct a wooden dam across White River between Potter's bridge and Conners dam in Hamilton County. The dam is to provide a millrace for the hydraulic company's power house, which will be erected north of city for generation of electrical power for Noblesville. W. C. Beardsley, South Bend, is engineer in charge of the work. Theodore D. Layman, of Indianapolis, is one of the incorporators.

ROCK VALLEY, IA.—It is stated that D. A. McKellar will construct an electric light plant here.

DES MOINES, IA.—The contract for laying eight miles of conduits for putting the overhead wires of the Edison Electric Light Company underground in the business district has been awarded to George King. The company also awarded to the Des Moines Clay Works the contract for the conduits.

HOPKINSVILLE, KY.—John H. Bell, Jr., of Hopkinsville, has secured a franchise for an electric light plant.

MADISON, ME.—The estimated cost of an electric light plant for Madison is $42,000. Dr. W. G. Sawyer is chairman of the committee.

PORTLAND, ME.—The Omaha Electric Light & Power Company has been organized at Portland, capital, $3,500,000. Ernst L. Carr, of Melrose, Mass., and Charles H. Tolman, of Portland, are among the incorporators.

ROCKVILLE, MD.—Joseph Schreiber, of Baltimore, is reported to have secured the contract for lighting the town with electricity at $1,500 per year. He will install new machinery in the power house.

BOSTON, MASS.—Penal Commissioner John B. Martin has awarded to Edwin C. Lewis, of Boston, the contract for furnishing and setting up a complete electric system in the new building for the House of Correction, Deer Island, for $23,336, and to Hodge Boiler Works, of Boston, for three horizontal tubular boilers for the same building at $3,586. The lowest bid opened July 1 by the Board of Trustees of Insane for installing an electrical system in the new building for women at Austin Farm, was that of the Lord Electric Company, at $14,250.

NECAXA, MEX.—The Mexican Light & Power Company is constructing a plant at Necaxa. Its first installation will comprise six 7,000-hp impulse wheels, direct-connected to 5,000-kw generators. The available head is 1,250 feet. In connection with this work it is proposed to construct a storage reservoir with a capacity sufficient to operate the plant four months independent of any flow in river. Jas. Ross, Toronto, Ont., is president. F. S. Pearson, 29 Broadway, New York, will award the contracts.

MARQUETTE, MICH.—It is proposed to expend about $15,000 in improving the municipal electric light plant.

MORRIS, MINN.—A 15-year franchise has been granted to the Fowler Electric Company.

LANESBORO, MINN.—Thompson & Habberstad have secured the contract for erecting the electric light plant, to take the place of the old one. An entire new system with new machinery for a 220-volt lighting system will be installed; also a new waterwheel, flume and connections of steel.

ST. LOUIS, MO.—The new $33,000 municipal lighting plant in the City Hall building was satisfactorily tested June 22. The entire plant will consist of six generators and three 185-hp engines. Two engines and four generators have been installed. The plant will light the City Hall, Four Courts and City Jail, Court House and Fire Engine House No. 6, and run the new elevators in the City Hall at a saving to the city of over $20,000 yearly.

PARADISE, NEV.—A. Pasquale, of this city, has announced his decision to install an electric plant on Martin Creek, eight miles from here, the power to be generated at the dam of the Paradise Mining Company. Power will also be furnished for the town of Winnemucca.

ANDOVER, N. B.—Bids will be received July 25 by the Andover and Perth Electric Light Commissioners for installing an electric plant for the villages of Andover and Perth, including the development of the water power, building power house, supplying and setting wheel, supplying and setting poles with cross arms, supplying and installing electrical plant. C. H. Elliott is secretary.

MT. HOLLY, N. J.—The Marlton Light, Heat & Power Company has been incorporated, with a capital of $10,000, by W. H. Zelly, H. B. Dunphey, and others.

NEWARK, N. J.—The United Electric Company of New Jersey has secured the contract for lighting the city for five years (1,860 lights) at $95 per light per year.

SANTA FE, N. M.—It is reported that the Capital Light & Power Company will soon begin the construction of an electric plant on Pecos River, the power to be transmitted to Santa Fe, Las Vegas and Albuquerque.

SCHOHARIE, N. Y.—The power plant of the Middletown and Schoharie Light, Heat & Power Company was destroyed by fire on July 2.

ALBANY, N. Y.—The Korona Heat & Light Company, of New York, has been incorporated; capital $100,000. Directors: David Ogilvy, H. H. Hayden and J. E. Walker, New York.

MANCHESTER, N. Y.—The Ontario Light & Traction Company, of Canandaigua has secured the contract to light the streets by electricity for ten years, the price to be $15 per light for the first year, $14 for the second year, and $13 for the remaining seven years.

MT. AIRY, N. C.—Bids will be received by the Mayor until July 27 for certain supplies incidental to the construction of the electric light, water works and water power plants. John W. Hays, of Petersburg, Va., is the engineer.

ASHEVILLE, N. C.—It is reported that Mr. George W. Vanderbilt will soon begin the construction of a model manufacturing city between Hendersonville and Brevard, N. C. The work will involve a complete system of water works, electric lighting, heat and power.

CASSELTON, N. D.—Bids will be received August 3 by B. D. Youells, City Auditor, for an electric light plant.

WILLIAMSBURG, OHIO.—The citizens have voted to issue electric light bonds.

JERMYN, PA.—The Household Electric Light, Heat & Power Company, Jermyn, has been incorporated with a capital of $6,000.

MAYFIELD, PA.—The Independent Electric Light, Heat & Power Company, of Mayfield, has been incorporated with a capital of $6,000.

GLEN CAMPBELL, PA.—The Electric Light, Power & Manufacturing Company has been organized, with S. J. Smith, president, and C. W. McCrady, Secretary.

HOUSTON, TEX.—It is reported that the Houston Electric Company has decided to expend about $100,000 in improvements to its power house.

LAREDO, TEX.—C. C. Pierce, of Laredo, is reported interested in the construction of an electric power plant on Rio Grande River, about 25 miles above Laredo.

BEAUMONT, TEX.—The Beaumont Light & Power Company has been incorporated with a capital of $600,000. Incorporators: W. A. Myrick and W. J. Crawford, of Beaumont, and C. H. Beauchamp, Jr., of Dallas. The company will probably purchase the plant of the Beaumont Ice, Light & Refrigerating Company.

SEATTLE, WASH.—The City Council has passed an ordinance directing the Comptroller to secure bids for $590,000 bonds for establishing or buying a municipal lighting and power plant.

JANESVILLE, WIS.—The Janesville Electric Company will construct an extensive power plant here.

GRANTSBURG, WIS.—W. I. Gray & Co., of Minneapolis, Minn., have secured the contract for an electric light plant, for $6,695.

SHEBOYGAN, WIS.—The Sheboygan & Elkhart Railway & Electric Company has applied to the city for a franchise to operate an electric lighting plant.

WEYAUWEGA, WIS.—The Weyauwega Electric Light Company, of Weyauwega, has been incorporated, capital $20,000. Incorporators: W. H. Weed, W. E. Hinchey and F. E. Phillips.

PORT WASHINGTON, WIS.—The Water Works Committee has recommended the construction of a combined water works and electric light plant, to be located in the gravel pit, the water to be supplied from artesian wells.

THE ELECTRIC RAILWAY.

PRESCOTT, ARIZ.—The Prescott Electric Company has commenced the construction of a street railway system in this city. When completed it will extend to Fort Whipple and will furnish transportation for the mines in that section.

LOS ANGELES, CAL.—The big deal between E. H. Harriman and H. E. Huntington for control of practically all the electric roads in Los Angeles County has been closed by the payment of $1,500,000 and the transfer of the Los Angeles Traction Company to Huntington. This, it is stated, ends all the threats of war between the two interests.

DECATUR, ILL.—The sale of the Decatur Traction & Electric Company's property has been effected by a syndicate of Eastern capitalists represented by W. B. McKinley, of Champaign, purchasing the entire issue of $250,000 in capital stock for $200,000. The system has been bonded for $212,000. This makes the total valuation of the plant $412,000. The capitalists represented by Mr. McKinley are now building interurban systems that will eventually be joined and make an electric railway from Danville through Champaign and Decatur to Springfield, thence to St. Louis.

CHICAGO, ILL.—It is announced that the Lake Street Elevated Railroad securities committee has secured sufficient deposits of stock to warrant its proceeding with its reorganization plan. Pending the preparation of such a plan the committee has adopted resolutions extending the time for depositing the securities to Sept. 15, 1903.

RICHMOND, IND.—The Eastern Indiana Electric Railway Company has commenced its survey of the proposed line from Richmond to Portland, Ind.

FORT WAYNE, IND.—It is stated that the Fort Wayne & Southwestern Traction Company, which is now in the hands of a receiver, will probably be restored to the stockholders within a few days. The property was placed in the hands of S. L. Nelson, the general manager, as receiver, at the instance of the National Bank of North America, New York, which held a $100,000 note of the company, and which sued to prevent its claim becoming a junior lien under a mortgage about to be executed. The bank has dismissed the case, the company having adjusted the claim to its satisfaction, and Mr. Nelson, it is said, will soon retire as receiver and resume his duties as general manager. The company has no floating debt.

DUBUQUE, IA.—The Dubuque & Western Railroad Company has filed articles of incorporation. Peter Kiene, of Dubuque, is president. The Eastern Securities Company, of New York, is backing the project.

WORCESTER, MASS.—The Railroad Commissioners have approved the extensions of the Boston & Worcester Street Railway Company in Eastern Avenue, Framingham; of the Framingham, Southboro & Marlboro Street Railway Company in Worcester Street, Framingham, and of the Hampshire & Worcester Street Railway Company, in Warren.

BOSTON, MASS.—The Boston Transit Commission has opened bids for the construction of the last section of the tunnel which will connect East Boston with the city proper. Eight bids were received, ranging from $125,000 to $229,170. The successful contractor will have until Dec. 20 to complete his work, and this will not include the laying of the tracks.

EXETER, MASS.—The Epping, Brentwood & Kingston Street Railway, chartered with an authorized capital of $200,000, has been organized. The directors are Russel H. Fellows, of Brentwood; Levi W. Bartlett and L. Waldo Collins, of Kingston; D. Frank Fellows, of Brentwood; John Scammon, of Exeter; Mr. Perrin, J. A. Edgerly, W. S. Goodridge and R. R. Morris, of Epping. Russel H. Fellows was elected president.

FALL RIVER, MASS.—The Tiverton & Seaconnet Street Railway incorporators—the company proposing to build from New Bedford to Horse Neck and thence through Little Compton and Tiverton to Fall River—have formed a corporation with the following directors: A. S. Pennock, B. W. Carlow, N. L. Sheldon and Henry M. Brett, of Boston; George T. Howard, of Little Compton; Job Wordell and Frank Grinnell, of Tiverton.

SPRINGFIELD, N. H.—At the annual meeting of the Springfield Electric Railway Company the following directors were elected: E. C. Crosby and C. W. Wyman, of Brattleboro; F. S. Coolidge and M. A. Coolidge, of Fitchburg, and W. W. Brown, of Springfield. The directors elected E. C. Crosby president and general manager; M. A. Coolidge, vice-president and treasurer, and Allyn J. Crosby, superintendent.

GLEN FALLS, N. Y.—Plattsburg men have formed a syndicate which has quietly secured the rights of way for an electric road up the Saranac Valley from that city to Clayburg, a distance of 20 miles.

ALBANY, N. Y.—The State Board of Railroad Commissioners has approved of a change of name of the New York and North Shore Railway Company to the Long Island Electric Railway Company.

JAMESTOWN, N. Y.—The Chautauqua Traction Company has been granted authority by the State Railroad Commission to build an electric railway 14 miles long from Lake Wood to Mayville. The company has a capital of $500,000.

BROOKLYN, N. Y.—Plans have been filed in the Building Bureau at Long Island City for new car houses to be erected at the corner of DeKalb and Covert Avenues, Ridgewood, by the Coney Island & Brooklyn Railroad. The building will be of brick, and will cover a space of 105 ft. by 700 ft.

COLUMBUS, OHIO.—The Lancaster, Logan & Nelsonville Traction Company, of Logan, has been incorporated, with a capital of $10,000, by A. Magoon, J. W. Jones, D. A. Rannells, F. M. McKay and F. E. Pierpont.

NEWARK, OHIO.—J. F. Shorontz, Edward Kibler, Edward H. Everett, Frank Moore and F. E. Elliott have applied for incorporation papers at Columbus for the Newark, Martinsburg & Mount Vernon Traction Company.

CINCINNATI, OHIO.—The stockholders of the Indianapolis & Cincinnati Traction Company have voted to increase the capital stock of the company from $1,500,000 to $2,000,000, and have authorized a bond issue of $4,000,000. The company's line will be double track. The right of way as far as Connersville has practically been secured, and the contract for the construction of the grade has been let. Rails for the line have been purchased from the Cambria Steel Company, and the ties have been contracted for from the Gray Tie Company, of Evansville.

HAZLETON, PA.—Surveys are being made for the new electric railway between Hazleton, Weatherly and Mauch Chunk. F. W. Larned, of Wilkesbarre is president.

YORK, PA.—The Gettysburg Battlefield Electric Railway, which was recently sold by the Gettysburg Transit Company to Philadelphia capitalists, will be extended to Westminster, Md.

PITTSBURG, PA.—An electric railway system is to be built between Avalon and Freedom, in the Ohio Valley. It is the project of officials of the Pennsylvania Railroad.

WILKESBARRE, PA.—A trackless trolley line has been projected to run from Buttermilk Falls by way of Lake Winola and the East Mountain Lithia Spring to Factoryville, a distance of about 9 miles. A power house is to be erected at the Falls.

HOMESTEAD, PA.—An electric railway is to be built from Hays Borough south to Currys Station, a distance of about 6 miles. The right of way has been secured by E. W. Curran, of Homestead. The capital of the new company is $36,000. The officers of the company are: President, F. N. McKinney, of Pittsburg; secretary, F. W. Curran, of Homestead.

DOYLESTOWN, PA.—The Bedminster Railway Company, capital $15,000, has been chartered. The incorporators are Isaac R. Rosenberger, of Colmar, president; Lewis Keller, Dr. N. S. Nonamaker, John S. Bissey and John H. Nickel, of Bedminster; Charles R. Rosenberger, of Colmar; Harry J. Shoemaker and Samuel A. Hellyer, of Doylestown; Aaron Kratz, of Plumsteadville, and L. P. Muthart, of Allentown.

FREELAND, PA.—The Freeland Electric Coach Company has been organized to operate a trackless trolley line from this place to Upper Lehigh, St. Johns, Eckley, Sandy Run and other towns. The officers are: President, Hugh Malloy; vice-president, Albert Goeppert; secretary, S. J. Neuberger; treasurer, M. Schwabe; directors, Hugh Malloy, A. Goeppert, S. J. Neuberger, M. Schwabe, A. Oswald, of Freeland, and Harry W. Davis, of Wilmington, Del.

SCRANTON, PA.—The Scranton Railway Company has entered into a three-year contract with Division No. 168 of the Amalgamated Association of Street Railway Employees, in which provision is made for every contingency that may arise in the relation of the company and its employees. It went into effect July 20, and remains in force until April 1, 1906. The agreement provides for a board of five arbitrators, one of whom shall be a neutral. Motormen and conductors are to receive 18 cents an hour for the first year, 19 cents for the second, and 20 cents thereafter.

HARRISBURG, PA.—A charter was granted July 9 to the Central Pennsylvania Traction Company, capital $2,100,000, which will take over the lines of the Harrisburg Traction Company by August. The directors are T. C. Calder, Edward Bailey, James M. Cameron, E. Z. Wallower, A. G. Knisely, H. A. Kelker, Dr. W. H. Seibert, James Russ, George W. Reily, B. E. Myers, E. E. Walz, S. F. Dunkle, Harris Cohen, E. C Felton, E. W. S. Parthemore. Edward Bailey is president; W. G. Calder, secretary and treasurer, and Frank Musser, general manager. It is stated that the property of the Harrisburg & Mechanicsburg Electric Railway Company will be acquired by the new company. New machinery will be installed at the power plant and new rolling stock secured.

COLUMBIA, S. C.—The City Council of Columbia has passed an ordinance providing separate seats on street cars for whites and blacks. Since the passage of the ordinance the negroes of the city have virtually determined upon a boycott against the street railway company.

NASHVILLE, TENN.—The Tennessee Western Railway Company has been incorporated, with $100,000 capital stock, to construct a railway from Humboldt to Alamo, a distance of about 40 miles. The incorporators of the company are W. H. Skevington, J. H. Connor, Albert Akers, James Brown and Bradley Walker.

NORFOLK, VA.—The Chesapeake Transit Company has increased its capital stock from $500,000 to $630,000. The additional capital is to be used for the construction of more cars and other equipment.

RICHMOND, VA.—The striking street car men announce that they have secured subscriptions to stock aggregating $40,000 and will purchase a large number of automobiles capable of carrying twenty-five persons each. These will be put on the streets paralleling the lines of the street car company.

MORGANTOWN, W. VA.—Surveys have been started on the proposed electric railway from Morgantown to Granville. The Union Utility Company is having the surveys made. It will build the line under the charter recently granted the Fairmont, Morgantown & Cheat River Trolley Company, and they will operate it together.

FOND DU LAC, WIS.—The Fond du Lac & Northwestern Railway Company has been incorporated to construct and operate an interurban railway from Fond du Lac to Manitowoc and Appleton. The incorporators are W. H. Phillips, H. W. Wilson, Franklin Phillips, J. E. McMullen and F. H. Sweet.

LA CROSSE, WIS.—The La Crosse & Black River Electric Railroad Company, which proposes to build between La Crosse and Black River Falls, has made application for a franchise. The construction of the road will begin in the fall, and it will cost $1,000,000. The road is incorporated temporarily at $500,000.

MARINETTE, WIS.—The Marinette and Menominee street railway and lighting companies will be formally combined. The capital stock is to be increased from $300,000 to $560,000 to make improvements. The name of the consolidated corporations is to be the Menominee & Marinette Light & Traction Company, with general offices in Menominee.

NEW INDUSTRIAL COMPANIES.

THE WILLIAM EBBITT ELECTRIC COMPANY, of Cleveland, Ohio, has been incorporated to own telephone lines, appliances and other devices, capital $150,000.

THE MANHATTAN SWITCHBOARD COMPANY, of Newark, N. J., has been incorporated, capital, $500,000. Incorporators: Charles Loeffler, August Schramm and Carl H. Van Baur.

THE SHAW ENGINEERING & MANUFACTURING COMPANY, of Newark, N. J., has been incorporated with a capital of $100,000. Incorporators, H. M. Shaw, J. C. Blevney, E. M. Shaw.

THE NASSAU TRANSPORTATION COMPANY, of New York, has been incorporated with a capital of $50,000. The directors are J. J. Hall and C. L. Hall, of New York, and James Hall, of Brooklyn.

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LEGAL.

MANHATTAN ELEVATED THIRD TRACK.—A decision in the matter of the third, or express, track on the West Side lines of the Manhattan Elevated Railway has been handed down by Supreme Court Justice Truax, who holds that though Henry B. Auchincloss, the plaintiff, is not entitled to have the extra track removed, yet he is entitled to receive both fee and rental damages, amounting in his case to $9,000 for fee and $8,000 for rental. Mr. Auchincloss objected to the third track on the ground that it was unauthorized by law, and contended that the building of the express track in short sidings was only an evasion of the statute which prohibited a continuous third track. When the suit was first brought Justice Bischoff dismissed it, but the Appellate Division reversed him and ordered a new trial, holding that the construction of the track was unauthorized, and imposed an extra burden on the plaintiff's property. Justice Truax in his decision says that it is unnecessary to consider whether the third track was a siding, as had been claimed, or not.

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PERSONAL.

EARNEST MCCLEARY.

MR. EARNEST McCLEARY, whose portrait is here shown, is the new president of the National Electrical Contractors' Association, succeeding Mr. Eidlitz, who has been so active and efficient in that capacity. Mr. McCleary is a member of the firm of McCleary and Colquitt, of Detroit. He has been association director for the state of Michigan, and one of the most popular men in the national organization. He not only possesses a thorough training as an electrical engineer, but has a knowledge of law that has been of inestimable value in all sessions of the directors of the association. He has been actively interested in the national body since its organization, and was early recognized as a leader among its members. It was largely through his efforts that the large exhibition of electrical apparatus was held in connection with this session of the convention at Detroit.

MR. G. M. GEST, the expert subway contractor, was in New York the early part of this week looking after some of his large contracts.

MR. M. R. FISTER, of the Home Telephone Company, Elkhart, Ind., has resigned to accept a position with the Stromberg-Carlson Telephone Mfg. Company at Rochester, N. Y.

CAPT. LEONARD D. WILDMAN, Signal Corps, has been ordered to proceed to New London, Conn., on business pertaining to the electric installations of the Signal Corps.

MR. FREDERIC NICHOLLS, ex-president of the National Electric Light Association, has been elected vice-president of the Toronto Street Railway Company in the place of James Ross, resigned.

MR. G. MARCONI will, it is said, return to this country in August to follow up the work here, when one improvement to be introduced, it is said, will be the abolition of the present tall towers and wire masts.

MR. W. VAN WHITALL has withdrawn from the firm of Gilbert Wilkes & Co., Denver, of which he was one of the organizers. His holdings in the company were purchased by Mr. Woolfington. Mr. Whitall will take up other lines of work for the future.

MR. J. D. MAGUIRE, of the National Electric Company (successor to the Christensen Engineering Company), Milwaukee, informs us that his company has just closed the contract for the World's Fair Exposition at St. Louis for the entire air brake equipments for their intramural road. It was a very keenly contested contract, and the company feels quite elated over its success.

MR. T. H. BAILEY WHIPPLE, who has been associated with the Sawyer-Man Electric Company as assistant to the second vice-president, succeeds Mr. C. W. Rice in the Nernst Lamp Company. Mr. Whipple, who was formerly connected with the Jandus Electric Company, of Cleveland, Ohio, is a man of wide experience and acquaintance in the electric lighting field, and eminently fitted for the position which he assumes.

MR. PHILIP DAWSON, the well-known civil and electrical engineer, presided at the Savage Club dinner in London recently, when affairs as well as the entrees had a decidedly electrical flavor. The broad sheet menu had an excellent portrait of Mr. Dawson in the center, surrounded by other sketches of well known men, and of electric railway apparatus, humorously depicted. In one corner a Yerkes car is shown butting a Morgan car off the track.

MR. HENRY HALLBERG, for a few years past the arc lighting expert of the General Incandescent Arc Light Company, has just been offered and has accepted the responsible position of general superintendent of the electrical department of the Cincinnati Gas & Electric Company. He will take over these new duties after August 15, when a large amount of important development work awaits his attention, in which his familiarity with the technical affairs of this large corporation will help him.

MR. CALVIN W. RICE, second vice-president of the Nernst Lamp Company, of Pittsburg, Pa., has announced his resignation from the Company, to the universal regret of his business associates, who found in him that combination of executive ability and personal attraction so much to be desired. Since May, 1902, Mr. Rice has held the position of second vice-president, to which he later added the duties of sales manager. To his efforts is due in a large measure the success of the company, the past year having been a particularly prosperous one.

MR. H. H. VREELAND, President of the Interborough Rapid Transit Company, New York, was at last reports in Holland. Referring to his desire to banish business from his mind and take a complete rest, he stated, while in London, that he had hard work to get himself down from 100 to zero. "Now that I feel that I have reached that point, I am making a steady effort to keep from rising again. I am not making a study of street railways; in fact, I am avoiding the subject."

BARONESS HELMHOLTZ.—Considerable space is given, says the New York *Evening Post*, in Prof. Leo Konigsberger's new three-volume biography of Helmholtz to the wife of that eminent man of science. Thanks to her intelligence and personal charms her home was for a long time the social headquarters of the savants in Berlin, most of whom were intimate friends of Helmholtz. Among his English friends the warmest were Lord Kelvin, Faraday and Tyndall. He used to visit Tyndall in his picturesquely situated villa near the Aletsch glacier, in Switzerland, and like that eminent Englishman he used to combine scientific study of the Alpine phenomena with climbing and recreation. When Edison went to Heidelberg in 1889 to exhi
to the German men of science, Helmholtz was formeost among those who extended to him a cordial greeting.

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OBITUARY.

MR. E. W. BLISS.—We regret to note the sudden death of Mr. Eliphalet W. Bliss, the head of the great mechanical and manufacturing concern that bore his name. He died late on Tuesday afternoon, July 21, at his country home, Owl's Head, Bay Ridge, from heart disease, following a week's illness due to indigestion. Mr. Bliss was born at Cooperstown, N. Y., on April 12, 1836. His school education ended with his sixteenth year, and he then served five years' apprenticeship in a machine shop. He worked as a journeyman machinist in Syracuse and Meriden, Conn., and served through the Civil War with the Union army. After the war he went to Brooklyn, where he established himself in business. He founded the manufacturing concern of E. W. Bliss & Co., and the United States Projectile Company, being President of both corporations. He was also identified with many other enterprises. Mr. Bliss was an enthusiastic yachtsman and clubman. He was a member of the New York, Atlantic, Larchmona and American Yacht Clubs. He was also a member of the Union League and Metropolitan Clubs, and of Lafayette Post No. 140, G. A. R. He leaves a widow, Mrs. Lane, his daughter, and several grandchildren. It is stated that he died while talking over with his wife the plans of a holiday trip to Germany, to be undertaken in a fe wdays.

◆

EDUCATIONAL.

AMERICAN SCHOOL OF CORRESPONDENCE.—As the result of his presence at a reception tendered by Dr. Gunsaulus, president of Armour Institute, to the students of American School of Correspondence, Mr. William E. Curtis, of the Chicago *Tribune*, was so impressed with the earnestness of the three thousand students who attended, that in the Chicago *Record-Herald* he devoted several columns to the subject of correspondence school education, which he commended in warmest terms. Prof. Elliott, of Harvard, while recently visiting the school, was also greatly impressed at the work being done, and expressed himself amazed at the scope, thoroughness and standard of the instruction. The character of the instruction papers is illustrated by the fact that they are used at Columbia University and by the United States Government at the Army Post Schools.

TULANE, UNIVERSITY, LA.—Prof. Douglas Anderson, of the department of electrical engineering, Tulane University of Louisiana, New Orleans, writes us as follows: Our engineering courses here are so organized that the four-year students in mechanical engineering get only one complete year in electrical engineering, there being no special course in that subject. A student desiring to take further work in and to make a specialty of electrical engineering has to come back for an additional year or two. Of this latter class Mr. George Howe completed this year a two-years' post-graduate course in electrical engineering and received the degree of mechanical engineer. He is now at Schenectady in the students' course of the General Electric Company and expects to return to Tulane next year as an instructor in the physical laboratory. As far as I know, none of the regular four-year graduates of this session has gone into electrical work, but several of them expect to return next session in order to continue their work in electrical engineering.

Trade Notes.

VARLEY DUPLEX MAGNET COMPANY requests that its mail be addressed to Providence, R. I., as well as Phillipsdale. It appears that letters properly addressed to Phillipsdale, R. I., go almost invariably to Philadelphia, and in some instances are sent to the Philippines. Hence correspondents will greatly facilitate their own affairs by adding Providence.

THE NATIONAL ENGINEERING COMPANY, 214 Terrace, Buffalo, N. Y., has been organized to do business as engineers, agents and contractors. As engineers it is prepared to furnish mechanical designs of machinery, power plants, transmission systems, shops, mills, etc.; as agents it will take charge of installation work for other companies, and as contractors will build and install plants.

THE MISSOURI-AMERICAN ELECTRIC COMPANY announces in a pamphlet the coming of the Miller incandescent lamp and describes the very complete preparations that have been made for its manufacture. A number of special machines never heretofore used will be employed in the manufacture of this lamp, and it is stated that the filament plant is the most up-to-date in the United States.

ROBBINS & MYERS COMPANY, Springfield, Ohio, has resolved to adopt for its well-known dynamo and motor apparatus the designation "The Standard," and will apply it to all its product after September 1, 1903. This term has, indeed, long been applied by it to the familiar Robbins & Myers fan motors, but will now cover the whole range up to the largest size of dynamo sent out from its factories.

NERNST LAMPS IN JEWELRY STORE.—A recent test of the Nernst lamp made at the instance of Mr. F. O. O'Neill, jeweler, of Philadelphia, showed an average consumption per hour of 88 watts, about half that required for incandescent lamps giving the same amount of light. This economy, with the superior quality of light given by the Nernst lamp—an especially desirable feature in the illumination of jewelry or other stores requiring a brilliant light showing true color values—led to the installation of twenty Nernst lamps.

PELTON WATER WHEELS.—The latest edition of the catalogue of the Pelton Water Wheel Company, San Francisco, includes 88 pages, bound in stiff covers. The pamphlet has rather the character of a technical treatise on high-head hydraulic engineering than of a trade bulletin. In a section under the head of "General Information," a concise resumé is given of the main features of this branch of hydraulic engineering, and in other parts of the pamphlet are many valuable hydraulic tables, such as for calculating the horse power of water, the loss of head by pipe friction, wire measurement, etc.

ELECTRICITY IN MINING.—The great part which electricity plays in mining is well illustrated by a recent publication of the Jeffrey Mfg. Company, of Columbus, Ohio. This consists of a 128-page catalogue relating to mining machinery, a greater part of which is devoted to electrically operated coal cutters and coal drills, and electric motors for mine and surface haulage. Every form of these appliances is illustrated in excellent wood cuts printed on half tone paper. The latter part of the catalogue is descriptive of electrical generating machinery, switchboards, mining pumps and details of electrical mining installations.

THE STANDARD ENGINEERING COMPANY, Cleveland, Ohio, has been incorporated to conduct a general engineering and contracting business, succeeding the business which was recently conducted under the firm name of the Standard Engineering Company, of Detroit, Mich. The officers are F. A. Little, president; George L. Wells, vice-president; A. J. Wells, secretary; J. Tufel, treasurer; W. E. Davis, consulting electrical engineer, and Henry L. Payne, consulting chemist. The company is prepared to do all kinds of engineering, including the construction of complete electric railway systems, electric power and lighting plants.

LIVE STEAM WATER PURIFIERS AND HEATERS.—The Hoppes Manufacturing Company, Springfield, Ohio, has issued a new edition of its catalogue on live steam water purifiers, exhaust steam feed water heaters, steam separators, oil eliminators and exhaust heads, and also a separate pamphlet on steam separators, oil eliminators and exhaust heads. Both of these publications are well printed on coated paper and illustrated by extremely good half tone cuts. In addition to illustrations showing all of the details of the various apparatuses, are cuts which show the condition of the trays when ready for cleaning; these details will particularly impress upon the minds of the steam users the great value of transferring from a boiler to a special apparatus easily cleaned, the deposit of impurities from feed water.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 14, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

732,730. TELEPHONE-RINGING DEVICE; James I. Gemmill, Cleveland, Ohio. App. filed Feb. 24, 1902. (See page 144.)

732,734. TELEPHONE RECEIVER; John S. Goldberg, Chicago, Ill. App. filed Feb. 14, 1903. (See page 143.)

732,795. SUB-STATION TELEPHONE-CIRCUIT; Almon B. Stetson, Malden, Mass. App. filed March 31, 1903. (See page 143.)

732,874. AUTOMATIC CENTRAL-STATION TELEPHONE SYSTEM; Friedrich Merk, Berlin, Germany. App. filed May 31, 1902. (See page 143.)

732,915. GUARD FOR SPEECH RECEIVERS AND TRANSMITTERS; Samuel J. Ballard, Los Angeles, Cal. App. filed Oct. 14, 1902. (See page 143.)

732,931. TELEPHONE-SWITCHBOARD; Charles E. Egan, Chicago, Ill. App. filed May 1, (See page 144.)

733,021. TELEPHONE; Benjamin O. Fox, Milwaukee, Wis. App. filed July 11, 1902. (See page 144.)

733,271. ELECTRIC BRAKE; William B. Potter, Schenectady, N. Y. App. filed Jan. 30, 1901. An auxiliary source of current can be thrown into the braking circuit of the motors to hold the brakes after the motor has ceased to rotate.

733,296. TELEPHONE; Ernest Hugo Strauss, Chicago, Ill. App. filed July 14, 1902. (See page 144.)

733,305. ELECTROMAGNET; Isaac G. Waterman, Santa Barbara, Cal. App. filed June 24, 1902. A modification of 733,097.

733,343. ELECTRICAL APPARATUS FOR USE OF ULTRA-VIOLET RAYS; Frederick F. Strong, Boston, Mass. App. filed May 11, 1903. A vacuum tube having a discharge electrode and a lens transparent to ultra-violet rays, located opposite the electrode.

733,389. PROCESS OF REMOVING SILICA FROM COKE; Charles M. Hall, Niagara Falls, N. Y. App. filed Sept. 24, 1902. (See page 142.)

733,401. ALTERNATING CURRENT MOTOR CONTROLLER; Austin Kimble, Chicago, Ill. App. filed Jan. 26, 1903. The field magnet is in the main circuit while the armature current is supplied from the secondary of a transformer, the voltage being determined by the number of coils of the secondary thrown into circuit.

733,436. CLAMP FOR USE IN CONNECTION WITH SOCKET CARBON BRUSH HOLDERS; Oscar M. Stiegler, Boston, Mass. App. filed Nov. 8, 1902. A clip fitting the rear end of a carbon brush.

733,485. MEANS FOR THE CONTROL OF THE ELECTRICAL DRIVING OR REVERSIBLE ROLLING MILLS; Carl Ilgner, Breslau, Germany. App. filed June 25, 1902. An arrangement of a motor-dynamo in combination with a fly-wheel to prevent fluctuations of current due to the reversal of rotation of the rolling mill motor.

733,496. TROLLEY FOR ELECTRIC LINES; Kennedy Lyons, New Rumley, Ohio. App. filed March 5, 1903. A device to retain the wheel on the wire.

733,502. MEANS FOR PROTECTING THE EXPOSED OR LIVE PARTS OF ELECTRIC SWITCHES, CUT OUTS, ETC.; William McDevitt, Philadelphia, Pa. App. filed April 14, 1903. The base block upon which the switches are mounted, is built up of a number of blocks of various sizes and shapes, so arranged as to house the metal parts in grooves or chambers.

733,524. TROLLEY POLE GUIDE; Hezekiah O. Woodbury, Beverly, Mass. App. filed Oct. 13, 1902. A pair of horns arranged to be thrown upward to act as a finder for the trolley wheel.

733,549. ELECTROMAGNET; David L. Lindquist, Yonkers, N. Y. App. filed March 25, 1903. A plurality of coils wound transversely upon a magnet core and symmetrically disposed with reference to an axis perpendicular to the pole face, whereby the armature will be prevented from chattering when the coils are traversed by an alternating current.

733,550. CONTROLLING DEVICE FOR ALTERNATING CURRENT MOTORS; David L. Lindquist, Yonkers, N. Y. App. filed March 25, 1903. The motor controls itself by the change of voltage in the secondary circuit from the period of starting to the attainment of full running speed, the voltage then decreasing from a maximum to zero.

733,551. ELECTRIC CONTROLLER; David L. Lindquist, Yonkers, N. Y. App. filed April 10, 1903. An induced current obtained from current fluctuations in starting, is used to control the cutting out of the starting resistance.

733,553. ELECTRIC CONTROLLER FOR HYDRAULIC ELEVATORS; Joseph W. Moore, Newton, Mass. App. filed Dec. 26, 1901. Instead of the usual pilot valve for operating the main valve of the elevator, it is proposed to use an electric controller acting directly on the main valve itself and capable of automatically controlling the same as well as being subject to control from the car.

733,556. SUBMARINE TELEGRAPHY; Alexander Muirhead, Shortlands, Eng. App. filed Dec. 27, 1898. Self-inductances serve to regulate the amount of "curb" required to produce the most rapid changes at the beginning of the cable and other self-inductances in shunt to the receiver and condenser, permit the steady current to pass while causing the rapid variations to operate the receiver.

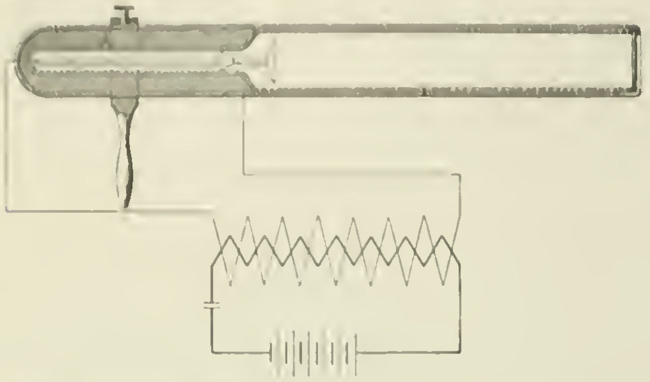
733,560. PROTECTIVE ELECTRIC SWITCH BOX; August Sundh, Yonkers, N. Y. App. filed Feb. 20, 1901. Details of a switch box arranged to be inserted at any point in a conduit.

733,561. PRESSURE REGULATED SWITCH; August Sundh, Yonkers, N. Y. App. filed July 11, 1902. Details of an automatic switch adapted to be actuated by fluid pressure.

733,562. ELECTROHYDRAULIC CONTROLLER FOR ELECTRIC MOTORS; August Sundh, Yonkers, N. Y. App. filed July 11, 1902. Means whereby a relatively light current in a primary circuit is enabled to set into operation hydraulic mechanism of considerable power for operating the devices which immediately control the circuits of the motor.

733,563. ELECTRIC CONTROLLER; August Sundh, Yonkers, N. Y. App. filed March 16, 1903. The invention consists in means for producing a compound magnetic circuit including a movable body, means for moving this body to reduce the reluctance in the circuit and other means for increasing the magnetic flux in said circuit simultaneously with the movement of the body.

733.564. ELECTRIC CONTROLLER; August Sundh, Yonkers, N. Y. App. filed March 16, 1903. A certain construction and combination of parts for a controller.



733.343. Electrical Apparatus for Use of Ultra Violet Rays.

733.565. ELECTRIC CONTROLLER; August Sundh, Yonkers, N. Y. App. filed March 16, 1903. An electromagnet, a movable armature, a circuit closing device controlled by the magnetic field of said armature and caused to close circuit when said armature is moved into attractive proximity thereto, and means for reducing the current strength in said electromagnet after said circuit has been closed.

733.566. ELECTRIC CONTROLLER; August Sundh, Yonkers, N. Y. App. filed March 16, 1903. A switch designed to be certain and positive in its action and unaffected by vibrations and jars that occur on vehicles.

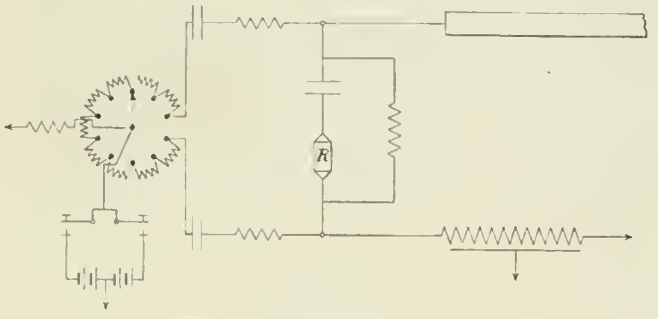
733.567. ELECTRIC CONTROLLER; August Sundh, Yonkers, N. Y. App. filed March 16, 1903. Consists of means for producing two magnetic fields, an armature movably supported in one field and actuated thereby to move into the other, and means controlled by the armature for neutralizing its actuating field upon the armature becoming subject to the holding control of the field into which it has been moved.

733.568. PIPE OR ROD COUPLING DEVICE; August Sundh, Yonkers, N. Y. App. filed March 16, 1903. A clamp for the end of a pipe consisting of two semi-circular parts held together by bolts and having threads engaging with the end of the pipe.

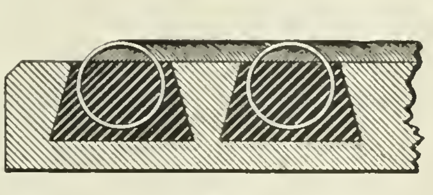
733.569. BINDING POST AND CONTACT FOR ELECTRIC SWITCHES; William C. Tregoning, Hartford, Conn. App. filed April 23, 1903. A peculiar form of sheet metal clip secured to the top of a binding post.

733.578. PROCESS OF SMELTING METALS AND METAL COMPOUNDS; Georg Egly, Charlottenburg, Germany. App. filed Jan. 14, 1903. (See page 143.)

733.587. ELECTRICAL ROTARY PORTABLE MACHINE FOR CUTTING SUGAR CANE; ETC.; Stephen J. Hylton-Bravo, Hawthorn, Victoria, Australia. App. filed April 18, 1903. A circular saw driven by a motor located at its hub.



733.556. Submarine Telegraphy.



733.610. Rheostat.

733.602. METAL ANODE; Harry E. Starrett, Chicago, Ill. App. filed Dec. 19, 1901. (See page 142.)

733.609. PROCESS OF WINDING FLAT WIRE; Richard Varley, Providence, R. I. App. filed March 15, 1903. Flat ribbon-like wire in long continuous lengths is wound up into a single coil in the shape of a disk by winding it against the faces of a step and pulley, and afterwards removing the different sections and forcing them one over the other into the same plane.

733.610. RHEOSTAT; Wm. C. Yates, Schenectady, N. Y. App. filed Oct. 3, 1902. The resistance coils are embedded lengthwise in grooves containing insulating material, a portion of the coil projecting for contact with the switch arm.

733.619. TROLLEY CIRCUIT BREAKER; Charles P. Breese, Norfolk, Va. App. filed April 1, 1903. A mechanical connector for the insulated sections of a trolley wire in which the two ends of the conductor overlap each other so that the wheel in passing will always be in contact with at least one of the conductors.

733.627. POLARITY INDICATOR; Frank P. Cox, Lynn, Mass. App. filed Jan. 21, 1901. A polarity indicator comprising a polarized relay and two indicating lamps in connection with double break contacts bridged by the armature of the relay at its limits of vibration and connections for cutting in either lamp.

733.611. CONDUIT AND TROUGH FOR ELECTRIC CONDUCTORS, Thomas F. Devonshire, Chislehurst, Eng. App. filed March 3, 1901. A conduit built up of cement in which metallic net work is embedded.

733.613. FORM FOR WINDING ARMATURE COILS, William F. Free, Schenectady, N. Y. App. filed Sept. 1, 1898. Details of construction.

733.617. DEMAGNETIZER, William J. Forster, Milwaukee, Wis. App. filed March 15, 1902. A convenient apparatus for demagnetizing watches, tools, etc.

733.667. AUTOMATIC GAS LIGHTING ATTACHMENT, Charles F. Mason, Dryden, N. Y. App. filed March 23, 1903. Details.

733.674. ARRANGEMENT FOR THE SUPPORT AND COOLING OF STATICAL OZONIZERS; Marius Otto, Paris, France. App. filed May 26, 1903. (See page 143.)

733.702. ELECTRICALLY OPERATED MUSICAL INSTRUMENT; George H. Davis, New York, N. Y. App. filed Nov. 9, 1896. Relates to the means for mounting and shifting the contact fingers which co-operate with the perforated music roll.

733.727. TROLLEY HEAD, Frederick V. Marsh, Mass. App. filed Aug. 22, 1902. The shaft of the trolley wheel is screwed into the end of the harp, the latter being in two pieces so that by swinging one of them around, it is unscrewed from the shaft and the wheel released.

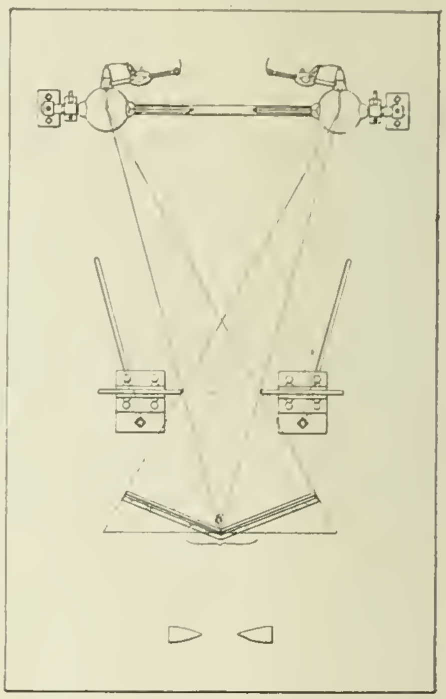
733.750. SIGNALING APPARATUS FOR ELEVATOR CARS; Charles A. Reiners, Chicago, Ill. App. filed April 17, 1899. The signal for a car approaching a landing is operated by two sets of circuits, one on the car, and the other on the shaft and landing. The circuits are automatically interconnected by attraction of the magnet on the car for an armature fixed in the shaft.

733.755. MEANS FOR PREVENTING BENDING STRAINS IN WIRES; Joseph J. Shickluna, Buffalo, N. Y. App. filed Oct. 28, 1901. The wire is provided with an annular spring portion which obviates bending strains.

733.756. STEREOSCOPIC APPARATUS; Homer C. Snook, Philadelphia, Pa. App. filed Dec. 4, 1902. Consists in arranging two sources of X-rays in such relation to the object to be viewed that the beams of radiation will cross each other at the point where the object is placed and will produce upon a fluoroscopic screen a pair of images side by side representing the object as viewed, respectively, by the right and left eye of the observer.

733.766. COMBINED PORTABLE ELECTRIC LAMP AND BATTERY; Malcolm Sutherland and Elias Marcuson, London, Eng. App. filed April 11, 1902. Details.

733.789. MAGNETO ELECTRIC SEMAPHORE SIGNALING; Leonidas G. Woolley, Kenton, Ohio. App. filed May 26, 1902. An electrically operated detent mechanism is so arranged that when an electrical generator is set in operation manually at the switch tower, a motor will actuate the semaphore from one position to the other.



733.756.—Stereoscopic Apparatus.

733.876. FIRE ARRESTER FOR ELECTRIC INCANDESCENT LIGHT WIRES; Oscar H. R. Schulze, Chicago, Ill. App. filed March 8, 1902. Two blocks of asbestos having grooved faces, are clamped upon the wire to prevent fire following up the insulation on the wire.

733.883. ELECTRICAL ANNUNCIATOR; John H. Taylor, Schenectady, N. Y. App. filed Jan. 14, 1903. A program clock provided with means for automatically operating circuit closers at predetermined times.

733.900. ELECTRIC BRAKE SYSTEM; Frank E. Case, Schenectady, N. Y. App. filed Feb. 19, 1900. An apparatus for braking by gradually clutching a dynamo-electric machine to the load and causing a current to flow through the machine in such a direction as to oppose the motion imparted by the load.

733.901. METHOD OF BRAKING MOVING LOADS; Frank E. Case, Schenectady, N. Y. App. filed Feb. 19, 1900. A companion to the preceding patent.

733.909. TELEGRAPH REPEATER; Francis W. Jones, New York, N. Y. App. filed April 17, 1903. A repeater consisting of two main circuits, two relays, one in each circuit, a local circuit for each relay, three separate and distinct magnets in each local circuit, the first magnet operating to hold its relay arm when circuit in said relay coil is broken, the second magnet operating a spring contact point in the second main circuit, and the third magnet operating a circuit breaker in a shunt circuit around the holding coil of the other relay.

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NEW YORK, SATURDAY, AUGUST 1, 1903.

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FOREIGN CUSTOMERS.

A letter is published in this issue from a reader in Manila, with regard to care to be exercised in sending commercial information to the Philippines in respect to electrical apparatus. It will be noted that Mr. Woolfe complains that not less than sixty per cent. of the data is defective, thus affecting not only possible sales, but ease in passing goods through the customs. We direct attention to this communication because it is more or less a duplicate of other letters from various parts of the world, especially where English is not in common use, suggesting that those who are reaching out for foreign orders must study up in regard to these requirements. Sometimes the complaints relate also to difficulties in the terms of sale, or deficiencies in the methods of packing.

There must, of course, be more or less physical and other friction and "resistance" in carrying on foreign trade, but it is evident that a great deal of it can be cut out, with benefit to seller and purchaser, and with increase in business not only as between our manufacturers and their new markets, but as between exporters to this country and their customers. It should certainly be a part of the higher commercial education of the day to master the technique of such intercourse, and to lessen by better comprehension the barriers interposed by tariffs, differences of language, variations of practice, and the accidents of transportation. The modern régime of electrical communication has done much to improve conditions in this field, by facilitating and quickening the interchange of ideas and intelligence, and every new cable lessens the barbaric meaning of the word "foreign," in its old, pre-cable sense.

FOREIGN TRADE.

It is obvious that the foreign trade of the United States is approaching a period of development attended by no little uncertainty and perplexity. For the last four or five years during the régime of redundant prosperity—a prosperity which is still happily with us—the manufacturing resources of the country have not been equal to the demands upon them, so that imports have been tremendously stimulated, even in articles that were previously being exported in large quantities, and at higher prices than had prevailed for many years previous. The increases in productive capacity have now, however, overtaken consumption, as would only be natural, in spite of increased power of absorption; and the questions that begin to arise are whether the present ratio between exports and imports will continue; whether the importations may not slacken, and whether the process of pushing American exports into all quarters of the globe will not be resumed with renewed vigor. The United States has apparently advanced from fourth place in the list of exporting nations to the first, by a narrow margin, so that the problem is whether it is to widen the gap or to fall back in the scale.

In Europe some fears are entertained, we note, as to the return of the wave of American trade invasion, but such anxiety seems to us exaggerated. It will certainly be difficult for manufacturers who have dropped the threads of their foreign connections to pick them up again, for that is one of the most difficult things in international commerce; and in the meantime there has been a marked revival of European activity and energy in the supply of goods to foreign markets. But the main point is that trade is reciprocal, and tends whether aided by wise legislation or not to put itself on a reciprocity basis. Besides, trade grows as the wants of a larger civilized area increase, and particularly with regard to new specialties like electrical apparatus, does an ever widening field present itself to view. We are inclined, therefore, on the whole, to expect with complacency the maintenance of a large aggregate of foreign trade, export and import, believing that all parties profit by it in liberal measure. We are also inclined to think that the growing tendency of foreign nations to buy manufactured goods from us can only be maintained by ability to purchase, which in turn is assisted not alone by our purchases from them but by the cheapness and excellence of what they buy from us.

A WIRELESS TELEGRAPH SQUABBLE.

For some weeks the correspondence columns of our London contemporary, *The Electrician*, have been the medium of a controversy which in bitterness of spirit displayed by the participants and, per contra, in amusement to the disinterested reader, is unique. The controversy had its origin in a letter written to the *London Times* by Prof. Fleming, who complained of a "cowardly and concealed attempt" to spoil a demonstration of the Marconi system of wireless telegraphy at a lecture delivered by him on June 4 before the Royal Institution. A Mr. Nevil Maskelyne immediately admitted publicly that he was an accomplice in the aforesaid attempt, the disturbance consisting in "the simple interjection of the word 'rats.'" In another communication, after accusing Prof. Fleming of falsehood, he said that the outside interference which disturbed the lecture was to determine if a simply untuned radiator could upset the tuned Marconi receiver—which Prof. Fleming's lecture proves was done. In a letter following this Prof. Fleming denied that the exhibition interfered with was intended as a demonstration of the Marconi syntony system, accused Mr. Maskelyne of making absolutely untrue allegations and of being guilty of "a piece of scientific hooliganism of the worst possible description." In a rejoinder Mr. Maskelyne endeavors by a series of quotations to convict Prof. Fleming of—well, tergiversation—and ends by reminding him that abuse is no argument.

At this point the controversy is taken up in our electrical contemporary, through which it has continued for a month, and with no sign of abatement. The first letter is from Prof. Fleming, in which he reiterates that he was not giving at the Royal Institution a demonstration of the reliability and efficacy of Marconi syntony, but showing an experiment for a totally different purpose—a somewhat ambiguous plea. In the following issue Mr. Maskelyne renews his contention that the experiment with which he interfered did relate to Marconi syntony. "Mr. Marconi," he said, "is constantly telling what he can do, but he never does it, the result being that he and his associates are subject to criticisms, experimental tests and a general surveillance from which otherwise they would be exempt." As to Prof. Fleming, his opponents merely ask, "What is he doing, then, in that galley?" In a following issue he asserts that no message was sent from Poldhu before 11.50 A. M., and he calls upon Prof. Fleming to explain the mystery as to the source of the messages stated to have been received earlier in the morning. In the last issue of the journal at hand, Mr. Maskelyne admits that a message was on June 4 repeated from Poldhu at intervals, five times, though its wording was not exactly that of the message received at the Royal Institution—this, however, not in any way affecting his statement as to the operations carried on during the hours to which the controversy relates. To the same issue the Marconi Wireless Telegraph Company contributes two letters, one of which gives transcripts of messages sent to and from the Royal Institution on June 4, and another of later date asking the editor if he had shown or communicated to Mr. Maskelyne this letter. In an editorial note this insinuation is repudiated with the comment, "Never has a more base insinuation been made, and it is difficult to understand what motive prompted this communication from the company." Without touching on the merits of this curious controversy, it may be said that its tone shows unhappily again the jingo spirit in which the wireless telegraph situation has been uniformly treated in Great Britain.

CONNECTIONS FOR TRANSMISSION SYSTEMS.

Mr. Peck's discussion of Mr. Blackwell's Institute paper is one of the most useful contributions to the literature of practical power transmission that we have seen for a long time. It deals with the subject of voltages on grounded and ungrounded three-phase circuits with an encyclopædic spirit that makes it especially valuable for ready reference, and takes up cases which from their infrequent occurrence would usually escape attention. What is still more to the point, it discusses the effect of entirely accidental and abnormal grounds. The troubles in transmission systems are not generally due to accidents of a commonplace character, for these are to a large extent preventable, but to curious and entirely unexpected occurrences that may produce very grave trouble of a kind not to be easily foreseen. If any one had predicted a year ago, for instance, that the Niagara station would be shut down by an accident within the power house, he would have been greeted with unseemly scoffing, and yet the thing happened. We drew the moral at the time, but it is quite safe to say that there will be plenty of other accidents elsewhere, equally impossible and unforeseen. In three-phase working there is a growing tendency to employ the grounded star connection to limit the voltage between wires and earth, or what amounts to the same thing, to increase the working voltage of transmission without increasing the voltage between wires and earth. The advantage in copper to be gained by this in case a neutral wire is employed is very considerable, as is well known—as great as that gained by working the three-wire system on continuous current distributions—and from the standpoint of fire risk the gain in safety over an underground system at the same working voltage is also very material.

Nevertheless, grounding is not without its added responsibilities and, as Mr. Peck shows, these are mainly concerned with the voltage distortions which result from the short-circuiting of transformers by grounding or otherwise. The effect of the distortion thus superinduced may be great enough to more than double the voltage across certain of the lines under certain conditions and with certain connections. To catalogue the conditions and their effects would be to cite bodily Mr. Peck's tables, to which reference should be made for particulars. Some things, however, are worth noting. Either pure star, grounded generator and all, or pure mesh connections are safe enough from abnormal voltages. Of the mixed systems in common use, most are somewhat liable to the chance of getting abnormally high voltages on some part of the circuit, of which the chance of a short circuit on a raising transformer is the most likely cause. With one branch of a raising mesh out there is a beautiful chance for trouble ahead. The moral is that the high-voltage transformers must be kept out of mischief by particular care. In ordinary practical operation the crippling of a raising or reducing transformer puts the circuit so thoroughly out of business that the distribution of voltages becomes a matter of secondary importance anyhow. Any system of operation which saves copper is liable to serious derangement of the voltages in its respective parts, and in using such a system, whether the common three-wire or some strange and complex polyphase system, it ought to be distinctly understood that one has to pay a reasonable price in care for the saving in cost of conductors. In the early days of the three-phase system it was a constant source of joy to the unregenerate to see the continuous current contingent, whose daily food was balancing and boosting, howling about the dreadful result of unbalanced load on a three-phase system. It is doubtless true that with the feeder drop common in direct-current practice, a three-phase distribution would be in a bad way; but this is all ancient history now, and we recur to the grounding question.

In our opinion, considered merely as a safety precaution, the grounded neutral is decidedly to be recommended. It unquestionably requires a little more care than an ungrounded system, but it reduces the main risks very materially. Incidentally, it allows the safe use of working transmission voltages which otherwise would have to be classed as somewhat hazardous. What is more, those plants which have adopted the plan find that it causes far less inconvenience than they were prepared to meet. Whether a system should employ a star system which permits grounding, is a question to be decided on its merits. Where a large secondary distribution is to be attempted, the saving in copper by using a star with neutral is so great that it will commonly be used whatever the connections back of it may be. And these latter connections should certainly be considered in the light of such posibilities as Mr. Peck has described. But in many cases the connection can be chosen without reference to any extended network, and the choice will generally fall on one of the mixed systems. Pure mesh connection in large plants has fallen into partial disuse, and the advantage, of which much was once made, in using two of the transformers to form a resultant mesh, has been proved to be of very little moment. Few who have tried it on a large scale would care to repeat the experiment, and on the scale of most recent plants, the gain in using two transformers instead of three is negligible. At present the whole question is largely a matter of convenience.

INTERNATIONAL ELECTRICAL STANDARDIZATION.

One of the most important recent developments of electrical engineering has been in the establishment of rules for the standardization of electrical machinery. Such rules have been prepared by the American Institute of Electrical Engineers in this country, by the Verband Deutscher Electrotechniker in Germany, and similar rules are under contemplation in other countries. Moreover, the Fire Insurance Associations in various countries have formulated rules of a different character, but which nevertheless bear some relation to the subject of standardization. Standardization rules exercise an important influence upon electrical engineering by adding precision to terminology, and by adding conventional concert to matters that would otherwise be left optional or uncertain. Moreover, they tend to prevent misunderstandings between manufacturer and purchaser, by eliminating uncertainty from the technical terms of contracts. Further, the standardization of types of machinery tends to reduce the cost of manufacture, and, therefore, the price to the purchaser.

It is of importance to electrical engineering industry that standardization rules should be made uniform all over the world. The same reasons which urge the introduction and maintenance of such rules in a single country are applicable to the extended application of such rules over different countries. As matters stand to-day, the rating of a dynamo, as expressed in kilowatts, is different in America and in Europe. This is essentially unfortunate. The physical tests which determine the output of a dynamo should be the same everywhere. In other words, a machine which has a rated output of, say, 500 kilowatts in one country, by reason of its temperature elevation under load, or other physical characteristic, should possess the same rating in all other countries. Otherwise, manufacturers of electrical machinery cannot be brought to a footing of uniform competition without tedious investigations and adjustment of specifications. Similarly, all definitions of the same or of corresponding technical terms should be exactly alike in all countries, in order to avoid the possibility of international misunderstanding in the specification or description of electrical machinery. Again, the margin of reserve in heating, or in other physical behavior, which should belong to a machine in view of possible overloads, should be normally the same in all countries, so as to ensure equality of rating under all conditions of service. This uniformity of international standardization does not exist at the present time.

It seems desirable, therefore, that an international standardization should be attempted, in order to reconcile the differences in detail which already exist upon such questions in different countries. The mechanism by which such an international standardization might be effected lies under the command of any international electrical congress. For example, the next electrical congress, which is scheduled to convene next year at St. Louis, might appoint a committee on standardization which should have its members chosen from the various countries principally interested in electrical engineering development. This committee might be instructed to consider the situation of standardization as it exists at present in different parts of the world, and to report at some future time upon an international code that would meet with the indorsement not merely of the various electrical engineering institutions or associations of engineers here and abroad, but also of the various industrial interests dealing with the manufacture of electrical machinery. Even if the efforts of such a committee looking towards the realization of international standardization were but partially successful, the effort would not have been made in vain. For instance, if only two countries could be persuaded to agree upon a set of rules, while other countries did not conform, the union of two countries on the project would be worth striving for.

It is evident that the chances of success in securing international conformity would depend in large measure upon the extent of the proposed international rules. Conformity would almost certainly be assured if the rules were limited in their scope to mere matters of terminology and definition. On the other hand, conformity would be almost hopeless, if the rules were attempted to be carried into matters of minute industrial detail, such as the best series of sizes for dynamos, or the best series of speeds for the same. Local custom and commercial precedent would probably render international uniformity impossible in such matters. Somewhere between these two extremes, consensus of opinion might be expected to be reached. Thus, there is no reason why a dynamo machine should not have one and the same rating in power all over the world, both as to full load and as to overload. Similarly, there is no reason why the efficiency or the regulation of an engine-driven alternator should not be reckoned in the same way all over the world. It would probably require at least a year for any committee, appointed on the subject, to reach a useful conclusion and file its report. It might not even be possible to secure a report before the convention of the next ensuing international electrical congress. But while no harm could apparently be done by such a committee, whether successful or not, there can be no doubt that great benefit would accrue to its successful accomplishment of the task imposed.

The International Electrical Congress of 1904 at St. Louis.

As is already known to many of our readers, it has been decided to hold an international electrical congress at St. Louis next year, in connection with the Universal Exposition. The date selected is the second week of September (12th 17th). The advantage of that period is that it offers the most convenient compromise between hot weather on the one hand, and the terminating limits of fall vacations on the other. If the date were set earlier, the weather at St. Louis might be found uncomfortably warm. If the date were postponed, it might be difficult for electrical workers on vacation to meet their fall engagements. Moreover, the week selected immediately precedes the great scientific congress appointed by the St. Louis Exposition, which convenes during the third week in September. Since many distinguished visitors and guests will attend the scientific congress, it is the more probable that a good attendance can be secured for the electrical congress immediately preceding.

The international electrical congress will, according to the present plan, comprise three distinct features: namely, first, a chamber of delegates appointed by governments; second, the main body of the congress divided into sections; third, conventions simultaneously held by various electrical organizations in the United States. The last international electrical congress was held at Paris in 1900. The next preceding was Chicago in 1893. The representatives in the chamber of delegates are nominated by the various foreign governments and by the United States. The chamber of delegates considers and votes upon such international questions as units and standards. There are various questions involving units and standards, which might properly occupy the attention of a chamber of delegates next year.

The sections which have been proposed for the main body of the congress are:

General Theory	—Section	A	Mathematical. Experimental.
Applications	"	B	General Applications.
	"	C	Electrochemistry.
	"	D	Electric Power Transmission.
	"	E	Electric Light and Distribution.
	"	F	Electric Transportation.
	"	G	Electric Communication.
	"	H	Electrotherapeutics.

It is expected that prominent electrical men in various parts of the world will be invited to contribute special papers on subjects in the various sections and their subdivisions.

Several of the prominent electrical organizations of the country have already taken steps to hold their conventions in St. Louis during the electrical congress week. It is hoped that all of the following bodies will complete arrangements to this effect: The Americal Institute of Electrical Engineers, the Electrochemical Society, the National Electric Light Association, the Association of Edison Illuminating Companies, the American Street Railway Association, the Pacific Coast Electrical Transmission Association, the American Electrotherapeutic Association. Some plan is expected to be made whereby a joint meeting or meetings may be held between each section of the congress and the particular national organization interested in that subject. In this manner, mutual advantages in membership, discussion and publication ought to be secured.

The transactions of the congress should form a very attractive and important publication not only as associated with the St. Louis Exposition, but also indicative of the world's progress in electromagnetism and its applications. The congress arrangements are in the hands of a committee of organization consisting of thirty-three members, all active representatives of American electrical progress. Prof. Elihu Thomson has been elected president. No other man in the country is so well fitted for the post, since he has united for many years the support of scientific, industrial and inventive electrical interests.

The vice-presidents are Prof. H. S. Carhart, of the University of Michigan, whose work is so well known in connection with electrical standards of e.m.f.; Mr. C. F. Scott, the retiring president of the American Institute of Electrical Engineers; Mr. B. J. Arnold, the incoming president of the same organization; Prof. W. E. Goldsborough, the active director of the Department of Electricity at the St. Louis Exposition, and Dr. W. S. Stratton, the director of the National Bureau of Standards.

Meetings of the Executive Committee and of the Advisory Committee have already been held. The work of preparing for the congress is already in progress. All communications should be addressed to the general secretary, Dr. A. E. Kennelly, Harvard University, Cambridge, Mass.

Programme of Edison Convention.

The nineteenth annual meeting (twenty fourth convention) of the Association of Edison Illuminating Companies will be held at the Frontenac, Thousand Islands, St. Lawrence River, N. Y., September 8, 9 and 10, 1903. A number of valuable papers are in course of preparation on subjects pertaining to the business of the member companies, and already there are indications which point to the coming convention as probably the most valuable of a long series of excellent meetings. The Edison Association was organized in 1885 by companies licensed under the Edison patents. It embraces all of the present licensees under these patents, excepting only a very few.

The Edison conventions are noted for their close attention to business, the absence of mere junketing, and the higher beneficial results to its members. The place of meeting this year is selectd because of the absence of outside allurements, with the expectation that this convention will exceed all others in the strict devotion to work. At the proper time a list of the papers presented and subjects discussed will be given by the technical press. Following is a list of the officers of the Association: President, Mr. Louis A. Ferguson, Chicago, Ill.; vice-president, Mr. A. W. Field, Columbus, O.; treasurer, Mr. Alex. Dow, Detroit, Mich.; secretary, Mr. Walter H. Johnson, Philadelphia, Pa.; assistant secretary, Wilson S. Howell, New York, N. Y.

A New Jersey Elevated Road.

A scheme is being pushed for an electric elevated railroad from Hoboken to the Oranges and Montclair and extensions to Summit. The plan contemplates a ferry at Fourteenth Street, New York City. The company is to be known as the Elevated Electric Railway of New Jersey, and it was originally planned to be built at a cost of $2,000,000, including the right of way and equipment. Leaving the ferry, a tunnel was to run in Hoboken for a distance of 4,600 ft., and the estimated cost is placed at $450,000. The tunnel is planned to be 25 ft. wide and 16 ft. high. The map shows the proposed line to run over Pen Horn Creek and Hackensack River, paralleling the Lackawanna and Erie tracks on the meadows and running between them through Kearny, over the Passaic River to Mount Prospect Avenue, Newark, and thence to Orange. The plans provide for a power house on the meadows and drawbridges over the rivers. The trestle is planned to be about 22 ft. high. Mr. James S. Holmes, of Orange, N. J., says the scheme is entirely practicable, and he believes that the road will be built.

New German Electric Lighthouse.

Note is made in Consular Reports of a new electric flash light on the Island of Heligoland, in the North Sea, equipped with a Schuckert parabolic glass mirror. "Experiments were made in Nuremberg. They went far beyond what the most sanguine had believed possible. The revolving reflector of the German apparatus was fully equal to the best French revolving light. As soon as the experts had demonstrated their point, work was begun on a light reflector or projector equal to the largest ever used. It was to represent 30,000,000 cp., and to flash no longer than one-tenth of a secend. The flashes must follow each other every five seconds. The flash light illumines the entire horizon. In normal weather it may be seen 23 sea miles (23 leagues). On the first night that the new light was used, its peculiar, flashing beams were seen by people standing on the mole at Busum, a distance of 65 kilometers, or a trifle over 40 miles. The watchers in the lighthouse at Amrum, about the same distance, were able in unfavorable weather to see the same beams as they rapidly appeared and disappeared. It was noted that the otherwise bluish-white light of the electric arc appeared red."

The Schuckert Electric Works at Nuremberg, Germany.

By S. N. Taylor, Ph. D.

The home works of the Schuckert Company, which company on April 1 combined with the Siemens & Halske Company, are located at Nüremberg, and there is no electrical establishment in Germany more perfect in construction or more complete in its appliances. It is usually difficult to gain access to electric works, and this is especially true of the electric works in Germany. It was due to the friendship and influence of Prof. Wiedemann that the writer was permitted to visit all parts of the Nuremberg works, even the departments where visitors are not usually allowed, and that special opportunities were afforded him of studying all the machinery and apparatus manufactured there.

The first impression upon a stranger visiting the "New Works" for the first time is given by the splendid buildings the company has erected for manufacturing purposes. In American manufactories, if the buildings are large enough and strong enough and adequately equipped, we are apt to think but little about appearances, but the latter point has not been neglected at the Schuckert Works. The buildings, which are of brick and trimmed with brown sand stone, are unusually attractive in design and finish. No care nor expense has apparently been spared in their construction, either in exterior or interior, to make them as nearly perfect as possible for the purposes intended.

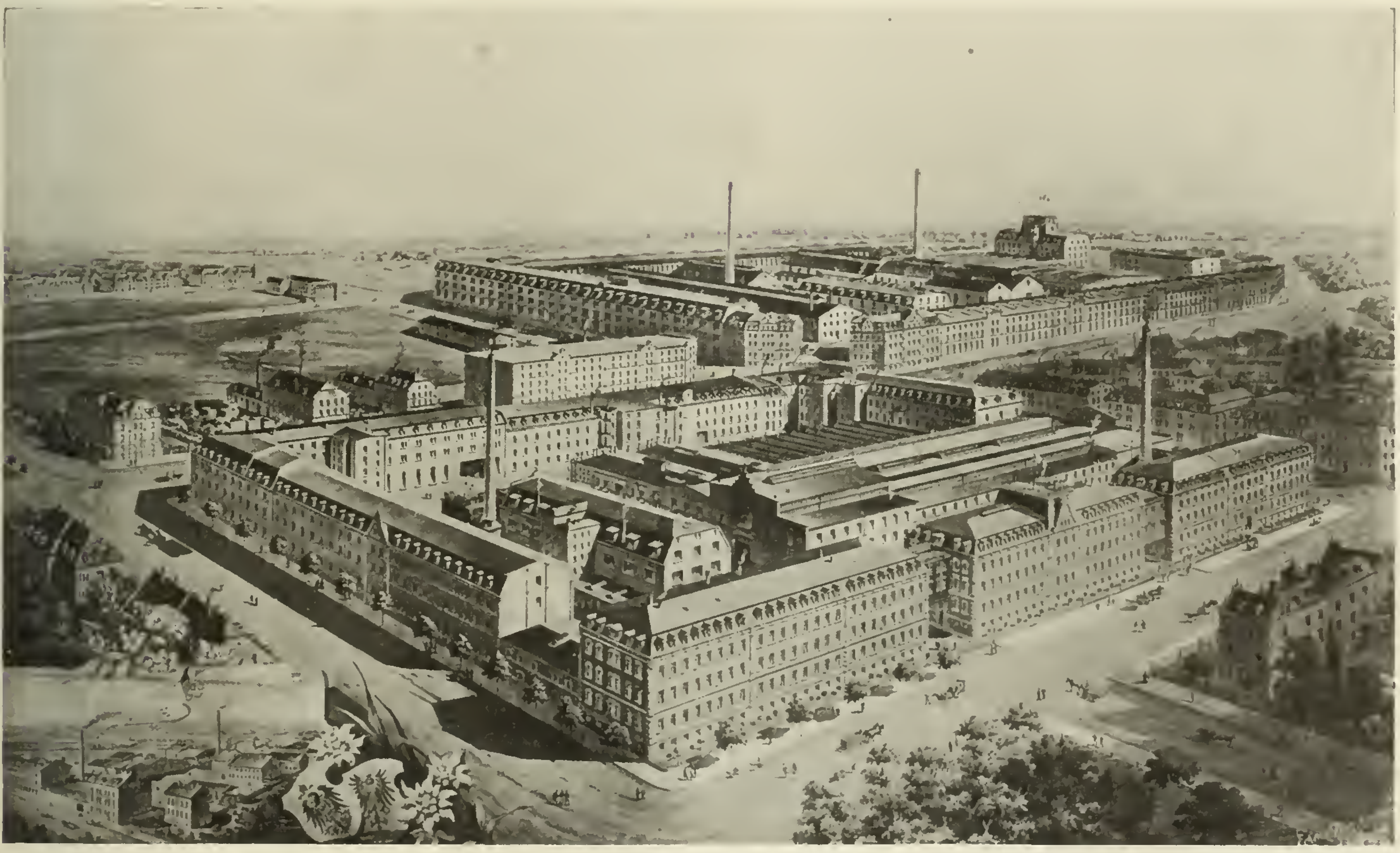


Fig. 1.—General View of the Schuckert Works, Nüremberg, Germany.

The interiors of the administration buildings are especially noticeable in this respect. The various offices are large and light and many of the departments are very handsome, the ceilings, doors, etc., being finished in curled maple inlaid with other ornamental woods highly polished, while the walls are neatly frescoed. The furniture, carpets, etc., in the rooms are in keeping with the finish.

The same care and attention to the completeness and perfection of each department is conspicuous throughout all the works. The machine shops, testing rooms, laboratories, etc., though naturally plain, are very durably built, roomy, light and well adapted to the purposes for which they are used. Some of the machinery departments are even very handsome. This is especially true of the central power station from which power is supplied to the various departments. The rooms are finished in hard woods, with frescoed walls, the floors are of polished tile, protected by carpets, the machinery and engines are polished and burnished till they glisten like mirrors, and they run so smoothly that there is scarcely a sound to be heard. All these combined tend to give one the impression of being in a very elaborate and well-furnished parlor, rather than that of the engine rooms of a large factory. These features in a German manufacturing establishment seem all the more striking to a stranger when considered in connection with the fact that so many of the German homes are so lacking in the attractiveness and home comforts which Americans look for.

But while speaking of the completeness and perfections of the Schuckert buildings, it should be mentioned before going further, that the machinery and instruments produced here are not less noteworthy for their beauty of finish and perfection of construction.

The Nüremberg Works at present comprise the "Old Works" and the "Three New Works." The "Old Works" are the buildings which were formerly occupied by the company for manufacturing purposes, but having become inadequate to the needs of the company, the extensive "New Works" were erected in 1888, and since then, so that now only the "New Works" are used for manufacturing purposes, the "Old Works" having been refitted by the company for various benevolent purposes.

The benevolent enterprises which have been established by the company for the benefit of the Schuckert workmen constitute a very important feature in the management of the works, and are very beneficial both to the employees and to the firm. They are an Industrial School for the boys less than 14 years of age; a Technical School for boys 14 years old and older; a Domestic School for girls who have been confirmed, and a pension fund.

The Technical School is intended for such sons of Schuckert employees as may wish to learn instrument making or machine construction of various kinds. The school comprises two branches. In one theoretical instruction is given and in the other practical. The literary and theoretical branches taught include modern languages, history, geography, mathematics, physiology, physics, mechanics, chemistry, electrotechnics and drawing. Three hours each day are given by each student to these branches, and Mr. Soyter, who has been connected with industrial school work in Baltimore for five years, has charge of them. The second branch of the school under the direction of Mr. Kuhne teaches the practical mechanical branches as applied to the various trades. Every boy in these courses is required to spend some seven hours each day, six days a week, in the shops in addition to the three hours a day spent in the theoretical work. He begins with the simplest kind of shop work, filing, etc., and proceeds rapidly through each grade of work in his own particular chosen trade, so that in less than two years he is able to do very creditable work in his line as a mechanic. The writer has seen very good screw gauges, micrometer calipers, electrometers, machine drills, and many other instruments made by the young instrument makers who were just beginning their third year. All branches of mechanical work are done here—carpenter work, pattern making, forging, casting, lathe work and precision work of all kinds—and always done from drawings if possible.

The work is continuous through all the stages until the machines or instruments are finished ready for market. Many of the tools for the Schuckert works are made by these apprentices; and many models of the large machines, dynamos, motors, switchboards, meters, etc., of every type, are also made here for the use of the company for commercial purposes. The students also manufacture many things for market, such as calipers, watchmaker's lathes, telephone apparatus, automatic fire alarms and the like, and a specialty is made of electric clocks of many types and kinds. Thus the student or apprentice in addition to obtaining a good theoretical training, receives also a practical drill such as he could scarcely expect from a regular technical school.

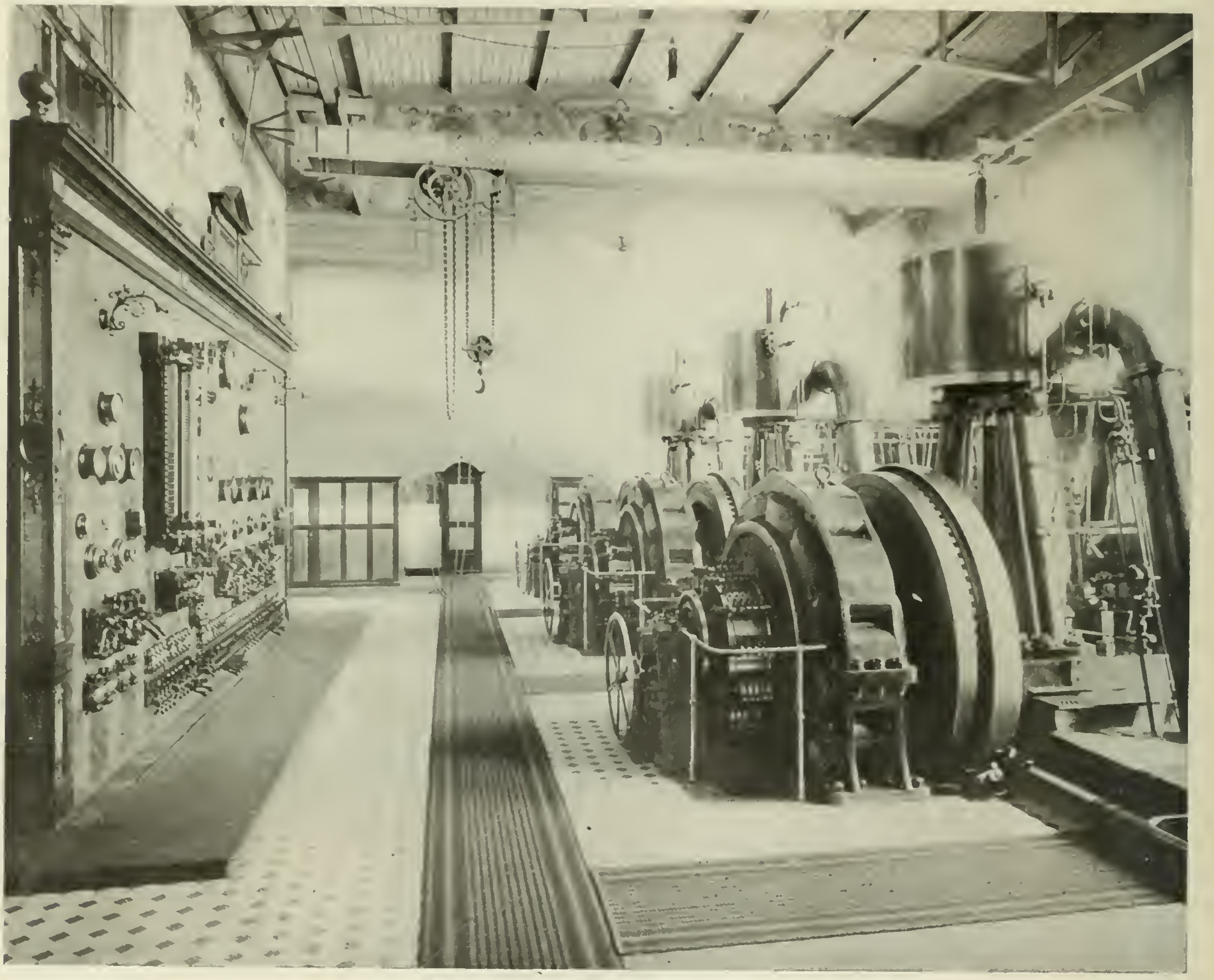


Fig. 3.—Direct-Current Generating Room.

This course lasts for four years. It costs the parents of the student nothing, while on the other hand the student may receive pay for his work. During the first year it is not customary to pay the students anything, except that a few of the very best may be granted a mere trifle each week as a prize to encourage greater effort. During the second year all are paid a little usually. During the third and fourth year all are paid wages regularly, varying in amount according to their skill.

Before they have finished their fourth year, however, many of the apprentices have been transferred to the regular Schuckert works, where they obtain permanent employment. Many of the foremen and heads of departments in the Schuckert factories are men who have been trained in this way. When a student has completed this course, if he has shown special skill and inclination in a certain direction, he can pursue his studies in the higher schools and state institutions to any extent that he may desire.

According to the caste conditions existing in Germany, a boy is quite certain to have the same kind of occupation that his father has had, or one similar to it. If, for example, the father is a machinist, the boy also is quite sure to be a machinist, or tool maker, or to have an occupation which is quite similar to that of his father. It therefore follows that the education and training of nearly all the sons of Schuckert workmen are provided for by these schools, and that without expense. More than that, the boys who have thus been specially trained for their particular trades become very desirable workmen and are quite sure to find employment with the Schuckert people. Thus this school system is mutually beneficial for both firm and workmen. It enables the firm to find suitable help when needed and, while preparing the young men for their life work, furnishes for them a market for their skill.

The daughters of the Schuckert employees are provided for by the Domestic School. All girls who have been confirmed, that is all the girls who have reached fourteen years of age, are here taught cooking, sewing, washing and ironing, dressmaking and all the domestic arts.

The schools are self-supporting to quite an extent. They are also provided for by an endowment left by Mr. Schuckert. If there should be a small deficiency, it is met by an insignificant assessment among the men.

From these funds pensions are granted to the disabled and aged and also to widows and orphans.

There is also a building society which has been organized among the workmen to enable them to obtain cheaper and better homes. This has been promoted and supported in many ways by the firm. The pension funds were organized in 1896. There is one fund for the wage-earners and another for the salaried men of the firm. The method adopted is to build blocks three stories high, each block containing eight dwellings. Fifty such houses have been built and occupied and many others are in progress. There is also a co-operative store, for the exclusive benefit of the workmen, where they may trade or not as they please.

The best idea of the appearance and general arrangement of the New Works that is possible without a lengthy description being given, will be obtained from the general view of the works shown in Fig. 1, together with the ground plan, Fig. 2. The New Works occupy a total ground area of about 25 acres, half of which is covered by the new buildings. The company during the present period of business depression employs 5,000 people, but during the busy seasons it employs 7,000 or more.

All the various electrical appliances which are usually manufactured by electrical companies, are manufactured here, with the exception of electrical conductors and incandescent lamps. On passing hastily through the various buildings it is interesting to notice how much American machinery is employed. In every department American and German machinery may be seen running side by side, but there does not appear to be any English machinery used. The common testimony of the workmen who operate these machines is that they like the American machinery better than the German, and the reasons usually given are that the American machines are more convenient, more sensitive to adjustment, and that they do better work. The machinery here as a rule is run much slower than in American manufactories.

There are several "power halls." The one for direct current has three shunt-wound dynamos, each with an output of 2,700 amp. at 110 volts, and one shunt-wound dynamo with an output of 1,300 amp at 110 volts, each being connected directly with a vertical triple-expansion engine of 450 to 500 hp. There is also a booster unit, consisting of a continuous-current motor for 110 volts connected with a shunt-wound dynamo of 800 amp. at from 10 to 40 volts. For use in connection with these there are two storage batteries, one of 62 cells with a capacity of 4,536 amp-hours, and a charging and discharging current of 1,512 amp.; and the other a battery of 77 cells with a capacity of 740 amp-hours, and 430 amp. maximum current.

Among the many objects of interest to be seen in the works are a single-phase transformer made for 78 volts in the primary and 100,000 volts in the secondary; three-phase generators of 3,600 kw at 5,500 volts, and three-phase continuous-current transformer sets, consisting of a three-phase synchronous motor of 1,403 hp, mounted on the same shaft and bedplate with a shunt-wound dynamo of 520 volts and 1,540 amp.

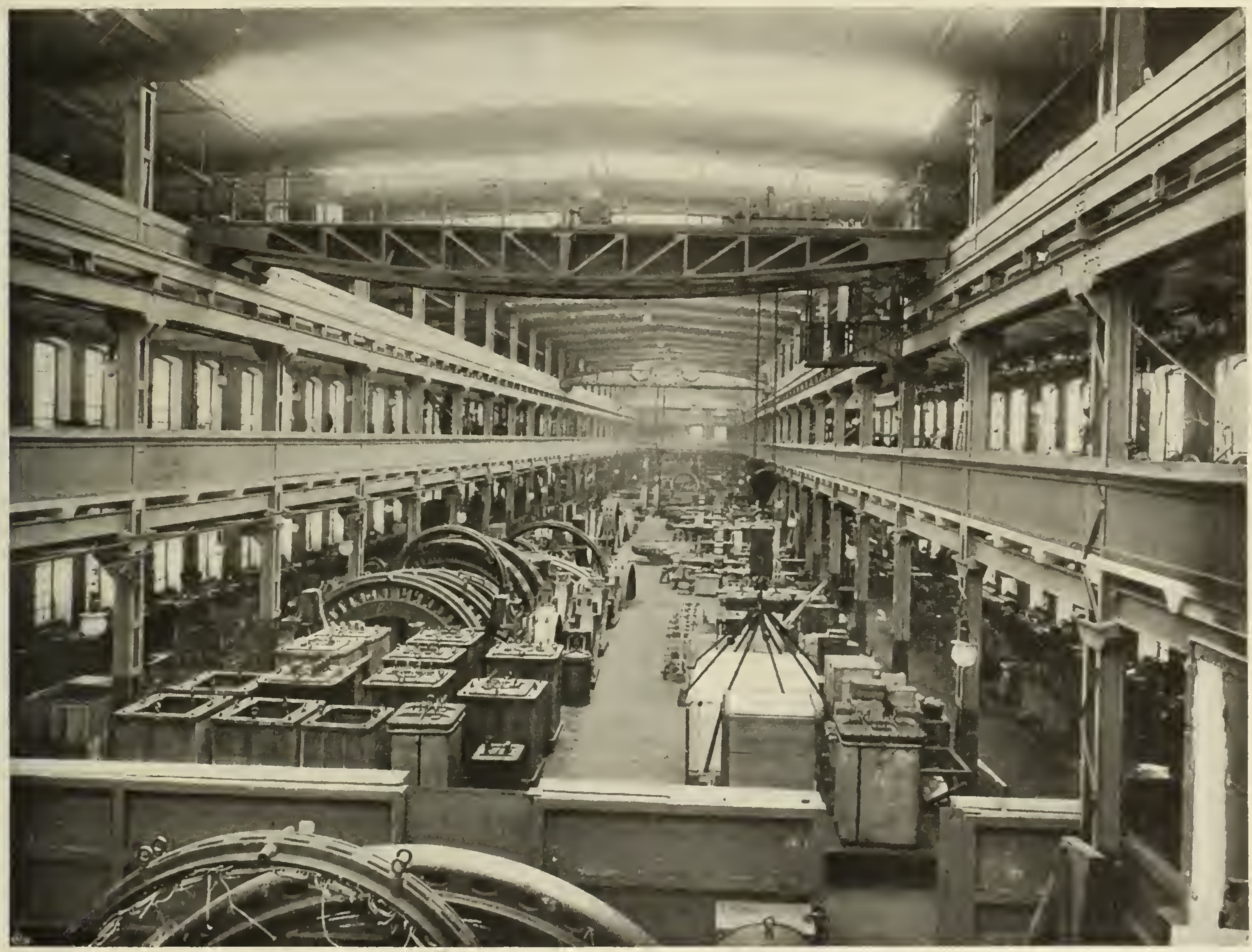


FIG. 4.—WORKSHOP FOR LARGE ALTERNATING-CURRENT MACHINES AND TRANSFORMERS.

The company also manufactures an isolated lighting plant for such homes, hotels, etc., as may desire electric light, but which cannot obtain it from a central lighting station. The plant consists of a 5-hp gasoline engine mounted with a 24-volt dynamo, which charges 12 large storage cells. For incandescent lighting, since the cost of wiring is small, the more efficient low-voltage lamps are used. The dynamo, run by gas engine, charges the battery during the daytime and at night the lamps are lighted directly from the battery. Two types are manufactured, one for incandescent lighting capable of running seventy 24-volt lamps and the other capable of lighting four or more arc lamps.

Among the latest developments to be seen in the works is a three-phase current motor capable of running with four different speeds, 500, 750, 1,000 and 1,500 r.p.m., the changes in speed being effected by merely manipulating a single controller. No resistance is introduced into the circuit to produce the speed changes. The armature is a simple "cage armature" and the invention lies entirely in the construction and winding of the field magnets.

Another new type is a three-phase crane motor, which has the casing of a three-phase induction motor and a continuous-current slot armature. This armature is provided with three lead wires at equal distances apart on its periphery, each of which connects to a slip ring. The motor, with load, is started with three-phase currents as an induction motor with phase armature. After having reached the normal speed, the rings are automatically short-circuited and the armature works as a short-circuit "cage armature." For brake work, as for example the lowering of a heavy weight, the continuous-current commutator is short circuited over the starting resistance to a pair of field coils. The armature then works like the armature of a continuous-current dynamo, starting with the residual magnetism of the fields; it thus works like a short circuited tramway motor in brake position.

It is, of course, known that the Schuckert Company supplies the world with parabolic glass mirrors for searchlight work. They therefore make a great specialty of searchlights and have produced the largest projectors in the world. The great one in the Sandy Hook lighthouse is a Schuckert searchlight, but one at the works is still larger and is said to be the largest ever made. The diameter of the mirror is over six and a half feet, while the power of the light is rated at 319,000,000 candles.

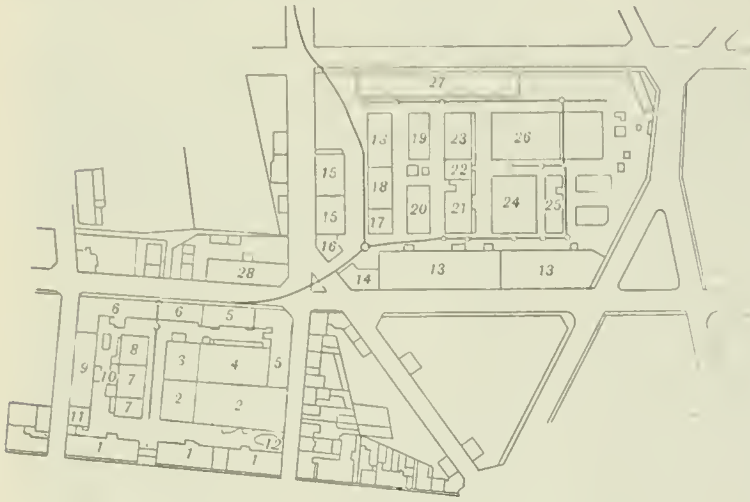


FIG. 2.—GROUND PLAN OF SCHUCKERT BUILDINGS.

No. 1.	Administration Buildings.
No. 2.	Direct Current Machinery.
No. 3.	Central Power Hall.
No. 4.	Machine Shops.
No. 5.	Meters and other Instruments.
No. 6.	Armature Winding.
No. 7.	Packing Rooms.
No. 8.	Boiler Rooms.
No. 9.	Switchboards, Volt and Ammeters.
No. 10.	Arc Lamps.
No. 11.	Transformer Testing Rooms.
No. 12.	Testing Rooms for large Dynamos.
No. 13.	Alternating Current Machines.
No. 14.	Laboratory, Chemical and Electric.
No. 15.	Street Railway Machines.
No. 16.	Engineer's Office.
No. 17.	Testing Room for Special Apparatus, New Models, etc.
No. 18.	Foundry, Iron, Brass and Copper.
No. 19.	Forging Shop.
No. 20.	Annealing Furnaces.
No. 21.	Alternating Current Testing Rooms.
No. 22.	Central Power Hall for Alternating Current.
No. 23.	Boiler House.
No. 24.	Carpenter Shop.
No. 25.	Pattern Makers' Shop.
No. 26.	Search Light Works.
No. 27.	Work Shops.
No. 28.	Store House.

A very perfect electric typesetting machine for setting up printers' type is manufactured here. By means of this machine the manuscript to be printed is first typewritten and spaced as by means of an ordinary Remington typewriter; at the same time a record is made on a paper band or ribbon similar to that used on the Morse telegraph instrument. This record is then placed upon the type-forming machine, and when the latter is set into operation, it casts new type from molten type metal as they are needed, cuts them to the proper size, places them consecutively in line, regularly forming the words and spaces, and carries them forward line by line to the compositor's table, so that when the type reach the hands of the compositor they are in regular position ready for the press, it being then only necessary to "lock" the matter and to place the columns in position. This work is all done automatically and at the rate of 90 letters per minute.

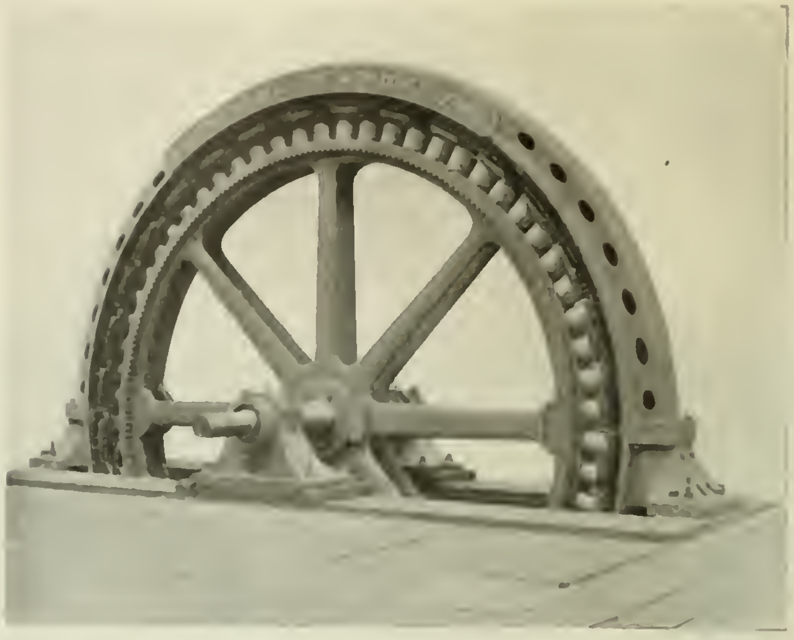


FIG. 5.—THREE-PHASE, 3,000-KW, 5,500-VOLT, SCHUCKERT GENERATOR, 96 PERIODS AND 94 R.P.M.

A novel model electric railway also is to be seen at the works, which requires no trolley and no conduit. The rails are charged negatively, and there are insulated studs in the middle of the track for the positive charge, but these studs are never charged except as the car passes over them.

Production of Platinum in 1902.

The report for 1902 to the United States Geological Survey on the production of platinum in 1902, now in press, is in two parts, the first being the report proper, by Dr. Joseph Struthers, and the second a paper by Prof. J. F. Kemp on platinum in the Rambler mine, Wyoming.

The production of platinum from domestic ores in the United States decreased from 1,408 ounces, valued at $27,526, in 1901—the largest output recorded by the Geological Survey since 1880—to 94 ounces valued at $1,814, the smallest production since 1893. In connection with the platinum there were also obtained from the ores 20 fine ounces of iridium, as against 253 ounces in 1901. The domestic supply of platinum in recent years has been obtained as a secondary product chiefly from gold placer deposits in Trinity and Shasta Counties, California. It is reported that the metal occurs, though not in commercially rich deposits, in many other gold placers of California, as well as in Washington, Oregon, Idaho, Montana, Colorado and Alaska. The Rambler Mine, Wyoming, continues to attract attention, and during the year a considerable quantity of the metal was collected, but not marketed, by the Waratah Minerals Company at Kerby, near Grants Pass, Josephine County, Oregon.

The Russian sources of platinum supply, which furnish about 90 per cent. of the total consumption of the world, are comparatively limited. The platinum-bearing ores extend along the eastern watershed of the Ural Mountains in Eastern Perm and along the watershed farther south. The imports of platinum into the United States during 1902 were valued at $1,987,980, as compared with $1,695,895 in 1901.

Prof. Kemp's paper contains a brief description of the situation, topography and geology of the Rambler Mine, which is in Albany County, Wyoming, about 45 miles southwest of Laramie, near the headwaters of Douglas Creek, in the Medicine Bow Mountains; a description of the Rambler dike and an account of the ore body itself. Great interest was excited late in 1901 and early in 1902 by the finding of the platinum group of metals in the copper ore of the mine and by the separation from the ore of sperrylite, diarsenide of platinum. The metal has not yet been extracted on the commercial scale.

The Lodge-Muirhead System of Wireless Telegraphy.

By A. Frederick Collins.

It is extremely gratifying to learn that Sir Oliver Lodge has at last made public the practical results of his investigations in wireless telegraphy—extending over a period of several years—and that, in collaboration with Dr. Alexander Muirhead, a new system embodying many novel features is now to be placed on the market.

The experimental stations employed in testing out the Lodge-Muirhead system were located at the works of Muirhead & Co., Elmers End, Beckenham, Kent, and at Downe, a village 8½ miles distant respectively. Between these two points the geological formation consists largely of Kentish chalk, which, it is estimated, offers five times the resistance to the propagation of electric waves encountered over salt water, so that all things considered, the effectual range was equivalent to 44 miles.

The results attained were so satisfactory that an agreement was entered into with the Eastern Extension Telegraph Company whereby the latter two cable ships, the *Patrol* and the *Restorer,* were equipped with the Lodge-Muirhead apparatus, while they were lying off Gravesend, and just before their departure for the Far East where they were destined to lay a cable for the Dutch Government.

Again the system was made the subject of especially severe trials between ship and shore, a land station having been erected near Holyhead and its complementary apparatus installed on a steamer of the Johnston line; then following the successful conclusion of these tests, Portsmouth and Portland were put into communication, the instruments operating splendidly over this range of 62 miles.

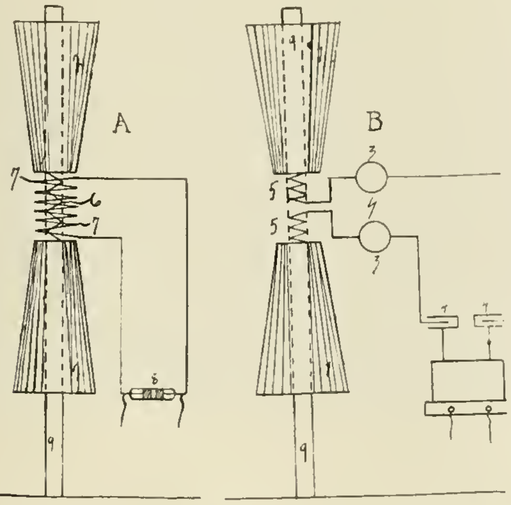


Fig. 1.—Lodge Tuned Wire. *A*, Receiver. *B*, Transmitter.

The transmission of wireless messages to a much greater distance is, of course, perfectly feasible, depending among other factors, on an increased initial e.m.f. and a greater elevation of the antennæ, but the inventors have not striven for longer range, as the desirability has not been shown to be of much importance, but what is needed is a system embodying speed and absolute accuracy, and to this end Messrs. Lodge and Muirhead have bended their energies.

Simplicity is another factor that enters largely into the make-up of a successful wireless telegraph, and this point has not been overlooked, since, practically, the receiver of the new system comprises only Sir Oliver Lodge's new coherer and Dr. Muirhead's improved syphon recorder. This combination marks an advance in the art of wireless telegraphy long sought for, i. e., the elimination of the relay and the decohering device or tapper usually employed in recording wireless apparatus.

Both the relay and the tapper for this purpose have a time constant that is far from low and this, together, with the excessively high time constant of the register, is the cause of the low speed limitations of Morse registering receivers. Oppositely disposed to these conditions, the Lodge coherer and Muirhead syphon recorder operate in unison and without the interposition of these extra appliances.

These are features of the new English system introduced and applied to the fundamental principles of syntonic wireless telegraphy already patented by Sir Oliver Lodge in 1897, and which marked the first attempt at selective signaling by properly proportioning the dimensions of the radiator and resonator and gives to the new company absolutely the sole rights on this method of construction.

It will be remembered that in Sir Oliver Lodge's first patent, No. 11,575, the transmitter comprised an oscillator circuit formed of two capacity areas and an inductance coil, and that the resonator circuit was of the compound type, having an open and closed circuit operating through a small transformer. The capacity areas which were made of copper cones with their apexes joined by the inductance coil were suspended and insulated in free air; these acted like the coatings of a gigantic air condenser; in the oscillator the inductance coil was divided into two parts, the terminal of the sub-divided coil joining the capacity areas whilst the other terminal was connected to one side of the spark-gap and the opposite side of the system to the complementary side of the gap, as shown in *A*, Fig. 1; both the capacity areas, with their respective inductance coils, were, however, separated from the spark-gap by adjustable condensers, so that any value of capacity might be obtained at the pleasure of the operator. The object of this arrangement was to prolong the oscillations in both the radiator and the resonator, and by a proper adjustment of the coefficients of these circuits produce any desired frequency of oscillation and, therefore, any length of wave to which the resonator would respond in consequence.

In this specific patent, granted to Sir Oliver Lodge in 1897, the idea of producing waves of a definite length, the cumulative effect of which would finally set up similar oscillations in the resonator to those surging in the radiator, and so indicate the transmitted impulses in a suitable receiver was clearly set forth and for the first time syntonic wireless telegraphy was based upon electrical resonance.

This system of selectivity devised by Sir Oliver was the outcome of a series of classical experiments based upon his syntonic Leyden jars in which one jar is caused to discharge through a circuit by the sparks of another jar, provided the two circuits are of equal electrical dimensions.

In the Lodge-Muirhead commercial system the tuning of the circuits is accomplished by adjustable capacities and variable inductances, which I have described in prior issues of the Electrical World and Engineer. The transformer used in the resonator system, or "jigger," as it has been termed in "English as she is spoke," is original with Principal Lodge. It is merely a high-potential transformer made of a very few turns of heavy wire for the primary, which also serves as an inductance, connecting the capacity areas of the resonator system, as shown in *B*, Fig. 1, and a greater number of turns of finer wire in the secondary, which is connected to the coherer; this transformer is without a core, as this would retard and tend to damp out currents of such enormous frequencies as are employed for signaling without wires.

This transforming device serves to effect an electrical connection between the open-circuit resonator and the local primary circuit, thus permitting the difference of potential between the upper strata of air at the top of the antennæ and that of the earth—always the cause of strays or "X's" in simple resonators—to equalize without giving rise to oscillations in the closed circuit, and therefore preventing false indications being registered on the tape.

Occasionally we find it stated that the transformer is necessary for long-distance work, but this is evidently misleading and fallacious. It is true that the reception of messages is more accurate when the device is used, but as the losses in transformation of low-potential, high-frequency currents are considerably greater than with low-potential, low-frequency currents; therefore, a greater amount of initial energy is required in transmitting a given distance where a transformer is used.

A higher potential may, of course, be obtained in the closed circuit connected with the terminals of the secondary, but it is obtained at the expense of current, resonance effects notwithstanding, and an electric oscillation to be effective in breaking down the resistance of a wave detector of the coherer type must have current as well as potential.

Two forms of oscillator systems are now employed in the Lodge-Muirhead equipment, and both are modifications of Dr. Lodge's original patent on wireless telegraphy. Referring to Fig. 2, *A* represents the most efficient type; it consists of a spark-gap, *s*, connected in series with the antenna, *a*, and having a condenser interposed at x_1; the opposite arm includes the inductance coil, *i*, a condenser, *x*, and grounded terminal, *E*; this system may be supplied with energy by means of the ordinary induction coil, with an interrupter, or the condensers may be formed of Leyden jars, and these charged by the secondary current of a commercial transformer —when they will discharge through the spark-gap, *s*. The compound oscillator system, *B*, Fig. 2, is made up of both an open circuit and a closed circuit the antenna, *a* being connected with the earth through the primary coil of a high frequency, high potential oil transformer and a condenser, c_1, the secondary coil forms a closed circuit in which is included a pair of oppositely disposed condensers and the primary of either an ordinary induction coil or a transformer operated by a commercial alternating current; the oscillator spheres are in shunt with the closed circuit.

In the resonator system and receiving circuits of the Lodge-Muirhead apparatus lies the ingenious application of some absolutely novel principles. Here again the equipment takes on a modified form of that described in Lodge's first patent on wireless. The open resonator circuit is composed of the antenna, *a*, primary of a transformer, *tp*, which also serves as an inductance condensers, *X* and *X1*, the latter leading to the earth as shown in the diagram, Fig. 2, *A*, the secondary of the transformer is in series with the new Lodge rotating coherer, *c*, forming a closed circuit, which includes the cell and recording instrument, *r*; in shunt with this circuit is a condenser, *X2*, the application of which was described in a patent issued to Lodge Muirhead in 1807, and numbered 18,644; in this patent it is stated that a condenser in shunt with the recorder permits the oscillations set up by the waves to surge through the closed circuit resonator with a predetermined and definite time period until it reaches its maximum amplitude and excludes these oscillations from the register and cell in consequence. This is claimed as one of the strong features of the new system and formed the basis of another patent issued to Lodge and Muirhead, and numbered 29,069.

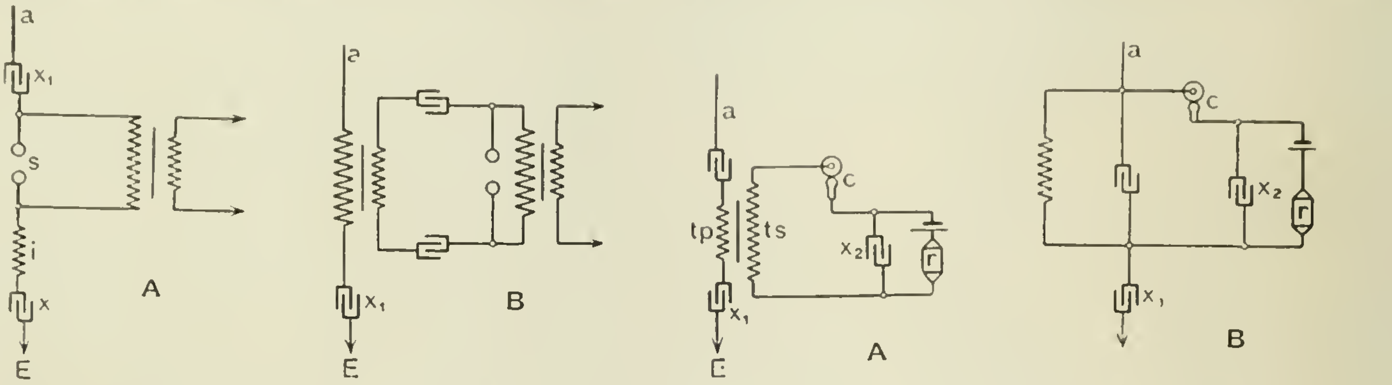


Fig. 2.—Simple Oscillator System. Compound Oscillator System. Compound Resonator System. Simple Resonator System.

A second modification of the system is drawn in diagram *B*, Fig. 2; in this case the antenna, *a*, leading to the earth through two condensers, and having an inductance in shunt on one side and a circuit in shunt on the opposite side, including a coherer, condenser, cell and recorder, as in *A*. In this patent one of the claims covers a metal case, which completely encloses the coherer, and this has been taken advantage of in the present commercial system now on the market.

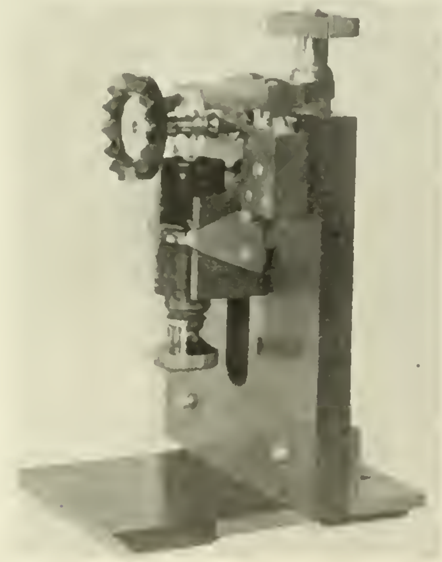
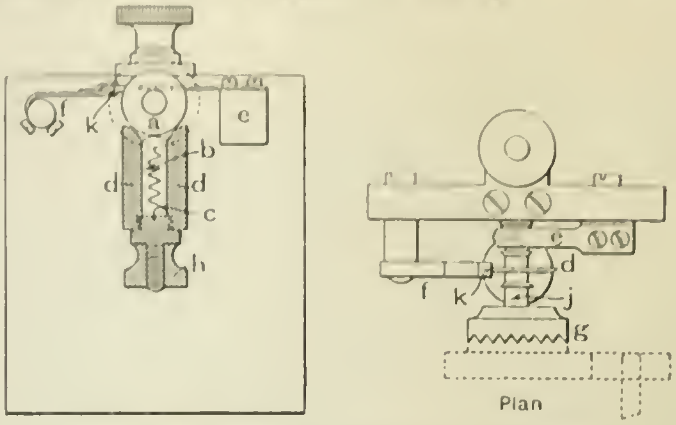


FIG. 3.—LODGE ROTATING MERCURIAL COHERER.

The new coherer of Sir Oliver Lodge is of absorbing interest to those who have watched the development of the art. To produce a wave detector, sensitive enough for long-distanc transmission, and having a variability ranging from maximum resistivity to maximum conductivity equal to a filings coherer, but without the disturbing element of mechanical decohesion of the latter, has been a desiratum of inventors ever since the discovery of Branley.



FIGS. 4 AND 5. SECTION AND PLAN OF COHERER.

The unreliability of the filings coherer has long been a source of annoyance to operators, for under certain atmospheric conditions it is often impossible to obtain indications at all. This is largely due to the variability of stroke of the tapper on the coherer tube and the changeability of position of the filings, which are as varied as the designs of a kaleidoscope; in some instances the filings are arranged so that they would respond to the feeblest impulse, and upon the very next stroke the marvelous sensitiveness is destroyed and the tube become inoperative.

The new Lodge-Muirhead coherer eliminates all these untoward features by keeping freshly and uniformly exposed surfaces constantly in action for cohesion. This is done by causing a small steel disc to revolve continuously in contact with a column of mercury, between which is interposed a thin film of oil; in action the coherer operates as follows: When the impinging waves set up oscillations in the resonator circuit the potential difference due to their cumulative effect disrupts the film of oil and at that instant cohesion takes place between the molecules of the solid and the fluid metals, only to be instantly restored by a partial revolution of the disc when

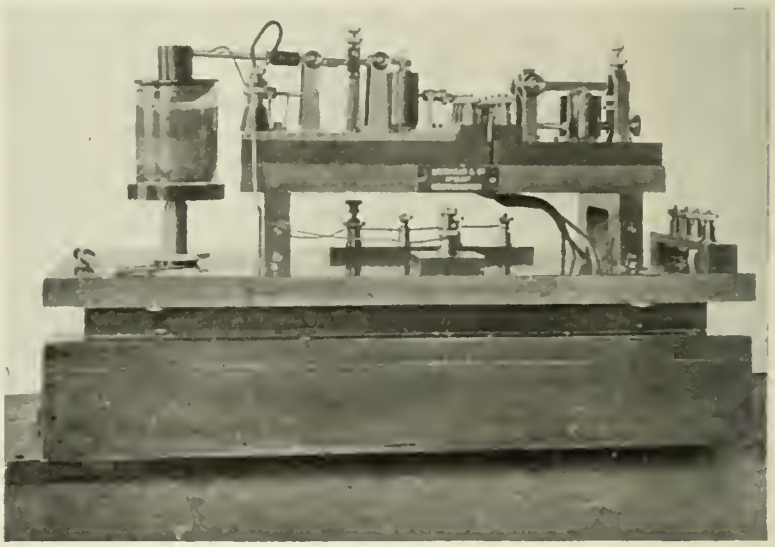


FIG. 6.—LODGE-MUIRHEAD "BUZZER."

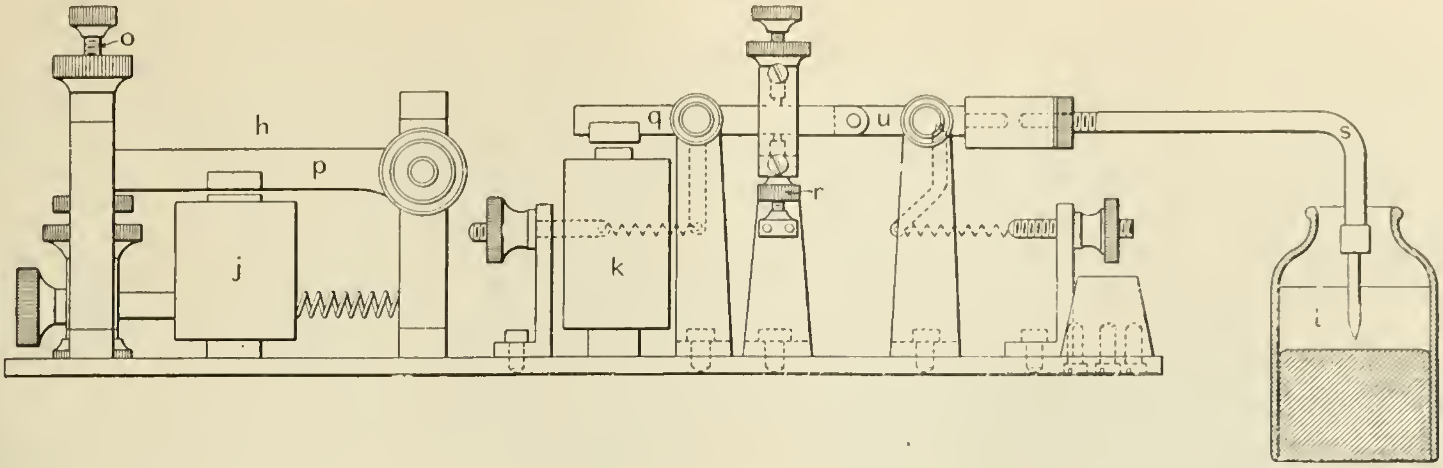


FIG. 7.—ELEVATION OF "BUZZER."

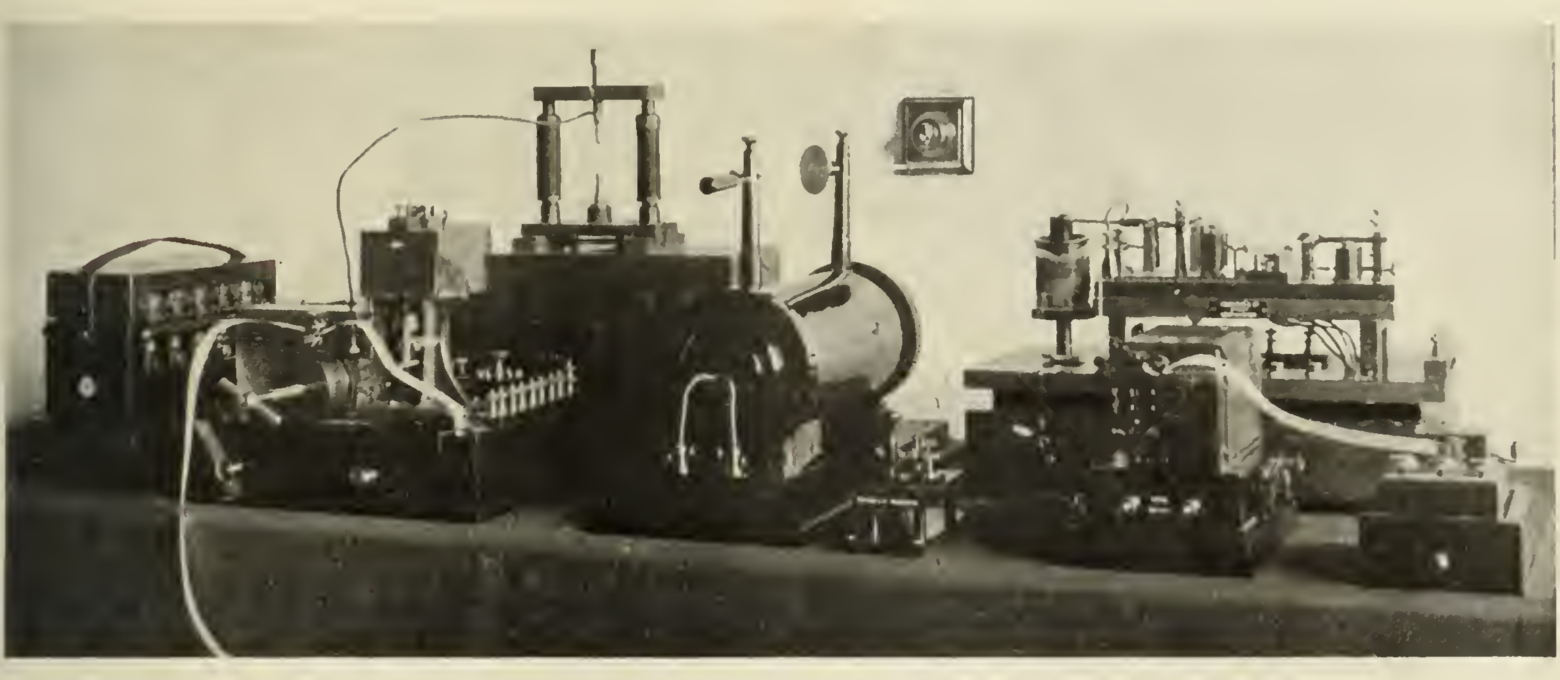


FIG. 8.—APPARATUS IN OPERATION.

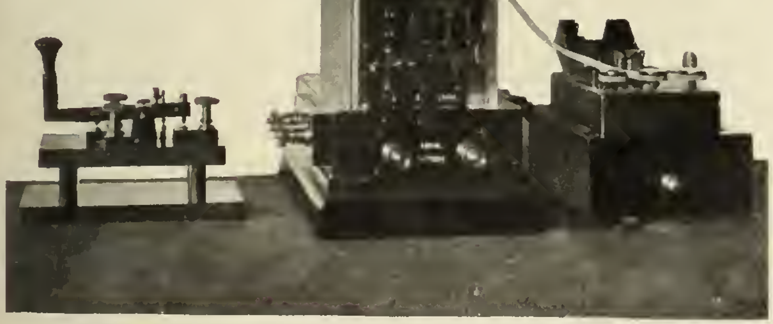


FIG. 9.—MORSE KEY, PERFORATOR AND AUTOMATIC MACHINE.

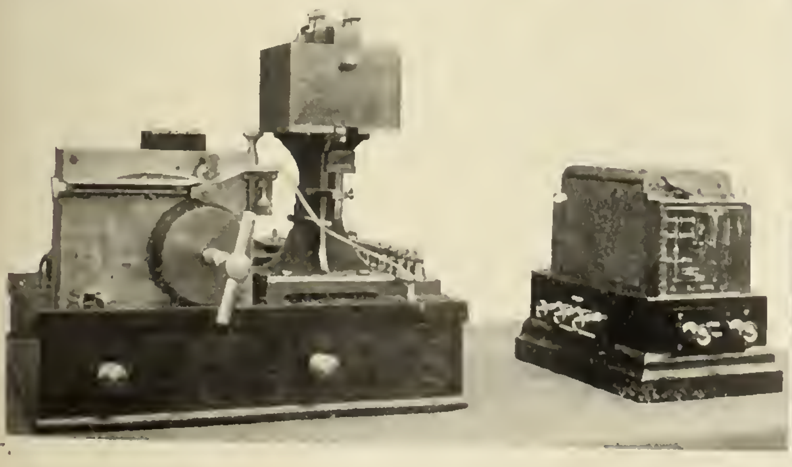


FIG. 10.—RECEIVING INSTRUMENT AND AUTOMATIC MACHINE.

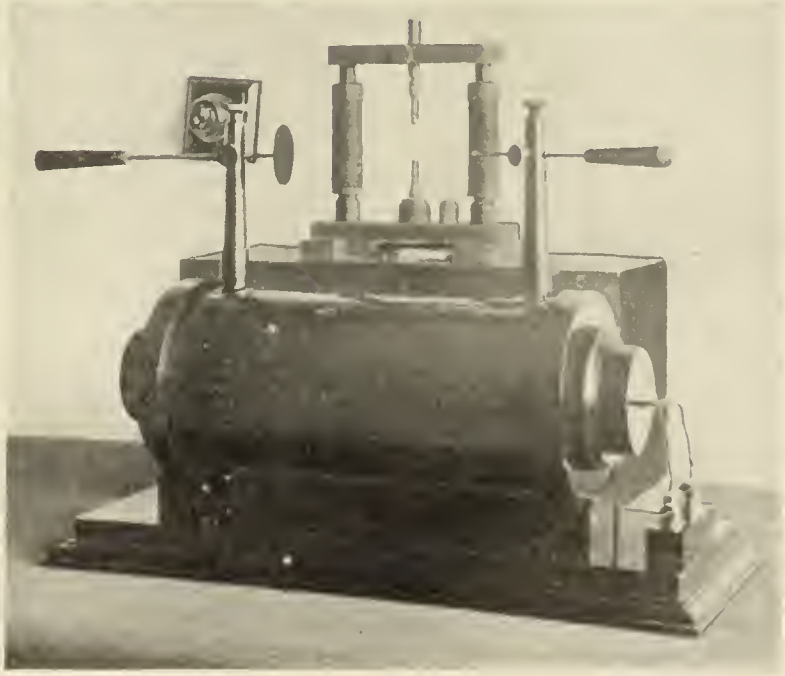


FIG. 11.—INDUCTION COIL WITH SPARK-GAP AND SYNTONIZING INDUCTANCES.

LODGE-MUIRHEAD SYSTEM OF WIRELESS TELEGRAPHY.

freshly exposed surfaces are brought into position ready for the next impulse.

The coherer is shown photographically in Fig. 3, in sectional elevation, Fig. 4, and a plan view in Fig. 5. The rotating steel wheel is represented by *a*, the trough of mercury, *d d*, and an amalgamated platinum wire spiral, *b*, which is connected to the binding post, *h*, a copper brush, *c*, makes connection with the steel disc, *a*, through the axle, *j*, a spring, *l*, having a small piece of felt, *k*, attached, rests lightly on the disc, serving the purpose of keeping its surface dry and clean and avoiding foreign particles before and after cohesion.

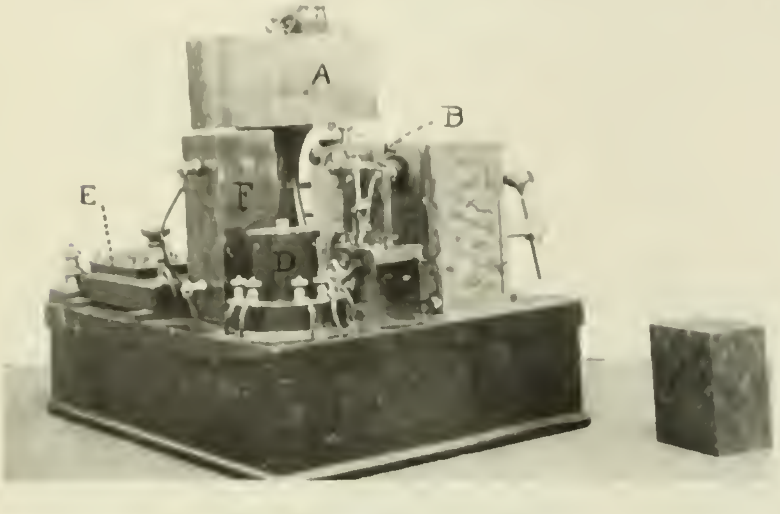


Fig. 12.—Receiving Apparatus Complete.

The steel disc is revolved by ebonite wheels gearing into wheels of the same material, operated by clockwork, which also actuates the syphon recorder. The coherer is connected directly in circuit with the syphon recorder, but has interposed a millivolt meter for regulating the potential difference, which experience has shown should be kept from 0.03 to 0.5 volt, according to the adjustment of the instruments. This type of coherer is so exceedingly sensitive that a potential difference of 1 volt will break down the film of oil when cohesion takes place. A single cell is, therefore, employed in the local circuit and the excessive e.m.f. of this is reduced by the proper resistance. The revolving mercurial coherer of Lodge operates to a better advantage when the oscillations set up in the resonator are slowed down, and as such oscillatory currents are the result of long electric waves, and as these are more penetrating than shorter wave lengths, it is obvious that all these factors work to the end of producing highly satisfactory results. The feeblest oscillations will break down its resisting medium and give the desired indication; besides, this coherer is as absolute in its action as any other piece of electrical apparatus.

The transmitter includes a special device in the form of a Morse key and may be operated either by hand or by Dr. Muirhead's automatic signaling machine, in conjunction with a perforator. Whichever method is adopted, the local circuit includes a "buzzer," shown in the photograph, Fig. 6, and in elevation in Fig. 7; the purpose of this buzzer is to open and close the circuit in which the primary of the induction coil is included so that a definite frequency is obtained in the local circuit: this device consists of two sounders connected with each other so that they operate alternately. An arm of aluminum is fastened to a copper rod and connects with the armature lever of one of the sounders; the copper rod has a pointed end dipping into a cup of mercury and making or breaking contact, as the lever is drawn up or down. By this arrangement the current is interrupted about 600 times per minute and sets up a current in the secondary of the coil having a similar frequency. In action, when the Morse key is pressed into contact, the current is segregated, with the result that the disruptive discharge is broken up into a succession of sparks, and these may be of any duration the operator desires by merely adjusting the play of the levers of the sounders, and therefore the length of the dip in the mercury.

When the "buzzer" sets up low frequency, high potential currents in the secondary charging the oscillator system and oscillations surge through the radiator as a consequence, long electric waves are propagated through space at small but definite periods of time. When these reach the resonator of the receiver they actaate the coherer accordingly and are translated into the code of the operator by the syphon recorder.

The sensitiveness of the coherer is so great and the recorder works so thoroughly in unison with it that if the frequency of interruption in the "buzzer" of the transmitter is too low the received impulses on the tape show a wavy line, or if very slow a broken line, but when the frequency of the disruptive discharge is sufficiently rapid a straight line shows a steady deflection owing to the lag of the syphon.

The general arrangement of the apparatus in operation is shown in Fig. 8; it consists of a six cell box of storage batteries, a complete receiving set, a spark rod frame, a 10-in. induction coil, a buzzer, a perforator, hand sending key, primary circuit switch, and an auto transmitter.

The Morse key, automatic machine and perforator are shown in Fig. 9, and the receiving instrument and automatic machine in Fig. 10; in Fig. 12 the receiving apparatus complete is illustrated in detail. *A* is the syphon recorder, *B* the recorder, *C* actuating mechanism, *D* reversing switch, *E* voltmeter, and *F* the transformer. Fig. 11 shows the 10-in. induction coil with special spark-gap joined by placing two metal points between two inductances for maintaining the proper relations with the capacity by the oscillator system. Fig. 13 is a sample of the tape when the buzzer was operating with a frequency equal to 600 alternations per minute.

When properly adjusted for sending a message the needle of the recorder is sustained so that if a dash is transmitted a long line is the result on the tape, whilst a dot is registered as a short line. While these recorded variations of the sparks sending out the waves are intensely interesting to the observer, the absolute adjustment to produce such accuracy is not of importance, for an operator can translate the recorded script, even though there are a number of impulses to each dash.

But as a matter of fact, its fine adjustment is not difficult, and when it is perfect the operator is enabled to determine even minute differences in the emitted wave by the fluctuations and peculiarities of the recorded impulses, and when these assume a serious aspect the cause may be easily and at once determined and rectified whether it occurs in the transmitter or the receiver. This is, of course, impossible where a relay and tapper are interposed in the local circuit; in this new feature lies one of the strongest points of the Lodge-Muirhead system.

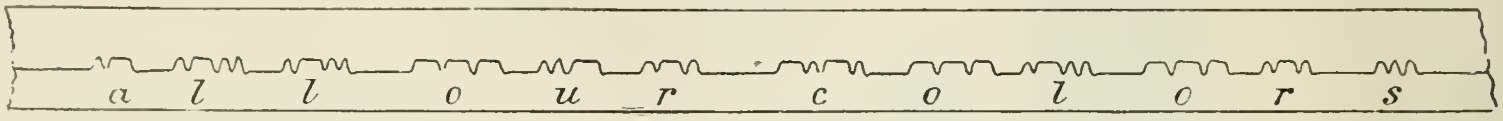


Fig. 13.—Tape of the Syphon Recorder.

Industrial Education in Germany.

The great attention paid in Germany to scholastic industrial training is shown by the statement that in Saxony alone there are no less than 287 industrial schools, as follows: 120 advanced industrial schools, 150 special industrial schools, 321 industrial schools for drawing and painting, 21 industrial schools for women, girls and children; 441 industrial primary or continuation schools. The advanced industrial schools are of five classes, known as the industrial academy and architecture, machine construction, dyeing and industrial drawing departments. The industrial academy furnishes four courses—namely, for mechanics, chemists, architects and electricians. A requirement of admission is that the candidate shall have passed at least two years in a factory acquiring practical knowledge in the branch in which he desires to perfect himself theoretically. The special schools are divided among 21 branches of industry, such as watchmakers, brewers, etc., but electricity is not represented. The primary schools prepare pupils in a general way for some trade or particular branch of industry. There are 9 technical high schools now in Germany with 15,000 students, and two more will soon be opened. An applicant is required to have had nine years of training in the classical "real" school, or gymnasium.

The Milan-Gallarate Electric Railway.

By P. Letheule.

Although the plans for the electric railway line between Milan and Gallarate, Italy, originally provided for a hydraulic plant on the Tessin River at Tornavento, it was later decided that a steam plant would be more economical, notwithstanding the high price of coal—$6—per ton. One reason perhaps is that the concession will expire in 1905, and the cost of a steam plant would be less than that required for water power development.

The accompanying map shows the railway system, which comprises one main and three sub-sections, with terminii at Gallarate, Porto Ceresio, Arona and Laveno, respectively. The generating plant is situated at Tornavento, as shown. The adjoining table gives data as to distances, elevation and grades.

Stations.	Distances in kilometers from Milan.	Height above sea level, metres.	Mean grades, per cent.	Maximum grades.
Milan	0	126		
			2.86	6
Gallarate	40.3	242		
			6.75	12
Tunnel d'Indumo	63.1	395		
			12.25	20
Porto-Ceresio	73	274		
Gallarate	40.3	242		
			2.81	8
Tunnel de Ronco	52.1	275		
			3.55	7
Laveno	71.5	206		
Gallarate	40.3	242		
			5.76	10
Pt. Culminant	47.7	284		
			4.66	11
Arona	66.2	198		

The running schedules on the lines are as follows: (1) On the trunk line from Milan to Gallarate, express trains are run without stops, but become ordinary trains on the branches of Porto-Ceresio, Laveno and Arona. (2) Semi-express trains between Milan and Gallarate, stopping only at Legnano and Bento. (3) Slow trains stopping at all stations between Milan and Gallarate.

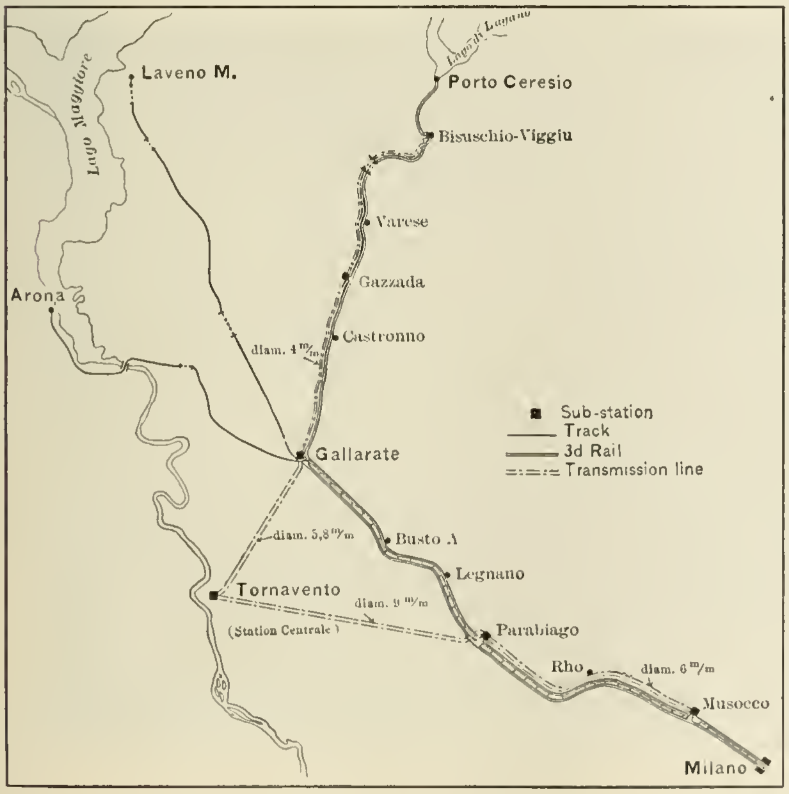


FIG. 1.—MAP OF RAILWAY SYSTEM.

Local reasons, as above stated, have prevented the use of hydraulic machinery and the power is now produced by a steam plant, the situation of which would of course have been better if nearer to the line. The steam generating station, however, gives economical results as shown by figures presented below. Excellent running of machines in parallel is obtained, and the regularity of the service has made this installation one of the best in Italy. It includes three generating sets of 750 kw with steam engines of the Sulzer type built by Franco Tosi.

The alternators are three-phase, 13,200-volt, 25-cycle, direct-connected machines, running at 94 r.p.m. As in most installations of this character, the revolving field type of alternator is used. These machines do not differ in any respect but the size from those built by the same company (the General Electric Company of New York) or by the British Thomson-Houston Company for the Glasgow tramways and the Central London Railway.

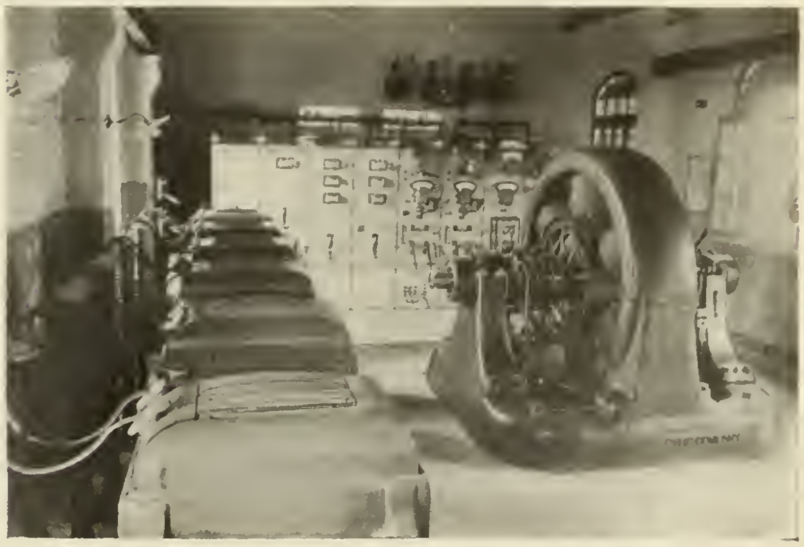


FIG. 2.—ONE OF THE CONVERTER STATIONS.

Two machines are in daily use running in parallel in summer time, one being sufficient for the winter traffic and the light traffic hours of the day. The service extends over 16 hours in the winter and 19 hours in the summer, and the running of the train service is exactly similar to that of a large trunk system of railway, with higher speeds, however, some trains running at exceptionally high speeds as will be seen later, and greater frequency of service.

The daily output of the generating station is 12,000 kw-hours in winter and over 18,000 during the summer, the average being 13,500 to 14,000 kw-hours. Momentary overloads of 75 and even 100 per cent. occur, and in summer the overloads jump to 2,000 or 2,200 kw, corresponding to 1,700 to 1,800 ihp per steam engine.

In spite of these unfavorable conditions, very economical results are obtained. In the last six months of 1902 3,800 tons of coal produced 2,500,000 kw-hours, and it is hoped still further to reduce this expense. The coal used is of good quality, costing $6 per ton. Good coal has been found to give the best results. In spite of the high price of coal in Italy and the disadvantages resulting from the choice of the station, the total expenses of the generating station during the last six months of 1902 did not exceed $31,800, corresponding to a price per kw-hour of 1.28 cents.

The generating station feeds 7 transformer stations by means of high-tension lines shown on the map. The line has given much satisfaction, only one interruption of service having taken place, this being due to a storm which broke an insulator and produced a short circuit at the switchboard, a few minutes sufficing to right matters.

These sub-stations are of the same type as is in general use on direct-current lines; that is, supplying 600 volts for traction, and current at 3,000 volts, three-phase, for distribution of power as in the case of the Glasgow tramways, London United tramways, Central London Railway, etc. There are seven sub-stations in all represented on the map, each containing two rotary-converters of 500 kw, three step-down transformers for feeding converters, one spare transformer, one reactance coil and one starting compensator.

There are, in addition, storage batteries of a capacity differing according to the service of the sub-stations, all but one having a capacity of 325 amp-hours, with a maximum discharge current of 600 amp; the remaining one, situated at Musocco, is of 500 amp-hours capacity, with a maximum discharge current of 1,000 amp.

The output of each of the sub-stations is 3,500 kw-hours, the maximum momentary overload attaining 1,000 kw in the case of Musocco sub-station. The working expenses of each sub-station, not including the storage battery, does not exceed $1,200 per year. The average efficiency is between 82 and 85 per cent.

At the commencement of operation, short circuits were frequent, the workmen being unfamiliar with electric traction. Now, however, the circuit breaker rarely acts more than once a day at each substation except on fete days.

The switchboard of the sub-station is built according to common practice, there being separate panels for the alternating and direct current sides. Fig. 2 illustrates a sub-station with two converters, the outside panels shown being the line panels. The direct-current line panel is provided with a recording wattmeter connected to the 600-volt third rail system. The track is bonded and forms the negative side, the positive side being the third rail of the same type as the track rails supported every 13 ft. by insulators formed of "reconstructed granite." Tests made have given a figure of 0.064 ohm for the resistance of a kilometre of single track and third rail.

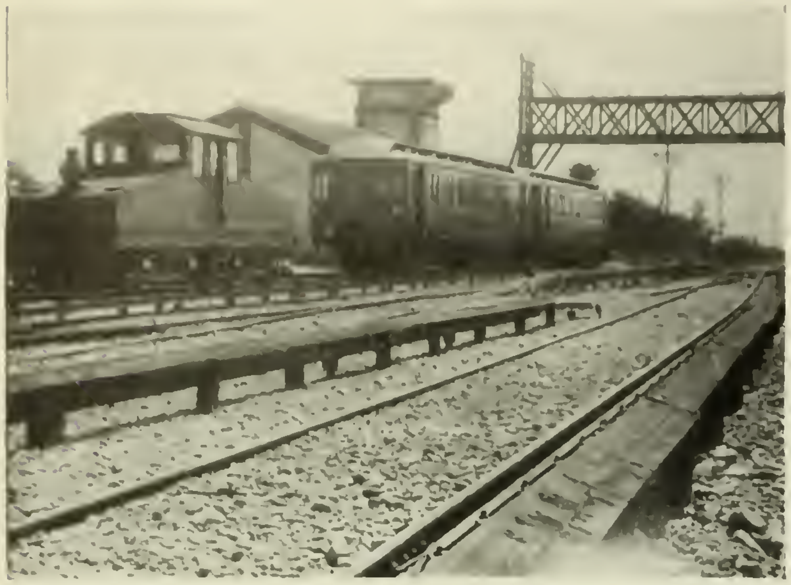


FIG. 3.—PROTECTION OF THIRD RAIL.

Wooden protection from the third rail is employed in stations, railway yards and level crossings, as shown in Fig. 3; these are independent of the track, a doubtful practice as the protection is thus liable to become displaced.

The third rail insulators at first proved defective by reason of the iron caps becoming loose on the insulator and the lead filling giving way under the voltage, causing short circuits and deposits on the insulator block. The lead filling has now been replaced by cement and the insulators give perfect satisfaction.

The average resistance of insulation is 60,000 ohms per insulator; the average loss per kilometre of single track, owing to imperfect insulation, does not exceed 0.1 amp. in dry weather and 0.2 in wet weather. The third rail collector shoes are of American pattern and supported from the journal box.

The rolling stock includes one electric locomotive for hauling freight trains, and twenty motor cars and twenty trailers for passenger trains. All motor cars and locomotives are equipped with direct-current motors of 160 hp, geared to the axles, the driving wheels having a diameter of 1.05 meter.

The weight of each motor with gear amounts to 2,500 kg. Series-parallel controllers of General Electric Company make are used with corresponding accessory apparatus in the motorman's cabin. The braking is done by compressed air obtained from an electrically-driven compressor.

Speeds have been attained of 56 and even 62 miles per hour. These high speeds have been easily obtained and have given rise to no inconveniences with respect to the gearing, current collection or bearings. The regular service is made at speeds varying from 35 to 45 miles per hour, with train weights of 75 to 90 tons. The maximum starting power per train is from 400 to 450 kw and 240 kw suffices to maintain a speed of 56 miles per hour on the level and 100 kw for a speed of 35 to 45 miles per hour on the level, the motors being coupled in series.

The express trains running from Milan to Gallarate make the journey in 34 minutes and the down trains in 33 minutes, including two slow-downs; this corresponds to a commercial speed of about 45 miles per hour.

Between Gallarate and Porto-Ceresio the speed is considerably diminished on account of the curves, but the whole distance between Milan and Porto Ceresio is made by express trains in 1¼ hours, corresponding to a schedule speed of 37 miles per hour. The average current consumption per ton-kilometre measured at the sub-stations is 50 watt-hours, which is lower than the guarantees of the contractors. Multiple-unit train control system has been experimented with and the Mediterranean Railroad Company will soon place a number of these equipments on the line.

The results of the operation have been perfectly satisfactory from all points of view. The results obtained have exceeded all hopes, and the railway company bears witness to this in its last annual report. The increase in traffic has been remarkable as the following figures will show:

During the first year of electric service the electric trains covered 11,000,000 kilometers, whereas the last year of steam service only effected 4,769,000 kilomtres. With the latter the average train kilometre per day amounted to 580, whereas 3,712 are now daily made: that is, more than seven times as many.

In spite of a decrease of 50 per cent. in the fares charged, the receipts for the first nine months increased to 993,150 lire, whereas during the last year of steam service they only amounted to 663,000 during the same period. On a certain holiday the receipts amounted

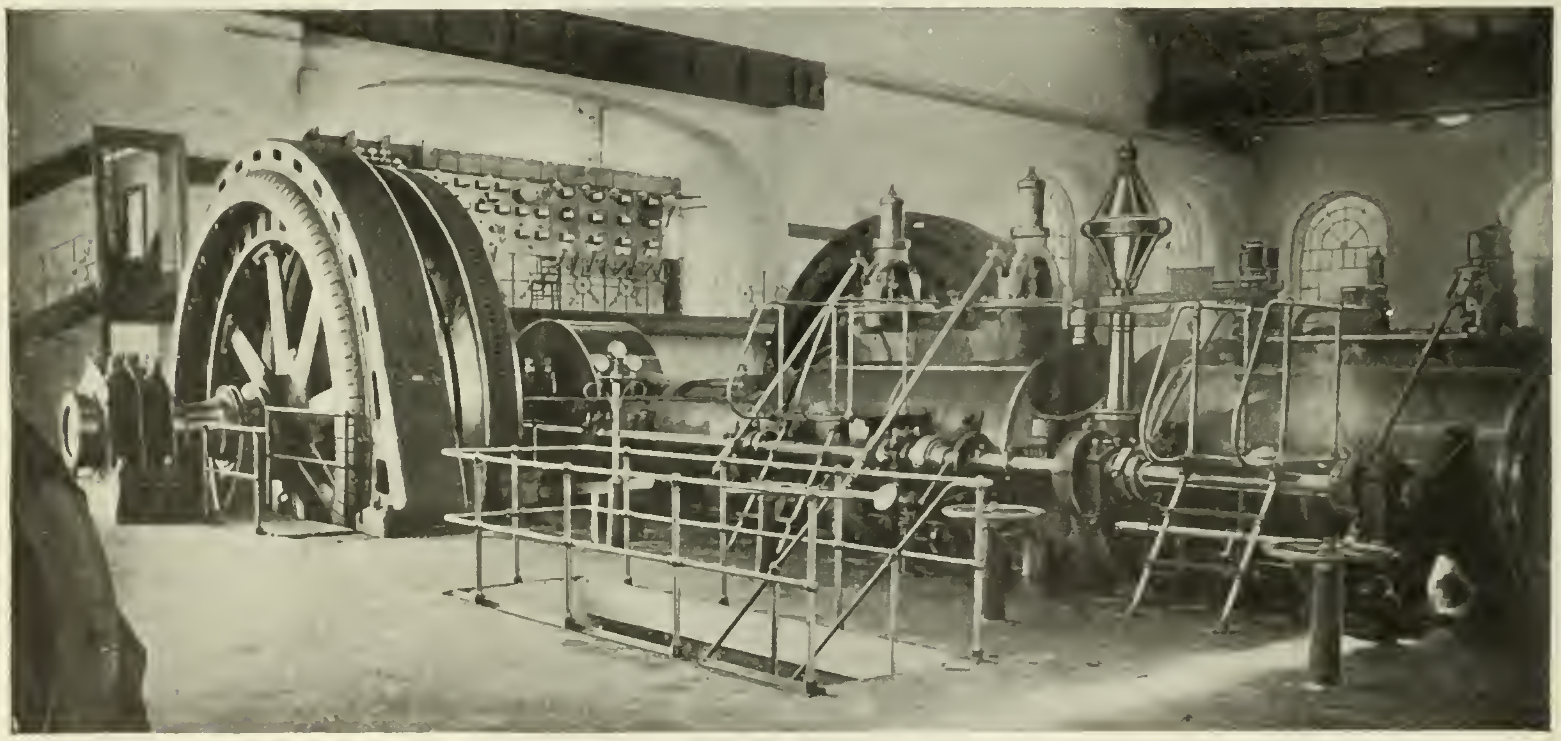


FIG. 4.—VIEW OF GENERATING STATION AT TORNAVENTO.

to 50,000 lire, against 22,900 lire for the last year of steam service for the same day. This represents four times the number of passengers, taking into account the decrease in fares.

The whole results prove incontestably that electric traction has been a very great success in connection with the working of this line. The whole electrical equipment was furnished by the Cie Francaise Thomson-Houston de la Mediterranée, the representative of the General Electric Company in Italy.

The Mechanical Cause of Gravity.

By Robert Stevenson, C. E.

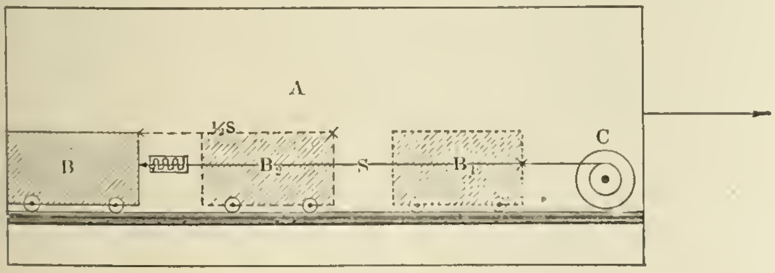
In an article on May 26, an experimental method of producing orbital motion without the mutual attraction of matter was given.

On June 2 a letter appeared from Mr. T. Wolcott saying that he had tried the experiment by means of a water nozzle held in his hands, and although the apparent motion of the water was helicoidal, yet he believed the actual motion was not so; and gave his reasons. On June 9, in reply to Mr. Wolcott, I explained that his experiment was entirely different from the one given by me, because he held the straight nozzle in a radial position, whereas in my experiment the water and balls were projected tangentially to the circle of rotation. Furthermore, the water in his case could not have a velocity of 100 ft. per second, because he could not rotate a nozzle by hand with water jetting through it at that velocity. And it should be constantly remembered that the stability produced by the momentum of the mass is the proximate cause of the novel effect.

I satisfied myself years ago that the effect could not be got from garden nozzles in the way he tried. But curious to say when I ask scientists to test this experiment, they invariably do as Mr. Wolcott did, and then make up their minds that the apparent effect is an optical illusion. I further mentioned in the letter of June 9 that I was prepared to prove that Galileo and Newton in formulating the first principles and laws of motion had neglected to recognize the all-important fact that lineal momentum produced kinetic stability, and that stability supplied the force which Newton called centripetal force, and which he ascribed to the mutual attraction of matter; that component force is the cause of the helicoidal motion of balls or planets; that force changes the direction without doing work. That is, the force which Sir Oliver Lodge has been trying to make out to be a mental force. And he is really nearer the truth than he imagines, because kinetic stability is produced by the combined effort of power and intelligence. But as we are only dealing with the physical effect here, it is unnecessary to trace the psychological interaction.

In proof of the statements made in the letter of June 9, I had a series of articles ready to be published, but as they dealt with first principles it has been thought that they would not interest technical readers so much as the practical application of them would do. Consequently, I propose to print them in pamphlet form, and will be pleased to send them gratis to any readers who will forward their address to the editors. In the meantime, I will devote this article to one phase of the practical application of the principles, so as to show by a kinetic illustration how motion can produce weight and energy without attraction.

Let us suppose a car, *A*, 25 ft. long and 10 ft. wide and 10 ft. high, with mass, *M* (but no weight), moving through free space in a straight line in accordance with Newton's first law of motion. (See Nat. Phil., § 244.) Inside of car *A* let there be another car, *B*, 3 ft. long, 2 ft. wide and 2 ft. high, whose mass is *m*, also having no weight. Let $M = n m$, where n is a very large number. At the front end of car *A* let a power hoist be fixed with a rope the full length of the car. At the rear end of car *A* let car *B* be at rest against the end partition, on a pair of rails which run all the length of car *A*. Then fix the rope to car *B*, and hoist it up towards the front end of car *A* with velocity v. A momentary impulse will supply all the force necessary to give it the uniform velocity, v, and momentum, $m v$. The amount of that impulse would be $m v/t = m a$. Now suppose we return car *B* to the rear again, and car *A* be given a uniform acceleration of 32 ft. per second. Now so long as this constant acceleration continues in the motion of car *A*, we can feel that car *B* is being pressed against the rear end of car *A* with the pressure $M g$, where $g = 32$.



MECHANICAL CAUSE OF GRAVITY.

Now that pressure is weight, exactly the same in quantity and quality as if *B* was on the surface of the earth. Now suppose a committee of philosophers were selected to investigate this pressure of *B* against the rear end of the car, and suppose there were no landmarks by which they could discover that *A* had acceleration. They having been born and brought up in the car. Let us call them Epicurus, Aristotle, Galileo, Newton, Boyle. Epicurus attempts to explain the cause of the pressure: First, he tugs at car *B*, and when he lets go it constantly falls back towards the partitions. After much experimenting and thinking, he gives his opinion that car *B* has a desire to rest against the partition, and that it takes a big effort to prevent it.

Aristotle said, Yes, there is an apparent desire, but the desire is due to everybody in the universe having a right place to which it belongs naturally, and it can only be prevented by an effort from getting there, and when once there it takes an effort to remove it, and when the effort stops it tends to go back to its right place. And, furthermore, he said that desire to get to its place increases with its density, and also with the shape of the body. That desire is its gravity.

For two thousand years that explanation of Aristotle was the orthodox doctrine of gravity, until Robert Boyle put the car, *B*, in a vacuum and kept reducing its density and found that it fell just as fast back to the partition when its substance was as light as down, as when it was gold; and that fact upset Aristotle's theory of gravity. But whilst Boyle was experimenting with his vacuum, Galileo was experimenting with the rate of fall. His idea was more scientific than philosophic. He wanted to find the law of the fall. He did not believe that the fall was due to desire; but whatever the cause might be was of very little consequence compared to the law of the fall; because the fall could not be utilized with certainty until the correct law of the motion and pressure was found.

The idea never seemed to enter Galileo's mind that the little car did not fall at all, but that it was the big car that was doing all the falling.

After Galileo came Newton, who accepted Galileo's laws of the fall of bodies, and never doubted but that the fall was genuine; and he also said that although it would be nice from a philosophic point of view to know why this car always tended to that partition, yet the law was of the greatest importance for mankind to know. He did not agree with Epicurus that it was by desire, but he thought a more appropriate term to use would be attraction. Then he demonstrated geometrically that the partition attracted the little car and the little car attracted the partition directly as the mass of the one multiplied into the mass of the other and inversely as the square of the distance between them, the formula being $g \frac{M m}{d^2}$, where g is the constant of gravitation, or as we have seen, the rate of acceleration of *A*. It might be asked what has M and m and d to do in the formula when the fall of the body depends entirely on g? But it must be remembered that although the rate of fall may be independent of the mass of a body, yet the force depends on the mass, $F = m g$; and although it is not m that is falling, yet it is the inertia of m which continually resists the constant impulse produced by the acceleration of car *A*; and the effect of that resistance is the pressure we call weight.

The car *B*, to begin with, had no weight, only mass, and now it has been converted into a weight, by a mode of motion; and that in spite of the orthodox theory, that weight could only be produced by the mutual attraction of the particles of matter in the partition and in the little car. There may be those who hope that I may be mistaken in my analysis, and that although it can be shown that weight is a mode of motion in this case, it may not apply to the case of bodies on the surface of the earth.

Now that the theory of attraction is shown to be untenable, let us investigate that most wonderful condition called energy. Energy has been adored as the greatest discovery made by science since Newton discovered the mutual attraction of matter, and with matter it is said to be the one eternal condition in the universe. Consciousness and force may come and go like a bank rate, but energy goes on forever. And there are many great philosophers and scientists who really believe that mankind can never know more of the Creator than what is shown in these two attributes of the cosmos. In the figure let A represent the large car, and B, B_1, B_2, represent the small car in different positions. Let C represent the hoist, and the arrow the direction of motion of A. Let us suppose the little car, B (which we will call the body) is resting against the rear end partition of car A; and car A is being accelerated uniformly at the rate of 32 ft. per second $= g$. Then car B, or body, would press against the partition with the weight, $m g$, exactly the same as it would do on the surface of the earth. Let a rigid but weightless rope connected with the hoist have a spring balance next the hook, which attaches it to the car B, or body; and when the hoist relieves the partition of the pressure of B, the spring will indicate the pressure, $m g$, the same as it would do if B was suspended by the balance at the earth's surface.

Now, if the hoist gives B uniform motion towards B_2 at the rate of 16 ft. per second, $= v$, the power required would be $m g v = P$. And in time, t, the work done would be $m g v t = P t = f s$, where $s =$ 16 ft. But when the power stops working at distance S, the body, B, will not stop at once, but by reason of the impetus, $m v$, will be carried a further distance, $h = v^2/2g$; at which height the body appears to come to rest relative to car A, but not relative to the fixed co-ordinates in space. When dealing with two sets of co-ordinates, great care must be taken in specifying which set is referred to. I find that it was due to that want of care on the part of Galileo and Newton that they were deceived into the belief that appearances were realities, and whilst thinking they were superimposing momenta they were only superimposing velocities, and consequently they failed to find the true physical result. So long as the power, P, is moving the weight, $m g$, with the uniform velocity, v, there is a definite amount of work being done, $= m g v t = m g s$, where t and s are time and distance, respectively. But when the power stops, then the impetus of the body carries it a further distance, $v^2/2g$, before it appears to stop, when the kinetic energy is said to be converted into potential energy. And the whole work, $W_1 = m g (s + h) = m g s + {}^1/_2\, m v^2 = {}^3/_2\, m v^2$.

If we take a case where B is projected forward from the partition by an impulse, with an initial velocity of 32 ft. per sec. $= v$, then in one second $= t$, the distance traveled by B is $v^2/2g$, $=$ 16 ft., the same distance as in the previous case that the power traveled in the same time with only half the initial velocity of this case; but in that case the velocity was uniform, whereas in this case there is a uniform retardation (apparently). Consequently, in this case the kinetic energy $= \frac{1}{2} m v^2$, the average velocity during this time being $\frac{1}{2} v$.

Now, when the body, B, comes to rest relative to the car A, all the kinetic energy of B has been said to be converted into potential energy, and then to appearances, B begins to fall of itself towards the partition at the rear end of A, with an accelerated velocity the same as bodies falling at the earth's surface. That is the phenomenon which is presented to the inhabitants of the car, who do not know that their car is being accelerated, and never dream that the apparent fall is due to that accelerated motion, but who believe with Galileo and Newton that the body actually falls, and that there must be some attractive influence in the rear end to produce that accelerated fall.

The formulæ in both cases are the same as that of falling bodies at the earth's surface, and in the pamphlet it will be proven that weight and energy are produced in the same way in both cases. The first law of motion will be subject only to the principle of *kinetic stability*, which is the only *new principle* to be established to take the place of attraction.

But in this change of principles we must not forget that kinetic stability produces an effect to all appearances the same as attraction, and consequently there will be little change in the integral resultants; although our ideas will change about the cause of a stone falling, yet that change in ideas will not alter the result. Whether it be the rate of fall, or the blow struck by the body when it reaches the earth, Galileo's and Newton's laws will still hold as before, only we will know the cause of those laws, which up till now had to be taken on faith. It is unnecessary to take up space analyzing the correlated motions of the two cars, as those readers who can follow the argument can do that for themselves, and so become convinced that B does not fall back, as it appears to do towards the rear end partition of car A. Consequently the mass of the partition cannot be the attracting cause of the apparent acceleration of B towards it.

The facts to be noted in this illustration are:

I. That the accelerated motion of car A induces weight on car B without attraction.

II. That to move that weight forward is like lifting a weight vertically upwards at the earth's surface, and it requires the same power.

III. To project B forward with an initial velocity requires power and work, and produces energy, the resultant being called the space integral of the force $= F S = {}^1/_2\, m v^2$.

IV. When the kinetic energy is transformed into potential energy, the true cause is the motion of A, not the attraction of its rear end, as taught at present.

V. The reversibility of the process is apparent, when we know that the velocity acquired by the car A in one second is equal to the initial velocity of B, when the two come to rest relative to each other in one second.

Suppose B be given an initial forward velocity, $v =$ 32 ft. per sec., it would continue uniformly at that speed, but owing to A having an accelerated velocity of 32 ft. per second, then at the end of the first second both are moving with the same velocity in the same line and direction, and consequently are at rest relative to each other. But at the end of the next second, A has acquired a velocity equal to $2v$, whereas B is still moving with velocity v; consequently, the rear partition of A strikes B with $2v-v = v$ velocity, but the philosophers in the car think it is B that strikes the partition in the same way as Galileo thought it was the projectile that fell to the earth.

What I intend to prove in the article which I propose to print and distribute in pamphlet form, is:

First. That Galileo, in studying the laws of falling bodies, made the mistake which many might make in supposing the little car, B, to be the falling body in the large car just shown. The appearances would be the same and the laws the same, but the causes are different. The scientist might say, "What does it matter whether the train goes to the stations or the stations come to the train; the time table is the important knowledge." But if old George Stephenson could have made mankind believe that the stations came to the train, as Galileo and Newton have made them believe that the stone falls to the ground, then who would ever have thought of improving the locomotives. And so throughout the whole range of the arts and sciences, new inventions and improvements have followed rapidly the true knowledge of causation.

Second. Galileo and Newton made a serious mistake in supposing that a cannon ball at rest in a moving car when rolled across the moving car was having the two motions or momenta compounded on the ball, whereas the motions so apparently superimposed are relative to different sets of co-ordinates and consequently it is not a case of compounded momenta at all. It is just as much an illusion as that of the falling body. To compound momenta on a moving ball, both components must be measured relative to the same fixed co-ordinates, and for such motion there is no law at present.

Third. Galileo and Newton, in laying the foundations of dynamical science, failed to notice that a mass which has inertia and acquired that inertia through certain kinds of motion to which it has been subjected, almost in a similar way to that by which an electric charge acquires inertia by self-induction, as Oliver Heaviside has so clearly shown.

Fourth. Having failed to grasp the true cause of inertia, they also failed to discover the persistence of lineal momentum, which without doubt is the most important principle in the universe, as it applies to both physical and mental forces. This persistence of momentum increases with the momentum, and it is this principle which produces the stress on a fixed guide, or connection, when a body with its own momentum describes a curve without loss of motion, and produces the stress apparently from nothing and disappearing when the body describes the tangential straight line again. That persistence increases with the momentum, although Galileo's law of inertia endorsed by Newton denies the existence of such a principle.

Fifth. Without a knowledge of the persistence of momentum it was impossible to grasp the hidden key to the treasures of nature. This key I have called kinetic stability. Kinetic stability is simply the tendency of displaced momenta to return to their place, as was taught by Aristotle two thousand years ago. But of course it has a meaning and purpose grander and more profound than even the wise old Stagyrite could appreciate; because it explains elasticity, gravity and all the other forces of nature whose causes are still ignorabimus to science. But the explanation, proof and application of this principle in its most rudimentary form will take up fifty pages of the pamphlet, and to that I must refer the reader.

Sixth. The parallelogram of forces when applied to free celestial motions is another fallacy, formulated and established by Galileo and Newton. But when applied to terrestrial mechanics is perfectly correct, when the components are compounded simultaneously, because then the problem is one of statics so far as the composition is concerned. The true resultant when two transverse component momenta are compounded relative to the same fixed co-ordinates, is a geodesic curve of least action, where $s \int v\,ds$ is a minimum. For the proof see the pamphlet.

Seventh. When a car is moving with uniform velocity, v, in a straight line in space, and a ball is at rest in the car, the ball having mass $= m$, and velocity v, the same as the car; its momentum $= mv$, relative to the co-ordinates by which the car's motion is measured. Now if that ball be given a velocity, v, backwards, and relative to the car, then its momentum relative to the car is $-mv$. Now Newton calls that compounding momenta in opposite directions, and he lays down the law, $mv - mv = 0$. (See Nat. Phil., § 252.) In this case we have two momenta which completely annihilate each other, masses and everything disappear, and nothing is left to show that they ever existed. However, when we more closely analyze the motions, we find there is no compounding of momenta, because the components were measured relative to different sets of co-ordinates. It is simply a case of two equal and opposite velocities equating each other, and the mass of the ball is left standing relative to the fixed co-ordinates in space. Had the ball been moving with the same speed, v, free and independent of the car, and it had been given an opposite velocity, v, without stopping its previous force, $mv/t = ma$. Then the power necessary to compound the two components would be mav, which is the true law, instead of that given as $mv - mv = 0$. The proof of this rule will be given in the pamphlet.

Having dealt with the laws of motion and shown that the Newtonian laws are only correct for terrestrial and apparent motions; that the most important motions in nature, celestial and molecular, are still without laws of a kinetic character, and have hitherto been only explained by the use of the mathematical metaphor which Newton called attraction, and the belief that bodies fall to the earth. We will then show how the true laws of motion explain the phenomena of the portions of the universe within our capacity to analyze and measure, thereby replacing the Newtonian system with one better suited to modern science, and more fruitful in its results, so far as the explanation of causes is concerned.

Rotary High-Frequency Interrupter.

By M. Eastham.

Interrupters for high-frequency coils may be divided into two classes—stationary and rotary. The stationary interrupter has in its favor simplicity and cheapness. The rotary type gives a much steadier spark and needs practically no attention. Anyone who has operated a coil with the ordinary spark-gap knows that it keeps a person busy most of the time regulating it. A slight variation in voltage, or change in the position of the arc between the discharge balls or plates, changes the length and nature of the secondary spark. The rotary interrupter requires less condenser capacity than is needed by the other, repolishing is very rarely needed, and, as stated above, it gives a very even secondary discharge. In Röntgen ray work, a steady spark is absolutely necessary for good fluoroscopic examinations, and is desirable in radiography.

Rotary interrupters are almost always run by a motor, the induction motor being the most practical. The interrupter described here is an induction motor in itself, the copper disc which makes and breaks the circuit acting also as the rotor to this motor, the stator being a V-shaped electromagnet, which requires about 35 watts to run it at a speed of 2,100 r.p.m.

The two figures show the positions and dimensions of most of the parts of this interrupter. *B, B* are the two coils, and *C* the core of the electromagnet, *D* being an angle of brass which holds it in place. *I* is the copper disc, or rotor, *N* the jewel bearing, and *E* the brass nut which holds it in place, and contains mercury to make contact with the shaft. *F* is a support for the top bearing *O*. To this brass support is fastened a piece of hard rubber, *H*, which holds the discharge ball, *M*. *R, R, R, R* are binding posts, two for the exciting current for the electromagnet, and two for the circuit to be interrupted. The latter two are connected to the mercury cup and the discharge ball, respectively.

The electromagnet is made up of laminæ of soft thin sheet iron, to a thickness of ⅞ in. Each leg of this magnet is wound with four layers of No. 26 B. & S. gauge copper wire, well insulated from the core. The two coils are connected in series. There should be ⅜ in. between coils to prevent sparking to the disc. The angle of brass is fastened to the core of the magnet with two small brass bolts, and to the wooden base with two screws. The copper disc is 5½ in. in diameter, and 1/32 in. thick. It is slotted around the edge as shown in the figure, there being 18 slots, ⅜ in. deep. A brass collar in the center serves to hold it to the shaft, which is 2 in. long and ⅛ in. in diameter. The jewel for the bearing is mounted in a screw, and the nut which holds it in place projects enough above it to hold a little mercury, to make a good contact with the shaft, and through that to the disc. It must be understood that this disc has no connection with the current which excites the electromagnet; the two must be well insulated from each other.

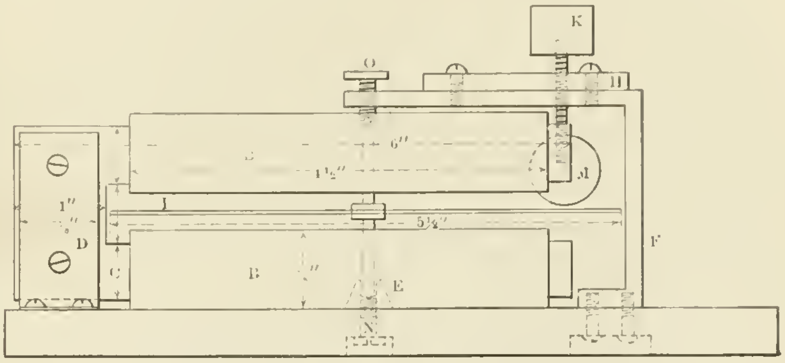


FIG. 1.—HIGH-FREQUENCY INTERRUPTER.

The support for the top bearing and discharge ball is made of brass, and fastened to the base with two screws. The top of the shaft is cut down for about ⅛ in. to a diameter of 1/32 in., and the screw, *O*, has a hole drilled in it which will receive the small end of the shaft, and allow it a little play. This screw should have a lock nut to prevent its coming loose. The discharge ball is ¾ in. in diameter, and bored and tapped part way through to receive the threaded brass rod which passes through the hard rubber support. This rod has an insulated handle to adjust the ball with; it should be of hard rubber and the ball should be of brass.

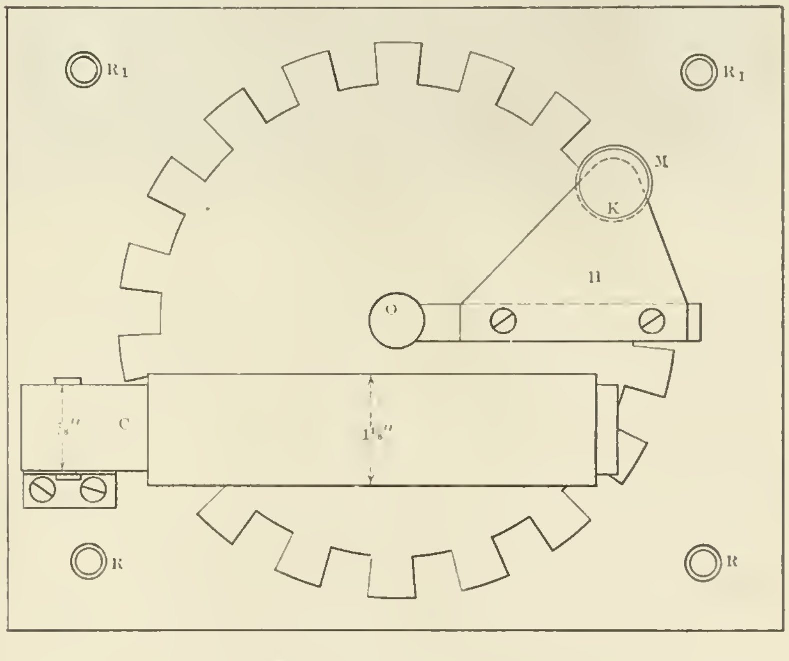


FIG. 2.—HIGH-FREQUENCY INTERRUPTER.

This motor is supposed to be run on 110 volts and 125 cycles. The voltage may be changed by changing the size and amount of wire, and for lower frequency more iron must be used. When this interrupter is used on Röntgen ray machines, it should be enclosed to prevent the light and noise from disturbing the operator.

An Electrically-Operated Coal Hoist.

By Richard Lamb, C. E., E. E.

At this period of electrical development it would seem that in municipalities where electric current can be procured at reasonable figures there should be more coal-handling plants using electricity for motive power than there are. One reason for the slow introduction of electricity in this line of business lies in the fact that the method of control which has heretofore been used is excessively expensive. A varying-voltage generator has been employed, made especially for the purpose of supplying the motor that is to do the hoisting. This same generator cannot be used for any other service while the hoist is in operation. In most coal-handling plants at least two motors are needed, one for hoisting the coal, the other for conveying it to various points for storing. It is, therefore, in such cases necessary to have two generators and two motors when varying voltage system is used.

We know of no coal-handling electrically-operated plant that does not use varying-voltage generators, with the exception of the one hereinafter described. Electrical equipments have, therefore, been very expensive as compared with steam.

It has been supposed that the torque required would be excessive in automatic coal digging bucket operation, that the power needed to draw together the jaws of the digger through the coal would be a dead pull from the start. The writer had arguments with engineers of electrical companies upon this subject, who feared that there would be an excessive resistance at the initial movement of the digger. He contended, however, that if the resistance of the coal was greater than the power necessary to elevate the bucket, the bucket would rise and not dig, which would be contrary to the facts as shown in the common use of these buckets. The weight of the bucket has much to do with its automatic loading. The initial resistance is not excessively great, and is not at its maximum immediately, but increases as the current is turned on. The service, therefore, admits of using the ordinary street car motor control.

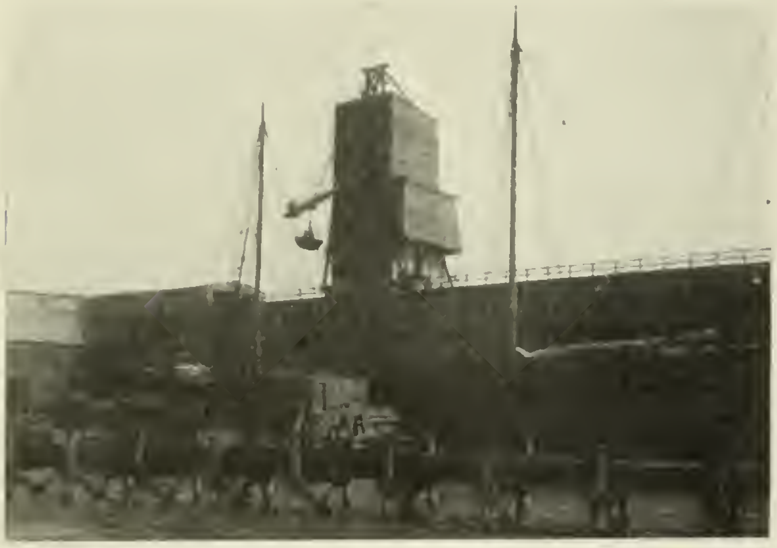


FIG. 1.—GENERAL VIEW OF COAL HOIST.

As the bucket is lowered by gravity, the motor service is intermittent. On this account voltage-regulating generators are practically of no greater efficiency than the constant-voltage. The steam power is constant in either case, and the regulation is very quickly made from no voltage to maximum and the duration of application is short, so that any advantage in an electrical hoist using a varying voltage generator, that might have existed in a case where there were comparatively long runs and varying speeds, becomes *nil*.

The problem of the writer in designing the coal-handling plant for Messrs. Rogers & Curran, of Hoboken, was to get the maximum storage capacity that could be secured in a structure to be built upon a pier already built. This pier is in L shape and had to be reinforced by an addition to the foundation of equal strength with the structure as was already built. The depth of the water is about 40 ft., and the width of the pier over all 30 ft. The height of the coal bin above water level is 40 ft. and the height of the moving tower 95 ft. Great care was in consequence necessary in providing for lateral strains upon the whole structure. The plant that was used before the present one was built had a storage capacity of about 1,700 tons, and the hoisting plant worked by steam. Two additional hoisting engines were used to discharge into barges, which acted as additional storage bins. The coal was rehandled from these boats into the bin, or was shipped about the harbor, as might be required.

The reciprocal motion of the hoisting engine in the tower weakened the structure excessively. There was considerable delay and annoyance in adjusting the steam pipes and moving the tower, when the tower had to be moved. A large loss of power was experienced by condensation of steam in the long line of steam pipe. In view of these facts and the fact that a reasonable contract could be made for electric power, the writer advised that the steam power plant be changed to electricity. The cylinders were removed from the hoisting engine and the countershaft extended, upon which an automatic break and an enclosed type 75-hp motor was attached. A controller and resistance boxes were used. The controller is operated by a foot control, especially designed for this plant by the writer. This feature overcame one of the difficulties to be met in electrically-operated coal hoists. The maximum horse-power used in elevating the bucket is 63 hp. The average is 50 hp. Closing the bucket requires 28 hp.

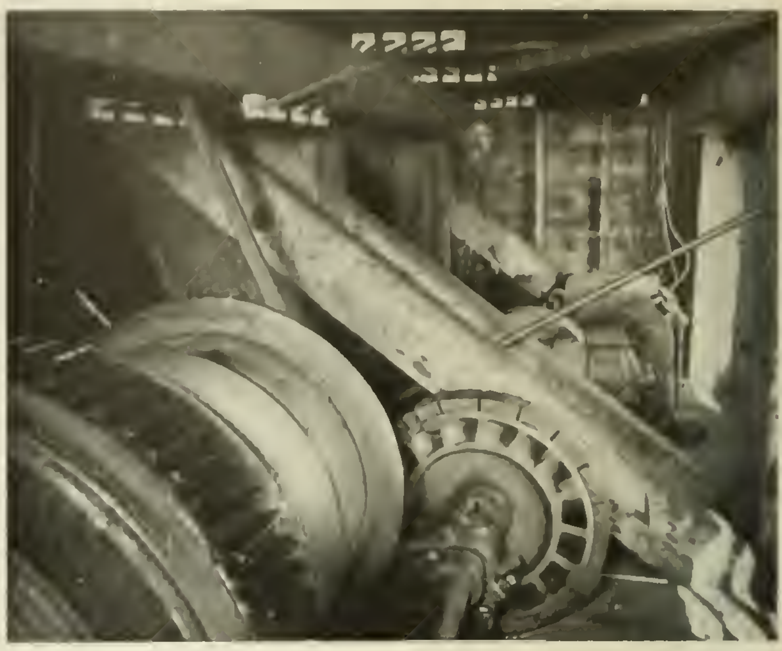


FIG. 2.—COAL HOIST.

A trolley pole connected with the tower conducts the current from the bare wire leads, situated on brackets on the upper part of the coal trestle. The same trolley furnishes current for both the tower traversing and the hoisting motors.

FIG. 3.—COAL HOIST.

The traversing motor is an enclosed type of 25 hp. This motor is geared so that when one friction clutch is engaged and another disengaged, the tower can be moved, and by reversing the operation the cableway that propels the distributing cars can be operated with the same motor. At no time would it be necessary to move the tower and run the cableway at the same time.

The tower weighs about 200,000 pounds, and is moved 15 ft. per minute, using about 5 hp. The motor is wired to reverse and drives a 30-in. diameter elliptical grooved sheave, about which is wrapped a ⅞-in. plowed steel cable, which is made taut and anchored at both ends, at the extremities of the coal bin. By the motor revolving the elliptically-grooved sheave, the cable is wound up and paid out, pulling along the tower. By reversing the motor the tower is moved in the opposite direction. This work is a great improvement over the old way of moving the tower.

The boom on which the bucket trolley works is first hoisted by the engine that operates the bucket, so as to clear the rigging of the coal vessel. The tower can then be instantly moved, so as to work in another hatch of the vessel.

The cableway consists of an endless cable, with a tension device at one end. It is propelled by an elliptical grooved sheave driven by the before-referred-to motor. The tracks have a right angle bend. The cars dump automatically, and are filled by the man who runs the motor. The power used is 6 hp.

In the varying-voltage generator plants the bucket is lowered by using a double-throw three-blade switch, which throws out the rheostat from the generator field circuit, and throws the current into the field circuit of the hoist motor. The armature leads of the hoist motor throw from the armature circuit of the generator to the rheostat. This is done to avoid the ordinary drum friction control. The objection to using rheostat resistance in place of frictional resistance is in the danger of the dropping of the circuit-breaker from any cause, or the temporary cessation of the current, which conditions are often met.

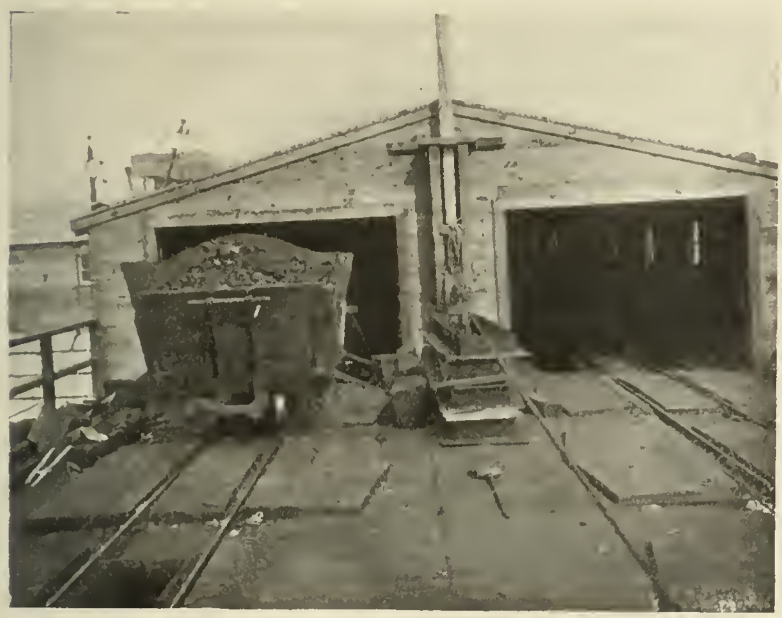


FIG. 4.—COAL HOIST.

In plants using overhanging booms or trackways, with automatic catch to hold the bucket as trolley runs into the tower, no device has heretofore been found that would prevent an occasional miss-catch, and the consequent pounding of the 5,200-pound bucket and load against the tower. To hold the trolley from coming in after such miss-catch, the writer put an endless cable attachment to the same, operated with elliptical grooved sheaves. To the sheave in the tower is attached a band break, operated by a foot lever by the hoistman. As soon as the bucket fails to clamp into the carriage or trolley, the foot lever is operated and the trolley is held in place and prevented from allowing the bucket to strike the tower. By an additional spring put upon the catch mechanism by the foreman of mechanics, Mr. Focht, the universal trouble of the dropping of the bucket has been entirely obviated. The confidence gained by the hoistman feeling secure from danger in the dropping of the bucket, enables him to operate the hoist more rapidly.

One man can unload 90 tons per hour, and one man distribute the same in the bins by the cableway cars. The storage capacity of the plant is 6,000 tons. The yachts and tugs can be loaded with maximum dispatch from four elevations, which are used respectively according to the heights of the boats out of the water. The loading cars have scales for weighing the coal, and also recording meters of the quantity weighed, which greatly facilitates dispatch in loading the boats.

Large Power Plant Projected on Grand River in Colorado.

The largest power plant built or that has any reasonable certainty of being built in the near future in Colorado is that of the Colorado Power & Irrigation Company, which is taking active steps to develop 25,000 hp on the Grand River, at Shoshone Falls, nine miles east of Glenwood Springs. This company was recently incorporated with a capital stock of $5,000,000, and its officers are prominent Colorado capitalists, miners and practical power men. The Grand River is the largest river in the State, and at the point of the proposed development the water will be drawn from a watershed 4,350 square miles in extent. The plan is a novel one for that country, as no large dams are to be built. The river in the vicinity of Shoshone and Glenwood Springs flows along a deep canon which is already occupied by the main line of the Denver & Rio Grande Railroad, so that no storage would be permitted at that point, which would interfere with the railroad. The scheme is to build a deflecting dam, probably not over 6 ft. high, just above the Shoshone Falls, and then carry the water in an open conduit 2,000 ft. long to a point where a 70-ft. head can be obtained. About 5,000 hp can be developed at this point and it is planned to build there the first plant.

By carrying the conduit 1½ miles farther about 12,000 hp additional can be developed with a head of 140 ft., or by continuing it for a total distance of 3.6 miles, at a point near the town of Grizzly, about 20,000 hp will be available, with a total head of 225 ft. It is probable that the first and third developments will be made, thus giving, in the two plants, a total of 25,000 hp. This power is figured for a flow of 1,000 cubic ft. of water per second, and the conduit will be constructed to carry that amount of water. The minimum flow of the river is about 800 cubic ft. per second, and with a system of small reservoirs near the headwaters of the Grand River and its tributaries, it is estimated that enough water can be easily stored to supply the full 1,000-second-ft. during the low water season. A feature that may be of some help to the plant is that some of the mines which will use the power developed shut down during the winter and thus will not be in operation during December, the month of lowest water. By building several small dams, none of them over 30 ft. in height, some of the small rivers can be backed up a distance of five to eight miles and in localities where no damage will be done by the impounded water. Sufficient storage will then be provided so that the reservoirs can be tapped one at a time and supply all the additional water that is required. By this method, also, the expense of a single dam 150 or 200 ft. high, which would be required at a point lower down the canon, is greatly lessened, and the element of risk from its failure is also considerably less than with several dams. It is likely that the conduit for carrying the water to the power houses below will be built in solid rock in the side of the canon, cement being used largely in its construction.

The upper power plant, where 5,000 hp is available, will be built first, and it is expected that this plant can be placed in operation within a year. Four 1,000-kw water wheel generating units will be installed and as the head, 70 ft., is comparatively low, horizontal turbine wheels will be used. Actual work has already begun on the construction of the conduit or flume leading to this plant.

At the main plant the generators will probably be installed in units of 2,000 kw. The De Remer water wheel will be used, its inventor, J. R. De Remer, being vice-president of the company and the one who made the original filing for the water power. In order to get the best results at this head of 225 ft. it is expected to have the generators designed specially for operation at the low speed of about 150 r.p.m. In this case three De Remer wheels, each about eight ft. in diameter, will be used for each generator, whereas if standard generators are used with a speed in the neighborhood of 350 r.p.m., as many as five or six four-foot wheels would be required for a generator, larger wheels being prohibited on account of peripheral speed limits.

The absence of a large dam and other favorable conditions will bring the initial cost per house-power for the Colorado Power & Irrigating Company's plants down to very low figures for mountain power plants. It is estimated that the first or auxiliary plant can be installed for $125 per horse-power. As much of the flume for the lower station would be completed by the construction of the first plant, the cost of the lower station will be proportionately less, and it is believed that it can be installed for $100 or $105 per horse power

The company is confident that it can profitably transmit power to Leadville, 60 miles distant, for about $100 per hp year, and has assurances that at this rate it can easily secure contracts for 10,000 hp About 1,500 hp could be similarly used at Red Cliff, a mining town between Leadville and Shoshone For lighting and power in several other small towns along the Denver & Rio Grande Railroad, and also along the probable route of the main pole line between Leadville and Glenwood Springs, it is estimated that 1,000 hp can be used At Glenwood 2,000 hp for manufacturing and lighting is figured on, and at Rifle, 50 miles west, the estimate is for 250 hp For irrigating pumps 1,000 hp is allowed, for electrochemical processes already projected, 1,500 hp, and for other definite purposes about 1,000 hp This makes a total of 18,250 hp, enough to warrant the installation of the power stations.

Three-phase current will be used for transmission and the initial transmission will probably be made at 40,000 volts, with delta connection, providing for changing over to Y connection for 60,000 volts if desired. A double pole line will be run to Leadville so as to provide against accident and to insure reliability of service.

The irrigating feature of the company's plans is also of interest. Just below Glenwood Springs and along the Grand River is 40,000 acres of arid but irrigible land, which, at present, is only developed to a very small extent The plan generally followed in Colorado of carrying water along in a high ditch from a point some distance above is impracticable in this case on account of the rough country through which the ditch would have to be carried, the expense not being warranted. With the electrical development, however, at Shoshone, electric pumps could be installed in this district and operated to lift water from the river to small storage reservoirs and the irrigating ditches proper As these pumps could be operated during periods of minimum load on the stations, and the water stored in the reservoirs, it will make a very desirable load on the stations and for that reason the power can be sold for about $50 to $60 per hp-year.

The incorporation papers of the Colorado Power & Irrigation Company include the right to build reservoirs, construct and operate telegraph and telephone lines and railways, acquire timber, mineral and agricultural lands and develop them, and also to do electrochemical work. The officers of the company include the following-named genalemen: President, Albert Sherwin, Leadville; vice-president, J. R. De Remer, Glenwood Springs, president De Remer Water Wheel Company; secretary, E. E. Lucas, Glenwood Springs, secretary and treasurer Colorado Hotel Company; treasurer, C. C. Parks, Glenwood Springs; general manager, L. W. Beard, Denver; chief engineer, F. H. Whiting, Denver; directors, C. C. Hendrie, Denver, and J. C. Beard, Decorah, Iowa. Judge J. Warner Mills, of Denver, is counsel for the company. The business headquarters of the company will be in Denver, with a branch office in Glenwood Springs.

Power Cable Conduits at Niagara.

The Niagara Falls Power Company is making a very important change in the method of running its cables between power house No. 1 and the transformer house. It will be remembered that power house No. 1 and the transformer station are on opposite sides of the inlet canal, the two being connected by a stone bridge over the canal. This bridge was erected for carrying the cables over the canal, and the practice has been to string them through the interior of the structure, but now a new conduit has been built immediately under the bridge.

On January 29 last, it will be remembered, lightning started a fire in the basement of the transformer station, and the flames were carried over the bridge, destroying the cable installation and temporarily putting power house No. 1 out of business. Following this fire, the company built a cable conduit, 805 ft. long and having 24 ducts, from the south end of power house No. 1 around the west side of the Forbes subway, and through 20 of the ducts cables of 1,000,000 circular mils were laid. This relieved the bridge over the canal of some of its cables, and now the new conduit will entirely do away with the service of the bridge, which is being torn down.

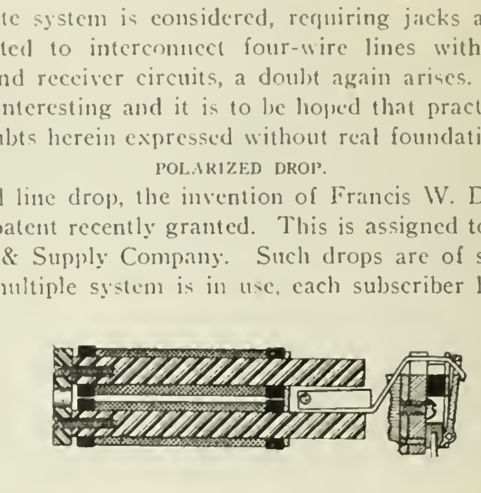
This new cable conduit has 60 ducts, the openings in which are 3¼ inches. The ducts are laid in groups of twelve, and a feature of their construction is that no concrete is placed around them except sufficient to hold them in place. This style of construction was adopted in order that the ventilation might be as free as possible, the difficulty being to get rid of the heat where such an amount of power is carried as passes through this conduit, for all of the load that is transformed, as well as some that is delivered direct, passes over the cables in the conduit To facilitate ventilation further, ventilators have been placed in a walk that is laid over and a little above the conduit. With this change, all of the current from power house No. 1 and also that from power house No 2 passes through underground conduits, giving much greater security and removing the danger of a repetition of such a disaster as that of last January

New Telephone Patents.

In the issue of July 14 brief comment was made, under the title "Local Repeater," upon a device designed to so hold together the transmitters and receivers of two adjacent but disconnected systems that these may act as a repeater and permit of intercommunication between the stations of the two systems. Repeater circuits have always been a source of considerable worry and our comments contemplated that this new device would suffer from the disabilities of all preceding repeating schemes. Mr. J. R. Trowland, the inventor of the local repeater, holds a different view and brings forward a wiring scheme in which undoubtedly the worst difficulty, that of singing, is overcome. This is accomplished, however, by the use of a four-wire, or possible three-wire scheme of wiring for the subscribers' lines of one of the systems. This four-wire line scheme will, of course, be confined to the private or smaller system in which the lines are very short. The expense due to the additional wires considered alone would not, therefore, be prohibitive. When, however, a switchboard for the private system is considered, requiring jacks and other apparatus adapted to interconnect four-wire lines with independent transmitter and receiver circuits, a doubt again arises. All repeater schemes are interesting and it is to be hoped that practical trial will prove the doubts herein expressed without real foundation.

POLARIZED DROP.

A polarized line drop, the invention of Francis W. Dunbar, is the subject of a patent recently granted. This is assigned to the Kellogg Switchboard & Supply Company. Such drops are of service where the divided multiple system is in use, each subscriber having power to signal any one of several parts of the switchboard. Mr. Dunbar's invention relates to details of construction, a side and a sectional view of a drop being shown in the accompanying figure. The drop has a multiple core supported from the shutter plate by formed brass clamping plates. The armature oscillates between the front end of the core legs, the magnetic system being polarized by a bar magnet paralleling the cores and shown in the side view.



DUNBAR POLARIZED LINE DROP.

LINE-TAPPING POLE.

A few months since a patent of German origin was noted herein which described a telescoping rod adapted to be extended and hook over a line wire that this latter may be temporarily extended within convenient reach. A similar apparatus, without the telescoping features but with a superior contacting device, has been patented by Messrs. J. P. Werner and W. H. Silvey. This contacting device is somewhat similar in appearance to the old style leaf spring snap hook used in harness. The leaf spring is, however, lengthened out so that while a wire may be pulled between the spring and the hook, it cannot leave this position and enter the hook. Thus a tight spring contact is maintained between the wire and hook and yet no great stress is put upon either when the connection is being made or broken.

Recent Electrochemical Developments.

MERCURY CATHODE.

A patent was granted on July 14 to Mr. Leo Gurwitsch, of Kiew, Russia, for a form of mercury cathode (for use in electrolysis of alkaline chlorides, etc.), requiring relatively small amounts of mercury. If a thin jet of mercury flows from an aperture of about 1-64 inch in diameter against a vertical iron plate placed in water, the mercury will spread upon the plate to form a streak of about ½ inch in width. If the iron plate is provided with minute grooves or flutes arranged continuously, the thin jet of mercury will spread out to form a streak of about one inch in width. Thus it is feasible to coat iron plates with very thin and uniform layers of mercury, and to employ them as cathodes without the necessity of setting large quantities of mercury in circulation. The mercury jets, flowing from apertures of about one-third of a millimeter in diameter, are arranged about one inch apart. The lower edges of the plates are bent round and form channels wherein the mercury flowing off is caught up. The inventor proposes to use these plates as bipolar electrodes, only the first and the last plate being connected to the source of current. If the anion should attack the iron, the anodic side of each plate (which is not grooved) is to be protected by an inert, conducting coating or by fixing carbon or lead plates on it.

DIAPHRAGM PROCESS FOR ELECTROLYSIS OF ALKALI CHLORIDES.

The difficulties experienced in the electrolysis of sodium chloride for the purpose of producing caustic soda and chlorine, are mainly due to the fact that, when the products of electrolysis—the caustic soda and chlorine gas—are allowed to come into contact, they form sodium hypochlorite and hypochlorous acid; this reduces the efficiency greatly. This fact has naturally led to the employment of a porous diaphragm for separating the anodic department from the cathodic department of the cell. If simple porous diaphragms are unconditionally used, the passing of the products of electrolysis from one department into the other cannot be completely overcome. It has therefore been proposed to use two diaphragms and to supply to the middle department—intermediate between the anodic and cathodic parts of the cell—sodium chloride under pressure. This would evidently prevent the caustic soda and chlorine from reacting with each other, but this arrangement has the drawbacks of difficulty in procuring low resistance diaphragms which stand the strong pressure, and an accumulation of sodium chloride in the caustic soda department.

A patent was granted on July 21 to Mr. Charles Fournier, of Geneva, Switzerland, for a modification of this scheme, based essentially on the fact that caustic soda is considerably more soluble than chlorine in a solution of sodium chloride. The inventor, therefore, does not exert an extra pressure from the middle department onto the anode department. On the other hand, the sodium chloride is supplied with pressure from the middle department to the cathode department. The latter, however, is arranged in various cells, through which the cathode liquid flows in succession, so that the caustic soda content increases successively from cell to cell; for this reason the pressure with which the sodium chloride is pressed from the middle compartment into each cathode cell varies from cell to cell, and the thickness of the porous walls between the different cathode cells and the middle department is also varied.

The inventor describes the construction of a cylindrical apparatus in which the porous diaphragm is made up of asbestos disks superimposed upon each other. Each disk has a central perforation, and these central perforations of all the disks assembled together form the anode compartment; each disk has also a number of perforations between these central perforations and the periphery, and a number of perforations adjacent to the periphery. The intermediate perforations form the intermediate compartment of the apparatus and the outer ones the cathode compartment. To divide the whole cathode compartment into various cells for the purpose above stated, slate disks are interposed.

PROCESS OF PRESERVING BEER.

A patent was granted on July 21 to Mr. F. Crotte, of New York City, for a method of conveying very small quantities of an antiseptic substance, like boric acid, into a cask of beer. This is done by what the inventor considers "cataphoric" action. The antiseptic substance is contained in a silver plated copper tube, which is placed into the cask so that its lower end nearly reaches the bottom of the cask. At the lower part of the cask, and at a point opposite to the end of the tube, a copper knob is pressed against the cask together with sponge. The copper tube and the copper knob are connected to a source of high-tension current for five to ten minutes.

Profit Sharing for Telephone Employees.

Mr. Frederick S. Dickson, the president of the Cuyahoga Telephone Company, of Cleveland, O., has just issued to the employees of the company a profit sharing circular. The subjoined is the pith of the text and programme:

I am not quite satisfied with your work. I do not think it is very bad, but I am sure it is not as good as it could be, and, therefore, it is not as good as it ought to be. You are doing pretty well, but you are not doing your very best. You know this business was started so that it might earn money for those who invested money in it. Now, money can be made out of this business if good service is rendered to our customers, but the character of our service will depend upon the character of your work. If your work is good, the service will be good. If you are patient, polite, prompt and skillful, you can give very good service with second-rate equipment, but if you are petulant, rude, dilatory and careless, the service will be poor, even if we have the best equipment in the world.

I am not talking to the operators alone, but to every man and woman, boy and girl in the company. Politeness, promptness, patience and skill are just as necessary for the office boy, the collector and the lineman as they are for the operator. There is no excuse for impatience in any official, high or low, who tries to serve the public.

Now, I want all of you to feel that each of you have a real interest in the success of this company. Remember, if we have careless employees, it will reduce our profits. If we have any employees who shirk their full duty, it will reduce our profits. If calls are not answered promptly, our subscribers will leave us and there will be no profits. If our solicitors are not active, we cannot increase our business. If our collectors are negligent, or show want of tact, we will not get paid even for the service we have rendered. Whether we make good profits, or none at all, will depend upon the way your work is done, therefore, I feel that if you honestly help us to earn money, you should honestly share in the money earned, just as you have shared in the labor.

Beginning on July 1st, after paying all expenses, taxes and the interest on our bonds, we will set aside one-fifth of the surplus remaining, and, during January next, we will distribute this among all of you who are in the employ of the company on December 31st, 1903, in proportion to the salary of each. Any one who leaves our employ before December 31st, will have no share in this fund. Any one going on a strike shall forfeit his share. Any one who comes with us at a later date will only receive his fair proportion. In other words, the distribution will be based upon the total amount of salary paid between July 1st, 1903, and January 1st, 1904. Now, what can you do for yourselves and for us on such a basis? If you do not earn a surplus for the company of $5,000 a month during the rest of this year, I will be both disappointed and surprised. If the surplus averages $5,000 a month, it would make a total of $30,000 for the half year. One-fifth of this would be $6,000. In June, 1903, we paid out a total of $11,739.52 in salaries. Distributing such a sum on such a basis would give every one of you an interest in the profits equal to more than half a months' salary.

Remember, the easiest way to make money is not to spend it. Do you realize that all of you are spending money for us? If you injure any part of our apparatus, you have spent the money it costs to repair it. If you cut wire to waste, you have spent the difference in value between good copper wire and junk. If you use a good sheet of paper to figure on, where the back of an old envelope would serve as well, you have added to the cost of operating this plant.

Electricity in St. Peters.

Recalling the opposition once made to the introduction of electric light into St. Peter's and the Vatican, the following pathetic little passage in a cable dispatch from Rome of July 25 says: "It having been remarked that persons passing the Pope's body were hardly able to see the features, especially as they were not allowed to pause, the authorities of the Vatican added this morning to the flickering candles a line of electric globes, fixed over the gates of the Chapel of the Holy Sacrament, the rays falling directly on the face of the late Pope."

Electrical Development in Madagascar.

The growing importance of electricity in new colonies has begun to arouse attention in Madagascar, where the orography and hydrography of the island lend themselves peculiarly well to the applications of water power. Since the French have created roads intersecting the country and have also a railway from the coast to the interior in course of construction, it has been remarked how great a number of waterfalls, especially along the line of railway, are to be met with, all of which are of more than 200 hp.

The River Mandrake, for example, which in a series of waterfalls, has a fall of more than 1,800 ft. over a length of only six miles, although of somewhat feeble volume, lends itself admirably to electrical installations, and being alongside of the great Eastern road it would greatly contribute to the economic development of the country served by that road. The rivers flowing down the western slope of the island afford the same advantages. The central plateau of the island is 4,000 ft. above the sea level, and Madagascar is exceedingly mountainous and exceptionally well watered. In the interior there are many remarkable waterfalls, the names of which it is not necessary to mention in detail, except to quote the two examples of Ramainandro and Kitsamby, each of which has a direct vertical fall of 65 ft., and which, even in the driest weather, would furnish 1,000 hp.

With these general remarks as to the recent awakening of the colony to the mechanical forces lying to hand and only waiting to be utilized it is gratifying to be able to state that General Gallieni, the Governor-General of the island, has made the innovation of lighting the Government buildings at Antananarivo by electricity.

The plant which weighs about 30 tons arrived from France in December last, and was furnished by Messrs. Sautter-Harle, of Paris. In the machine room are mounted two generating groups of 8,000 to 9,000 watts, working under 120 volts pressure. Each group consists of a petroleum motor coupled directly with a direct-current dynamo, the whole mounted on a cast-iron base bolted to a strong bed of masonry. The machines make 600 r.p.m. The engines work with petroleum used in ordinary lamps of 0.8 specific gravity. There is also a set of Tudor accumulators.

On the 1st of January, 1903, the buildings of the Governor-General were lighted by the new apparatus for the first time, but only the lower stories. The incandescent lamps of the galleries and dining room are of 10 and 16 cp., those of the drawing room 5 cp., but the effect of the latter was novel and pleasing in the centre of the rows of 185 sunken panels which form the ceiling of the vast saloon, and which might have been originally prepared expressly for this effect.

Naturally, insignificant as this may appear in the light of the enormous progress made elsewhere in electric engineering, still for a country which has been for a century so very backward, this first effort does great credit to the French and deserves to be chronicled in the annals of electric progress. Madagascar is now commencing to have a well organized telephone service, especially at Tamatave, and a few long-distance lines, particularly between Tamatave and the capital are at work. By telegraph lines the country will soon be connected in every part, the French having spent $179,640 last year on the Postal and Telegraph Department alone, so that taking all things into consideration, Madagascar may at length be said to have made a start in electricity.

Cabling the News of the Pope's Death.

As was noted in these pages last week, the illness and death of Pope Leo XIII have created an immense amount of cable and telegraphic traffic. Mr. Melville P. Stone, general manager of the Associated Press, says on the subject: "The telegraphic service from Rome was the result of arrangements effected last year. Upon the suggestion of Ambassador Cambon, M. Delcassé, the French Minister of Foreign Affairs, took a lively interest in the work of expediting the Associated Press service. He not only enlisted his colleague, the Minister of Posts and Telegraphs of France, in the work, but instructed M. Barrere, the French Ambassador to Italy, to use his good offices with the Italian Government. Signor Galimberti, the Italian Minister of Communications, joined heartily in the effort.

"As a result, messages which formerly took from five to six hours from Rome to New York are now transmitted in much less than an hour. A number of the bulletins upon the Pope's condition were transmitted from the Vatican, which is over two miles from the central telegraph office in Rome, to New York in twelve, fourteen and sixteen minutes.

"This involved transmission by telephone from the Vatican to the Associated Press office adjoining the central telegraph bureau in Rome, despatch by telegraph to Paris, relay to Brest, and cabling by the French Cable Company to New York, and finally retransmission by short wire from the New York office of the French Cable Company to the main office of the Associated Press in the Western Union Building, 195 Broadway.

"One bulletin thus transmitted occupied precisely nine minutes from the Vatican. When the condition of the Holy Father became critical, competent men were ordered to Rome from London, Paris and Vienna to assist the local Italian bureau. Notwithstanding the formalities which must be observed, they were able to put themselves in touch with the authorities at the Vatican in such fashion as to enable them to present a graphic picture at all times, including the most minute detail, and the information was forwarded with amazing celerity.

"It is interesting to note that it frequently took less time to transmit a bulletin from the Vatican than to send one by wireless telegraphy from Sir Thomas Lipton's *Erin* off Sandy Hook. Finally, the bulletin announcing the Pope's death was received in New York in time to transmit it to London and deliver it to the papers of the British capital in advance of the receipt of a like bulletin direct from Rome."

Mr. Stone said he had cabled his appreciation of the service to the French and Italian Ministers of Foreign Affairs, as well as to the postal authorities and chief director of the French Cable Company.

Possibilities of Hertzian Waves.

A special dispatch from Paris states that Dr. Le Bon has reported a curious accidental discovery. He was experimenting with Hertzian rays in his laboratory when he was suddenly surrounded by what he describes as a rain of fire from all the metallic objects in the room. He bases upon this a speculation that it would be possible to construct large metal mirrors, capable of reflecting for several miles the Hertzian rays, which, while remaining invisible, would ignite any explosive substance encountered, such as shells and gunpowder in magazines and aboard war vessels and cartridges in soldiers' belts.

Telephone Tax Values in New York State.

A charge or, perhaps more strictly speaking, an inuendo, is given publicity by the *Brooklyn Eagle* in regard to telephone tax valuations in New York State; and it is even asserted in that journal that the subject demands the attention of Governor Odell, a special attack being made on Tax Commissioner Stearns, of Dunkirk. A large amount of argumentation as to tax value is given in the article, and it is claimed that because of long-distance connections the Bell franchises are more valuable than the independent, anyhow. The most concrete and practical part of the article is as follows:

"In Ithaca there are now 1,000 Bell telephones in use and 700 independents. The difference in 1902 was greater, for there has been some growth of the latter during the year, ending June 30, 1903. The valuation placed by the State board was, Bell $4,600, and the independent $4,000. The number of telephones in use is indicative of franchise value at least, and if made the basis of valuation would show that if the Bell valuation is just, that of the independent should be $3,220 instead of $4,000; or if the independent valuation is just, the Bell valuation should be $5,715, instead of $4,600. In New York City there is no opposition to the Bell company—nothing in competition, and there is no basis for a comparison of the valuation. Commissioner Stearns has been set forth as formerly and for a period of time subsequent to his assumption of his office, counsel for Bell interests. It is notable, too, that the most marked instances of excessive valuation of the independent companies occurs in the western portion of the State, whence he comes. It is a notable fact that in Dunkirk, the city of his residence, the valuation placed on the Bell company is $3,400, and that on the independent is $8,000; that the number of Bell telephones in use is 430; of the independent 330, and that the independent is of comparatively recent establishment.

That if the basis of visible property is used for valuation then, if the Bell valuation is the proper one, the independent should be $2,600 instead of $8,000, and that if the independent is proper the Bell valuation should be $10,000 instead of $3,400. It is still more notable that in that now celebrated building in Dunkirk, known as the Stearns building owned by Tax Commissioner Stearns and Supreme Court Justice Hooker, the building of which was undertaken only after the leases for the occupancy of spaces in it were taken by the United States Government through the now indicted Beavers, the Western Union Telegraph Company and the Bell Telephone Company has space, and that on the same floor with and adjoining the law offices of Tax Commissioner Stearns."

In another part of the article the subjoined table is given:

Location.	Valuation on Bell companies.	Valuation on Indep'd't comp'n's.
Cobleskill	$1,500	$2,050
Johnstown	5,000	7,500
Gloversville	9,500	18,500
Auburn	15,000	16,100
Watertown	9,900	15,000
Cortland	4,170	20,000
Elmira	14,500	15,000
Dunkirk	3,400	8,000
Mayville	2,000	2,500
Lockport	4,000	12,000
Niagara Falls	26,000	45,000

Underground Wires in Lower New York.

It is stated that the municipal authorities of New York City have determined to build, in conjunction with the Broadway section of the electric underground railroad extension to Brooklyn, a gallery for the carrying of the water mains, gas mains and other pipes and wires which are laid, without any attempt at proper system, below the surface of the streets in the lower part of the city. The pipe gallery will be built in accordance with suggestions made by Dr. James C. Bayles, the well-known engineer who was employed by Borough President Cantor, and who has made a study of the problem of laying underground wires and pipes. The plans for the gallery have been approved by Chief Engineer Parsons, of the Rapid Transit Commission and by Mayor Low, and by August Belmont, president of the Interborough Rapid Transit Company. The expenditure for the gallery will have to be approved by the Aldermen, but the members of the Finance Committee of the board have promised that the committee will report favorably on the subject.

The construction of a gallery of this kind will obviate, in future, the incessant and expensive tearing up of the streets to repair mains and wires. The wires for carrying power and for lighting will be separated from those used for telephones. All the surface of the street will be restored to public use, unbroken by manholes. The structural features of the pipe gallery conform to those of the railroad tunnel. The electric conductors are to be carried in vitrified ducts built into the concrete. Dr. Bayles says that the advantages of pipe galleries are to reduce danger to life and health from gas leakage, because such leaks can be readily located; for the same reason underground water waste will be entirely avoided and there will be no obstruction to traffic by the tearing up of streets.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPH CONFERENCE.—In accordance with the announcements already made, an international wireless telegraph conference will be held at Berlin next week, August 4, to consider the various commercial aspects of the new art. Representatives from all of the leading nations will attend the convention, the idea of which was originated by Emperor William. The idea is to formulate such regulations regarding wireless telegraphy as may be thought to be in the best interests of the nations of the world. The general conditions under which wireless systems can be operated in the different countries will be discussed.

TELEGRAPHERS' UNION.—The Commercial Telegraphers' Union of America, which is now holding in New York its first annual convention, has adopted a resolution, in the preamble of which it is stated that the Western Union Telegraph Company had dismissed many efficient telegraphers throughout the United States because of their affiliation with the union, and endeavored to destroy and disrupt the union. The resolution is as follows: "All fair-minded Americans, workingmen, employers and manufacturers are hereby notified of the action of the Western Union Telegraph Company and its officers, and the public is most urgently requested to rebuke the said company in the strongest way possible."

H. BARRINGER COX IN THE WEST.—The *New York Herald* of last Sunday contains a half-column dispatch from Indianapolis, setting forth that H. Barringer Cox "has discovered a method by which heat may be transformed directly into electricity by means of a simple apparatus which he has completed after years of toil." In an interview, Mr. Cox says: "Some people always brand any apparently extraordinary invention as a fake until they see it in every home. Edison, with his phonograph and his electric lights, Bell with his telephone, Morse with his telegraph, all had to pass the suspicious scrutiny of a doubting public. I have talked to Tesla and Edison about my work trying to invent the little machine you see before you. Edison said, 'Stick it out. Hang to it, Cox. You'll win in the end.'" Continuing, he says that he has hung to it, though at times so poor that he did not have enough to eat and had to leave his investigations to go to work writing on scientific subjects for newspapers. He said that the idea of the apparatus was suggested to him while playing a violin. The only information given as to the apparatus is as follows: "It is only a hollow cylinder of vitrified cement of my own composition, made in a casting in one piece. The deflectors in the centre are as simple as the cast." This description, in a measure, fits the thermopile exploited some years ago by Mr. Cox in the East and in England.

BURNETT LUMINOMETER.—That illumination and not intensity of source is the quantity to be measured in determining the efficiency of light, is becoming more and more to be recognized. Several forms of apparatus for measuring illumination as distinguished from intensity of the source of light have been devised, the most recent of which is described in a patent issued July 15, to Douglass Burnett. In this arrangement the standard lamp is placed in a horizontal tube, all of the sides of which are opaque, except one of the ends, which latter is covered by a photometer screen. At right angles to this screen and extending beyond the box is another photometer screen, which receives the general illumination of the space to be measured. These two screens are viewed simultaneously through a tube at an angle of 45 degrees to the horizontal tube, and therefore at an angle of 135 degrees with each of the screens, an opaque partition extending into the inclined tube from the angle of the two screens. When one looks into the eye tube he sees simultaneously the two photometer screens, and by moving the standard of light in one direction or other in the horizontal tube until the two screens have the same illumination, the value of this illumination may then be read off from a scale, the reading being indicated by a pointer attached to the standard of light and extending through the horizontal tube.

RUDOLPH M. HUNTER IN A NEW ROLE.—The place of honor in the sensational section of the *New York Herald* of last Sunday is given to an article which presents the claim of Rudolph M. Hunter, of Philadelphia, that he has solved the problem of the alchemists, and will soon begin the manufacture of gold on a large scale, with a "yearly profit on the plant" of 57,000 per cent. Two views of Mr. Hunter are included, and one of a massive machine, towering many feet above a workman, who appears to be polishing a moving belt with a smoothing iron. "To forestall the inevitable smile of incredulity and insure a serious hearing," the writer of the article introduces Mr. Hunter as "the original inventor and patentee of the alternating-transforming system of electrical transmission, trolley, conduit and electrical accumulator systems of electric railways, the series multiple controller, electric brakes, electric car heating, etc." In an interview Mr. Hunter says Prof. E. J. Houston has made the statement, "Gold can be made if the split atoms of electrons can be separated and re-collected," and then adds, "I have made and am making it by this breaking asunder of the atoms of electrons." At the conclusion of the interview, Mr. Hunter says that for some time he debated if he should merely convert the gold privately for himself, but finally concluded $500,000 capital is necessary. In a tabulation of figures he then shows a net profit of $16,159,500 on this investment, and adds, "I stake my scientific reputation upon the correctness of these figures."

CAUSE OF GRAVITATION.—We are requested by Mr. Robert Stevenson to say that he will be glad to send to any of our readers who may apply by letter through this office, a copy of a pamphlet, when printed, in which he will develop at length his views on the cause of gravitation.

TELEGRAPH RATES AND CODES.—A cable dispatch from London of July 17 says: "The International Telegraph Conference, which met recently in London, has arranged for considerable reductions in rates and has decided that any pronounceable combination of ten letters will be accepted as a word in code messages.

KOREAN TELEGRAPH POLES.—A cable dispatch from Europe of July 24 has the following: The Tokio correspondent of the *Times* says that M. Pavloff, the Russian Minister to Korea, declares that the removal of the Russian telegraph poles by the Korean authorities was illegal and demands compensation. He says that if this is refused the money will be deducted from the royalty paid by the lumber company. M. Pavloff further announces that he has instructed the company to re-erect the poles. The Korean Government has issued an order for the removal of the poles if erected.

A NEW ILLUMINANT.—According to a consular report from Munich, a Bavarian chemist, Hermann Blau, has perfected a process for the manufacture of a new illuminant. It is stated that the methane and hydrogen are separated from the other constituents of oil gas and liquefied in steel receivers under a pressure of 40 atmospheres. It is said that the light from the gas is of a quality that renders it preferable even to electric light, and by proper mixture any desired quality of illumination may be obtained. The cost per 100 heat units is stated to be 1.13 cents, with round burners, as compared with 1.06 cents for coal gas and 2.14 cents for acetylene.

POSTAL TELEGRAPH EXTENSION IN THE WEST.—The Postal Telegraph Company has entered into an arrangement with the Union Pacific Railroad Company to construct a telegraph system along the right of way of the Union Pacific from Omaha to Ogden, from Denver to Cheyenne, from Ogden to Butte, and along the line of the Oregon Short Line. Poles will be placed in position and wires strung at an early date at Butte, Omaha Denver and Ogden and a division station of the postal system, it is announced, will be established at Denver. This will be the first time the Western Union system has encountered strong competition in the Western States. It is stated that the contract between the Western Union and the Union Pacific Railway provides that no other telegraph line shall be permitted along the right of way of the railroad. The Western Union Company, it is said, has given the Union Pacific notice that the latter will be held to the letter of the contract.

STORAGE BATTERY INDUSTRIAL LOCOMOTIVES.—At the recent Niagara meeting of the Institute, Mr. Edgar H. Berry brought out a distinction that should be made when a storage battery is discharged at a high rate—namely, that it is not completely discharged at the end of the number of hours corresponding to such a rate, but can still discharge for a further period at a lower rate. Consequently, when efficiency is considered, the battery should not be debited with a full charge, since it is only necessary to put back as many watt-hours as were taken out, plus the transformation loss. If this be done, the efficiency on a one-hour rate is nearer 70 per cent. than 41 per cent., which latter figure has been put forth. Mr. Berry pointed out that owing to the usual unskilled attendance on industrial locomotives, there may be considerable loss of energy in the use of starting resistances instead of the more efficient controller combination; and that a locomotive and its motors should be so proportioned that the wheels will skid before either the battery or motor or motor is overloaded.

CIRCUIT-BREAKER TIME CONSTANTS.—In a paper read before the English Institution of Civil Engineers, Mr. Bertram Hopkinson gave the results of some tests to determine the time constants of circuit-breakers when interrupting large currents. In the case of a carbon contact circuit-breaker experimented with, the current remained practically constant .018 second after the circuit-breaker began to operate, this being the period during which the plunger is rising and the switch is closed. At .036 second the current dropped to 3,000 amp., showing that some resistance had been induced, probably by reason of the arc having commenced to form. At 0.45 second the current was reduced to 2,400 amp., and at .5 second diminished rapidly, being 1,300 amp. at that time. At .058 second the current was almost but not quite shut off, and at .063 second was totally interrupted. In the case of experiments with a magnetic blow-out, the cut-off proper began at the end of .045 second, the current then being 3,500 amp., and at .053 second the current was sharply interrupted. The effect of the magnetic blow out is thus to interrupt the current much more sharply than in the case of the carbon contact circuit-breaker.

COLUMBIAN CABLE SQUABBLE.—It is stated in special dispatches from Washington that the United States State Department is the victim of a boycott which has been declared against Colombia by the Central & South American Cable Company. That company has discontinued cable service with Buena Ventura, from which point Bogota is supplied with information from the outside world. The boycott will be continued until Colombia grants the company a concession giving it exclusive right to operate cables and land lines on both the Atlantic and Pacific sides of the Isthmus of Panama for the period of twenty years. The State Department cannot now communicate with its representatives at the Colombian capital except by mail. The same is true of Colombia with respect to its minister here. The object of the company is alleged to be to force Colombia into the agreement desired so as to use the concession as a club over the head of the United States in case the Panama treaty is ratified. The United States could not build the canal without first making terms with the company. Colombia has so far resisted the demands of the company, which cut off the service with Buena Ventura three days ago. At the time it issued notice of the suspension of the service it called attention to the fact that there is a fortnightly steamer service between Buena Ventura and Panama, the point to which it still sends messages. The present concession of the company has a year to run, but that fact does not help the Colombian Government any. To forfeit the franchise would merely cut off the slow communication that is now maintained via Panama and the steamer to Buena Ventura.

LETTERS TO THE EDITORS.

Three-Phase Power Measurement.

To the Editors of Electrical World and Engineer:

Sirs:—Referring to the use of two wattmeters in three-phase circuits (discussed in your issue of July 4), and the determination whether the watts consumed by the circuit are the sum or the difference of the two wattmeter readings, there are some cases in which this can be easily determined.

1. We open the main circuit of the wattmeter which has the larger reading (this is always positive). Then the indication of the other wattmeter will always be positive, being now in a single-phase circuit.

2. We change the amount of the load in the three-phase circuit without changing the character of load. (For instance, if we have induction motors on the line, we put a heavier or smaller load on them without changing the number of motors.) If the lower reading wattmeter indicates more at increasing and less at decreasing load, then both wattmeters indicate positive watts. In the opposite case, the small indication is negative. This is true as far as the power factor of the induction motors or any other apparatus increases at increasing load.

Pittsfield, Mass. Henry Pikler.

Technical Trade Requirements in the Philippines.

To the Editors of Electrical World and Engineer:

Sirs.—For the past four years I have received by nearly every mail circulars, catalogues and descriptive flyers of various electrical apparatus from dealers and manufacturers in the United States. Sixty per cent of these are sent with no prices, discounts or any date, to enable me to base calculations upon, thus necessitating either cabling, which is very expensive, or a long wait to obtain replies by mail. Might I ask you to suggest to your numerous clients the advisability of giving quotations with confidential discounts to those in the trade when sending out their matter? Foreign firms, English, German and Italian, who are in the electrical business, give this data. Another matter that should merit attention from our manufacturers is the making out of all invoices in triplicate, as the custom house files the original and the duplicate. All invoices must be signed by the shippers, weights are required in kilos, both net and gross of the packages, and all the packages must be numbered consecutively and correspond with the numbers on the invoice. Failure in these details results in a fine being imposed by the custom house. By "net weight" is meant the weight of the goods with the weight off of all wrappers and packing. By gross is meant the entire weight of the package. Packages should be very secure, and strapped, to avoid breakage. Weights net and gross should be shown on each package very legibly.

While all these items are annoying to Americans, still the rules of the customs are such that these must be complied with, until a wise and beneficent Congress gives us free trade between the United States and these islands.

Manila, P. I. Henry D. Woolfe.

DIGEST
OF
Current Electrical Literature.

Induction Motor with Commutator.—Latour.—A paper discussing the principles of his motor, repeatedly mentioned in the Digest, before the Soc. Intern. des Electriciens, Paris. Experiments with a 15-hp motor, built according to his ideas, were then described by Gratzmueller. The machine was bipolar and the experiments have been carried out with a frequency of 25. Curves are given showing the characteristic of the magnetic circuit of the machine and the conditions of running as series motor with 200 volts, indicating the variations of the speed and the tension between the non-short-circuited brushes of the rotor. A curve is also given for the starting torque as a function of the tension at the motor terminals, from which it appears that the starting torque is more than 4½ times that of the normal one. A slip and efficiency curve as shunt motor is shown, according to which the shunt motor has a practically constant speed, like a direct-current motor. Gratzmueller states that the experiment has completely verified the theory.—*Bull. de la Soc. Intern. des Elec.*, June.

Power.

Equipment of Docks.—Pitt.—A paper read before the Engineering Conference in London, with discussion, on the modern equipment of docks, with special reference to hydraulic and electric appliances. The author reviews the conditions obtaining with each of these two motive powers and summarizes his conclusions as follows: 1. The first cost of an electric installation is not more than that of a hydraulic plant. 2. The cost of upkeep is no more. 3. The electric machines are more efficient and take less power for the same amount of work done. 4. The power is less costly to generate. 5. The transmission costs are less. 6. The general adaptability is incomparably greater.—Lond. *Elec.*, July 3.

Factory Power Plant.—A short article, containing a description of the extension of the electric motive power equipment of a large bicycle plant. Power was furnished by electricity generated by means of steam engines and when extension became necessary, it was decided to utilize a water power available at a distance of 200 meters from the works. Three turbo electric units of 150 kw each will be installed, the turbines driving, by belt, three triphase alternators of 2,200 volts 50 cycles. The exciting current is furnished by three 3.5-kw exciters, mounted on the shaft of the alternators. As the system adopted for driving the machine tools is direct current of 110 volts, the current is stepped down at the sub-station at the works to 70 volts, which feeds three rotary converters of 100 kw each, furnishing direct current of 115 volts.—*L'Ind. Elec.*, June 25.

References.

Automatic Starter for Air Compressor.—A description of a large air compressor in the shops of the St. Louis Transit Company for supplying air to compressed-air tools and for cleaning. It is provided with an automatic starter, which differs from the usual starter, in which a rheostat handle is moved over the different rheostat contacts. The rheostat coils are thrown into circuit by means of a number of contacts operated by separate magnets, which cut out or short-circuit the resistances automatically, according to the pressure in the air reservoir.—*St. R'y Jour.*, July 18.

Electric Motive Power in Car Works.—An article describing the recent additions to the power plant and mechanical equipment of the Stephenson car shops. A 450-hp generating set and a large number of additional motors aggregating upwards of 200 hp, have been installed, making the total capacity of motors approximately 1,100 hp. Pneumatic tools are also employed in several departments and portable motor-driven air compressors are moved about the shops to furnish the power wherever it may be needed. An electrically-driven forger is another interesting addition to the plant.—*St. R'y Jour.*, July 4.

Electrically-Driven Armor Plate Planer.—An illustrated note on a recently constructed 32-ft heavy plate planer. A 50-hp multipolar motor is direct-connected by means of gearing and magnetic clutches to the main driving screw of the planer. The motor is of 220 volts and runs at slow speed. It furnishes ample power to enable the machine to plane two-inch armor plate, taking a heavy chip.—*West. Elec.*, July 11.

Traction.

High-Speed Electric Traction on Railways.—Jacomb-Hood.—A paper presented before the recent engineering conference in London. The author discusses the subject from the standpoint of the railway engineer. He treats the subject under three headings, viz.: generation of current, consumption of current and transmission, distribution and collection of current. He thinks that after taking account of the increased cost and losses in extended transmission lines, reason would seem to dictate that the power stations should be as widely separated and as few in number as possible, to insure a steadier load and a better load factor. As power station practice is rapidly becoming standardized in detail, he thinks that it can be foreseen with some confidence that moderate-speed engines, directly coupled to alternators generating in single or multiple form at tensions as high as circumstances will allow, will be used. The author then discusses the difficulties from the standpoint of the railway engineer of the distribution and the transmission of the current.—Lond. *Elec.*, July 3.

The Position and Protection of the Third Rail on Electric Railways.—Langdon.—A paper read before the Engineering Conference in London, with discussion. The author gives a table showing the location of the positive collector rail on a number of main line steam railways and interurban, elevated and underground railways where electric traction has been installed. The distance from the top of the positive rail to the top of the track rail as well as the distances from the track gauge line to the center of the positive rail are given. The protection of the conductor rail with respect to climatic effect and accidental or intentional interference, is also discussed. Such protection it is thought may be better effected by adopting a roof cover instead of the usual planks on one or both sides of the rail.—Lond. *Elec.*, July 3.

The Electrification of British Railways.—A British Engineer.—A long article illustrated with maps. Two of the large steam railway companies of Great Britain have decided to install electricity on some of their branch lines. There seems to be great activity in this direction, also in continental Europe. In England a bill has been introduced to allow steam railroad companies to use electricity as a motive power, to build generating stations, etc. There have been several reasons for the British companies holding back from work of this kind. One is that the limit in speed with steam locomotives has not yet been reached and could probably be increased some 10 or 20 per cent., but as higher fares could probably not be charged there would be no reason for going to the expense; another reason is that coal is cheap, while water power is practically non-existent; a third reason is that the companies are very heavily capitalized now, as it has not been the practice in Great Britain to charge off anything for depreciation, and some of the companies are still carrying on their books, at their full value, apparatus that was purchased 30 years ago and is now obsolete. There has been so little unanimity of opinion among electrical engineers as to the proper equipment for heavy railroad service, as instanced in the dispute over the electrical equipment of the Inner Circle, that steam railroads have found another reason for postponement of action. Two important companies have the idea that self contained steam motor cars, either of the Serpollet type or operated by petroleum, would be preferable and have built motors of this kind. The writer believes, however, that the experience in Belgium with such steam motor cars and in Italy with accumulator cars is such as not to encourage construction of this kind. With the electrical equipment of the District Underground Railway, there will undoubtedly be greater interest felt in the subject, especially as some of these underground lines in the suburbs come to the surface and do a regular suburban business. A number of maps are given of the districts in which the competition between tramways and railways is most keen. The writer comments on a number of these maps and points out local conditions. He believes that in the next 5 or 10 years many of the steam railroads will be driven to operating their suburban traffic electrically.—*St. R'y Jour.*, July 4.

Interurban Railway in Iowa.—An illustrated description of a line 23½ miles in length. The company hauls freight, including a considerable amount of live stock. It also has one electric locomotive and carries package freight in an express car, which makes from two to three trips a day. Polyphase transmission is used, with direct current on the trolley wire. Every car carries a telephone and there are plugs at each turnout, so that the car crews can talk with the dispatcher.—*St. R'y Jour.*, June 20.

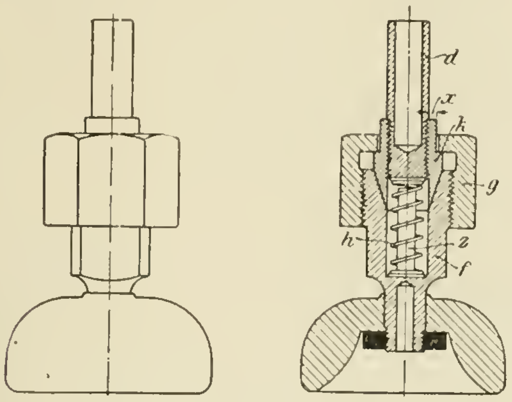
INSTALLATIONS, SYSTEMS AND APPLIANCES.

Power Station Generators.—An illustrated description of the 600-kw, double-current generators at the Trafford Park (England) power station. The machine has 20 poles, with laminated pole pieces. They carry both shunt and series field windings in order to run the machines shunt or compound. The armature is of the slotted drum type, and is built up of 15 segments, each of which consists of 774 stampings, 0.5 mm thick, and of six end stampings 2 mm thick. Each armature segment has 31 slots and a half slot at each end, amounting for the whole periphery to 480 slots. The winding consists of 480 form-wound double coils, the bars of which are 3 mm by 4 mm bare and 3.5 mm by 4.5 mm insulated. The winding pitch is from 1 to 98 to 195, and so on. There are 960 segments on the commutator. The machine is directly coupled to a 1,000-hp steam engine at 180 r.p.m. Its normal capacity is 600 kw either for continuous or alternating current or both simultaneously, but it will give 825 kw for 15 minutes without undue electrical or mechanical strain. Three-phase current is generated at 325 to 355 volts, regulated by field resistances, and at a frequency of 30 cycles per second. The guaranteed maximum temperature rise in any part of the machine, after an eight-hour test at full load, is 70° F. The specified efficiency at full load is 95.5 per cent., and at half load 93.5 per cent.—Lond. *Elec.*, July 10.

Construction of Central Stations.—WIKANDER.—An article in which the author discusses the installation of central stations with a view of obtaining the greatest efficiency. He discusses the principles governing the location of a station, the disposition of the buildings, and the machinery equipment, consisting of boilers, pipes, engines, dynamos and boosters. He concludes that as the load on central stations is a very variable one, it is of advantage to choose the equipment with a view to this condition, and consequently to install more expensive, economically working boilers, engines and dynamos for the permanent load, and cheaper, less economic aggregates for the short times of high load and for reserve. He states that there is a great difference of opinion with regard to boilers, i. e., whether tubular or water tube boilers should be installed. He thinks it most favorable, however, to choose a mixed system and to install tubular boilers at least for the permanent load. For steam turbine central stations, in order to get the full benefit of the advantages, there are also required boilers which occupy a very small space. New types will therefore have to be constructed, leading probably to water tube boilers with narrow tubes and large heating surface, or to vertical boilers. Too little attention is paid, according to the author, to the question of the steam mains, they being generally diminished for maximum load and 20 to 30 meters steam velocity per second. For average load they are, however, much too large and give rise to enormous condensation losses. The author proposes as a solution only to provide one steam main, with such dimensions that at maximum load there is reached a maximum steam velocity of about 80 metres per second, or to arrange a second main with only ½ to ⅓ of the sectional area of the first, using both mains at the times of maximum load and at other times such other one as conforms best to the average load. On the question of large dynamos the author is of the opinion that a division of them into two smaller ones, situated close to each other, would be advantageous, from 1,500 kw on. For equalizers he advocates the direct coupling with the main dynamo. With regard to the contention that such direct coupling of the two machines on account of the small number of revolutions of the main dynamo, will be too bulky and costly, the author thinks that it is erroneous, because the fact is not taken into consideration, that in the first place two small machines have to be provided and secondly the main machine has to be made larger. The main reason, however, is the very low average efficiency of the small aggregates, 40 to 50 per cent. of the energy being lost on an average. He advocates placing the small dynamos on the main shaft in such a way that the brushes can be taken off and the machine kept running as a fly-wheel, when it is not in use.—*Elek. Zeit.*, July 2.

New Electricity Works in Manchester.—The conclusion of the illustrated article previously noted in the Digest. Extensions in course of construction comprise a generating plant of 12,000 hp, in buildings designed to accommodate twice that amount. The steam will be furnished by 12 water tube boilers, each of 5,700 sq. ft. heating surface, and capable of evaporating easily 20,000 pounds of water per hour. Parallel with the boiler house there is to be an extensive range of workshops, including even a foundry, in which any part of the plant can be handled. The generating plant will consist of two 3,750-kw sets, each comprising a 6,000-ihp vertical triple-expansion engine, running at 75 r.p.m., and a three-phase alternator, working at 6,500 volts, 50 cycles. The generators will be of the revolving field type, with the poles mounted on the periphery of a fly-wheel weighing 160 tons and 27 ft. in diameter. For excitation there will be two 200-kw dynamos driven by induction motors, and generating at 200 volts. A description of the equipment of one of the ten sub-stations is given, they being all alike. The standard equipment consists of four 150-kw motor-generators and one 100-kw motor-balancer. Each motor-generator consists of a three-phase motor, receiving current at 6,500 volts, coupled to a six-pole dynamo, giving 375 to 275 amp. at 400 to 550 volts, at 500 r.p.m. The generator is available either as a shunt-wound machine for lighting or compound-wound for traction. The balancer consists of two dynamos, each rated at 255 to 230 amp., 205 to 225 volts, driven by an induction motor at 480 r.p.m. The balancers can be started without difficulty from the alternating side, after which the other sets can be run up with direct current, without assistance from the distributing network, though the latter is available if required. The synchronous motors are excited either from the balancer, at 200 volts, from the lighting bus-bars, or by a special arrangement of slip rings and chokers, each set can be made self-exciting. The latter method is adopted for all sets running on traction, thus making them independent of any faults of the lighting network. The switchboards are in two sets, the high-pressure boards on one side of the room and the low-pressure on the other. Their arrangement is described in detail. A description of two new turbo-generators, which have recently been installed at the Dickinson Street station, is also given. Each consists of two 900-kw dynamos, coupled to a Parsons steam turbine and running at 1,040 r.p.m. The two dynamos of each set are treated as one machine, giving 400 volts, and are used for lighting only.—Lond. *Elec. Rev.*, July 3.

Construction of Electric Safety Devices for Low-Potential Current Installations.—STEIDLE.—An illustrated discussion of the principles of the arrangement of efficient safety devices for low-voltage installations, in order to protect them as well against lightning as against dangers resulting from their transmission lines coming into accidental contact with high-potential current lines. The author describes a new construction which he has devised, and which is illustrated in the adjoining Fig. It consists essentially of a rod, *d*, to which the transmission wire is connected. The wire entering the station is connected with the metallic receptacle, *f*. A cone, *k*, of insulating material separates one from the other. Connection between the two is made by means of a wire spiral, *h*. The core, *z*, of the spiral consists of a celluloid rod. In cases where the intensity of the current entering the device is only a little above that which the device can carry, the spiral simply burns out. But under the action of a high-potential current, not only the spiral will burn out in the first place, but there will be an arc produced between the two wires. The heat of the arc will then burn the celluloid core and thus produce a violent explosion, which has the effect of bursting the apparatus and thus disconnecting the two wires. The author states that experiments have been conducted with pressures up to 5,000 volts, showing that the separation is quickly and effectively accomplished.—*Elek. Zeit.*, July 2.



SAFETY DEVICES.

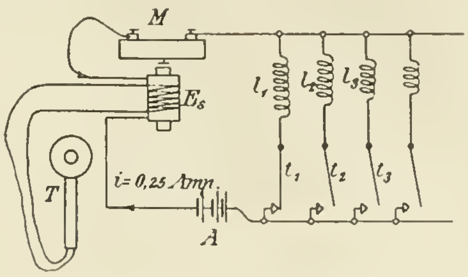
The Design of Extra High-Tension Switch Gears.—WARRILOW.—The first part of an illustrated article. The author states that it is interesting to note that, whereas the design of generators and their prime-movers is practically standardized, much diversity of opinion is to be seen in the controlling gear by the many varieties of apparatus constructed for use on switchboards. As defective types are, however, being weeded out by continued experience, there is hope that few more years will lapse before the principles underlying switchboard devices will have become firmly grounded. A 10,000 and 20,000 Oerlikon air brake switch are described, the author stating that they favor the air break switch for pressures up to 20,000 volts, even at this potential, finding no difficulty in breaking the circuit.—Lond. *Elec. Eng.*, July 3.

ELECTRO-PHYSICS AND MAGNETISM.

Experiments on the Loss of Weight of Radium.—DORN.—An account of experiments conducted by Prof. Dorn to settle the question as to the loss of weight sustained by radium in the course of time. As determined by Heydweiller, there is an appreciable loss even in comparatively short time. His results are directly contradictory of what had been found by Becquerel. Dorn operated on about 30 grams of very active radium bromide and his results do not agree with those of Heydweiller, inasmuch as he finds that the loss is certainly not more than 0.001 mgm in 3 months and perhaps not that much. The radioactivity of the substance used by Dorn was at least ten times greater than that of Heydweiller.—*Phys. Zeit.*, July 1.

On the Radioactive Emanation in Atmospheric Air.—ELSTER AND GEITEL.—A continuation of the experiments of the well-known authors, bearing upon the origin of the radioactive emanation contained in the air in the ground. They found great difference in the ionization of air from different cellars; in one instance the ionization of the outside air being about 11 times greater than that of the cellar air. Samples of ground from different localities were then investigated, and the air contained in them tested. It was found that air which came from ground rich in clay and lime was strongly active, though the different samples were not equal. Ground from a gravel pit and from a slate formation were less active, and still less active were samples from shell chalk and basalt. Experiments were conducted to see whether treatment of the clay with hydrochloric acid had any effect. It was found that a lesser activity resulted after the treatment, but it regained its former value in a few days, the material being kept uncovered. Washed chalk, ground heavy spar, pure potters' clay, sea salt and Carlsbad salts were tried with generally negative results. The authors also tried to find out whether neutral bodies, by burying them in the ground, might take on a sensible induced activity from contact with the ground air. Ground heavy spar, washed chalk, potters' clay and cotton were tried. After at least 4 weeks the materials were taken out, but no sensible activity could be found with the barytes, the chalk and the cotton, while the effect was unmistakable with the clay. It therefore is a curious coincidence, which makes the study of the phenomena more difficult, that clay which contains the body which activates the ground air, is in its turn excited to secondary radiation by the ground air. Natural carbonic acid was also found perceptibly ionized. A pasteboard cylinder, covered with Sidot blende and not showing any phosphorescence, was brought into a tabulated bell of sheet iron, the rim of which reached 25 cm deep into the ground, and charged negatively to 2,000-3,000 volts for several hours. After taking the cylinder out of the bell it showed scintillating phosphorescence, as has been described by Crookes. The latter thought that this phosphorescence is due to the electrons shot off from the radium striking against the screen. The authors think it more likely, in view of the fact that a radioactive body was not present in their experiments, that those scintillations mark the place where negative electrons are given off from the radioactive layer on the screen. Elster also gives an account of a large number of experiments which he conducted in order to determine the dependence of the radioactivity of the atmosphere on the meteorological conditions. He found a decided dependence of the radioactivity of the air on the barometric pressure. He calls attention to the necessity of using exactly the same charging potential of the apparatus from day to day, and also to working with quite constant potential during the time of activation.—*Phys. Zeit.*, July 1.

Generation of Wave Currents by a Microphone Arrangement.—V. LIEBEN AND REISZ.—The authors describe an arrangement of a microphone and telephone, in which, by carrying the resistance of the microphone in a circuit containing self-induction, they were able to get continuous sounds in the telephone. The number of vibrations of the sounds could be easily varied between 300 and 1,000 per second. The experimental arrangements as shown in the accompanying figure, were chosen in such a way that a series of variable self-induction coils, l_1, l_2, could be inserted into the microphone circuit by means of the keys t_1, t_2, etc. *M* is the microphone, *Es* the electromagnet with secondary coil, *T* the telephone and *A* a storage battery. The authors think that the easy variability of the vibrations, as well as the sine character of the current waves, present considerable advantages over the tuning fork and string interrupters. This arrangement might, therefore, find a successful employment in the replacement of the above interrupters in Mercadier's multiplex telegraphy. The principle in a somewhat changed form might also find use for measuring purposes, as in the comparison and measurement of self-induction coefficients.—*Elek. Zeit.*, June 25.



GENERATION OF WAVE CURRENTS.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrochemistry in the United States.—HABER, T. W. RICHARDS, J. W. RICHARDS, SMITH, BRADLEY, BROWNE, JOHNSON.—The conclusion of the translation in abstract of Prof. Haber's report, the first part of which was recently noticed in the Digest. He discusses the use of diaphragm processes for electrolyzing brine; the simplicity of the operation is pointed out; the ampere-hour efficiency of the production of chlorine varies between 70 and 90 per cent., and is greater the higher the percentage of sodium chloride and the less the percentage of hydroxide in the cathode department. For paper and pulp mills the diaphragm process is preferable to the hypochlorite apparatus, often used abroad; the latter may have, however, a future in textile mills in this country Darling's sodium process is said to have been highly interesting as an experiment, but while the process was in operation, it was not proven that it was of commercial value As sodium is of importance as starting point for the production of various valuable chemicals, it is probable that Darling's experiment may be revived or that new suggestions may be made. Concerning the process of the Atmospheric Products Company, he says that it is still in an experimental stage, and that it is not yet possible to judge with safety what the commercial result will be. He gives a comparison of the relative advantages and disadvantages of the series and multiple system of cells for copper refining and points out the very creditable development of mechanical labor saving apparatus in modern American refineries. Some remarks are made on the Betts process of lead refining. The electrochemical treatment of copper-nickel matte is discussed at great length; after an outline of the commercial conditions before and after the formation of the Nickel Trust, a detailed illustrated description of the Browne process is given. In the first step the electrolyte is a mixture of nickel chloride, cuprous chloride, sodium chloride and ferrous chloride and is electrolyzed between nickel-copper anodes and copper cathodes; nearly all the copper is deposited and the rest is separated by treating the electrolyte with sodium sulphide and filtering the cuprous sulphide off. The solution is then treated with chlorine gas to oxidize the iron from the ferrous to the ferric state and by means of sodium hydroxide the iron is removed from the solution, which is then a mixture of nickel chloride and sodium chloride. It is brought into an evaporator and the sodium chloride is separated out. The solution now contains only nickel chloride and while still hot, it is passed to the nickel depositing cells; nickel is deposited on the cathodes and chlorine is developed at the graphite anodes. This chloride is used partly for oxidizing the ferrous chloride, as mentioned above, but to the greatest part it is supplied to the shot tower in which the electrolyte for the start of the process is made by reaction with fresh nickel-copper shot and the sodium chloride from the evaporator. The process is nearly perfectly cyclic with regard to the chlorine. Haber then makes the following general remark on electrometallurgical processes. The reason why electrochemical processes which were successful in the laboratory often prove a failure in practice, is that in practice it is often difficult to maintain the purity of the solutions. The success of industrial electrolysis of aqueous solutions is mainly a question of maintaining the solutions pure during electrolysis. While the chemical industries in general have grown up in the United States in connection with the older development in Europe, this is not the case with various electrochemical industries which were built up independently of European practice. Haber refers to the pioneer work of Hall, Bradley, Castner, the Cowles brothers, Acheson, Acker and Willson. He thinks that ozone apparatus for sterilizing water and various other electrochemical processes which are used commercially in Europe, should also have a future in the United States. The same issue contains a series of critical notes on Haber's report by American electrochemists. T. W. Richards speaks on chemical education in the United States and Germany; he emphatically endorses Haber's remarks on the practical importance of physical chemistry; whether the present theories advanced by this branch of science are transitory or permanent, knowledge both of its subject matter and of its method is essential as well to the manufacturer as to the investigator in any branch of chemistry. J. W. Richards criticizes some remarks of Haber's on American universities: the golden well-balanced mean between academic pedantry on the one hand and narrow commercialism on the other, is the goal toward which our best institutions are tending and toward which they are advancing more rapidly and more hopefully than European universities. A. Smith emphasizes the importance of teaching physical chemistry, which enlarges our knowledge of the conditions under which chemical changes occur, and consequently the results of physical chemistry cannot be excluded from any instruction in chemistry, from the most elementary to the most advanced. Bradley replies to Haber's criticisms of the process of the Atmospheric Products Company. That company is trying to avoid making mistakes on a large scale and operate single units until they shall be absolutely certain that no changes are necessary. The collection and conversion of the fumes into the various merchantable products are all provided for at a very low cost and the power is the principal item of expense in the operation. Browne emphatically agrees with Haber that it is a fundamental principle in electrometallurgy that everything can be accomplished with pure solutions, nothing with foul solutions. It is the neglect to keep initially good conditions permanently good which consigns so many promising processes to the scrap pile. Johnson discusses the relative advantages of the series and the multiple systems of cells in electrorefining. He thinks there is very little to choose between these two systems, for nickel refining. To meet the general conditions of copper refining, he believes the multiple system to be the simpler and better. There are also some shorter notes by others.—*Electrochem. Ind.*, July.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Hot-Wire Wattmeters.—BAUCH.—A long theoretical article intended to prove the correctness of the measuring principle embodied in the construction of the author's instruments. The instrument is based upon the use of two hot wires, one of which is traversed by the sum of the acting current and a current proportional to the line potential, and the other one by the difference between these two currents. The author deduces mathematically that the indications of the instrument are quite correct even when a phase difference exists. When the phases are equal, the indications are quite correct for a triangular curve and a sine curve. The author also discusses the influence of what he calls the "imparity" factor (or also called "form factor") relating to a peculiarity of alternating currents, which he states has not been treated in electrotechnical as well as in electrophysical science, namely that with equal phase, but different form of a current and a potential wave, the watts are not equal to the product of their effective mean values. This imparity factor, he states, is not to be neglected, if one works with unusual curve forms. From a calculation he comes to the conclusion that the imparity factor calculated from the indications of the instrument, is exactly equal to the true value and that therefore the instrument also takes account of this magnitude without error. In regard to the criticism made, that the scale of the hot-wire instruments is not proportional to the watts, as the elongation of the hot wire is not proportional to the square of the current traversing it, the author finds that this error amounts to only 0.09 per cent., if the instrument is used up to the maximum current strength, for which it was built, even with inductive load. In the practical form of the apparatus, platinum-silver wires of 0.15 to 0.25 mm thickness are used. To reduce the consumption of current in the instrument, both hot wires are connected with a measuring transformer, which steps down the potentials. All paths of the main current in the instrument are perfectly free from self-induction; therefore, shunts can be arranged parallel to the instrument to increase the range of measurements.—*Elek. Zeit.*, July 9.

MISCELLANEOUS.

Carborundum as Furnace Lining.—GREMPE.—The author discusses the advantages of lining fire boxes with carborundum. The mixture is composed of 75 parts by weight of carborundum and 25 per cent. water glass, or, in cases where it can come into contact with basic slags and like materials, of 85 parts of carborundum and 15 parts clay. The author states that a layer of this material of one-half mm thickness suffices for the highest degree of heat met with in practice.—*Zeitsch. f. Beleucht.*, June 30.

Winding Machine for Coils of Flat Copper Ribbon.—A well-illustrated article describing a machine at the Schenectady works of the General Electric Company, which winds automatically and edgewise, coils of flat copper ribbon upon forms which may be circular, oblong with semi-circular ends, square or rectangular with quadrant corners. The coils are for the revolving fields of alternators and the strips from which they are wound vary between .012 in. and .07 in. in thickness, and between ⅞ and 2 in. in width. The interesting mechanical devices by which the winding is accomplished, are described and illustrated in detail.—*Am. Mach.*, July 9.

Utilization of Steam in Mine-Hoisting Engines.—An illustrated article describing installation by which the steam of a large mine-hoisting engine, which works intermittently, is caught in a specially-constructed apparatus. At the other end of this apparatus the steam is conducted with a considerably smaller pressure into a 300-hp steam turbine, which works with condensation and continuously and drives two dynamos of together over 300 hp. A detailed calculation of the saving of power effected by this arrangement is given, which in this particular case may reach 400 hp.—*Glueckauf,* June 13.

New Books.

Photographic Lenses. A Simple Treatise. By Conrad Beck and Herbert Andrews. London: R. & J. Beck. 320 pages, 31 illustrations. Price, 75 cents.

Within the past two decades photography has expanded from the narrow circle of the carte-de-visite gallery and has become an art of precision in the hands of the engineer and a pastime for the amateur. The foundation of photography is the lens and the art owes its present remarkable development as much to the improvement in lenses as to the improvement in plates. In the present volume the authors have given a very complete account of the principles which underlie the construction of various forms of photographic lenses, accompanied with photographs both from test charts and from natural objects by which the performance of the various kinds of lenses may be adjudged. The book is written very largely from the standpoint of the manufacturer in his endeavor to meet the wants of the customer, and is decidedly more scientific than will appeal to those who follow photography for æsthetics or pleasure. Nevertheless, the scientific photographer will find therein much that is interesting and instructive and its perusal will particularly repay those who use photography with precision. The book is divided into seven sections, the first three of which are chiefly valuable to the manufacturer. Section 4 upon the properties of lenses is of greater interest to the amateur, as enabling him to select the kind of lens best suited for his purposes. Section 5 describes very fully the types of lenses now to be obtained, and in section 6 the practical application of lenses, accompanied with numerous illustrations, is shown. Chapter VII takes up special lenses and devotes much space to the very interesting question of the telephoto lens. The typography and the illustrations of the volume are excellent, but unfortunately so constant an effort is made to exhibit the Beck-Steinheil lenses in a favorable light, as compared with those of other makers that the volume leaves upon the reader's mind the uncomfortable flavor of a merely trade publication.

L'Année Electrique, Electrothérapique et Radiographique: An Annual Review of Electrical Progress in 1902. Third year. By Foveau de Courmelles. Paris: Librairie Polytechnique. 320 pp. Price, 3 francs 50 centimes.

Although mainly devoted to electrotherapy, this volume contains much valuable information concerning electrical progress in 1902 that has been carefully accumulated and excerpted from the general literature of the period. The first half of the book is devoted to a general review of new facts and theories in conjunction with electric lighting, heating, traction, chemistry, wireless telegraphy, etc.

The treatment of the various topics is simple, clear and precise. It is not, of course, to be expected that over so wide a range of subjects, great detail could be entered into, but for most readers the description will be found sufficient.

The book is specially adapted for the use of physicians and electrotherapeutists who are desirous of becoming acquainted with the most recent electrical developments.

British Standard Sections. Issued by the Engineering Standards Committee. New York: D. Van Nostrand Company. Price, $1.

An example of what useful work may be accomplished by co-operation among professional engineering bodies is furnished by the recent standardization in Great Britain of structural iron sections. The task of arriving at an agreement on standard sections was entrusted to a committee—the Engineering Standards Committee—and the adoption of their recommendations by the Institutions of Civil, Mechanical and Electrical Engineers and Naval Architects, and the Iron and Steel Institute, settles beyond peradventure that the standards fixed upon will prevail in Great Britain. The recommendations cover equal, unequal and bulb angles, bulb ties and plates, Z-bars, channels and beams. A lettered drawing of each section is accompanied by a table of dimensions for all commercial sizes, with remarks as to special points to be observed.

Experiments on the Flexure of Beams. By Albert E. Guy. New York: D. Van Nostrand Company. 122 pages. Price, $1.25.

A book upon the flexure of beams strikes the engineering reader as being excessively trite, for one is accustomed to think of this subject as having been mulled over until the last possible word has long since been said, but Mr. Guy has presented the matter in a decidedly new light, for he deals with the question of the failure not by crushing or bending, but by the buckling of the compression flange and on this aspect there is little engineering literature. Throughout the volume Mr. Guy makes constant and copious citations from the formulæ developed by the best writers upon strength of materials and then proceeds to detail a large number of experiments, which he has conducted upon test beams of various proportions in the endeavor to formulate the laws which govern the failure of beams through buckling. These investigations embrace beams supported at one end and cantilever beams, and for each class experiments are made with distributed and concentrated loads. From his experiments Mr. Guy deduces a new law which he states as follows:

"The maximum transverse section of a beam of length L being divided (rightly conceived as such for the purpose of delineating only, the adherence of the parts being unaffected) into any number of parts—equal, similar, or otherwise:

"1. Any one part may be treated independently of the others, provided that the same form of treatment is applied to the others one by one or altogether;

"2. Each part may be considered as the transverse section of a beam or elementary prism of length L;

"3. The size of the transverse section of such a prism at any point along L depends only on the value of the bending moment, $P x$, at that point;

"4. Consequently each prism will be of uniform strength, and the combination of all the prisms or the solid beam will also be of uniform strength."

The work is distinctly mathematical in character and by no means easy reading, although it is written in a clear and lucid style and may be regarded as a distinct contribution to the literature on the strength of materials.

Directory of Electrical Societies, Etc.

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

American Order of Steam Engineers. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York.

American Street Railway Association. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa. Next meeting, Thousand Islands, N. Y., September 8, 9 and 10, 1903.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, Indianapolis, Ind., third Wednesday in June, 1904.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., 1904.

Engine Builders' Association. Secretary, F. P. Ide, Springfield, Ill.

Electrical Contractors' Association of New York State. Secretary, Wm. J. Davis, Ithaca, N. Y.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September 2, 3 and 4, 1903.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky.

Iowa Telephone Association. Secretary, C. C. Deering, Des Moines, Iowa.

National Electric Light Association. Secretary, Ernest H. Davis, Williamsport, Pa.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, Utica, N. Y.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association. Secretary, E. W. Pichardt, Huntingburg, Ind.

The Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

"Meridian" Lamp.

A new type of incandescent lamp is being introduced by the General Electric Company to cover the field of lighting for which the arc light is too large and the incandescent light is too small. From the accompanying illustrations it will be seen that the Meridian lamp is a neat combination of a properly designed incandescent lamp with a suitable reflector and ornamental collar detachable from the lamp. The lamp filament is of special shape and accurately located in the bulb with reference to the reflector. The combinations of these features with sand blasted globe produces a soft, brilliant white light uniformly distributed. The lamp is very attractive in appearance and effective in results.

The Meridian lamp is as free from all complexity as the ordinary incandescent lamp, and it is claimed that its efficiency equals that of any other electric illuminant except the arc light. It is inexpensive in first cost and in maintenance, and its renewal cost is the same as ordinary incandescent lamps. It may be operated on either alternating or direct-current circuits, on all commercial frequencies and on any of the usual standard voltages and fits in standard sockets, requiring no special connections.

The lamp is designed for interior lighting, not only where artistic effects are essential, as in residences, hotels and theatres, but also where the chief requirement is the greatest amount of evenly-diffused light for the least consumption of energy, as in office buildings, libraries, studios, drafting rooms, factories and retail stores. It is especially suitable for low ceilings and window lighting, and as it is not affected by vibration or acid fumes, can be installed at any angle and in confined and inaccessible places.

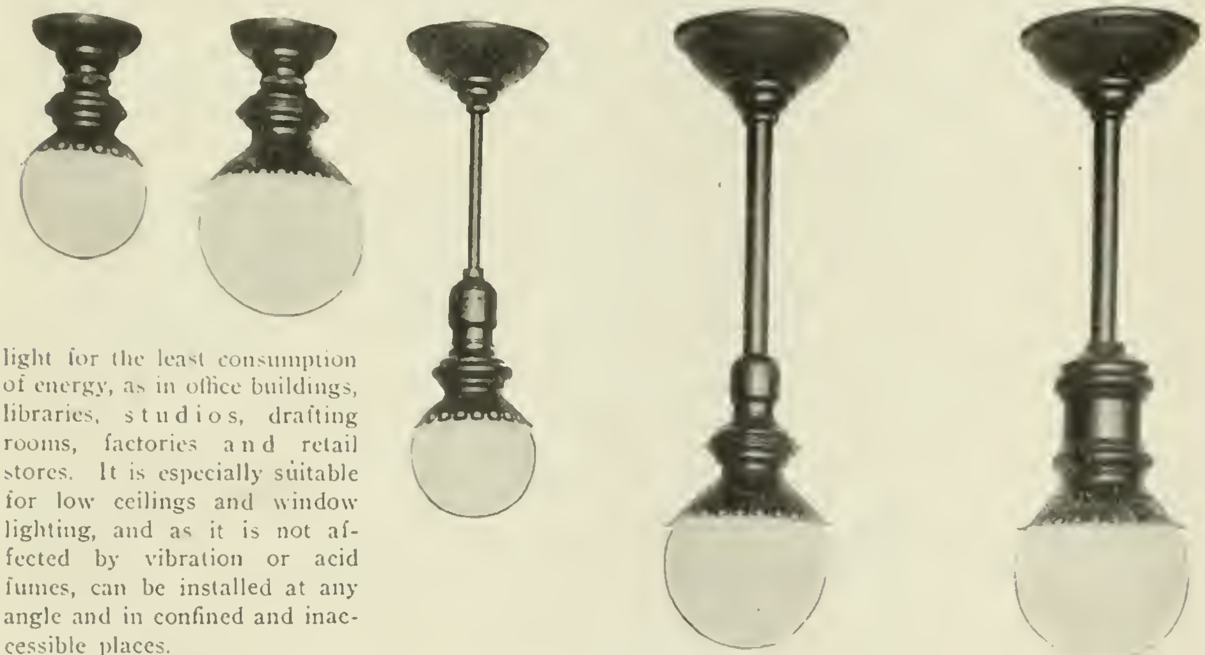


FIG. 1.—"MERIDIAN" LAMPS.

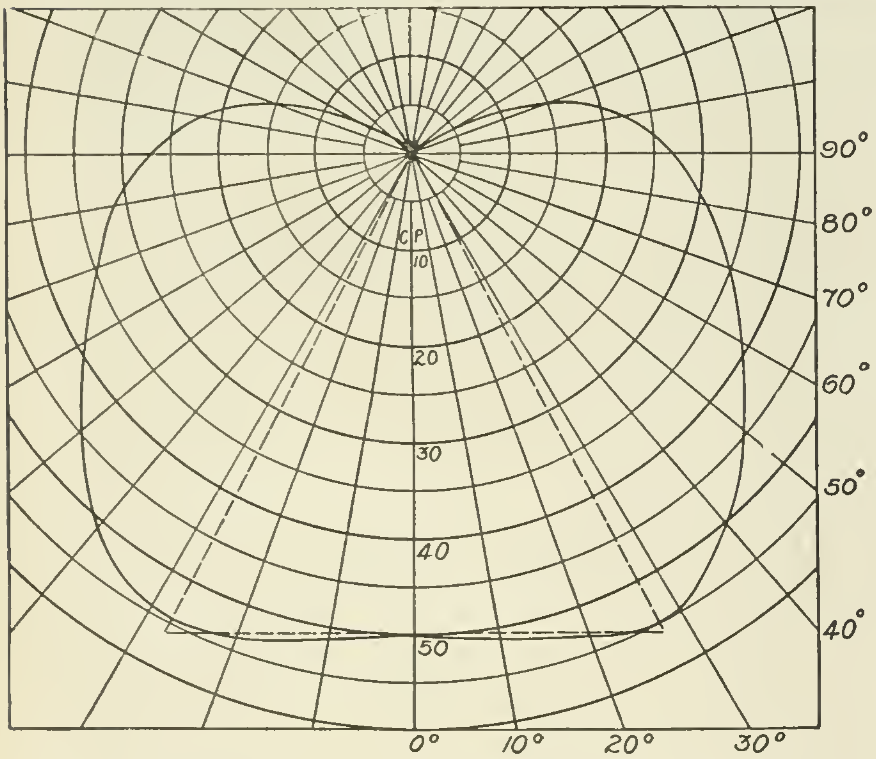


FIG. 2.—ILLUMINATION CURVE.

Each lamp when properly installed distributes a uniform candle-power over a circular area having a diameter equal to the height of the lamp above it, as shown by curves in the accompanying diagram. Thus a lamp suspended 10 ft. from the floor will give a uniform candle-power at all points of a circular area of the floor 10 ft. in diameter.

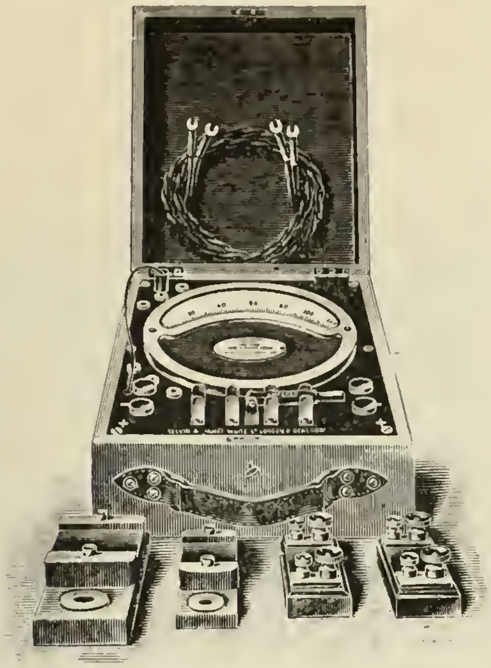
FIG. 3.—"MERIDIAN" LAMPS.

The lamp is made in two sizes, one giving 25 cp and consuming 60 watts, and the other giving 50 cp and consuming 120 watts. The first-mentioned is especially suited for residence lighting, for deck and table illumination, while the second is best suited for general illumination of interiors of stores, offices, etc. Both lamps are supplied with simple collar and reflector or extension tube fitting, as in various designs, as shown in the accompanying illustrations. The extension tube fitting is the more desirable type, as with the usual height of ceiling it suspends the lamp about eight or ten feet from the floor—a suitable height for good uniform illumination. For very low ceilings the lamp may be used with single collar and reflector, fitting the lamp directly on the ceiling in suitable wall receptacles. For very high ceilings the extension tube fitting with the extra length of tubing should be ordered.

Combined Ammeter and Voltmeter.

An exceedingly useful instrument for general testing work has lately been placed on the market by Messrs. Kelvin & James White, Limited, of Glasgow, Scotland. It consists of one of Lord Kelvin's patent S. R. or moving coil instruments, which can be used either as a voltmeter or an ammeter, terminals and plugs and also a D. P. throw-over switch provided to simplify the alteration in the range of the instrument. Used as a voltmeter the coil has a large resistance fitted in series with it, this resistance being subdivided and connected to sockets arranged around the left side of the instrument so as to enable six different volt-ranges to be obtained as follows: 0 to 0.12, 0 to 1.2, 0 to 12, 0 to 120, 0 to 240, 0 to 600 volts. The instrument has a scale of 120 divisions, and it will be seen that at its lowest range the sensibility is 0.001 volt per division, thus enabling it to be used for low-resistance tests. By throwing the D. P. switch to the right-hand side and connecting the instrument to the various shunts supplied, the instrument can be used for ampere measurement. Four shunts are usually supplied so as to give the following ranges: 0 to 1.2, 0 to 12, 0 to 120, 0 to 600 amperes, but larger ranges can be given, depending on the shunts supplied.

The instrument is fitted in a neat teakwood box, which contains all the necessary plugs, switches, etc., the shunts being supplied in a separate wooden box. This set can be used for making conductivity tests, either by comparing the deflections obtained from the standard shunt and the unknown resistance with the same current passing through both. By this method resistances as low as 0.0000008 ohm can be measured. Low resistances can also be measured by taking ampere and volt readings when resistances as low as 0.0000016 ohm can be measured. When used for measuring insulation resistances, a sensibility of 4 megohms per division can be obtained. From the information given it will be seen that the instrument has a very wide range, and will be of great service in the testing of meters, dynamos, of cables and for other general testing work.



COMBINED AMMETER AND VOLTMETER.

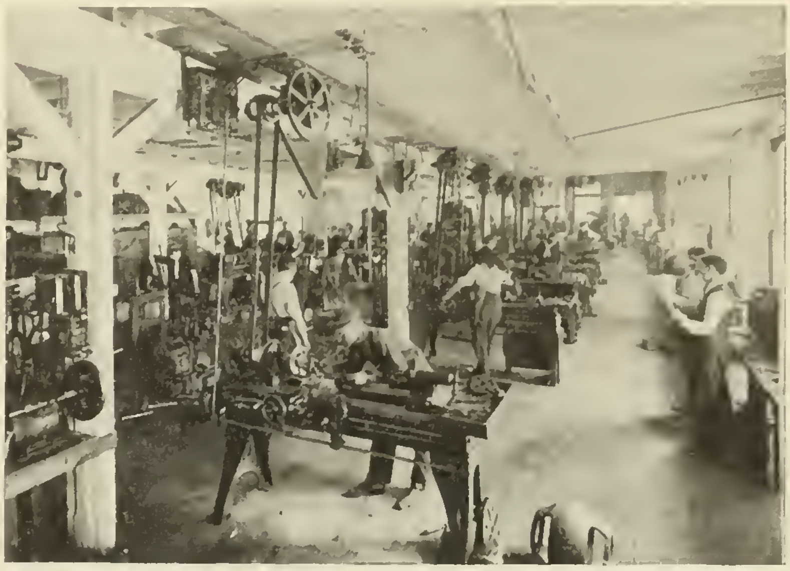
Electric Motors on the Canals.

According to a dispatch from Schenectady, the State Department of Public Works at Albany has granted permission to the General Electric Company to conduct experiments in canal boat electric propulsion along a stretch of the canal in the vicinity of Schenectady. The experiments are to be conducted under the supervision of the department. The plans contemplate the use of a double track.

Dynamo and Motor Production in Chicago.

Roth Brothers & Co. have recently moved into new quarters at 27-29 South Clinton Street, Chicago, which they have completely fitted out with the most modern machinery for the manufacture of their well-known type of motors and dynamos. Their facilities in their new factory are very much increased with a corresponding ability to turn out work very much quicker. This further has enabled them to increase their promptness in filling orders for their standard and also special product. The power apparatus trade has increased to such an extent that it was necessary for them to increase their facilities. They state that their new location in the heart of the machinery district, has proven very satisfactory, and from appearances prospects of very good trade in the near future are assured.

The accompanying photograph shows part of one floor of their machine shop, which, as can be seen, receives excellent light from three sides, and also from skylights. Every machine tool in their shops is fitted out with its own electric motor, many of the motors being direct-connected to their respective machines. For driving their lathes they make use of their well-known electric countershaft, which is an electric motor suspended from the ceiling, having a back-geared shaft upon which is mounted the cone pulley of the lathe. The coarse changes of speed on the line are obtained by shifting the belt on the cone pulleys, and the intermediate speeds are obtained by the controller. The latter is reversible, and is suspended from the ceiling. It is operated by a rod that is connected with a spliced shaft on the lathe, which in turn is operated by a handle which moves with the carriage of the latter.



VIEW OF PART OF MACHINE SHOP.

Aside from their regular product, they have done considerable work of late in the fitting up of machine tools with motors.

Clark Wireless Telegraphy.

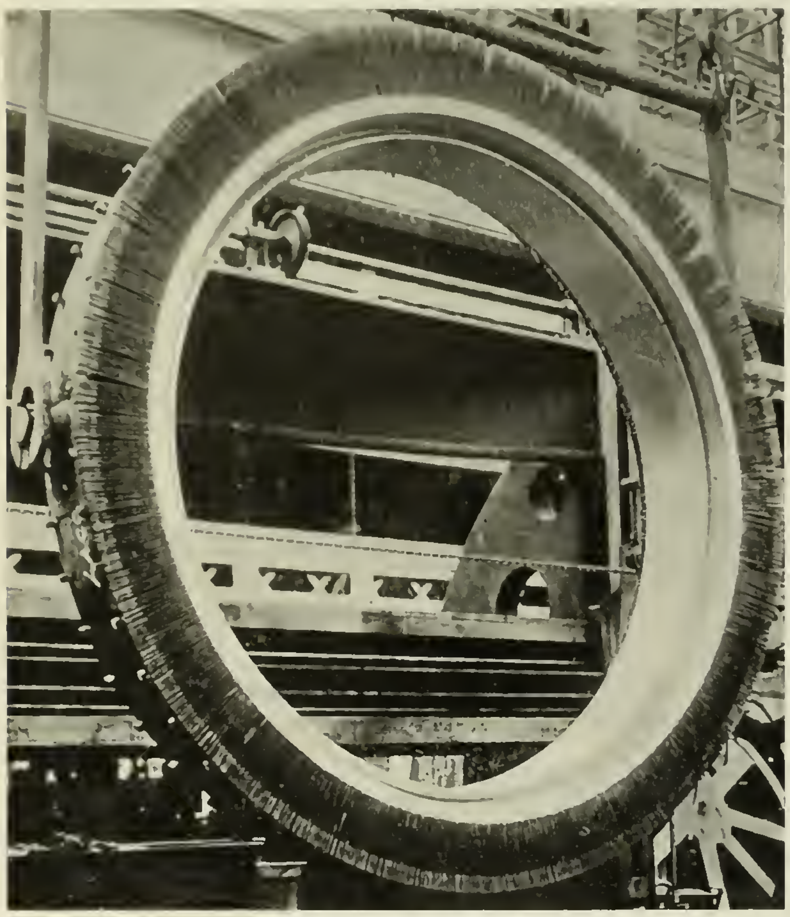
At the recent Detroit meeting of the National Electrical Contractors' Association, the Thomas E. Clark Wireless Telegraph-Telephone Company, of Detroit, had an exhibit which was a feature of the convention aside from the sessions, being constantly surrounded by a crowd. As will be seen from the accompanying illustration, the booth was tastefully decorated and was surmounted by a wireless mast such as is used for short-distance work. The exterior was elaborately decorated with Elblight lights and an arrangement enabled the oscillations passing between two stations to be observed. The Clark system of automatic signaling or telegraphing from engine to caboose, from one train to another and from a station to trains, was kept constantly in operation and messages were sent back and forth. While the operators of the instruments were professionals, the spectators were invited to manipulate the transmitter, and a line was always waiting to take advantage of the opportunity. All of the large line of Clark wireless apparatus was represented by the exhibits. This exhibit and a similar one in Chicago some weeks ago offered the first opportunities that the public has had to view all of

WIRELESS TELEGRAPH EXHIBIT.

the many parts of a wireless telegraph system, one or more of these usually being guarded from close public view by wireless telegraph operating companies.

A Large Commutator.

The accompanying cut illustrates the assembly of a commutator, which is to form part of an 1,800-kw. direct-current generator field under construction in the shops of the British Westinghouse Company, Manchester. The generator is being supplied to the order of the City of London Electric Lighting Company, and will be run in conjunction with units of similar size already supplied by the company, and working at the Bankside Station. The external diameter of the commutator is 10 ft., and there are 900 segments, each of hard-drawn copper, around the circumference. The generator is designed for a normal output of 1,800 kw. at 450-500 volts, and will be capable of supporting a continuous overload of 20 per cent. of its total output.



LARGE COMMUTATOR IN PROCESS OF ASSEMBLING.

The commutator serves to illustrate the class and size of work being turned out from the Westinghouse works, now that the organization has become settled into definite operation. The development of this large undertaking will be watched with considerable interest during the next few years, especially as some of the largest schemes for power distribution and railway operation are passing through the company's hands.

Spectacular Effects at the Contractors' Convention.

Note was made in these pages last week of the fine lighting displays at the Detroit meeting of the electrical contractors. We now are able to illustrate another exhibit, that of the Elblight Company of America. The entire Light Guard Armory, in which the exhibition was held, was decorated with 5,000 Elblight lamps strung on curves of Elblight cable which formed a trellis over all the main and side aisles between the exhibits and which were profusely decorated with greens. The lamps used were American Beauty pink and apple green in alternation. The outside of the Armory was festooned with white frosted lamps and across the street swung the Stars and Stripes mounted on a flexible Elblight curtain into which lamps were stuck so that lamps and flag followed the undulations produced by the not infrequent breezes which prevail in the City of Straits.

A most attractive and unique exhibition was made by the Elblight Company in the space which had been set aside for that purpose. The chief novelty was the festooned hand rail made of silk cable, into which vari-colored lamps were stuck; the cordon thus formed being decorated with smilax and the supporting iron posts being surrounded with palms. At the back of the space against the wall hung an elaborate iron frame surrounding which the word "Elblight" appeared. Underneath this a four-by-four board was covered with a handsome monogram which appeared in the Automobile Show in New York, and which was outlined by several hundred miniature lamps of various colors. An Elblight table was also shown.

A UNIQUE LIGHTING EXHIBIT.

The most interesting technical exhibit from the contractors and engineer's point of view consisted of three jars in which lamps stuck on Elblight cable were burning submerged. The center jar contained a lamp mounted which had been burning continuously under water for over four months. To the right a similar lamp was burning in a saturated solution of sea salt and to the left the third lamp was burning in a fifteen-per-cent. solution of concentrated sulphuric acid, showing the weather and water-proof qualities of the system as well as the grade of insulating material employed.

Stone Pipe for Underground Conduits.

A conduit that is increasing greatly in popularity with electrical and contracting engineers and electric lighting, power, telephone, telegraph and street railway companies, is that of the American Stone Conduit Company, of Chicago. The practical underground man will at once recognize on a thorough examination that it combines the essentials of a working conduit.

The method of manufacture is such as to give assurances from the very beginning that the completed structure in the trench will meet all demands made upon it. It is made from crushed limestone and the best quality of Portland cement. In the process of manufacture, the conduit is subjected to an interior pressure of 3,500 pounds per square inch, displacement taking place from the interior, which gives great strength to the wall and a highly polished and smooth inner surface of perfect form. The product is uniform in every particular, and offers advantages not possessed by others. It is made in single-duct, 6-ft. lengths, 4½ in. in diameter, with a 3⅛-in. bore.

The conduit is laid in the usual manner, the best of alignment being secured by means of rubber mandrels, which are furnished by the company. It may be well to note here that the conduit being of the same nature as the concrete, which surrounds the former, a solid mass is formed by the union of the concrete and the conduit, thus forming a system of a single unit from manhole to manhole. This is a most important feature, when it is considered that excavations are frequently made alongside of and under conduit lines, and unless this is able to bridge such excavations, settlement must occur, which not only destroys the conduit, but endangers permanently the cables contained. This, in the case of a short-circuit in any one duct, readily permits of the destruction of the other cables, and consequently removes the very feature which makes an underground conduit system of value. This point will in particular appeal to the high-tension electrical engineer.

The conduit being in 6-ft. lengths reduces the cost of installation, and because of single ducts, will adapt itself readily to any and all obstructions met with in the congested streets of cities. Thus a multiple-duct run can be readily separated so as to allow part of the ducts to be laid above and part below such an obstruction, or separated in a vertical plane. In fact, this conduit can be readily made to overcome difficulties which with a multiple duct, would compel the establishment of a new grade, thus entailing additional expense. Stone conduit will also appeal to the underground man from the fact that it is an ideal system in the case of branch or lateral lines. Although only a single duct may here be laid, nevertheless this, with its enveloping mass of concrete, will form a unit mass that will be strong enough to withstand the rough handling it will subsequently receive. Another feature is the ease with which the conduit can be cut, this greatly facilitating rapid and economical construction. No wrapping or liquid compound is required for making joints, thus insuring a further saving. It is acid, gas and water-proof. The character of the conduit system further insures a minimum of maintenance cost, which is no small item in an extensive system. The conduit, when once laid, will maintain its alignment.

The pulling-in of cable into the finished lines is of the greatest importance, as is well known. With the distance between manholes sometimes met with, this becomes almost impossible with some makes of conduit, the latter offering such resistance that the lead covering, if not actually severed, is very much reduced, and prevents the subsequent installation of the cables at other points. With the stone conduit, however, this is not the case, the interior surface being exceedingly smooth and the ducts in perfect alignment, so that no impedance is offered to the drawing in of the cable. The American Stone Conduit Company is prepared to make immediate shipment on all orders and expects to establish a plant in the east to take care of its eastern business.

High Tension Oil Switch.

A high-tension oil switch embodying several new features of construction, the invention of Dr. Gustaf Benischke, chief engineer of the Allgemeine Electricitäts Gesellschaft, Berlin, is shown in Figs. 1 and 2. Dr. Benischke states that in the operation of such a switch two things are necessary: First, that no air shall enter between the contacts when the switch is opened, and second, that a dielectric such as oil be forced between the contacts under a given pressure at the instant they are drawn apart. The type of switch here illustrated fulfills both of these conditions.

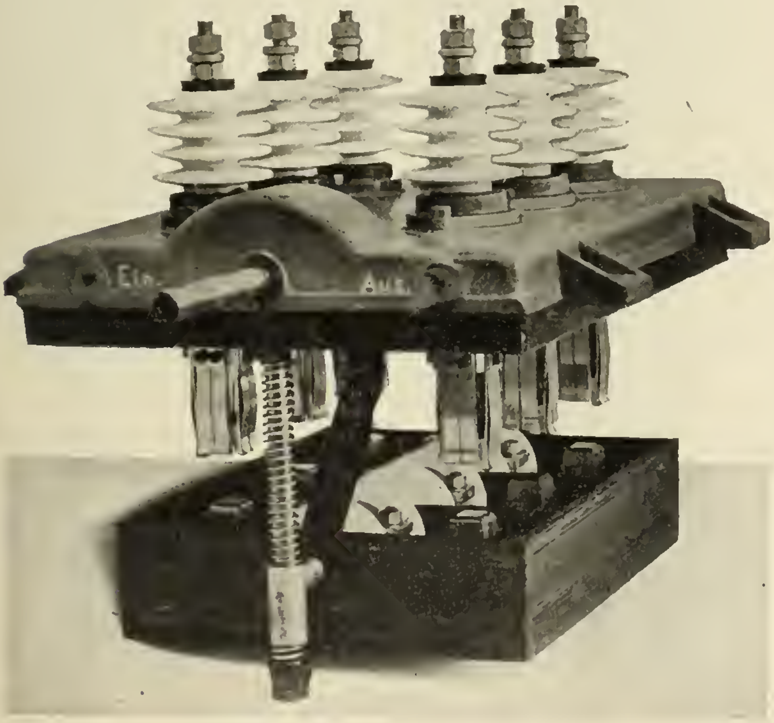


FIG. 1.—HIGH-TENSION SWITCH.

The line wires brought into the casing of the switch through the lid are secured at *K*, the connection between these being made by the cross piece, *M*. The circuit is broken simultaneously in two places by moving this piece, *M*, downward. Beneath this cross piece and attached to it is a wooden plate, *P*, which when suddenly moved downward, forces oil beneath the switch blade, *M*, and the fingers of the contact, *K*, thus extinguishing the arc before it reaches a length of more than two or three mm (see Fig. 1); in this way the oxidizing of the oil and of the contacts is prevented. Switches of this construction have been tested by short-circuiting a 1,000-hp, 6,000-volt, three-phase alternator, and immediately opening the circuit; under this severe test the break was made clearly and without any appreciable arc.

Fig. 2 shows diagrammatically the latest type of this switch, from which it will be seen that the wooden plate is provided with vertical guide boards to direct the oil between the contacts, and holes are also provided in the board, *P*, immediately beneath the contacts through which the oil is directed against the same. It will be noticed that the contact pieces on the bar, *M*, are tapered to secure good contacts, and that one of the four pairs of switch fingers is longer than the others; it is between this finger and the contacts on *M* that the small arc takes place in opening.

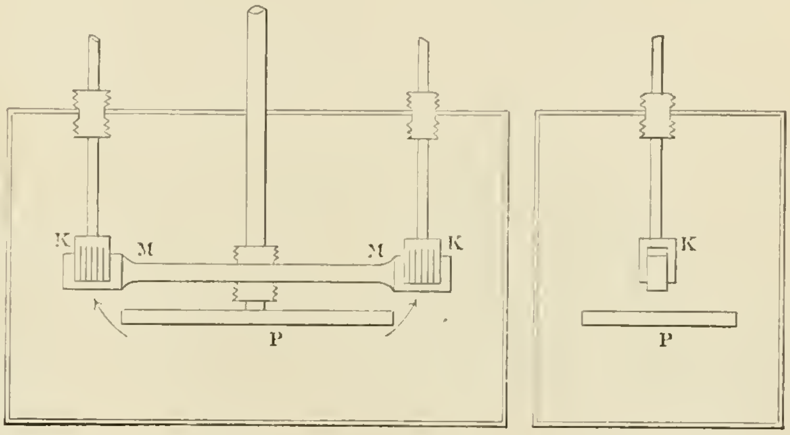


FIG. 2.—HIGH-TENSION SWITCH.

Tests have also been made with this switch by short-circuiting a 1,100-kw, 12,000-volt transformer connected with a 4,000-kw, 6,000-volt alternator. This short-circuiting was repeated ten times in rapid succession, and each time the circuit was cleanly opened. The current in this case was about 300 amp., and, under the short-circuiting, the voltage of the alternator fell from 6,000 to 5,500 volts. Under such excessive tests the oil was considerably darkened, but its insulating qualities were not impaired, the 5 mm withstanding a pressure of 13,500 volts. Under ordinary conditions it is stated that the oil will last several years.

The Steel Industry at Niagara Falls.

The recent merging of the MacPherson Switch and Frog Company with the Ramapo Iron Company, of Hilburn, at Niagara Falls, affects the city materially, giving it an immense new factory furnishing employment to some hundreds of skilled mechanics. The officers of the new company are as follows: President, F. W. Snow; vice-president, W. W. Snow; secretary and treasurer, R. J. Davidson. The board of directors consists of F. W. Snow, W. W. Snow, W. B. Rankine, R. J. Davidson and J. M. Van Winkle. Col. W. W. Snow, the vice-president, is a pioneer in railway supply work, and is known all over the country, being connected with many important industries. He is the father of F. W. Snow, the president.

The capitalization of the Ramapo Iron Company is $1,400,000. The company will still maintain its great plant at Hilburn which has been in successful operation for the past 22 years, and will at once quadruple the capacity of the switch and frog plant, enlarging it to a size equaling that of the one in the east.

Four buildings will at once be erected, and the company has secured sufficient land from the Niagara Falls Power Company to double the new plant when necessary. Because of the unusual facilities for manufacture and the advantages for transportation offered by the new location, it is expected that this increase will prove but a few years distant. Machinery will be installed immediately, including sixteen planers, which will be run night and day, giving an output equal to thirty-two as usually run, and quadrupling the output of the old MacPherson plant.

Bath Electric Tramways, England.

The British Westinghouse Electric & Manufacturing Company, Limited, is now executing a contract for the Bath Electric Tramways, Limited, London, which includes the building of the generating station and car sheds, and the supply, delivery and erection of the entire equipment for the two buildings, in accordance with designs prepared in conjunction with the engineers of the Bath Electric Tramways Company. The generating station equipment is to consist of three 200-kw Westinghouse generators, direct connected to Yates and Thom horizontal, tandem, compound engines, and one 75-kw Westinghouse generator direct-connected to a Westinghouse compound steam engine. Two 15-kw negative boosters are to be supplied, with a 12-panel switchboard of the Westinghouse tramway type, as well as such other auxiliary apparatus as is involved in a tramway generating station. The boiler house is to be equipped with three 10,000-pound Babcock & Wilcox straight tube, water tube boilers, and a Clay cross economizer; surface condensers are to be used, and also a complete equipment of water softening and grease separating apparatus. The car shed is to have a capacity of 40 double deck, 56 passenger cars. On the second floor and across the front of the car sheds are to be located the offices of the company.

The rolling stock is to consist of 40 cars, the bodies and trucks being of the Milnes make, with Westinghouse equipments. Most of the cars will, at the outset, be equipped with the Westinghouse magnetic brake, which should be found particularly useful on the Bath system, because of the large number of severe gradients.

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Rubber Shipments from Para.

The shipments of rubber from the Amazon Valley during May last, according to a report from Consul Kenneday, amounted to 2,070 tons, as against 2,083 tons for the same month in 1902. The total export of rubber for this season—July 1, 1902, to May 31, 1903—is 28,110 tons, as against 28,738 tons for the corresponding period of the previous season. It does not appear likely that the business of this closing month of the season will materially change the relative bearing of these figures. The crop shortage this year, as compared with the year of 1901-2, will, therefore, be only about 2 per cent., instead of 5 per cent., as estimated January 1.

◆

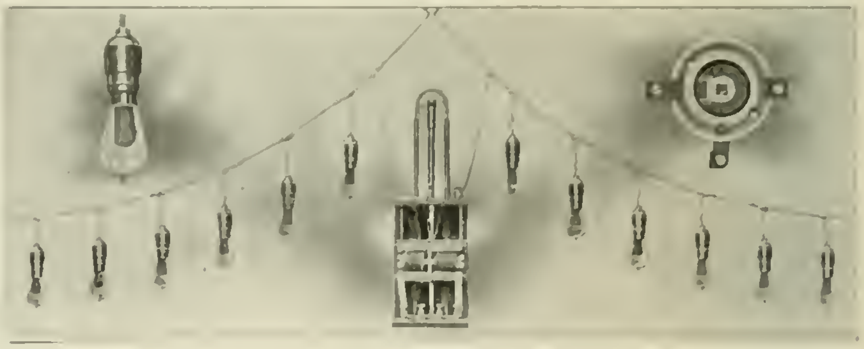
New Double Incandescent Sign Lamp.

The use of electric signs is becoming more and more popular among merchants and business houses generally, and manufacturers vie with each other in producing signs that are meant to catch the eye and still are not too expensive. One of the latest devices produced for electric sign work is the double incandescent lamp illustrated herewith. This lamp has double globes and carbon filaments, with separate connections so that a colored lamp may be furnished by lighting the inner globe, the outer globe being in darkness. The inner bulbs may be made of blue, green, red or amber glass, as desired, while the outer bulb is of clean glass or etched white. When a white light is wanted the outer filament is cut in and the colored bulb left in darkness. Thus with a flasher attachment the same lamp may be made to produce a white and colored light alternately. The socket is arranged with three terminals, one being common to both filaments, and three wires are run to each lamp.

The lamps are made in 2, 4, 6, 8, 10 and 16 cp, and usually, the two bulbs have carbon filaments of the same candle-power. However, in order to produce a stronger light in the colored bulb, that filament may be made to give 2 cp more than the outer bulb.

The new lamp is naturally more expensive than an ordinary incandescent sign lamp with one filament, but when it is considered that one of these new lamps is equivalent to a white and a red lamp, and give the double service in the same space as one ordinary lamp, its advantages can be appreciated. The rest of the new lamp also makes more desirable shaped letters, as every socket is always in use, while with a letter with ordinary white and colored lamp the number of lamps must be large in proportion to the size of the latter in order to bring out the outline with either the white or colored lamps. The new lamps are said to have a life practically as long as the ordinary incandescent lamp, while the efficiency is nearly as good.

The lamps can be flashed by any type of flasher, but the manufacturer makes an automatic flasher for use with the lamps which is an ingenious device, and which possesses several points of merit. This flasher is illustrated in the cut. It consists of two long solenoids, one connected with the white side of the lamps and the other with the colored side. Plungers that operate inside these solenoids are suspended by means of a flexible cable or wire, which runs over the wheel shown at the top of the device. When one of these plungers reaches the bottom of its coil, the current automatically operates one of two small solenoids in front, which throws a switch and connects the other side of the circuit through the other long solenoid. This latter solenoid begins to exert a pull on its plunger, which is now at the top. The plunger is gradually pulled down to the bottom, when it operates the other of the two small magnets and throws the connection over to the other circuit and the other long solenoid. This process is repeated continually, the intervals of flash always being equal, although flashes of unequal length may be made by proportioning the windings properly on the long solenoids. The flashes can also be made to range from 1 to 15 seconds, or any given time that may be thought suitable by varying the size of wire or length of the solenoids. By using this automatic flasher the ordinary motor and commutator is done away with, thus saving the current required to operate them.



DOUBLE INCANDESCENT LAMP.

The new double lamps and the automatic flasher used to operate them are being manufactured by the Electric Flash Light Company, of Denver, Colo., which claims to furnish a sign of two colors and flash them for less money than one can possibly operate a sign made of plain lamps. The Electric Flash Light Company was incorporated last December, and purchased the plant and equipment of the Colorado Lamp Company, which had been manufacturing plain incandescent lamps for several years. The company is capitalized for $150,000, and has the following officers: President, J. L. Beard; vice-president, H. E. Meyers; secretary, treasurer and manager, J. C. Ryan. Mr. Meyers is the inventor of the entire apparatus. The company has recently placed signs in Denver and San Francisco, where they are said to be giving the greatest of satisfaction.

Mining Locomotives for De Beer's Consolidated Mines.

Mule haulage is to be replaced by electric traction on the De Beers Mines, an order having just been placed with the British Westinghouse Electric & Manufacturing Company, Limited, for the supply of twelve mining locomotives with the requisite spare parts, etc. The locomotives have four wheels, each pair driven by a motor of 10-h.p. capacity at a conservative rating. They can thus develop a full load draw-bar pull of about 900 lbs., running at six to ten miles per hour on the level. The most interesting features of these tractors is that the gauge being very narrow—18 inches—the motors have to be mounted clear of the wheels. The motor pinion meshes in the ordinary way with an additional intermediate gear wheel. The journals of the shaft carrying this gear wheel run in boxes working in pedestals over the main journal boxes of the locomotive frame, which is supported on springs in the usual manner, and free to rise and fall on the axles and without disengaging the gears. The motors are hung on the shafts of the intermediate gear as if these were the ordinary wheel axles and the usual "nose" suspension is employed.

Arc Works, Chelmsford, England.

The chairman and directors of Crampton & Co., Limited, entertained a large and influential party of friends recently at the Arc Works, Chelmsford, England, after which all attended the annual athletic race meeting of the Arc Works Club, held in the vicinity. Special saloon carriages were provided for the guests, who, on arriving at Chelmsford, were speedily driven to the works, where they were met by members of the staff, who conducted them over the interesting and extensive works. Great interest was taken in the methods of construction of their dynamo motors, arc lamps, searchlights, fan motors, etc. About noon the guests assembled in an extremely handsome and commodious room in the club buildings, which it appears is the workmen's dining room at ordinary times, and a most excellent luncheon was provided, purveyed by the men's own staff. Carriages were afterwards taken to the race grounds, where an enjoyable afternoon was spent and some really good sport witnessed.

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Vacuum Pump.

The vacuum pump shown in the accompanying illustrations, made by the Pulsometer Engineering Company, Limited, Reading, England, is largely used under the name of the Geryk pump for exhausting incandescent lamps, and in laboratories.

Referring to Fig. 2, *A* is the suction pipe, *B* the air port into cylinder above piston, and *C* the piston bucket leather, which is made an easy fit in cylinder, and kept up to the walls thereof by pressure of oil in annular space, *D*. *E* is a piston valve which moves when commencing to exhaust only, and is quite inactive when the vacuum is within about ½ in. *F* is an air pipe to relieve the piston on the first few strokes, and *G* is a collar through which piston rod passes freely. *L* is an oil filling plug; the oil should fill chamber *K* up the level of oil plug to the point of overflow.

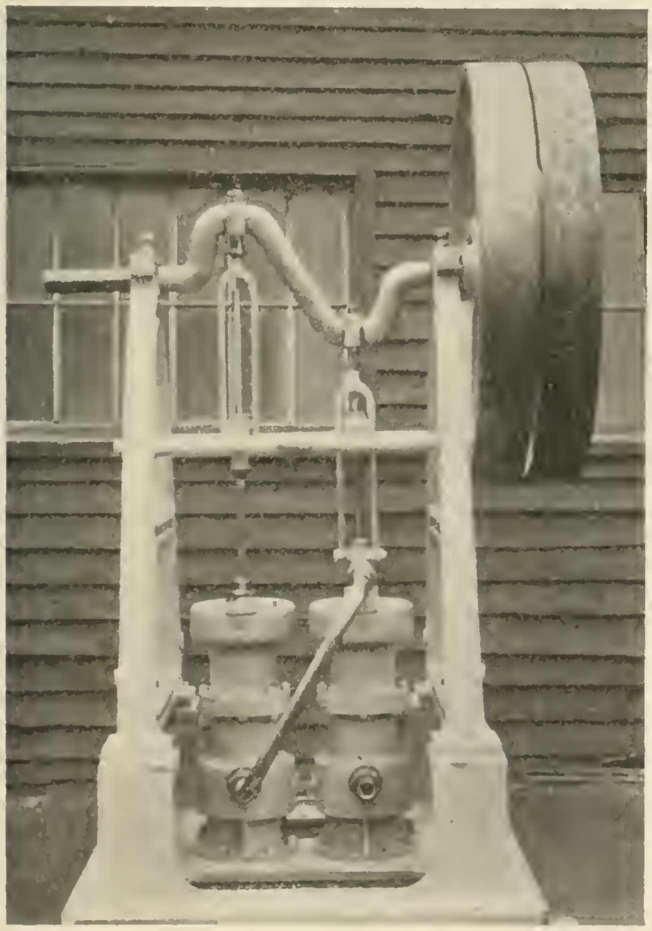

FIG. 1.—VACUUM PUMP.

I is a hydraulic collar to make joint with the piston rod, the flange or face of which covers the joint of *G* with the cover, *H*, thus forming a frictionless equivalent of a stuffing box and a delivery valve combined. When the piston is at bottom of the stroke there is a perfectly free opening from *A* to *B*. As the piston rises, the port, *B*, is cut off and the cylinder full of air is irresistibly carried up to the outlet valve, *G*. No air can by any possibility get back past the piston, as it is covered more than half an inch deep with oil. As the piston continues to rise and the pressure upon it increases, the bucket leather is forced more tightly against the walls of the cylinder. Whatever oil gets below the piston is immediately picked up through the valve, *E*, when the piston gets to the bottom of its stroke again. When the piston is at the top of its stroke, it is in contact with the valve, *G*, and lifts *G* ¼ in. off its face, giving a free outlet for the air; but there is so much oil on the piston that a considerable quantity of it is forced through the valve at *G*, driving all air before it. While the piston is at top of stroke the valve cannot close and the oil at *J* and *K* becomes for the time being all one body, so that no air can possibly return, although the valve is fully open. As the valve, *G*, is resting on the piston, it cannot close until the piston has made ¼ in. of its descent, and consequently oil equal ¼ in. in depth will have entered the cylinder ready to be discharged behind the air upon the next up stroke.

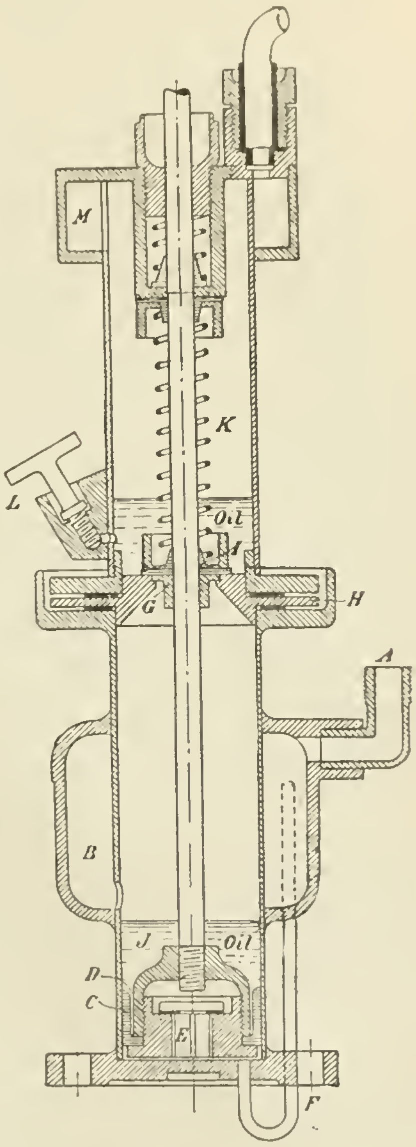

FIG. 2.—CROSS-SECTION OF VACUUM PUMP.

With a single cylinder pump a vacuum within ¼ of a millimetre can readily be obtained. With a double cylinder pump in series, i. e., with the second barrel exhausting from the first, a very much higher vacuum can be produced. With a good drying tube a vacuum within $\frac{1}{5000}$ part of a millimetre (measuring on a large McLeod gauge) has been obtained.

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Testing Batteries in Gasoline Automobiles.

The Electric Contract Company, 202-204 Centre Street, New York, is putting a device on the market for testing the batteries used in automobile work. This device, which is shown in the illustration, is intended to prevent the failure of gas engine operation through the weakness of the cells. It is made somewhat after the form of the electric gas lighter, having a platinum coil which glows on touching the terminals of the battery, provided, of course, the battery is still in commission. If the strength of the cell is sufficient to illuminate the platinum coil, then there is current enough in the battery to operate the sparking apparatus. The contact is made by the plug shown in its normal position in the base of the device, which is connected to one side of the platinum coil through a flexible cord. The base itself forms the contact for the other terminal. The tester is a small device easily carried in the vest pocket and should prove a boon to automobilists and others who have fear of trouble from battery weakness.

BATTERY TESTER.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a fair demand for time money, the closing rates being 4½ to 5 per cent. for 60 days, and 5 to 6 per cent. for 90 days to six months. Very heavy liquidation and bear selling depressed prices on the stock market, quotations being in many cases lower than at any time in the past three or four years. The principal selling was in the industrial stocks, United States Steel shares falling sharply. There were heavy dealings in Brooklyn Rapid Transit, the total sales for the week aggregating 112,800 shares, the closing quotation being 41½. This stock reached the lowest point of the year, viz.: 41, the closing price representing a net loss of 95⁄8 points. Metropolitan Street Railway also touched the lowest figure of the year, viz.: 113, which was also the closing price, and represented a loss of 5½ points. The highest price was 119. General Electric, on sales of 9,195 shares, dropped from 165¾, the highest, to 155, which was also the lowest for the year, closing at 157, a net loss of 8½ points. Westinghouse common lost 4½ points and preferred 6 points, the closing quotations in each case being the lowest for the year, viz.: 166 and 170 respectively. Western Union closed at 83¼, and was very quiet throughout the week, the sales aggregating 3,869 shares. The Commercial Cable closed at 155, being a net loss of 6 points compared with the last quotations. Following are the closing quotations of July 28:

NEW YORK.

	July 21	July 28		July 21.	July 28
American Tel. & Cable......	77	77	General Electric.	162	162
American Tel. & Tel........	130½	131	Hudson River Tel...........	..	..
American Dist. Tel	25	25	Metropolitan St. Ry.........	115⅞	117
Brooklyn Rapid Transit ..	46½	44¾	N. E. Elec. Veh. Trns........	..	..
Commercial Cable.	.	.	N. Y. & N. J. Tel............	..	..
Electric Boat	15	15	N. Y. E. V. T. Co......	4¾	4⅛
Electric Boat pfd	35	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.. .	1	1⅜	Western Union Tel...... ...	82½	83¼
Electric Vehicle	5	6½	Westinghouse com....	170	171
Electric Vehicle pfd........	13	8	Westinghouse pfd...........	170	172

BOSTON.

	July 21.	July 28		July 21.	July 28
American Tel. & Tel	150¼	113¼	Western Tel. & Tel. pfd....	85	80
Cumberland Telephone....	..	..	Mexican Telephone.........	1⅝	1½
Edison Elec. Illum..........	239	237½	New England Telephone ..	123	124
General Electric............	162	164½	Westinghouse	85	..
Western Tel. & Tel.........	12	12	Westinghouse pfd....... . .	88½	..

PHILADELPHIA.

	July 21.	July 28		July 21.	July 28
American Railways	..	..	Phila. Traction..	95¼	94⅛
Elec. Storage Battery	55*	52	Phila. Electric	5¾	5⅝
Elec. Storage Battery pfd.	..	..	Pa. Electric Vehicle.........	..	..
Elec. Co. of America.	8¼	7⅞	Pa. Electric Vehicle pfd ...	..	..

CHICAGO.

	July 21	July 28		July 21.	July 28
Central Union Tel	..	..	National Carbon pfd........	92	90
Chicago Edison.........	..	147	Northwest Elev. com........	..	..
Chicago City Ry....	185*	170	Union Traction	3½	4
Chicago Tel. Co	..	..	Union Traction pfd.........	30	30
National Carbon	23	21			

* Asked.

TRACTION MEASURES IN CHICAGO.—A four months' truce in the local traction war has been secured by the passage of two non-committal measures by the Chicago City Council. An ordinance has been passed extending the franchises of the City Railway Company, which the city claimed expired July 30, until November 30, and a resolution adopted empowering the city's legal representatives to agree to an extension of the hearing in the traction suit until the same date. Great care was taken to provide that neither document should be construed as any recognition of the franchise claims made by either company. The protective committee of stockholders of the Union Traction Company, and also of the North and West Chicago Street Railway Companies, which are leased by the former, have been at work on a new lease. Their official statement as to the agreement reached, subject to ratification by the stockholders, is as follows: The old leases between the Union Traction Company and the two underlying corporations are rewritten so that the title to the property is vested absolutely in the underlying companies and the Union Traction Company is merely a tenant. It is provided specifically that the "guarantee fund" shall revert to the underlying companies in case of a default on the contract. While the old rental figures of 12 per cent. for the North Side Company and 6 per cent. for the West Side Company shall be preserved for a period of five years, they are not to be guaranteed, but be simply a preferred stock, cumulative up to the amount of 8 and 4 per cent., these accumulations to be paid before any dividends are paid on the Union Traction Company stock. At the end of the five years, which is supposed to represent the time necessary to put the system into good physical condition, the old rentals of 12 and 6 per cent. are to be fixed again and a guaranteed charge on the Union Traction Company for which the guarantee fund is responsible. The Union Traction Company is to bear all the charges of the rehabilitation of the property.

LAKE SUPERIOR POWER.—With regard to the recent troubles at Sault Ste. Marie, and their effect on the power and traction interests there, belonging in the group of properties, an official report says: "The principal earnings of the Lake Superior Power Company are accounted for in the income from the Helen Mine, which is owned and operated by this company. A large amount of electrical power is furnished to other companies, but this is omitted from these calculations. There are two power contracts, however, which it is proper to include in this estimate of earnings. The Canadian Electric-Chemical Company pay $12,500 per annum, and the International Transit Company will use and pay for about $8,000 worth of power. About $20,000 will come from these two sources." The estimated earnings of the Michigan Lake Superior Power Company are given at $110,000.

CLAUS SPRECKELS OUT OF GAS AND ELECTRIC.—Claus Spreckels has sold his independent gas, power and electric and power companies for a price in excess of $6,000,000 cash. The purchasers are bankers and other capitalists principally interested in San Francisco gas and electric and Pacific coast improvement companies. They have an option already on the Equitable Gas Light Company. The purchase of the Spreckels plant insures an end of the lighting war, which has been in progress five years or more in San Francisco, during which time the price of gas has been reduced from $2.25 per thousand to 50 cents. The rate will be advanced to $1 for gas and 4 and 10 cents per kw-hour for electricity, according as supplied in the business or residence section of the city.

STREET RAILWAY SALE.—The Marlborough (Mass.) Street Railway, consisting of 39,000 ft. of track and several buildings, including a power house, together with cars and equipment, was sold at public auction last week to William A. Quigley, of Boston, for $102,775. He represented the Boston and Worcester Electric Company controlled by James F. Shaw, of Boston. Mr. Shaw was the owner of the railway when it was placed in the hands of a receiver. The sale was the result of an order issued by the courts, and it was conducted by George W. Estabrook, the receiver. The Marlborough road was crippled in 1892 by the burden of claims made against it as the result of an accident on the Hudson division when many persons were injured. The claims amounted to $100,000.

NEW ENGLAND ELECTRIC VEHICLE.—The trustees in dissolution of the New England Electric Vehicle Company have declared a third and final dividend of 26 cents per share, making the total dividend in liquidation $3.76 per share. This third and last dividend was paid July 15 upon surrender of the trustee receipts at the Old Colony Trust Company in Boston or the Manhattan Trust Company, New York. The trustees in dissolution are Francis R. Hart, James E. Hays and Charles L. Edgar.

FALL RIVER AUTOMATIC EXCHANGE DIVIDEND.—The Fall River Automatic Telephone Company has paid its second dividend at the rate of 5 per cent. per year and has a surplus left after charging off depreciation. Its copper toll line connecting with the New Bedford Automatic exchange, has just been completed and the service is said to be excellent. With the opening of the Automatic Company's toll line the opposition announced a cut of 33⅓ per cent. between these points.

CINCINNATI ELECTRIC MERGER OFF.—The negotiations having for their object the taking over by the United Gas & Improvement Company of the controlling interest in the Cincinnati Gas & Electric Company, have, according to advices from Cincinnati, been declared off. The contemplated deal involved $29,000,000 and would have been the preliminary step to the consolidation of all the quasi-public concerns in and around the city of Cincinnati.

THE SOUTHERN ELECTRIC SECURITIES COMPANY has been incorporated at Trenton, N. J., with a capital stock of $1,000,000 to hold as investments bonds, securities and other evidences of indebtedness. The incorporators are Kenneth K. McLaren, Joseph M. Mitchell and Louis B. Dailey, all of 15 Exchange Place, Jersey City, the registered office of the company.

DIVIDENDS.—The New England Telephone & Telegraph Company has declared the regular quarterly dividend of 1½ per cent., payable August 15, to stock of record July 31. National Carbon directors have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable August 15.

CINCINNATI GAS & ELECTRIC.—The earnings of the Cincinnati Gas & Electric Company for the first half of the year, represent the largest income in the history of the company. The entire force of the company is working night and on Sundays in connection with the installation of meters. The company is also increasing largely its installation of 4 amp. alternating-current arc lamps, for street circuits, in the use of which it has been a pioneer. It will soon have over 5,000 of these.

PHILADELPHIA BELL STOCK.—The Philadelphia Bell Telephone Company stockholders have authorized the proposed increase of the stock from $12,000,000 to $16,000,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Stock market liquidation at the expense of industrials, *Bradstreet's* points out, affects the sentiment and ignores but does not conceal improvement in the corn and cotton crops; a change for the better in industrial conditions at New York and other distributing centers and a continued cheerful feeling in Western and Southwestern trade circles. The iron and steel markets and those for other metals feel the reflex action of depression in securities. Strike troubles are reported the cause of dullness in Eastern lumber markets and of the embarrassment of a large building concern. Railway earnings are exceptionally good, showing a gain of 15 per cent. for the first half of July, and the only source of complaint is of car congestion at Kansas City, affecting arrivals of new wheat and dulling Western flour milling operations. Bank clearings show a smaller aggregate than last year, but a gain outside of New York. Trade reports are in harmony with crop advices. West of the Mississippi, from Texas north to the Canadian line, the feeling is optimistic. Texas has harvested a record wheat crop; a large corn yield is assured and cotton reports are good. Hence reports of improving trade. In Kansas and Missouri the feeling is excellent. Northwestern trade advices are cheerful on the expectation that the wheat yield will be little below last year. Pacific coast trade and crop advices are good and building is very active. At the south trade is of full volume with crop advices inducing a cheerful feeling. Industrial operations are active in the central West. The business failures for the week ending July 23, according to *Bradstreet's,* numbered 183, against 173 the previous week, and 178 the corresponding week last year. In the copper market official prices have again been reduced in the absence of business. The closing quotations were 13⅝c. to 13¾c. for Lake and electrolytic and 13¾c. to 13⅜c. for casting stock.

POWER IN CANADA.—The Hamilton Electric Light & Cataract Power Company's steam power station in Hamilton, Can., which will be used as an auxiliary to its water power plant at De Cew Falls, 34 miles distant, is to be equipped with the following machinery recently ordered from the Westinghouse Electric & Manufacturing Company: Two 1,000-kw, two-phase, 2,400-volt, 66-cycle engine type generators, each driven by a vertical Corliss engine furnished by the Goldie & McCulloch Company, of Galt, Ont.; one 50-kw motor-generator exciter set for these alternating-current generators, consisting of one 75-hp, two-phase, 400-volt induction motor and a 50-kw, 125-volt, compound-wound, engine type generator, constituting a two-bearing set; also a switchboard consisting of two generator panels. In the receiving station of the Hamilton Light & Power Company, which adjoins the auxiliary steam power station in Hamilton, will be installed six 500-kw, oil-insulated, self-cooling transformers with transformer panels, stepping down the current from 20,000 volts or 40,000 volts three phase, to 2,400 volts two phase. The two engine type alternators mentioned above will be operated in parallel with the secondaries from these transformers. For the water power station at De Cew Falls, the Westinghouse Company will furnish two 5,000-kw, three-phase, 2,400-volt alternators, which will be direct-coupled to water wheels that are being built in Italy; two 100-kw motor-generator exciter sets, each consisting of a 150-hp, 2,400-volt induction motor, and two 100-kw, 70-volt, direct-current, compound-wound, engine type generators, constituting three-bearing sets; five 2,500-kw, oil-insulated, water-cooled transformers, transforming from 2,400 volts three phase to 22,500, or 45,000 volts three phase. Also the necessary switchboards to control the apparatus recently ordered as well as that already installed in the station, aggregating eight separate switchboards with a total of 18 panels, equipped with oil switches throughout.

LIGHTING EXTENSIONS AT DETROIT.—The Detroit Edison Company is about to install a new motor-generator sub-station in the business district of that city, to relieve the load on its direct-current stations, which are already taxed to their limit. Three-phase, 60-cycle, 4,600-volt current will be supplied from the new power house, which is being built at Delray, and will be delivered to the motors direct, without the interposition of transformers. All switching operations on the high-tension side will be done by General Electric motor-controlled form H switches. The generators will deliver 250-volt direct current to the Edison system, whereas a 3-unit, 400-kw motor-generator balancing set will maintain the neutral. The immediate equipment will include two 1,000-kw units, which it is expected will be in operation by the middle of October, whereas the final installation is laid out for six units. The plans for the equipment are being made under the supervision of Mr. George Cato, the superintendent and electrician of the company. The building, 38 x 100 ft., will be two stories in height with basement, the second story being used as living apartments by the station operator. Work on the new power house at Delray is being pushed as rapidly as possible, and it is expected that current will be furnished by the same in the early fall. This will prove a most interesting installation, not only because of its magnitude, but also because of the economic and engineering problems which are involved, as was pointed out in a paper on "Salt as a By-Product," read before the last convention of the National Electric Light Association by Mr. Alex. Dow, the second vice-president and general manager of the company.

ORDERS FOR WATERTOWN ENGINES have recently been received as follows: Hanson-Ward Veneer Company, Bay City, Mich.; one 13 x 22 x 14 tandem compound high-speed engine arranged for direct connection to Westinghouse generators; town of Lewes, Del., one 11 and 188 x 12 tandem compound high-speed engine, second order; South Norwalk, Conn., Electric Light Company, one 20 x 18 four-valve high-speed engine, arranged for direct connection to Ft. Wayne generators, being the fifth order from this company within five years; Equitable Life Insurance Company, Boston, one 14 x 16 high-speed engine; Merrimack Manufacturing Company, Boston, one 12 x 12 high-speed engine; *Commercial Tribune* Building, Cincinnati, Ohio, one 24 x 18 four-valve high-speed engine arranged for direct connection to Triumph generator; Republican Smelting & Reduction Company, Leadville, Colo., one 11 x 12 high-speed engine, arranged for direct connection to Milwaukee generators; Trow Printing & Publishing Company, one 12 x 12 high-speed engine direct-connected to Bullock generator; National Electric Supply Company, Washington, D. C., one 10 x 10 engine direct-connected to Crocker-Wheeler generator for a fort.

A CAR LOAD OF WATTMETERS.—We have received a photograph representing the recent shipment of a carload of electricity wattmeters (some 1,400 in number) by the Stanley Instrument Company, Great Barrington, Mass., through Messrs. John Martin & Co., of San Francisco, Cal., its Pacific coast agent, to the Edison Electric Company, Los Angeles, Cal. The shipment, intended for the equipment for measurement of current used in the comparatively small installations of general house lighting aggregates, however, a total capacity of upwards of 3,000 hp, and while the instruments are small, the total weight of the shipment was nearly 40,000 pounds. The destination, Los Angeles, Cal., indicates the widespread use of electrical apparatus of the highest class. The wattmeters of the Stanley Instrument Company, besides being shipped to all parts of the United States, have been sent for years to South America, Mexico, Porto Rico, etc., and since the beginning of this year, when an office was established at No. 23 Boulevard des Italiens, Paris, France, a brisk demand for its wattmeters has arisen in France, Italy, Switzerland, Germany, Austria, Hungary, England and the British possessions.

GISHOLT MACHINE DEVELOPMENT.—The Gisholt Machine Company, of Madison, Wis., has recently amended its articles of incorporation, increasing its capital to $750,000. Up to the present time the Gisholt Company has confined itself almost exclusively to the manufacture of the now well-known "Gisholt" lathe. These tools are made in several varieties and sizes, and the line is being constantly extended. The increasing business in lathes has necessitated a very considerable increase in the manufacturing facilities of the company, and additions have recently been made, both in buildings and equipment, that will double the former capacity of the plant. While the new buildings and equipment will be largely used for producing "Gisholt" lathes, they will, in part, be used for the manufacture of other types of machine tools, such as boring mills, etc. The last-named machines, however, will not be manufactured on a large scale until new buildings now in contemplation are completed. Contracts have recently been made by the Gisholt Company for a large new foundry, to be equipped throughout with modern up-to-date appliances. The buildings will be strictly fire-proof.

EXPORTS FOR THE YEAR.—The fact that the exports of the United States in the fiscal year just ended are greater than those in any preceding year except 1000, lends special interest to a statement presented by the Department of Commerce and Labor through its Bureau of Statistics, which shows the relative growth of the export trade of the principal countries of the world for a term of years and compares that of the United States with other countries. The table in question shows the total value of exports of domestic products from the principal countries of the world in 1870, 1880, 1890, and the latest available year approximating 1902-3. A study of this table of exports from the principal exporting countries of the world shows facts of especial interest to the people of the United States. One of these is that the United States, which occupied fourth place in the list of exporting countries in 1870, now shows a larger total in the final period which represents the latest available year than does any other country of the world, viz.: 1,392 million dollars. The United Kingdom is 1,379 millions and Germany 1,113 millions.

NERNST LAMP PLANTS.—The New Jersey Zinc Company, of Hazard, Pa., is supplying current for the Nernst lamps recently installed in an adjacent silk mill at Palmerton, Pa. Not only is the uniform distribution of light from a plane above the eye of advantage to the employees in the very trying work incidental to the handling of silk, but the total absence of flicker and shadow, together with the daylight quality of the light, is of great assistance in determining the proper colors to be used in the various processes of manufacture in this industry. The Chicago office of the Nernst Lamp Company reports that the Illinois Steel Company, of South Chicago, has recently illuminated its draughting room exclusively with the three-glower lamps, doing away with all desk lights, thereby gaining a superior distribution, as well as a superior quality of light for the use of its employees in the exacting work of tracing and draughting.

TRANSMISSION IN MADRAS.—With regard to the power transmission plant installed by the General Electric Company at Cauvery Falls, in the native State of Mysore, India, of seven units of 750 kw each to transmit power current 92 miles to the Kolar gold fields, Mr. W. T. Fee, United States Consul at Bombay, writes: "So well have the mining companies of the Kolar gold fields been pleased with the use of the electrical power, and so greatly has the output of the mines been increased thereby, that they recently made application to the Mysore government for the delivery on the gold fields of an additional 2,000 horse-power, and that government has now placed orders with the company who supplied the initial plant for the generating and transforming apparatus necessary to deliver this extra power.

EDISON STORAGE BATTERY.—In a recent interview, Mr. T. A. Edison spoke very hopefully of work on his storage battery, a set of which has recently been put on a dry goods delivery wagon in New York City. In the official test made of the new battery in the delivery wagon at Altman's, the books showed that the old lead battery weighed 1,260 pounds and had a maximum of 25 miles, while the Edison battery which replaced it weighed 650 pounds and drove the wagon 36.8 miles. Besides which, the old battery occupied 12.8 cubic ft., while the Edison took up only 8.5 cubic ft. The battery has also been doing good work, it is said, in runs from Orange to Atlantic City and back.

HYDRAULIC PLANT FOR MEXICAN MINES.—The United Mexican Mining & Exploration Company, in which Henry S. Mackay is primarily interested, has been granted a concession by the Mexican authorities permitting of the utilization of the water power that can be generated through the damming of the Rio del Fuerte, amounting, according to the latest estimates, to a minimum of 3,000 hp and a maximum of 5,000 hp. This power it is proposed to use for the operating of the important Realitos mining property located in the district of Andres del Rio, State of Chihuahua, which the United Mexican concern has just bought at a cost of some $2,500,000.

RICH COPPER IN MEXICO.—The official newspaper of the State of Mechoacan, Mexico, which is published under direction of the Governor, says that the most extensive and richest bed of copper ore in the world has just been discovered near the town of Tinguindon, in that State. The ore bed has been examined by mining experts, and it is said to cover an area of 125,000 acres. Fourteen veins have been located. One vein is 200 meters wide and more than 20,000 meters long, extending on the surface of the soil. The discovery was made by J. Ciceron Castillor, who has applied to the government for title to the property.

ELECTRIC RAILWAY FOR MEXICAN COPPER MINES.—The Greene Consolidated Copper Company, 377 Broadway, New York, is about to build an electric road between its Ronquillo mines and La Cananea, State of Sonora, Mexico. The distance is about 2½ miles. Power will be derived from the 2,100-hp plant which the company has just installed. Electricity is utilized to operate practically everything on the property. The engines are from the Union Iron Works, San Francisco. The generators are General Electric. The plant is expected to be added to in the near future.

EQUIPMENT FOR KEIHIN TRACTION COMPANY.—The Japanese house of Mitsui & Co., 445-447 Broome Street, has just placed a contract for trucks and motor equipments for use in the Keihin Traction Company's system, between Tokio and Yokohama. Ten trucks have been ordered from the Peckham Manufacturing Company. The General Electric Company secured the contract for motor equipments. Each truck will have four motors of 50 hp capacity. The car bodies will be built in Japan.

WATSON STILLMAN MACHINERY FOR GERMANY.—The Watson Stillman Company, 204-210 East Forty-third Street, New York, has secured a cable order from Germany calling for the shipment of twenty medium sized hydraulic presses. Seventy presses are to be installed in the Glen Cove (N. Y.) plant of Fayerweather & Ladew, 91 Liberty Street, New York. With a view to securing larger capacity the Watson-Stillman people contemplate the erection of a large factory in New Jersey.

KELLOGG TELEPHONE STRIKE.—The strike situation at the factory of the Kellogg Switchboard & Supply Company, Chicago, is improving. Acknowledging their inability to force the company to accede to the demands of its striking employees, the teamsters have formally withdrawn from the struggle, and the former is again in a position to receive raw material and ship freight. The unions of all the trades involved in the strike have, however, decided to continue the present struggle; and the Federation of Labor has voted to assess its 300,000 members 5 cents each monthly while it runs the strike.

VARIOUS EQUIPMENTS FOR CHINA.—Fearon, Daniel & Co., of China, New York offices 90-96 Wall Street, received several orders by last mail for equipment for Shanghai for use in connection with the electric lighting system of the foreign settlements. The orders call for several standard motors of one and three hp; five machines for 25-light circuits; constant-current transformers; series-alternating arc lamps, with all accessories; portable indicating wattmeters, etc.

MONTEREY ELECTRIC TRACTION PROJECT.—The Mexican Mining & Exploration Company, whose head offices are in Washington, D. C., proposes to furnish the necessary capital for the construction of an electric traction system in the Mexican city of Monterey and vicinity. Later the system may be extended to a number of other small towns in the outlying regions. Power to operate the system it is proposed to derive from San Juan River.

LIGHTING A COUNTRY CLUB.—The Country Club, of Newton, Mass., believes in keeping up-to-date in respect to methods of illumination used. The beautiful quality of the light disseminated by the Nernst lamp, as well as the pleasing distribution, has resulted in the installation of a large number of single-glower Nernst lamps for lighting the club-house throughout, and great satisfaction is expressed with the results obtained by this innovation.

THE ISAAC LEISY BREWING COMPANY, of Cleveland, is making an interesting installation by replacing an old equipment consisting of 125-volt generators with a 100-kw and a 50-kw, Westinghouse 125-250-volt, three-wire engine-type generator. The change is being made to effect the double purpose of obtaining 220 volts for running the motors and 110 volts for use in connection with its arc and incandescent lighting.

THE NATIONAL MINING COMPANY, of Pittsburg, Pa., has recently added to its electrical equipment one 13-ton Baldwin-Westinghouse locomotive; two Westinghouse 200-kw, 500-volt, 200 r.p.m., engine type generators, connected to Buckeye engine; one Westinghouse 20-kw, 125-volt, 390 r.p.m. engine type generator, connected to Westinghouse standard engine, and the usual switchboard, etc.

ELECTRIC MACHINERY COMPANY, of Minneapolis, Minn., have been installing an electric light plant in the Donaldson Glass Block, that city. The dynamo they have built for the purpose is a direct-current, ten-pole, 110-120 volts, 100 r.p.m., with a normal capacity of about 500 hp. It was designed by Mr. James T. Boustead, superintendent of the company's mechanical department.

HYDRAULIC PLANT FOR MEXICAN MINES.—Contracts will shortly be let for the construction and equipment of a large hydraulic plant to generate energy to operate Las Dos Estrellas, one of the principal mines in the El Oro district, Mexico. The plant is to be built on the Cienega River, Tlalpujahua, close to the mines. The initial capacity of the plant will be about 1,500 hp.

GENERAL ELECTRIC EQUIPMENT FOR BURMAH RAILWAY SHOPS.—The General Electric Company has secured a contract for the electrical equipment of the Insein shops of the Burmah railways. The machinery will furnish energy for both light and power purposes. The "punkah" hand-driven fans are to be replaced by up-to-date Yankee electric fans.

ELECTRIC SUPPLIES FOR THE PHILIPPINES.—Paul S. Carter, the United States purchasing agent for the civil government of the Philippine Islands, is at present purchasing considerable quantities of electrical supplies, etc. His offices are on the fifth floor of the new Whitehall Building, New York.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, of Rochester, N. Y., and Chicago, Ill., has recently sold a 400-capacity new style generator call visual signal switchboard with complete protective apparatus to the Geiger Telephone Company, Churubusco, Ind.

General News.

THE TELEPHONE.

DENVER, COLO.—The Colorado Telephone Company's new headquarters on Champa Street have been opened.

DENVER, COLO.—The Colorado Midland Railroad is rapidly completing its private telephone system along the road. The line is now in operation between Denver and Leadville and will soon be in operation as far as Grand Junction.

DENVER, COLO.—In response to a request of the public utilities committee of the charter convention, the Colorado Telephone Company has submitted a report showing returns on invested capital. The report shows a capitalization of $5,000,000; issued capital, $3,400,000. The investment in plant and real estate up to January 1, this year, was $3,623.56; gross earnings for the year $1,083,037.43; expenses $771,231.34. The net profit for the year in this State was $311,806.09. The net earnings for the year upon the actual investment in the plant, says the report, was only a trifle over 9 per cent. This is taken as an argument against municipal ownership of public utilities.

SUEZ, ILL.—The Suez Mutual and Greenwood Telephone Exchange has 90 subscribers and four trunk lines. A new metallic switchboard is to be put in.

WARRENSBURG, ILL.—The Warrensburg Telephone Company has 200 subscribers and a 50-drop board. It has 100 miles of toll line, its rates being $12 per year.

RUSHVILLE, ILL.—The City Council has revoked the franchise of the Western Illinois Telephone Company and has ordered the company to remove its plant within ten days. The telephone company has employed counsel.

FLORA, ILL.—The new rural telephone line extending south-east of this city and covering portions of Clay and Wayne counties has been opened for business. The line which was built expressly for the farming communities will be followed by the construction of other lines, with Flora as the center of the system.

CORYDON, IND.—The Indiana Home Telephone Company has been granted a franchise over the highways of Harrison County.

EDINBURG, IND.—The Citizens' Telephone Company operates a 300-drop board, and has 280 subscribers and 28 miles of toll line.

LAPEL, IND.—Messrs. E. A. Tull & Co. operate the telephone station here. They have a 200-drop board with 200 subscribers. They purpose connecting all farms within a radius of four miles from town.

BROWNSTOWN, IND.—The Brownstown Telephone Company purchased this business last September and since then has added another 100-drop board and about 65 new subscribers. There are now a 200-drop board and 200 subscribers.

HALL, IND.—The Hall Mutual Telephone Company has a 25-drop board and 45 subscribers. The prospects are good as lines are being built all the time connecting with other lines giving patrons connections with about 2,000 telephones.

INDIANAPOLIS, IND.—The Central Union Telephone Company, which recently moved its general offices from Chicago to this city, is now running its shops and supply department from Chicago to a building on West Maryland Street, in this city.

EVANSVILLE, IND.—During the recent excitement and incidents relative to the riot that occurred in this city, the long-distance telephone company handled at least half of the business of correspondents of the newspapers in Indianapolis, Cincinnati and Louisville.

INDIANAPOLIS, IND.—The Carthage Telephone Company has filed articles of incorporation. It will build telephone lines and exchanges in Rush, Henry, Hancock and Shelby counties. The capital stock is $10,000. The principal office and exchange will be in Carthage. Van Hood, F. W. Cregor, L. A. Hood and M. A. Greager are the promoters.

TORRES, MEX.—A new telephone line has been constructed between this place and Campo Santo Nino.

CHIHUAHUA, MEX.—A movement has been inaugurated here looking towards the organization of a new telephone company to put in a telephone system in competition with that of the existing company.

CULIACAN, MEX.—An extensive telephone system is to be established in this state by a company which has been organized for that purpose. The first long distance line to be constructed will be between this city and the port of Mazatlan.

SALTILLO, MEX.—John Woessner, of this city, who is at the head of a syndicate which obtained a concession from the Mexican Government for the establishment of toll telephone lines and local exchanges throughout Mexico, says that good progress is being made in the construction work. The first section of the toll lines is now in operation between Torreon, Gomez Palacio and Lerdo and is being rapidly extended to Saltillo, Monterey and Durango.

PLAINFIELD, MICH.—The Michigan Telephone Company has a 10-drop board, three subscribers and five miles of toll line. The Rural Telephone Company and the Livingstone County Telephone Company are connected with this office.

PLAINVIEW, MINN.—The Greenwood Prairie Telephone Company has a 110-drop board and 300 subscribers, with 50 miles of toll line. The monthly rental is $1.00, $1.50 and $2.00.

MORRIS, MINN.—The Stevens County Telephone Company operates a 250-drop board at Morris; 25 at Hancock; 30 at Chokio and 25 at Cyrus, with 275 subscribers in all. There are 40 miles of toll line, and rural lines will soon be built.

MONTEVIDEO, MINN.—The Citizens' Telephone Company has a 300-drop board and 250 subscribers. It has recently built a brick central station and put in some cable, and is now building farmers' lines. As soon as present improvements are completed, 300 more subscribers are expected, there being a great demand for farmers' telephones.

PALMYRA, MO.—The Palmyra Telephone Company operates a 200-drop board, has 158 subscribers and 150 miles of toll line.

POPLAR BLUFF, MO. The Poplar Bluff Telephone Company operates a 400-drop Eureka switchboard, with 400 subscribers. There are 35 miles of toll line.

SENECA, MO.—The Seneca Telephone Company operates a 110-drop board, with the same number of subscribers, and 50 miles of toll line. The rates are $12 and $24.

LA PLATA, MO.—The La Plata Telephone Company gives service to 175 subscribers at $12 per year. It has also 75 miles of toll line and operates a 200-drop board.

MOUND CITY, MO.—The telephone exchange here has doubled its capacity within the past year. It has a 200-drop board and 350 subscribers, city and party lines; also 10 miles of toll line.

LIPTON, MO.—The Lipton Telephone Company operates a 200-drop board, has 148 subscribers and 20 miles of toll line. Farmers' lines average 900 calls daily. The company intends rebuilding.

OREGON, MO.—The Oregon & Forest City Telephone Company operates a 200-drop board with 260 subscribers and 50 miles of toll line. A switchboard of 400 drop capacity is to be installed.

NOVINGER, MO.—The Novinger Telephone Company has a 200-drop board, 75 subscribers and 55 miles of toll line. Several more lines are to be built, and a great deal of work is projected for this season.

GALLATIN, MO.—The Daviess County Telephone Company gives good service to 500 subscribers and operates a 300 drop board. There are 80 miles of toll line. The territory hereabouts is pretty well covered.

LADDONIA, MO.—The Laddonia Telephone Company is now putting in a new metallic system, and building two farmers' lines. It operates a 100-drop board, has 65 subscribers and 16 miles of toll line. Rates are $15.

LEBANON, MO.—The Ozark Telephone Company has just increased its capital stock from $6,000 to $12,000, and is rebuilding and enlarging its exchange for an increase of 50 per cent. more business. It has a 200-drop board, 225 subscribers and 105 miles of toll line.

WEATHERBY, MO.—The De Kalb County Mutual Telephone Company has 100 subscribers and 600 miles of toll line, with four wires to the pole. The annual dues are $3. The company started with $5,000 capital. It now has $25,000 paid up, and has bought and placed 17 switchboards in De Kalb county. The main office is at Maysville, Mo.

PLYMOUTH, OHIO.—An ordinance has passed providing for an issue of $4,000 bonds for the purpose of building a municipal lighting plant.

ELYRIA, OHIO.—The Elyria Home Telephone Company has purchased a new building and will install a new central-energy board to accommodate 2,000 patrons.

CECIL, OHIO.—The Cecil Telephone Company has been incorporated with $10,000 capital stock. The incorporators are S. E. Demuth, W. A. Weaver, William Green, Boyd Randolph and C. H. Weaver.

BUCYRUS, OHIO.—Dr. J. A. Chesney has succeeded E. Blair as president of the Bucyrus Telephone Company. J. C. F. Hall has been elected secretary-treasurer and A. J. Unger, manager of the company.

LA RUE, OHIO.—The La Rue Telephone Company has been chartered under West Virginia laws, with a capital of $50,000. The incorporators are J. H. Leonard, C. F. Stoll, M. A. Taylor, W. F. Kniffin and W. F. Johnson, of La Rue.

JACKSON CENTER, OHIO.—The Jackson Center Telephone Company has increased its capital stock from $12,000 to $25,000. It is planning a number of extensions. W. H. Fledderjohann is president, and J. P. Zehner general manager of the company.

MT. VERNON, OHIO.—The Mt. Vernon Telephone Construction Company has been organized with $5,000 for the purpose of building telephone lines in Knox County. E. W. Breece, C. E. Painter, E. O. Arnold, P. S. Kelser and H. C. Devin are the incorporators.

DELAWARE, OHIO.—The Citizens' Telephone Company is planning extensions to its exchange. The company is building a large number of farmers' lines throughout the country and is installing branch exchanges at Lewis Center, Ostrander, Leonardsburg and other neighboring towns.

CLEVELAND, OHIO.—The Federal Telephone Company has extended its option on the stock of the Columbus Citizens' Telephone Company from July 1 to September 1. The option provided for the sale by the Federal Company of its holdings in the Columbus Citizens' to Columbus parties at $60 per share. The option also extended the right of the Federal Company to buy back 2,000 shares of the Columbus stock which was sold to Columbus parties some time ago at $45.

PIQUA, OHIO.—Representatives of the telephone companies in Champaign, Miami, Logan, Shelby, Darke, Auglaize and Union counties met at Piqua recently and formed an association for the purpose of perfecting better traffic arrangements for the handling of toll business in this district. These officers were chosen: L. M. Flesh, Piqua, president; C. H. Marvin, Urbana, vice-president; A. J. Hess, Sidney, secretary-treasurer. Another meeting will be held in Piqua in September.

EL PASO, TEX.—The Southern Independent Telephone Company will have its system here completed and in operation within ninety days.

SARATOGA, TEX.—The Beaumont-Northwestern Telephone Company is establishing a telephone exchange here. It will open about August 1 with 250 subscribers.

HOUSTON, TEX.—It is reported that the Southwestern Telegraph & Telephone Company has purchased the telephone system of the Citizens' Telephone Company in this city. It is stated that the latter company has ceased construction work.

SPOKANE, WASH.—The Trades Council has instructed all union men to order their telephones taken out unless the telephone company accedes to the demands of the striking telephone exchange girls.

SPOKANE, WASH.—Doerr, Mitchell & Co., are making an effort to secure a franchise for an independent telephone system in this city. It is proposed to place the wires underground and to extend the lines into the farming districts.

SPOKANE, WASH.—Being unwilling to submit to the company's rule forbidding the telephone operators to dispense with neck ribbons or to wear their hair low on hot days, eighty of the telephone girls have gone out on a strike. The trades council is assisting the girls and an effort is being made to have all the union men take out their telephones. The places are being filled by other girls and the service continues in operation.

ELECTRIC LIGHT AND POWER.

GADSDEN, ALA.—It is reported that Capt. W. P. Lay intends to utilize the water power developed on his recently purchased property on Wills Creek for furnishing electric power to Gadsden, Attalla and Alabama City. It is his intention to construct a plant on Big Creek to develop 500 horse power.

GRAND VIEW, ARIZ.—The Grand Canyon Company of this place has had estimates made on the cost of a power plant that may be established at Mooney Falls, on Cataract Creek, about forty miles from the mine. The establishment of an electrical generating plant for that place for the purpose of affording power for the operation of the mine here is contemplated.

MAYER, ARIZ.—The sub-station of the electric transmission line which is being built in this section by a company of which Mrs. I. E. Tutt is vice-president and general manager, will be located here. The proposed power plants of the company will be located on Fossil Creek, in Yavapai County. According to the statements of the promoters of the project 6,000 horse power is to be developed in two plants, one of 2,500-hp and the other of 3,500-hp. A number of tunnels, ditches and flumes are to be constructed. The transmission lines are to run to Mayer, Portland, Prescott, Jerome and other mining and industrial centers. The several lines will each be 50 to 75 miles long.

IDAHO SPRINGS, COLO.—The rate war that has been in existence in Idaho Springs for the last two years on incandescent and arc-light service is at an end. The fight has been between the electrical department of the Gem Extension Mines Company, Consolidated, and the Canada Electric Company which receives its power from the United Light & Power Company, of Georgetown. The competition brought the rates for incandescent lighting down to as low as 10 cents a month per incandescent lamp, but an agreement has now been reached and equitable rates restored.

BARNESVILLE, GA.—Bonds have just been sold, the proceeds to be used for an electric light plant and to improve the water works.

CONYERS, GA.—The question of constructing an electric light plant and water works is under consideration. John H. Almand is mayor.

BARNESVILLE, GA.—Bids will be received Aug. 3 by the City Council for furnishing apparatus and supplies for the municipal electric light plant, including one 100-kw alternating current generator, one exciter for same, one 150-hp high speed engine, one 150-hp Corliss engine, one 150-hp closed feed-water heater, etc. J. A. Blalock is City Clerk.

JERSEYVILLE, ILL.—A deed of trust for $15,000, given by the Jerseyville Light, Heat & Power Company to William Morgan Hand, has been filed.

PLYMOUTH, ILL.—The Plymouth Gas, Light & Fuel Company has been incorporated, with a capital of $30,000, by John B. Bowell, Prosper A. Ball, Chas. A. Wallace, and others.

ALTON, ILL.—The City Council has authorized the drawing of a ten-year contract with the Alton Railway, Gas & Electric Company for lighting the city streets. The proposition is to install 160 2,000-cp open arc lamps, at $69 per light per year.

WABASH, IND.—A. S. Maltby has submitted his report to Council on the proposed electric light plant. He estimates the cost of constructing a plant here as $41,000.

BURLINGTON, IA.—The Council has under consideration an ordinance providing for the placing of all wires underground.

GUTHRIE CENTER, IA.—The contract for the construction of the municipal electric light plant has been awarded to the Rock Island Electric Construction Company, of Rock Island, Ill. The plant will have a capacity of 2,000 lights and will cost $20,000.

DANVILLE, KY.—An election will probably soon be held to vote on the question of constructing an electric light plant to cost about $30,000.

VIDALIA, LA.—An election will be held to vote on issuing bonds for an electric light plant and water works.

WILLIAMSTOWN, MASS.—The trustees of Williams College are reported to be considering the construction of an electric light plant.

FALL RIVER, MASS.—The Board of Aldermen has passed an ordinance providing for the establishment of a municipal electric light plant.

FORD, MICH.—The Michigan Electric Company, of Detroit, has secured the contract for an electric light system for $3,337.

BADAXE, MICH.—Bids will be received July 30 by George W. Clark, Village Clerk, for $11,750 bonds for electric light and water works extension.

SAN BLAS, MEX.—H. B. Masset, who is said to represent a syndicate of California capitalists, has been investigating the situation here with the view of establishing an electric light plant and street railway system.

VICTORIA, MEX.—An American company recently sent a representative to this section to investigate the feasibility of establishing an electric power plant on some of the rivers that flow through the region between here and the Gulf coast. It is stated that an abundance of water power is available on some of these streams and that it is the intention of the company, if the report of its expert is favorable, to utilize this for generating electrical energy that will be supplied to this city and to mines and ranches for commercial and industrial purposes.

FT. SNELLING, MINN.—C. F. McBride, of St. Paul, is stated to have secured the contract for an electric light plant at $19,276.

MERIDIAN, MISS.—It is stated that the Meridian Light & Power Company will erect at once a new brick power house and install new machinery, at a cost of $100,000. The contract for boilers has been let. Ford, Bacon & Davis, 149 Broadway, New York, N. Y., are the engineers.

SEWARD, NEB.—The citizens have voted to issue $7,000 bonds for an electric light plant.

LINCOLN, NEB.—T. K. Craven, of Bloomfield, has filed with the State Board of Irrigation a petition for permission to use the waters of the Niobrara just above its confluence with the Missouri to develop power for street railways and electric lighting.

LAS VEGAS, N. M.—It is reported that the Las Vegas & Hot Springs Electric Railway, Light & Power Company proposes to construct a lighting plant at a cost of about $28,000.

AKRON, N. Y.—Contracts for lighting this village by electricity have been awarded to the Niagara Engineering Company, which will do the line construction work. The Ft. Wayne Electric Company will install the dynamos and station equipment.

PORT DICKINSON, N. Y.—The George O. Moon Power Company has been organized to build a dam across Chenango River at Port Dickinson, from which about 400-hp will be developed for the operation of an electric power and lighting plant for Port Dickinson and the furnishing of power for the mills and elevator of G. O. Moon & Co., Binghamton. Walter C. Moon is president.

BURLINGTON, N. C.—It was voted, July 14, to issue bonds for an electric light plant.

BURLINGTON, N. C.—The town of Burlington has voted $18,000 bonds for an electric light plant to be owned and operated by the city.

DAYTON, OHIO.—The Citizens Heat, Light & Power Company has applied for a franchise for lighting the streets of Dayton. H. J. Myers is president and general manager.

BAKER CITY, ORE.—The plant of the Baker Gas & Electric Company, which was recently destroyed by fire has been entirely rebuilt, including the installation of a new Nordberg-Corliss and 200-kw generator and the erection of a new building. The new plant was operating in 38 days from the time the old plant burned. T. B. Whitted, consulting engineer of Denver, Colo., had charge of the installation of the new equipment.

BAKER CITY, ORE.—The Rock Creek Power & Transmission Company has recently let contracts and is beginning the installation of a 1,000-hp water power plant on Rock Creek, 16 miles from Baker City. The plant will consist of two 400-kw three-phase alternators, driven by De Remer water wheels under a 940 ft. head, switchboard, step-up and step-down transformers and a 16-mile transmission line. Power will be supplied to the Baker Gas & Electric Company and to mines in the vicinity. Water will be carried to the power station through a 1¾ mile flume and a 2,600 ft. riveted pipe line. The transmission will be made at 22,500 volts over No. 6 bare copper wires. T. B. Whitted, of Denver, Colo., is the consulting engineer and contractor for the entire plant with the exception of the flume and building. It is expected that the plant will be in operation by January 1 next.

MONTREAL, QUE.—The Montreal Light, Heat & Power Company, which recently secured a monopoly of all the water power around Montreal by purchasing the Lachine Hydraulic & Land Company, announces that an increase in the price of electricity will be made. All existing contracts will be cancelled and when the new contracts are made a discount of only 10 per cent. will be allowed on one year contracts, and 15 per cent. on five-year contracts will be allowed instead of 33⅓ per cent. discounts.

TRENTON, TENN.—On August 12 the town of Trenton will vote on the question of issuing bonds to purchase the local electric light plant and put in an up-to-date system.

BRENHAM, TEX.—William Perry, general superintendent of the electric light plant here says that the plant is to be improved and its capacity increased.

WACO, TEX.—The preliminary steps have been taken looking to obtaining power from the Brazos and Bosque Rivers at points near here to be utilized in generating electrical energy to be distributed throughout Central Texas. The enterprise is being promoted by the Business Men's Club, of Waco, which is co-operating with the citizens of other localities of this region. The local committee which has charge of the matter consists of J. T. Davis, Bart Moore, R. T. Dennis, C. M. Hobby, T. N. McMullen, Jr., William Cameron and C. W. Hobson.

PALOUSE, WASH.—The City Council has granted D. G. Klinefelter, of Shelton, Wash., a 25-year electric light franchise.

NEENAH, WIS.—The Wisconsin Traction, Light, Heat & Power Company will petition the Council of Neenah and Menasha for electric light franchises.

INDEPENDENCE, WIS.—Contracts for constructing the electric light plant have been awarded as follows: Electric equipment to the Ft. Wayne Electric Works, Ft. Wayne, Ind., for $2,998, and steam plant to the Crowley Electric Company, Duluth, Minn., for $3,050.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—Work has begun on changing the Powderly-Bessemer line of the Birmingham Railway, Light & Power Company from steam to electricity.

NORWICH, CONN.—It is reported that the controlling interest in the Norwich Street Railway Company and the Montville Street Railway Company, which has been held by Tucker, Anthony & Co., of Boston, has been purchased by Stillman F. Kelley, of that city.

ATLANTA, GA.—The committee on roads and bridges has recommended that right of way be granted to the Piedmont Electric Railway Company which proposes to build a road from Atlanta to Rosewell.

ROCKFORD, ILL.—The Interstate Electric Railway Company, of Rockford, has been incorporated, with a capital of $50,000. The incorporators and first board of directors are N. F. Thompson, M. A. Beal, E. H. Keeler, H. N. Starr, R. G. McEvoy, all of Rockford.

OTTAWA, ILL.—All the property of the Ottawa Railway, Light & Power Company has been sold to Rollins & Sons, the Boston bankers, who hold all the outstanding bonds of the company. The price paid was $160,000. It is understood that the purchasers will at once proceed to make many improvements in the road.

BELLEVILLE, ILL.—Articles of incorporation have been filed by the Southern Illinois Electric Railroad Company, capitalized at $50,000. The principal office of the company will be at Mount Vernon, Ill. The incorporators are J. R. Pierce, G. F. M. Ward, Sam Casey, Louis G. Pavey, Samuel T. Maxey and A. N. Johnson.

BLUFFTON, IND.—The Muncie, Hartford & Fort Wayne Interurban Railroad Company has bought ground to be used as a location for the power plant and car houses at Bluffton.

SOUTH BEND, IND.—The Hobart & Western Interurban Company, under the name of the Indiana Northern, has obtained a franchise through South Bend and St. Joseph County to the Laporte County Line.

INDIANAPOLIS, IND.—The Indianapolis & Southwestern Electric Railway, the new Martinsville line by the way of Waverly, is to be constructed by the Interurban Railway Construction Company, of Indianapolis, which has been incorporated, with $10,000 capital stock. F. E. Bakeman, W. S. Taylor, Mrs. Jean Brudi, W. G. Wagenhals and O. M. Murphy are the directors.

NEW ALBANY, IND.—The stockholders of the New Albany Street Railway Company, at their annual meeting, elected the following board of directors for the ensuing year: Samuel Insull, of Chicago; R. W. Waite, James W. Dunbar, Louis Hartman and Alexander Hartman, New Albany. Samuel Insull was elected president; Louis Hartman, vice-president; R. W. Waite, secretary and treasurer.

INDIANAPOLIS, IND.—Work on the Indianapolis, Danville & Rockville Traction Company's line, which will reach the Parke County coal fields, will begin this month, according to the announcement of President Fauvre, of the Indianapolis & Eastern, of which the new road will be an extension. The Danville Construction Company, which is to build the road, has been incorporated with $100,000 capital. F. M. Fauvre, John W. Chipman, Melford B. Wilson, Ansel Fatout and C. E. Morgan are directors. The distance between Indianapolis and Danville is 20 miles.

ARDMORE, I. T.—The Ardmore Coal & Power Company has applied to the City Council for a franchise to construct an electric railway here.

WICHITA, KAN.—The Arkansas Valley Interurban Railway Company has been chartered to build an electric railway from Wichita to Arkansas City. The total length of the line will be 83 miles. The main power station will be at Oxford, where it is believed there is sufficient water-power to run the whole line, unless it may be a month or two in summer, when they will possibly need a small steam plant as an auxiliary. The water-power is to be taken from the Arkansas River, which it is estimated will furnish 2,200-hp at ordinary low water, and 1,500-hp is the amount estimated to run the road. The company is capitalized at $1,000,000. The officers of the company are O. A. Boyle, president; William Allison, vice-president; J. E. Howard, secretary; C. L. Davison, treasurer. All the officers are residents of Wichita.

FRANKFORT, KY.—W. S. Louge, of Cleveland, Ohio, said to be representing Pennsylvania capitalists, has purchased a twenty-year franchise for the operation of an electric street passenger and express railway here.

THIBODAUX, LA.—It is said that work will soon begin upon the proposed third-rail electric railway between Thibodaux and Donaldsville and the important towns down the Gulf Coast. The road will be 124 miles long. C. P. Young is said to be the principal promoter of the project.

FITCHBURG, MASS.—The Leominster, Ayer & Shirley Street Railway will be built from North Leominster to Ayer this year. The line is nine miles long. It is also stated that the Lowell & Ayer Street Railway, in which the same persons are interested, will also be built this year.

MINNEAPOLIS, MINN.—Henry C. Hanke and Edwin J. Forster have petitioned the County Commissioners for a franchise for the construction of an electric railway from Minneapolis through Robbinsdale, Osseo and Champlin to Anoka. It is the intention of the promoters to connect with the Twin City Rapid Transit Company's line now running to Robbinsdale.

LINCOLN, NEB.—Articles of incorporation have been filed for the Sioux City, Homer & Southern Railway. The capital stock is fixed at $500,000, although the articles provide for an increase to $1,000,000. The incorporators are largely Sioux City and Omaha people, including Senator Joseph H. Millard, Postmaster Crow and J. B. Haynes, of Omaha; R. A. Talbot, of Sioux City, and R. S. Hall and C. J. O'Connor, of Homer.

CHARLOTTE, N. C.—It is reported that Washington, N. C., Kinston and Greenville will be connected by an electric railway and that Upshur & Co., of Philadelphia, will underwrite it.

ALBANY, N. Y.—The Albany & Hudson Railway Company has secured permission from the State Railroad Board to issue $150,000 in bonds for making improvements to its line.

ALBANY, N. Y.—The opposition to the building of the Albany-Catskill Electric Railroad has been withdrawn. The road will begin construction next Spring. The distance is about 35 miles.

NEW YORK, N. Y.—The contract for sinking the Weehawken shaft of the Hudson River Tunnel of the Pennsylvania Railroad has been filed in the Hudson County Clerk's office at Jersey City. The contracting parties are the Pennsylvania and New Jersey & New York Railroad Companies and the United Engineering & Construction Company, of New York. The work is to be completed by Dec. 8, 1903, the contractors to forfeit $250 for each day's delay.

ROCHESTER, N. Y.—The Monroe County Belt Line, owned by the Rochester, Syracuse & Eastern Railroad and built through the village of Fairport, has elected officers as follows: Andrew H. Brown, president; De Witt C. Becker, vice-president; Merton E. Lewis, secretary; Percy R. McPhail, treasurer; Andrew H. Brown, of Despatch; Percy R. McPhail, Charles T. Chapin, Merton E. Lewis, of Rochester; William Nottingham, of Syracuse; Walter A. Paroe, of Fairport, directors.

COHOES, N. Y.—At a meeting held at Crescent, N. Y., for the purpose of forming an electric railway company to connect Schenectady and Cohoes by trolley the following board of directors was selected: William K. Mansfield, E. H. Stiles, D. C. Fry, Peter Smith, Freeman Guyer, James A. Buck, E. H. Shear, R. E. Dedrick, C. L. Van Slyke. Subsequently the board of directors elected the following officers: President, James A. Buck; vice-president, Wm. K. Mansfield; secretary and treasurer, R. E. Dedrick. Steps will be taken at once to secure the right of way and franchise, and it is expected that active operations will be commenced in the near future.

DAYTON, OHIO.—The Lebanon & Franklin Traction Company has increased its capital stock from $10,000 to $160,000.

DAYTON, OHIO.—The Dayton & Southern Railroad Company has increased its capital stock from $10,000 to $150,000. M. L. Mourer is president and F. E. James, secretary.

COLUMBUS, OHIO.—The Scioto Valley Traction Company has increased its capital stock from $1,000,000 to $3,000,000. W. F. Burdell is president of the company, and E. R. Sharp, secretary.

LOGAN, OHIO.—The Lancaster, Logan & Nelsonville Traction Company has filed papers of incorporation with a capital stock of $10,000, the incorporators being A. Magoon, J. W. Jones, D. A. Bannells and others.

TOLEDO, OHIO.—The Findlay, Fort Wayne & Western Railway has been sold at Master's sale at Ottawa to Judge J. J. Moore, of New York, who, it is said, represented the Cincinnati, Hamilton & Dayton Traction Company, which has been in control of the property for the past year.

CLEVELAND, OHIO.—The Kingsville & Southern Railway Company, of Cleveland, has been incorporated, with $20,000 capital stock, by E. F. Pegg, L. E. McAuley, F. M. Nowak, C. W. Sailtzer and Thos. H. Bell. The company plans to build an electric railway from Kingsville to North Kingsville.

NAZARETH, PA.—The Town Council has granted a franchise to the Easton & Belvidere Electric Railway Company.

HUMMELSTOWN, PA.—The Borough Council has granted a franchise to the Palmyra & Hummelstown Electric Railway Company.

SCRANTON, PA.—A route has been surveyed for an electric railway from Scranton to the summit of Bald Mountain, and a charter will soon be applied for. Local capitalists are backing the venture.

POTTSTOWN, PA.—It is reported that the Pottstown & Reading Street Railway has closed all contracts for material, and that the construction of the road, which will form the connecting link by electric railway between Philadelphia and Reading, will be started at once.

CORRY, PA.—The Erie, Cambridge, Union & Corry Traction Company has purchased the abandoned Clark & Warren refinery site, where its power house and car houses will be built. This road has accepted the local franchise, and cars will probably be running between Corry and Erie by July, 1904.

LEGAL.

TELEPHONE TAXES.—In a recent case before the Supreme Court of New Hampshire, between the New England Tel. & Tel. Co. and the city of Manchester, it was held that real estate owned by a telephone company and used in its ordinary business is not subject to taxation by the town in which it is situated; being already taxed by the state board of equalization. In 1901 the state board of equalization, acting under chapter 64 of the Public Statutes, determined the value of the plaintiff's property in this state for purposes of taxation to be $320,000, and assessed a tax thereon of $5,408, which sum was paid to the state treasurer. In the same year the assessors of Manchester assessed a tax upon the plaintiffs' real estate on Concord Street, and payment of the same was demanded. A petition for abatement was seasonably filed and denied. March 8, 1902, the plaintiffs under protest paid to the city the sum of $256.26, as the amount of the tax and interest thereon.

NEW INDUSTRIAL COMPANIES.

THE ELECTRIC RUBBER MANUFACTURING COMPANY, of Jersey City, has been incorporated, capital, $1,000,000. Incorporators: Charles H. George, Smith J. Mullin, William O. McCarthy.

THE ST. LOUIS AUTOLECTRIC COMPANY, St. Louis, Mo., has been incorporated with a capital stock of $4,000, fully paid. The shareholders are S. H. Wheelhouse, E. V. P. Ritter and R. F. Goodnow.

THE GILL ELECTRIC COMPANY, of New York, has been incorporated with a capital stock of $100,000. The directors are C. P. Gately, of Mamaroneck; E. R. Gill, of Yonkers, and C. D. Wood, Jr., of Brooklyn.

THE LAMPSON ELECTRICAL INDICATOR & ADVERTISING DEVICE COMPANY, of New York, has been incorporated with a capital of $25,000. Directors: R. D. Lampson, Meyer Michael and E. C. Stoddard, New York.

THE WORLD'S FAIR AUTOMOBILE COMPANY filed articles of incorporation at St. Louis, with a capital stock of $600,000, full paid. Thomas J. Hoolan, Charles M. Polk, T. J. Flanagan, Lawrence W. Day, Spencer L. Finley, A. L. V. Mueller, James C. Espey, James Axtell, Michael Hurst, Charles Vastine and H. F. Simon are the incorporators.

THE ZAHN ELECTRIC COMPANY, located at 203 North 11th Street, St. Louis, Mo., has been formed with a capital of $5,000, paid up. Mr. William G. Zahn is president and general manager, Mr. William L. Howard, secretary. The company was incorporated for the purpose of buying and selling electrical machinery and supplies and doing a general contracting business.

OBITUARY.

MR. RALPH LAZARUS, of Columbus, Ohio, a director in both the local electric lighting and street railway companies died in that city on July 25. He was 52 years of age and as a hotel manager and business man had acquired a large fortune.

MR. R. H. FOERDERER.—Congressman Robert H. Foerderer, of the Fourth Pennsylvania District, died at his home in Torresdale, a surburb of Philadelphia, on July 26. He had been ill for some time from a complication of diseases. Mr. Foerderer was born in Germany in 1860 while his parents were sojourning in Europe. He was elected to the Fifty-seventh Congress as a Congressman-at-Large and re-elected to the Fifty-eighth Congress from the Fourth District of Philadelphia. He was a large manufacturer of leather and was president of the Keystone Telephone Company, of Philadelphia, whose large independent system has been described in these pages. He was also very greatly interested in electric traction developments in Philadelphia.

MR. C. A. MORSS.—Advices from Boston, Mass., state that Mr. Charles Anthony Morss, president of the Simplex Electrical Company, died suddenly on July 27, of heart disease. He was born in Boston on October 15, 1822, and his ancestors on both sides were among the original Puritan settlers of Newburyport. Soon after leaving school Mr. Morss entered the wire business with a firm occupying the same Cornhill Building which for nearly sixty-five years had been his own headquarters. He was identified with the Old South Church as a member of its standing committee. His wife and four sons survive him. For many years past he has been through the Simplex Company identified prominently with electrical wire insulation and electric heating interests.

MR. GEORGE A. COOKE.—We regret exceedingly to record the death at Oak Park, Chicago, of Mr. George A. Cooke, son of Mr. and Mrs. W. J. Cooke. This promising young engineer, whose father is so well known in the electric and street railway field from his connection with the McGuire Truck interests in Chicago, was brought up at Oak Park in the public and high school. Deciding to obtain training as a mechanical and electrical engineer he then began a special course of training in Chicago, and later pursued a course at Purdue University. With characteristic energy and ambition he immediately began what he hoped to make his life work, with the Westinghouse Company, and for a time was located at Toledo, Ohio, the former home of his family, in the construction of an electric railway where he had a great deal to do with the construction of the feeder conduits, etc. From overwork and exposure his health became impaired. After spending a winter in Florida he seemed entirely restored, and resumed work in Toledo, where he met with signal success. As the result of a severe cold he was compelled to go to Arizona for a winter. Later he went to California, and then for a year to Honolulu. During these years, while seeking restoration by change of climate, he persisted in business activity, engaging in the installing of mining and electrical apparatus. After a severe illness last winter he went back to Oak Park, and for five months made a brave fight for life. He was a fine type of young American manhood with all its capability, push, energy, cheerfulness and determination to win. He was a member of the First Presbyterian church, and leaves a wide circle of friends who mourn his loss and extend heartfelt personal sympathy to the bereaved parents and sister.

PERSONAL.

MR. FREDERICK C. MOTT has taken charge of the Eastern office of the American Conduit Company at 170 Broadway, New York.

MR. GEORGE YOUNGMAN has gone into the electrical supply business at Portsmouth, Ohio, and will do general electrical contracting work.

GENERAL A. W. GREELY, head of the U. S. Signal Corps, has sailed for Berlin to attend the international wireless telegraph conference at Berlin on August 4.

MR. GEORGE L. COLGATE, electrical engineer, resigned recently from management of the Batavia, N. Y., electric lighting system, and has been visiting New York City in regard to various engineering matters.

PROF. A. J. WOOD, of Delaware College, Newark, Del., has been visiting friends in New York and vicinity and making arrangements for lecture courses, etc. A new power plant is being put up at the College, and probably current will be received from one of the new transmission plants within the state.

MR. JAMES S. FEARON, head of the house of Fearon, Daniel & Company, of China, New York offices 90-96 Wall Street, which concern purchases considerable electrical equipment, supplies, fans, etc., for the Far East, particularly for shipment to the Shanghai municipal council, is now on his way to New York from China. He is expected to arrive here about the middle of next month.

PROF. A. E. KENNELLY, head of the electrical department of Harvard University, was married on July 22 to Miss Julia Grice, at Boston, Mass. They are now upon their honeymoon trip somewhere on the North American continent and will be at home after November 1 at 12 Hawthorne Street, Cambridge, Mass. A host of friends and admirers extend their heartiest congratulations and good wishes.

MR. J. L. CONWAY, who has been in charge of one of the divisions of the construction work for the Guanajuato Power & Electric Company, has taken a position with the Mexican Light & Power Company. This concern, it will be recalled, is to build an initial plant of 28,000 hp capacity at Necaxa for the purpose of developing current for transmission to Mexico City, some 90 miles distant. Mr. F. S. Pearson is primarily interested. The New York offices of the company are at 29 Broadway.

MR. U. N. BETHELL.—It is announced that James E. Mitchell, president of the Bell Telephone Company of Philadelphia since 1895, has tendered his resignation at a special meeting of the board of directors last week. Mr. U. N. Bethell, of New York, was elected to succeed him in this important capacity. Mr. Bethell is general manager of the New York Telephone Company and before being given charge of the Philadelphia territory was entrusted with that of the Potomac Bell Company. Not many years ago Mr. Bethell was a government clerk in Washington studying hard at law in his spare hours.

MR. J. K. ROBINSON, of Iquique, Chili, who represents the Westinghouse interests in Chili, etc., and who has been in the States for several weeks past, sailed for Colon July 27, but expects to return to New York within a fortnight. He went south so as to meet his wife and family who have left Chili owing to the plague. They will come back to New York with him. Shortly after his arrival here he expects to place further important contracts for the electrical equipment of Chilian nitrate plants. Mr. Robinson, while here, will make his headquarters at the offices, 116 Broad Street, of the William E. Peck Company.

MR. JAMES H. WHITE, one of Thomas A. Edison's foreign representatives, is recovering from an operation performed at the Orange Memorial Hospital by Dr. William Graves, of East Orange, which consisted of the removal from his skull of a piece of glass a quarter of an inch thick and about half an inch square. It became lodged there over three years ago, while Mr. White was superintending a reproduction of the battle of Spion Kop on Orange Mountain for an Edison moving picture machine. Mr. White acted as a Boer general and during the fight a bottle of powder exploded and showered him with fragments of glass.

MR. CLOYD M. CHAPMAN, who has been developing Thomas A. Edison's dry gold separating process, has gone to Australia to install a separating plant there. When the news of Mr. Edison's separator was announced, it was read by an Australian mining engineer in San Francisco, who was in this country to secure mining machinery. Mr. Edison's scheme appealed to him; he visited the plant in West Orange, and as a result a separator was built for him and shipped to Australia. London engineers who have tested the gold deposits upon which the separator is to work are said to think that they may prove to be the greatest in the world.

MR. ADOLPH M. BARRON, a well-known consulting engineer, at present the president of the New Albany Water Works Company, of which he is also a director, as well as being interested in an official way with a Chicago syndicate of power, light and heating interests at Jeffersonville, Franklin, Worthington and Bloomington, Ind.; St. Ann, Mt. Vernon and other points in Illinois, finds South Bend not central enough for operations. He has left for Indianapolis at the syndicate's request, to make that a center for operations. From there, among other things, he will direct the location and erection of a central power plant at some of the great bituminous coal mines, which will utilize the slack and refuse coal, too small to be utilized in shipment. This fuel will cost but very little, there will be no transportation charges and great results are expected. Power will be furnished at a radius of 100 miles it is is said.

MR. J. S. BADGER, general manager of the Brisbane Tramways Company, Brisbane, Australia, is visiting the United States. As many of our readers will recall, he was one of the pioneers in the electric railway business in this country, and supervised the installation of a number of the early roads for the Sprague and Edison companies. He went to Brisbane from Schenectady, N. Y., about seven years ago to install an electric tramway system in that city, and was appointed general manager. He left Brisbane on May 18 as a delegate to the Fifth Annual Convention of the Chambers of Commerce of the British Empire from the Brisbane Chamber to attend the Convention in Montreal, September 17 to 20. He also expects to attend the convention of the American Street Railway Association in Saratoga. Later on he proposes to visit London, where are the headquarters of the Brisbane Tramways Company. He will then return to Brisbane via New York.

COL. N. H. HEFT.—Taking a step already forenoted in these columns, Col. N. H. Heft has resigned from the presidency of the Stamford Street Railroad Company, which is owned by the New York, New Haven & Hartford Railroad, and the directors elected H. M. Kochsperger as his successor. Col. Heft will resign also from the presidency of the Meriden Street Railroad, which is controlled by the Consolidated, and again Mr. Kochsperger is to be chosen to succeed him. The action taken means that there is to he a closer union in operation between the New Haven Railroad system and the street railway lines it controls. Col. Heft's retirement is due to a desire for a long vacation in Europe. He retains his interest in the New York & Stamford Railroad Company, of which he is a director. Col. Heft is the originator of many extensions and improvements which are now under advisement, including an arrangement whereby the Consolidated will operate an electric suburban system from New York to Stamford, having trains from there to connect with the elevated system at 129th Street and the subway at 177th Street. He has had a great deal to do with pioneer third rail work in this country.

EDUCATIONAL.

STANFORD UNIVERSITY, CAL.—Prof. F. G. Baum, of Stanford University, California, reports that this year's electrical graduates there are: A. S. Kalenborn, who has secured a position with Westinghouse, Church, Kerr & Co., New York; A. J. Pahl, with the Westinghouse Co., at Pittsburgh; J. P. Jollyman, with the Valley Counties Power Co., at Ninishen, Butte Co., Cal.; A. O. Austin and R. J. Hughes with the General Electric Co., at Schenectady.

LEHIGH UNIVERSITY.—The department of physics and electrical engineering at Lehigh University has been re-organized with Prof. W. S. Franklin in charge of physics and Prof. W. Esty in charge of electrical engineering. Prof. Franklin is a graduate of the University of Kansas of the class of '87 and pursued graduate study in physics at the University of Kansas, at the University of Berlin, at Harvard University and at Cornell University. He was five years in charge of physics and electrical engineering at Iowa State College and he has been for six years in charge of physics and electrical engineering at Lehigh University. Prof. Esty is a graduate of Amherst College, of the class of '89, and of the Mass. Inst. of Technology of the class of '92. He was one year with the General Electric Company, at Lynn, Mass., and eight years at the University of Illinois as instructor and as assistant professor of electrical engineering, and he has been two years assistant professor in the same capacity at Lehigh.

LEHIGH UNIVERSITY.—The following are the graduates at Lehigh University in 1903, in electrical engineering, with the positions taken by them: J. J. Cort, Interborough Ry. Co., New York City; A. J. Diefenderfer, Electrical Inspection Bureau, New York City; S. W. Goldschmidt, General Electric Co., Lynn, Mass. C. B. Graham, Westinghouse, Church, Kerr & Co., Ry. Dept.; C. F. Hinckle, Jr., General Electric Co., Schenectady, N. Y.; R. Hunt, Consolidated Light, Ry. & Power Co., Wilmington, N. C.; C. E. Marks, General Electric Co., Schenectady, N. Y.; C. L. H. Ruggles, Capt. Ordinance Dept., U. S. A., Watertown Arsenal; R. N. Skillman, Fort Wayne Electric Works, Fort Wayne, Ind.; N. A. Wolcott, Electrical Engineer of the New York & Ohio Co., Warren, O. The past year has been a prosperous one for the department. It has been able to add by purchase and by gift a large number of new dynamos, motors, transformers, and meters to its equipment. The alumni have been more than usually active in co-operating to replace the apparatus and library destroyed by fire three years ago.

Trade Notes.

THE MARION INSULATED WIRE & RUBBER COMPANY, Marion, Ind., has completed plans for the erection of a new factory.

NERNST LAMPS.—Some time ago Swift & Company made a trial test of the Nernst lamp in their temporary office buildings. This test has proved so satisfactory that they are now installing about seven hundred of these illuminants, of the three-glower type, in their new office building at the Union Stock Yards, Chicago.

THE IDEAL ELECTRIC & MANUFACTURING COMPANY, recently organized at Mansfield, Ohio, to manufacture electrical goods, has commenced work on a factory building 100 x 65 feet and two stories high. Later it will build a power house.

STORAGE BATTERIES FOR ISOLATED PLANTS.—The application of storage batteries to isolated plants is the subject of Bulletin No. 79 recently issued by the Electric Storage Battery Company, Philadelphia. The particular plant represented in this bulletin is that in the Ferguson-McKinney Building in St. Louis, Mo. The subject is well illustrated with large half-tone cuts.

CONNECTICUT TELEPHONES.—Owing to the increased demand for "Connecticut" apparatus, the Connecticut Telephone & Electrical Company, Inc., of Meriden, Conn., has been obliged to print another edition of its new catalogue. This company has just purchased a new building in order to enlarge its capacity, which became necessary owing to the increasing demand for its products.

THE HELIOS-UPTON COMPANY has moved to Garden and Bridge Sts., Bridesburg, Philadelphia. It has obtained possession of a large and commodious plant and will consolidate its Chicago and Peabody factories with the Philadelphia factory, which was formerly at 1229 Callowhill St. This new arrangement will give the company superior facilities for manufacturing its line of arc lamps, storage batteries, telephone protectors, switches, etc.

DIRECT CURRENT ENGINE TYPE GENERATORS.—Circular No. 1033 of the Westinghouse Electric & Mfg. Company, is devoted to direct current engine type generators for lighting and power. The illustrations show the various parts in detail, and complete machines as set up for operation. The final pages give complete dimensions of machines ranging from 5¾ kw to 1,050-kw.

THE L. B. ALLEN CO., of Chicago, manufacturer of soldering sticks, soldering paste, salts, etc., and maker of commutator compound, has issued a very neat reminder of itself in the form of a 12-inch rule on folding cardboard. It is a very convenient device for those who have frequent use for a rule and desire one that will go into the pocket.

GERMAN ELECTRIC HOISTS.—The Gesellschaft fur Elektrische Industrie of Karlsruhe, Germany, sends us two catalogues relating to electrical hoists, which are excellent specimens of trade publications. The text and numerous illustrations are printed on toned backgrounds, the text in the more comprehensive catalogue being in German, French and English in parallel columns. An unusually extensive line of cranes is made by this company, both for direct and alternating current and all details appear to have been worked out with great skill.

STRUCTURAL IRON WORK.—In a 24-page catalogue, just issued, the Berlin Construction Company, Berlin, Conn., gives 20 full-page half-tone views of structures erected by it. Each illustration typifies a distinct class of structural work. The list embraces buildings of a large variety, roofs and bridges. The final pages of the catalogue contain a partial list of the company's customers. Besides its facilities for manufacturing steel work for buildings and bridges of all descriptions the company is prepared to contract for the design and erection of complete plants, ready for the installation of machinery.

TOWER-BINFORD ELEC. MFG. CO., Richmond, Va., has issued an excellent and surprisingly large catalogue of its products. It has 68 pages, and all the articles shown are of its own manufacture with the exception of the I. T. E. circuit breakers and the D. & W. renewable plug fuses, cases and cartridge fuses—which fit in with the other lines. Among the novelties and improvements shown are the Regina knife switch, the tank alarm, theatre switchboards, panel boards and other switches, all of which have some new feature of design or construction. These products are illustrated in the catalogue and are seen to be well thought out and of substantial construction.

LONDON TRANSPORTATION.—Every American city is interested in the solution of London's greatest problem—the question of transportation, the daily handling of its millions of street car passengers. How the London County Council, backed by a Royal Commission, is grappling with the problem of locomotion, seeking a wise adjustment of surface traffic and underground systems, is a story full of suggestion to every other great municipality in the world. The record of past methods and of achievement up to date is fully set forth by F. A. Acland, in *The Booklovers Magazine* for August, together with an account of large ideas projected or already in process of realization. Numerous illustrations and a map of Central London's underground system help to make the situation clear.

AIR BRAKE EQUIPMENTS.—The Westinghouse Traction Brake Company reports the following sales of street car air brake equipments, all being provided with motor-driven compressors. Five equipments to Evansville & Princeton Traction Co. Seven equipments to Wooster & Southbridge St. Ry. Co. Eight equipments to Concord & Manchester St. Ry. Co. Twelve equipments to Concord Street Railway Co. One equipment to Holland Palace Car Co. for use on electric sleeper. The company has also recently equipped a number of cars with its magnetic brake and car heating apparatus. The following is a list of some of the roads to whom this apparatus has been sold: Pennsylvania & Mahoning Valley Ry. Co., of New Castle, Pa., equipments for 16 cars. Morgantown Electric & Traction Co., equipments for 12 cars. Washington & Canonsburg Ry. Co., Washington, Pa., equipments for 15 cars. Altoona & Logan Valley Electric Ry. Co. equipments for 8 cars.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 21, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

733,468. ANNUNCIATOR; Francis W. Dunbar, Chicago, Ill. App. filed May 27, 1901. (See page 184.)

733,643. ELECTROLYTIC APPARATUS; Leo Gurwitsch, Kiew, Russia. App. filed Nov. 10, 1902. (See page 185.)

733,782. TELEPHONE-LINE CONTACT APPARATUS; Joseph P. Werner, Cliftonforge, and William H. Silvey, Lowmoor, Va. App. filed Feb. 21, 1903. (See page 184.)

733,948. MAGNETO-ELECTRIC MACHINE; Daniel Drawbaugh, Eberlys Mill, Pa. App. filed Jan. 12, 1903. The machine embodies an automatic cut-out which breaks the circuit at the point in the rotation of the armature where the potential is at the maximum; it is designed to avoid the use of Rhumkorff coils for sparking purposes.

733,951. CURRENT REGULATOR; James P. Erie, New York, N. Y. App. filed Dec. 9, 1901. Means for breaking the circuit simultaneously at a number of points in series, thereby distributing the sparking over a number of points and reducing it at a particular pair of contacts where sparking is undesirable.

733,952. BRUSH SUPPORT; James P. Erie, New York, N. Y. App. filed Dec. 9, 1901. Details.

733,971. LIQUID RHEOSTAT OPERATED BY COMPRESSED AIR; Koloman De Kanto, Budapest, Austria-Hungary. App. filed May 25, 1901. A throttle valve which controls the pressure of air operating a rheostat, is itself automatically controlled by the current in circuit with the rheostat.

733,977. MASSAGE APPARATUS; Francis G. Lagerstrom and Andrew G. Anderson, Salina, Kansas. App. filed March 30, 1903. A hollow rolling sphere containing a battery whose poles are connected with various insulated segments in the surface of the sphere.

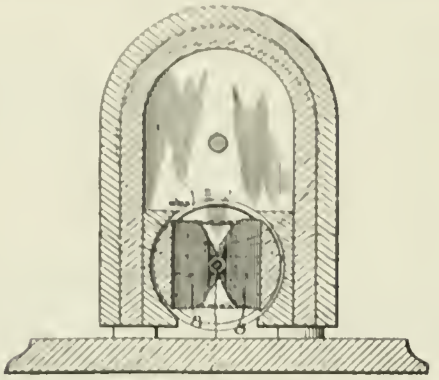
733,997. SAFETY DOOR SWITCH; Elden R. Renfrow, St. Joseph, Mo. App. filed Nov. 26, 1902. A connection between an elevator door and an electric switch rendering it impossible for the door to be open and the car at the same instant in motion.

734,046. RETURN CURRENT CIRCUIT BREAKER; Cummings C. Chesney, Pittsfield, Mass. App. filed July 18, 1902. A mechanism is used which is entirely controlled by currents flowing in the main distribution circuit and is entirely independent of the electromotive force upon the line, thus avoiding the use of a potential transformer or a shunt circuit on high potential systems.

734,[illegible]. THERMOSTATIC ALARM; Jules L. Fortin, Montreal, Canada. App. filed Nov. 30, 190[illegible]. A liquid is confined in one end of a pivoted tube by the fusible plug, when the plug is melted, the liquid flows to the opposite end causing the tube to swing on its pivot and close an alarm circuit.

734,090. GUARD FOR FLEXIBLE CONDUCTORS; George R. Pindott, Chicago, Ill. App. filed June 25, 1902. A bell-shaped collar attached to an incandescent lamp socket to prevent sharp bends in the flexible conductor and also serving as a trap for moisture.

734,098. ELECTRIC SWITCH; John J. Ruddick, Newton, Mass. App. filed Oct. 15, 1900. A trolley wire switch consisting of a box applied to the wire and containing the switch mechanism from which a tappet projects into position to be struck by the wheel to throw the switch.


733,948.—Magneto Eectric Machine.

734,178. MOTOR CONTROL; John D. Ihlder, Yonkers, N. Y. App. filed Sept. 9, 1902. Controlling means for an elevator motor connected to operate under control of the armature potential for de-energizing the series field when the motor reaches substantially full speed.

734,197. INDUCTION COIL; Charles F. Splitdorf, New York, N. Y. App. filed May 19, 1903. The secondary is divided into two separate coils spaced apart and embracing the primary, each coil being housed in a separate casing.

734,227. GUARDING APPARATUS FOR VEHICLES OR MOVABLE STRUCTURES; Isaac Frank and Joseph Hutchison, New York, N.Y. App. filed Jan. 24, 1903. An electrical alarm apparatus placed upon a vehicle to indicate when the vehicle is being carried away by unauthorized persons.

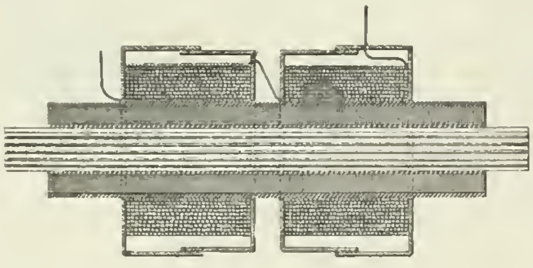
734,267. CONDUIT THREADED DEVICE; Arthur H. Knott, Milwaukee, Wis. App. filed Dec. 18, 1902. Details.

734,297. PAPER FEEDING MECHANISM; John Burry, Ridgefield Park, N. J. App. filed April 13, 1900. Paper feeding mechanism for printing telegraphs consisting of a spring-actuated feed device and variable escapement mechanism for controlling the rotation of the paper holder in order to give a uniform feed.

734,298. ELECTRIC ILLUMINATION FOR RAILROAD CARS; Max Buttner, Deutsch Wilmersdorf, Germany. App. filed April 25, 1902. A train lighting system in which a resistance in series with the lamp is maintained at such a temperature that any increase in the current causes a corresponding increase in the resistance and thus maintains a constant candle power.

734,305. PROCESS OF PRESERVING BEER; Francisque Crôtte, New York, N. Y. App. filed Jan. 19, 1900. (See page 185.)

734,310. COIL FOR DYNAMO ELECTRIC MACHINES; Hermann F. T. Erben, Schenectady, N. Y. App. filed April 19, 1902. Heavy field coils are built up of flat wire wound edgewise and with their terminals bunched and secured together.


734,197.—Induction Coil.

734,312. APPARATUS FOR THE ELECTROLYTIC DECOMPOSITION OF ALKALI CHLORIDS; Charles Fournier, Geneva, Switzerland. App. filed June 25, 1902. (See page 185.)

734,341. ELECTRIC SIGNAL; Henry L. Lee, Timpas, Colo. App. filed Aug. 5, 1902. A circuit closed for a railway signal constructed to be applied at any desired point to the rail and embodying a tappet which is struck by the car wheel to close the circuit.

734,353. ELECTRIC CLEANING KNIFE; Frank Nettleton and Edward R. Dempsey, Philadelphia, Pa. App. filed Feb. 24, 1903. A handle carrying an electrically heated blade to be used for burning off the fur and hair from hides and skins.

734,366. ELECTRIC CLOCK; Henry Rempe, Danville, Pa. App. filed July 2, 1902. Details.

734,169. MEANS FOR TRANSMISSION OF MOTION OR ROTATING PARTS; Carl F. Rodde, Berlin, Ger. App. filed Nov. 24, 1899. Mechanism for transmitting rotary motion comprising a rotary member, a plurality of circuits, means for impressing upon one of said circuits dependent upon the position of the rotary member, oppositely directioned currents of different potentials, means for suppressing the currents in one direction, and mechanism for translating the resulting unidirectional current into rotary motion proportional to the movement of said rotary member.

734,187. ELECTRIC HAMMER; Albert J. Woodworth, Sparrows Point, Md. App. filed Nov. 6, 1902. The momentum of the hammer on its upward stroke is utilized to produce the initial motion of the hammer on its downward stroke and electrically controlled means are used to accelerate the hammer and increase the rapidity and force of the blow.

734,389. SECONDARY ELECTRIC CLOCK; Theodore H. Wurmb and Robert Baumann, St. Louis, Mo. App. filed May 11, 1903. Details.

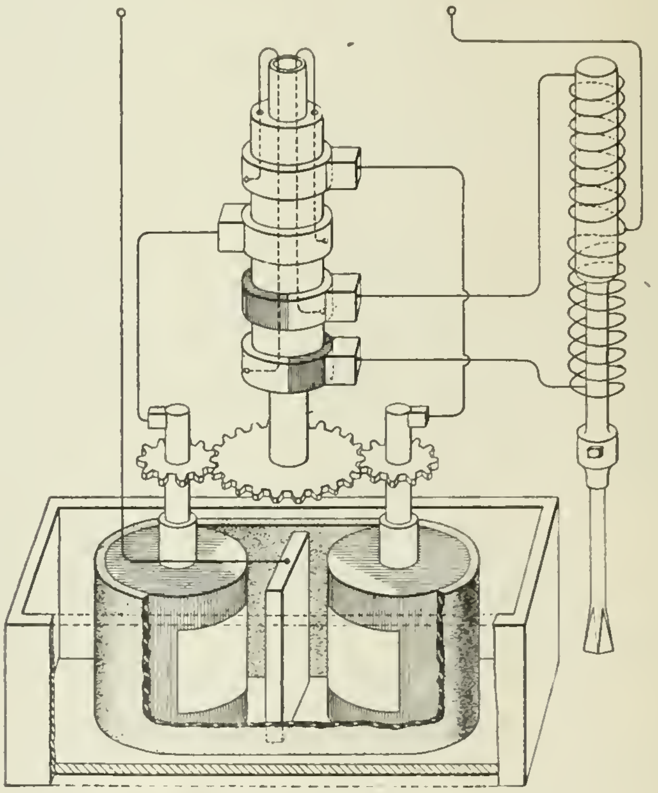
734,402. ROTARY EXTENSION BELL SWITCH; George E. Cork, Packerton, Ind. App. filed Sept. 6, 1902. A switch applied where two telephone lines terminate and only one telephone and an extension bell are in use, the purpose being to switch the telephone to either line and keep the extension bell on the line to which the telephone is not connected.

734,407. CIRCUIT TERMINAL FOR FUSES; Louis W. Downes, Providence, R. I. App. filed March 21, 1903. Details of a clamp to hold the end of the fuse tube.

734,424. COMMUTATING AND CURRENT SHAPING DEVICE; Frederick H. Loring, Chester, England. App. filed March 4, 1903. An apparatus for shaping or modifying the form of an electric current comprising a conducting fluid, electrodes and an insulating body immersed therein and adapted by their relative movements to periodically vary the area of electrode surface exposed to the fluid and thereby vary the current.

734,438. VOLTAGE REGULATOR; Charles E. Skinner, Wilkinsburg, Pa. App. filed Nov. 13, 1902. A main transformer one of whose windings has a plurality of leads extending therefrom to a series of contact terminals and an auxiliary winding also having leads extending therefrom to a suitable switching device and which has its end terminals connected to contact devices for making engagement with the contact terminals of the main transformer winding.

734,442. TROLLEY; Harry Spurrier, Montreal, Canada. App. filed Oct. 2, 1900. A trolley provided with means for automatically causing its wheel to turn and meet the curves of the trolley wire simultaneously with the turning of curves in the rails by the car.


734,424.—Commutating and Current Shaping Device.

734,450. STATIC MACHINE; Henry E. Waite and Harry F. Waite, New York, N. Y. App. filed April 4, 1903. Provision for mounting any number of plates upon an axis.

734,456. AUTOMATIC BRIDGE FOR ELECTRICAL LOOP LINES; George E. Brett, Philadelphia, Pa. App. filed Oct. 23, 1902. A simple form of main line circuit closer combined with main and loop line terminals so that it will be readily accessible to the lineman and can be handled by him without risk.

734,476. ART OF TRANSMITTING INTELLIGENCE; Harry Shoemaker, Philadelphia, Pa. App. filed Jan. 8, 1903. An instance of the use of the Poulsen telegraphone as a receiving, recording and reproducing device for the signals in wireless telegraphy.

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THE ELECTRIC LIGHT INDUSTRY.

The United States Census Office has issued this week a preliminary report on the figures which it compiled last year of the electric light industry in this country. These figures come in due sequence after those of the electrical manufacturing industries and the street railways, and will be succeeded by those on telephony and telegraphy. When the series is complete, at no very distant period, the public will be in possession of a body of most valuable data in regard to the new arts that have so distinguished the last fifty years, and whose exploitation has been so peculiarly a feature of American industrial advance. The great bulk of this data is, in fact, now collected for the first time, so that even here it is difficult to institute comparisons; while unfortunately hardly any country in Europe has yet begun to take statistical note in the same manner of anything but the governmental telegraphs and telephones. However, it may readily be believed that the example of the United States will be strongly stimulating in this respect, and that ultimately uniform methods will prevail for the collection of these important data throughout the civilized world, whose conditions are now being so markedly shaped by electrical influences.

The figures now published show 3,619 central station systems, with $502,000,000 invested, earning $85,145,423 a year, with expenditures of $67,688,075, inclusive of $12,501,045 interest on bonds, or exclusive of the interest, the expenditures were $55,187,030. This would show operating expenses of about 64 per cent. The figures of municipal plants are too small to disturb the general averages, but taking the private plants alone, it would appear that the $480,161,038 invested in them earns gross $78,180,318, with expenditures $50,445,848, exclusive of interest on bonds. This, it will be seen, works out at about 62 per cent. operating expenses, and shows a net of $27,734,470, or a return on bonds and stock capital invested of a little less than 6 per cent. Postponing further consideration of the other interesting data presented by the Census Office, it may here be noted that these figures do not by any means reveal the true extent of electric light and power development in America, for they do not include any isolated plants. In a city like New York there are hundreds of such plants, many of remarkable magnitude, and the country over there are probably not far from forty or fifty thousand of them—just how many will not be known until the next general census. It is sometimes assumed that all the isolated light and power plants equal in investment and capacity the central stations, and it is doubtless not far from the mark to say that electric light and power in this country reaches a total capitalization of $1,000,000,000, for it must also be borne in mind that thousands of buildings now have supply of current where the cost of installation has been met entirely by the customer, who has no plant of his own, and depends upon the local central station.

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THE EFFECTS OF PLACING ALL CITY WIRES UNDERGROUND.

Only a few years ago the telephone, telegraph and electric lighting wires were all strung overhead, even in the largest cities. In New York City, for example, there once reigned a giant maze of overhead conductors in the principal thoroughfares. Owing to the accidents that occurred through frequent crosses, to the pressure of public opinion, and to the force of municipal ordinance, these wires have almost wholly disappeared from view, and have been buried underground, except in certain districts or public byways, where overhead wires are less objectionable. It made but little difference to the electric light wires, from the operative standpoint, whether they went underground or not. The telegraph wires suffered to some extent by the transfer, but the telephone wires and systems suffered most of all.

The objection to underground wires does not lie solely in the expense of the transfer. A single overhead wire is far cheaper to install than a single underground wire. A dozen overhead wires are very considerably cheaper to install than a dozen underground wires. Two hundred overhead wires are, however, usually more expensive to install and to maintain than two hundred underground wires. The greater the number of wires to be run over the same route the relatively cheaper it becomes to place the wires underground. Consequently, the telephone engineer who carries a large number of wires along a given street is not likely to be perplexed by the necessity for burying the wires on the score of relative expense. The difficulty he experiences comes from the retardation and distortion of transmitted speech waves over the buried wires, owing to their greater capacity and resistance, together with their reduced inductance.

These conditions, taken with the ever-increasing areas of cities and the relatively great length of underground wires in cities, often bring on the result of imperfect communication between distant residents of the same city, owing to reaching the limits of effective length, or limiting distance of good speech transmission, with such buried wires in the city limits. Twenty miles of underground circuit in a city may give worse telephonic results than six hundred miles of overhead circuit. It is true that the modern method of loading telephone circuits either markedly increases the range or markedly improves the quality of telephonic speech; but even with the aid of loading, the constantly increasing lengths of underground wire connecting distant city exchanges make the problem of long-distance telephony continually more difficult to face.

PLOTTING OF SPEED-TIME AND SPEED-DISTANCE CURVES.

The article by Prof. L. A. Freudenberger, appearing on page 219 of this number, in extension of the valuable Great Barrington Institute paper of Mr. C. O. Mailloux, forms an interesting contribution to the subjects of electric railway kinematics in general, and of predetermining electric railway schedules, in particular. It affords independent methods of predetermining the speed-time and distance-time curves of an electric car, when the profile of the road, the characteristic curves of the car motors, and the weights of the car are given. The methods depend upon the facts that the velocity-integral of acceleration-reciprocal is the time of action of the acceleration; also that the velocity-integral of the velocity per acceleration is the distance through which the acceleration acts. The ordinary characteristic curves of electric railway motor performance give the relation between current and torque, and also the relation between current and speed. They contain, therefore, implicitly, if not explicitly, the relation between torque and speed. That is to say, for every steady speed of the motors there is a definite torque. This will be correct within commercial limits when the rheostat is cut out, and will also be correct when the rheostat is in circuit, provided that the current strength in the circuit remains constant.

It is shown that since the torque-speed curve is either given, or may be drawn from the motor characteristics, the total tractive effort or equivalent draw bar pull on the car at all speeds can be determined. By deducting the train resistance at various speeds, the residual accelerative tractive effort at all speeds becomes known. This gives the acceleration of the car at all speeds on a level track. The grades on the profile will increase or decrease these accelerations in known degree. With speeds as abscissæ, two curves can now be plotted, one a curve of reciprocals of acceleration and the other a curve of velocity divided by acceleration. The area enclosed by these curves with the base will then be the time and the distance respectively. The time will be the number of seconds required to attain the specified velocity, and the distance will be the number of feet run over from rest in reaching that velocity. Two new curves may now be drawn with the integrals thus obtained, and they will be the speed-distance and the speed-time curves of the run, respectively. The effects of curves and grades on the profile are included in the ordinary way.

The specific case computed deals with some observed cases of Mr. Mailloux taken under practical conditions. The speeds, however, reach sixty miles per hour, and the braking resistances have been extrapolated from speeds of fifty-five miles per hour from Mailloux's observations on braking at sixteen miles per hour. It is evident that experimental observations on braking electric cars at high speeds are much needed. The braking accelerations thus derived involve the second power of the velocity, as well as the first term and a constant. That is to say, the braking force is greater at high speeds than at low speeds, and increases faster than the speed. Even if this complexity be ignored, however, by taking the brake-retardation as constant, the error introduced into the results does not seem to be very serious. Whenever the labor of predetermining the schedule of an electric car from its motor characteristics is justified, there can be little doubt of the utility of these graphical methods of computation.

CURRENT CLASSIFICATION AND LITERATURE.

The report of the Committee on Current Classification and Nomenclature appointed by the American Electro-Therapeutic Association has been published this year, and forms a useful compendium in electrotherapeutic literature of definition. There are special reasons for seeking to define the various electric currents employed electro-therapeutically. In the first place, much confusion exists in the old textbooks on the subject, owing to misconceptions as to the nature and origin of electric currents. In the second place, the electric currents employed in electro-therapeutics are characteristic of the particular apparatus employed, and differ markedly in type from the electric currents used in other branches of applied electricity. Consequently, it is important to define and agree upon the terminology to be employed. Two distinct methods of classification have been adopted, viz.: one based on the source of the currents, and the other based on their type, or graphical representation.

On the former plan, currents are defined as voltaic, static, dynamic, dynamo-static, thermo, induced, reaction and shunted. This list seems to be satisfactory. The voltaic includes all battery currents or currents of electrochemical origin. It would not, however, include capillary currents or currents due to osmose. Consequently the term "endosmotic" might conveniently be inserted at this point to include electromotive sources of electrolytic nature other than electrochemical. Static currents are conveniently defined as currents obtained from electrostatic sources. When the electrostatic machine is a hydrostatic machine—a very rare practical condition—the currents might be aptly described as hydrostatic. Similarly the currents derived from a dynamo-static machine are described as dynamo-static currents. Induced currents are sufficiently definite and comprise several subdivisions, such as primary-induced, secondary-induced and static-induced. Reaction currents are less definite and seem to be the least desirable item in the category. Thus, a steady electromotive force connected through resistance to a vacuum tube may set up periodic pulsations of currents in the circuit, owing to the periodic breaking down of the dielectric within the tube. A pulsating electromotive force may thus be derived from the terminals of the tube, and a pulsatory current through any derived circuit therefrom. This type of current is defined as a reaction current under the classification named, for the reason that a vacuum tube may be regarded as analogous to a condenser, and a condenser possesses reactance in an alternating-current circuit.

With regard to the second method of classification—by reference to current type—an important distinction is made between direct currents and continuous currents. A direct current is virtually defined as a current whose direction does not change, but whose magnitude with respect to time is purely arbitrary. A continuous current is a direct current with the prescription in regard to magnitude that it shall always be different from zero. That is to say, it shall always flow in one and the same direction, although it need not be always of uniform strength. A uniform continuous current is defined as a constant current. All these definitions seem very good and should be generally adopted. There is perpetual confusion in electric literature between the terms continuous current and direct current. This is partly due to the influence of French literature, in which the continuous current is generally defined like the direct current above referred to. Pulsating, alternating and oscillating currents complete the list, all in conformity with established electrochemical practice.

ECONOMY OF ENERGY.

There are times when every thoughtful engineer turns his mind to the great and pressing problems concerning the visible supply of energy—problems of most serious import to the growth of civilization, and to the prosperity of mankind. The fact is that the world's supply of fuel, while far from being exhausted, is depleted to an extent that is already beginning to be felt, and will year by year be felt more seriously. True enough, the situation last season was abnormal, and will not soon be duplicated, but nevertheless it served to show how grave an industrial crisis could be precipitated by even a small shortage of the annual coal supply. The total consumption of anthracite in this country is less than 20 per cent. of the aggregate coal consumption, and there was by no means a complete stoppage of the anthracite output, and yet the small extra demand sent the price of steam coal skywards with appalling rapidity. Of course, in the anthracite field there is practically a close monopoly and the price can be and is often put as high as the public can be bullied into paying. But with soft coal the case is different, and although the evil effect of combinations is felt to a certain extent there is no real corner. And yet the price is forced up by the operation of ordinary economic laws, owing mainly to the great corner in anthracite. The result is that steam coal, the great general source of energy, shows every indication of steadily rising in price from now on. We fear that this increase will continue without a material break. Many electrical stations felt the pinch last year and they must look forward now to steadily increasing fuel bills. We of the modern world have used our material resources like besotted spendthrifts drunken with the wine of overbearing prosperity, and the day of reckoning is drawing near.

We need not fear for a century or two to come anything like absolute exhaustion of the coal supply, even of civilized and accessible countries, but we shall find in a decade or two, and even now catch here and there, such shortage in the coal supply as will greatly enhance the cost of fuel in every manufacturing industry. It therefore behooves the engineer to cast about for means of help, and the task though not a light one is not by any means hopeless. To begin with, the day has gone by in which there is any economic justification in using simple noncondensing engines for any serious work, unless in the rare case of burning waste material unusable otherwise. With coal at a dollar a ton or so, the temptation was strong to put in a plant cheap in first cost and to trust to the cheapness of the fuel to offset its uneconomical use. In some cases, indeed, the cheap plant actually showed the best economic results, but we do not hesitate to say to-day that almost any refinement of apparatus that will save fuel will pay, if not this year then next, or five years hence, certainly long before its useful life is ended. The company that builds to-day and puts in the most economical steam plant that money will buy, may be considered extravagant; but ten years from now it will be solvent, while the others will have gone into bankruptcy or reorganized. When hard times come, as they assuredly will before many years, it is the fellow with the smallest running expenses that will weather the storm. Watertube boilers, the best furnaces that can be planned, every device that can utilize the waste heat, triple-expansion condensing engines, or turbines if they can hold their own—every per cent. of efficiency that can be juggled out of engine and dynamo—any and every means of keeping down the fuel bill—is fully justified under the conditions which now seem inevitably approaching. High pressures and superheating are coming and recent results abroad show plainly that they will pay.

How near to a pound of coal per horse-power-hour the performance of a big engine in regular use may come is as yet undetermined; but unless we miss our guess that sort of economy will not seem so nearly unattainable ten years from now as it does to-day. It is difficult to say, too, what are the commercial possibilities of large gas engines. In theory they are very great, and surely if the gas engine can be made to double the thermodynamic efficiency of the steam engine, as seems possible, it must be taken very seriously as a future prime-mover. But we must not forget that for electrical purposes the real question is not alone engine performance, but the amount of saleable energy that can be extracted from a pound of fuel. It therefore behooves the engineer to get after the electrical losses as far as is possible. A recent report of the National Electric Light Association on which we commented at the time gave a vivid idea of the leaks that may exist between the switchboard and the returns from the consumer's meters. It pays in the long run to keep after these small, or sometimes large, losses. It is certainly well within bounds to say that in many a station to-day the output sold per ton of fuel consumed might be increased thirty per cent. without going into any questionable refinements. This increase is quite enough to make the difference between dividends and a receiver, and we will go still further any say that not a few stations will earn the latter before the former unless they realize the drift of events and study the business of power saving. We will not here speculate on the possibilities of replacing the use of fuel by water power, or wind power or sun power—these are questions not of to-day, but of a long to-morrow. But the fuel bill is imminent, insistent, not to be escaped, and those improvements which are able to lessen it are necessary improvements. In the power station the question no longer is how cheaply it can be built, but how cheaply it can be operated. If any step toward economy is advisable now, it will be absolutely necessary five or ten years from now, and electric power stations should be regarded at least in that degree as permanent investments.

Statistics of the American Electric Light and Power Industry.

The Hon. S. N. D. North, Director of the United States Census Office, has given to the press this week a preliminary report on the statistics of the electric light and power industry, as compiled by Mr. W. M. Steuart, chief statistician of the department of manufactures, Mr. T. C. Martin being special expert agent associated with the work. It will be remembered that the statistics of the street railway industry were similarly issued a few months ago, and that a bulky bulletin has just been issued on that subject. The figures of the telephone industry will, in turn, follow in a few months, and the telegraph industry will come last of all.

The figures given below are for the results at the end of the year closing June 30, 1902. The report includes central stations only, and does not embrace any isolated plants, plants operated by electric railway companies or idle plants, or plants under construction. It may be recalled here that the street railway census showed 118 trolley companies to be in the light and power business, earning gross from it $6,469,720, and that all told this item, including sale of current reached $7,703,574.

CENTRAL ELECTRIC LIGHT AND POWER PLANTS.

	Total.	Private.	Municipal.
Number of establishments	3,619	2,804	815
Cost of plants	$502,181,511	$480,161,038	$22,020,473
Earnings from operation, total	83,585,410	76,748,554	6,836,856
From light service	69,731,931	62,983,068	6,748,863
Arc lighting	25,459,437	22,070,192	3,389,245
Commercial or private	8,443,280	8,203,114	240,166
Public	17,016,157	13,867,078	*3,149,079
Incandescent lighting	44,272,494	40,912,876	3,359,618
Commercial or private	41,536,392	38,668,096	2,868,296
Public	2,736,102	2,244,780	*491,322
All other electrical service	13,853,479	13,765,486	87,993
Income from all other service	1,560,013	1,431,764	128,249
Gross income	85,145,423	78,180,318	6,965,105
Expenses:			
Total	67,688,075	62,442,088	5,245,987
Salaries and wages	20,551,989	18,672,267	1,879,722
Supplies and materials	22,814,758	20,392,467	2,422,291
Rent of stations and offices	1,285,546	1,270,798	14,748
Taxes	2,654,065	2,643,945	10,120
Insurance	886,445	820,804	65,641
Miscellaneous	6,994,227	6,645,567	348,660
Interest on bonds	12,501,045	11,996,240	504,805
Power-plant equipment:			
Steam engines—			
Number	5,921	4,861	1,060
Horsepower	1,377,041	1,230,023	147,018
Water wheels—			
Number	1,378	1,296	82
Horsepower	381,134	369,916	11,218
Generating plant:			
Dynamos—			
Direct-current, constant voltage—			
Number	3,820	3,402	418
Horsepower	441,621	418,088	23,533
Direct-current, constant amperage			
Number	3,537	2,955	582
Horsepower	195,431	157,668	37,763
Alternating and polyphase current—			
Number	5,106	4,284	822
Horsepower	978,428	887,740	90,688
Output of station:			
Kilowatt hours—total for year	2,437,218,732	2,241,314,293	195,904,439
Line construction:			
Miles of mains and feeders	12,470,494	10,936,603	1,533,891
Lighting service:			
Arc lamps—			
Total number	385,208	334,413	50,795
Commercial or private	173,502	167,709	5,793
Public	211,706	166,704	45,002
Incandescent lamps—			
Total number	18,006,521	16,429,060	1,577,461
Commercial or private	17,552,756	16,058,111	1,494,645
Public	453,765	370,949	82,816
Average number of employees and total salaries and wages:			
Salaried officials and clerks	6,976	6,026	950
Salaries	$5,632,880	$5,175,499	$457,381
Wage earners	23,258	20,791	2,467
Wages	14,919,109	13,496,768	1,422,341
Foremen and inspectors	1,560	1,478	82
Wages	1,358,272	1,297,585	60,687
Engineers and firemen	8,020	6,671	1,349
Wages	5,201,988	4,416,929	785,059
Linemen	4,209	3,860	349
Wages	2,704,529	2,504,957	200,572
All other employees	9,469	8,782	687
Wages	5,654,320	5,278,297	376,023

* Estimated value if paid for at prevailing rates.

The final report will contain an analysis of the above totals, and present detailed statistics by states and for other phases of the industry. The statistics for this industry at the census of 1890 were confined to the State of New York, the city of St. Louis and the District of Columbia, therefore no comparison can be made with the totals for the United States. In other words, these are the first and only authentic figures of the industry in America.

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Trolley Road Network for Long Island.

Long Island, with but one steam road, and with numerous small and scattered communities yielding little support for a steam system but still needing frequent communication, is an ideal territory for interurban trolleys, and plans are now being pushed it would appear for the creation of such a network at the hands of a group of Western capitalists. Last week more than two hundred miles of electric railway, extending throughout Queens and Nassau Counties, passed into the control of these interests, said to include Mr. C. Schwab, the United States Mortgage and Trust Company acting as the clearing agent. The deal was put through by William K. Giles, of No. 41 Wall Street. It is known that both the Pennsylvania Railroad Company and the interests represented in the subway transit have had an eye on these roads, among which is the New York and Queens County Electric Railway, which was owned by a Philadelphia syndicate, and of which W. R. Shelmerdine, of Philadelphia, was president. This road operates branches extending all through Queens, to College Point, Flushing and Jamaica, and all through Long Island City. It also controls the New York and North Shore Road, which extends through Jamaica and Far Rockaway, and connects at Queens with the Nassau County Electric Railway, another branch which connects villages in Nassau County, and expects to send connecting lines into Suffolk County. The tracks of this railway also go to the new race track now being built on the line between Nassau and Queens Counties, to be known as Belmont Park.

The plan of the promoters is to build an up-to-date trolley system that shall traverse Long Island from east to west—from Brooklyn to Orient Point on the north and to Montauk Point on the south, with intermediate cross lines, some six or eight in number. One of the companies that has had surveys made along the lines of its projected roads is the Brooklyn, Bay View Landing, Freeport and Mineola Transportation Company. Another line is the Bayside and North Shore Transportation Company. Another corporation mentioned is the South Side Traction Company, which has obtained rights of way east and west of Patchogue, and is endeavoring to secure others so as to reach projected lines to the west. Still another enterprise, also said to be a branch of the scheme, is the Long Island Traction Company, now engaged in getting franchises between Riverhead and Orient Point. It already has secured the rights of way between Riverhead and Mineola. From Riverhead it is trying to get further rights of way to Patchogue. A line is also being projected between Huntington and Amityville; still another from St. James to Babylon, and it is reported, articles of incorporation are to be filed for another company, which will run from Sea Cliff to Massapequa. Even this does not exhaust the list of roads which might become either valuable feeders or important rivals of the Pennsylvania-Long Island Railroad system.

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Wireless Telegraph Conference.

A special cable dispatch from Berlin of August 3 says: "The international conference on wireless telegraphy, at which is to be discussed the formulation of regulations for governmental control of the industry, will assemble to-morrow in the Imperial Post Office building. Germany, Great Britain, France, Russia, Austria-Hungary, Italy, Spain and the United States will be represented. The American delegates are General. Greely, Chief Signal Officer U. S. A.; Commander Barbour, U. S. N., and John I. Waterbury, of the New York Chamber of Commerce. There will be no representatives of companies or inventors present."

Hydraulic-Electric Development of the Neversink Light and Power Company, Middletown, N. Y.

An interesting hydraulic-electric development has recently been completed in the Neversink Valley, Orange County, N. Y., through the use of the abandoned works and canal of the Delaware & Hudson Company. The old Delaware & Hudson Canal, which during more than half a century served for the transportation of "stone" coal from the region of Pennsylvania to Kingston, N. Y., on the Hudson River and to tidewater, was abandoned under a special act of the New York State Legislature passed in 1900. The canal has always taken its supply of water for its highest level, known as the "Summit," from the Neversink River, of Ulster, Sullivan and Orange Counties, N. Y. The canal company maintained a dam across the river which diverted the water into a feeder about one mile long, the lower end of which supplied the canal at such an elevation as to permit the canal being carried across and above the river by means of a cable suspension aqueduct. The hydraulic development, including the dam, feeder and the part of the canal now owned by the Neversink Company, cost the Delaware & Hudson Company originally considerably in excess of a quarter of a million dollars. The abandonment of these works for canal purposes made them readily available for the hydraulic power development, and by raising the embankments a head of about 40 ft. was afforded at the lower end of the feeder. Reference to the accompanying map will show the relative location of the dam, river and canal.

About a year ago the Neversink Light & Power Company entered into a contract for carrying out the complete improvements contemplated, including the transmission lines, aggregating 35 miles, to supply energy to Middletown, Port Jervis, Monticello and Liberty, N. Y. The work was carried on so energetically that despite unforeseen difficulties in execution, labor troubles and delays of manufacturers in deliveries of apparatus, the plant was put in operation the first of the present year.

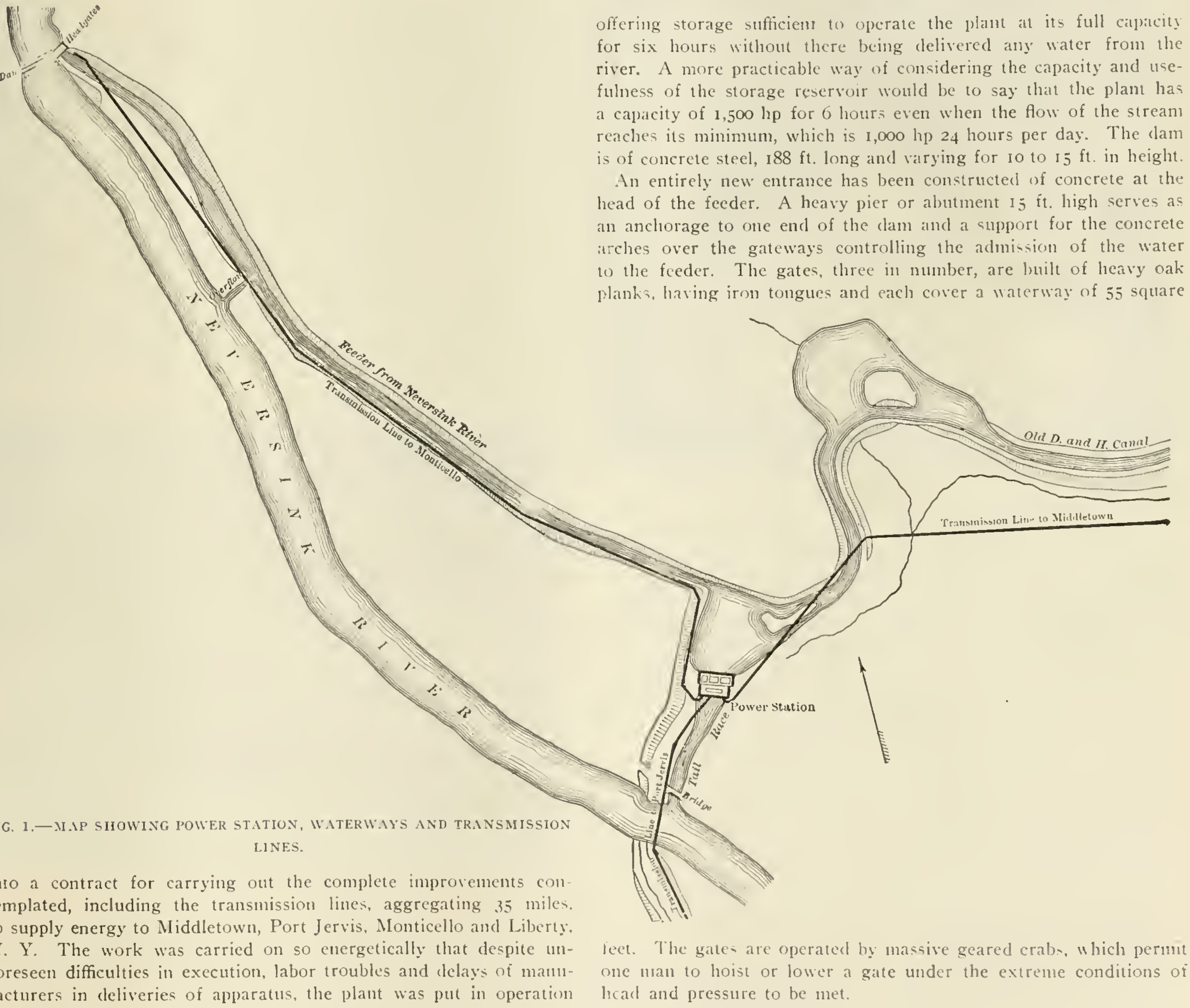


FIG. 1.—MAP SHOWING POWER STATION, WATERWAYS AND TRANSMISSION LINES.

In order to secure the advantages of a storage reservoir, the Neversink Company acquired title to about two miles of the canal. A cut-off dam was built across one end of the canal and the other end enlarged so as to make a good-sized basin or forebay, into which the feeder empties and on which is located the power house. This forebay with the two miles of canal and the one mile of feeder and the considerable poundage above the dam makes a reservoir offering storage sufficient to operate the plant at its full capacity for six hours without there being delivered any water from the river. A more practicable way of considering the capacity and usefulness of the storage reservoir would be to say that the plant has a capacity of 1,500 hp for 6 hours even when the flow of the stream reaches its minimum, which is 1,000 hp 24 hours per day. The dam is of concrete steel, 188 ft. long and varying for 10 to 15 ft. in height.

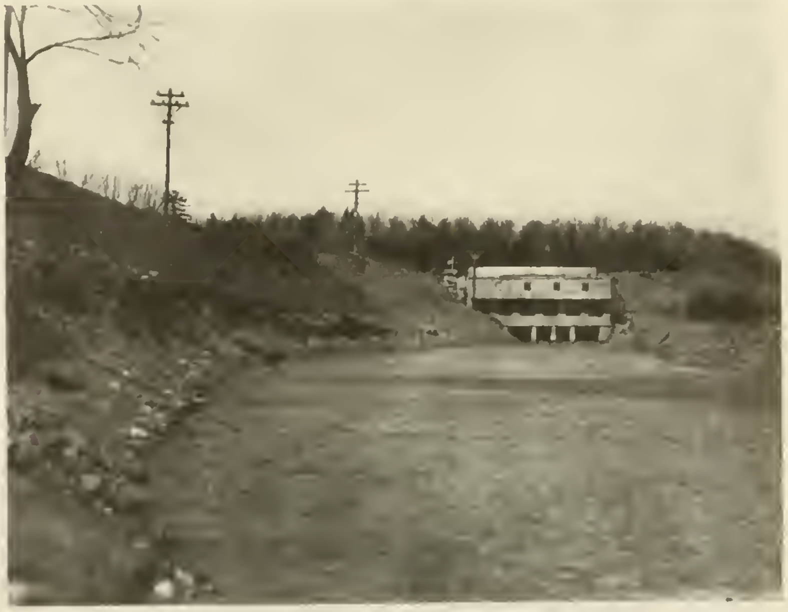


FIG. 2.—TAIL RACE.

An entirely new entrance has been constructed of concrete at the head of the feeder. A heavy pier or abutment 15 ft. high serves as an anchorage to one end of the dam and a support for the concrete arches over the gateways controlling the admission of the water to the feeder. The gates, three in number, are built of heavy oak planks, having iron tongues and each cover a waterway of 55 square feet. The gates are operated by massive geared crabs, which permit one man to hoist or lower a gate under the extreme conditions of head and pressure to be met.

A unique feature of the installation is the use of concrete steel in the design of a combined dam and power house. The structure was built directly across the old canal and although there is a head of 23 ft. on the walls surrounding the wheel chambers the walls themselves are only 3 ft. thick at the bottom, tapering to 14 in. at the top. If steel had not been used with the concrete and the walls properly designed to withstand the overturning moment, they would have been perhaps 10 ft. thick at their base.

In front of the penstocks is a large chamber running entirely across the front of the building with concrete walls on either end and an iron inclined rack on its front to prevent ice and debris from entering the wheels. The rack is supported on a massive iron beam construction and has an area of some 1,200 square ft., so that the velocity of the water even when the wheels are operating at full gate will not exceed .3 (3/10) of a foot per second.

The wheel chambers are each provided with three oak gates of sufficient area to allow slow movement of the water to the wheels. The gates are similar to those at the head of the feeder and are operated by crabs on top of the masonry.

The power house is of concrete steel throughout, including the roof, floors and girders, walls and foundations, and is built under the Ransome patents. The building is 40 ft. x 60 ft. in plan and is 45 ft. in height.

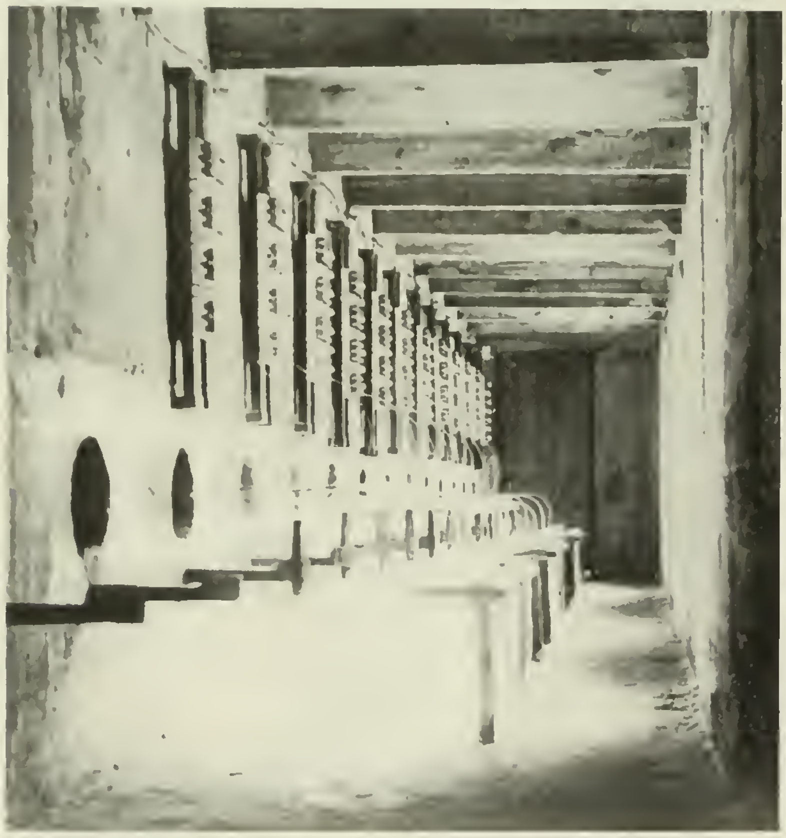


FIG. 3.—LIGHTNING ARRESTER ROOM.

Three wheel chambers are provided, two of which contain pairs of 27-in. horizontal S. Morgan Smith Company, McCormick wheels, and also a single 15-in. wheel direct-connected to an exciter. The third wheel chamber has been built with the expectation that another 550-hp unit, the size of those already installed, will be later added when the market for the power is developed. Each pair of large wheels and each exciter wheel is provided with a 17-ft draft tube.

The steel flume heads are built into the concrete-steel wall, separating the wheel chambers from the dynamo room. The shafts of the wheels project through the flume heads and by means of flexible couplings are direct-connected to the alternators and exciters. The generators were furnished by the General Electric Company and are each of 300-kw capacity, three-phase, 60-cycle, 600 volts, revolving field type, running at 300 r.p.m. The exciters are each of 30-kw, 125-volt, direct-connected type of sufficient capacity to excite all three alternators. The switchboard is of marble, also furnished by the General Electric Company, and supplied with all the latest and most approved instruments, in the way of voltmeters, wattmeters, switches, etc.

The switchboard is equipped with two sets of three-phase bus-bars, from which current is supplied to two separate banks consisting each of three transformers. Current from the transformers is fed to two separate sets of three-phase, high-tension bus-bars, running the length of the station. Each conductor of the six three-phase circuits entering the building may be connected by means of a jaw switch to either set of the high-tension bus-bars, providing an arrangement for supplying any transmission line from either generator or operating the railway and motor load in various towns from one set of bus-bars with its generator, and the lighting load from the other set with its generator.

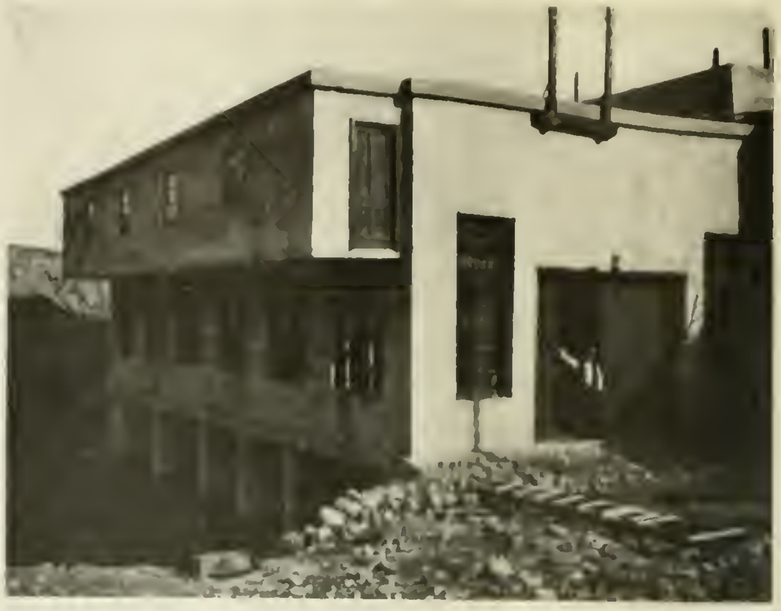


FIG. 4.—POWER HOUSE.

The step-up transformers are of the oil-insulated, self-cooling type. Those in the station are of 100-kw capacity, each provided with special taps to permit of adjustment of the voltage and installation of the Pearson-Cutcheon Lightning Protection device. The transformers step up from 600 to 10,000 volts, which latter pressure is the potential of transmission on all circuits. The step-down transformers in Middletown and Port Jervis are each of 50-kw capacity, and they are also provided with taps for adjustment of voltage. They were furnished by the Westinghouse Electric & Manufacturing Company.

Two types of governors are used and an interesting test as to their comparative merits in controlling the speed of the water wheels is being made. One governor of each make has been installed and as each controls the speed of a separate generating unit, in all respects identical with the other, every facility is offered for determining which governor is the most satisfactory both as to speed regulation and general working.

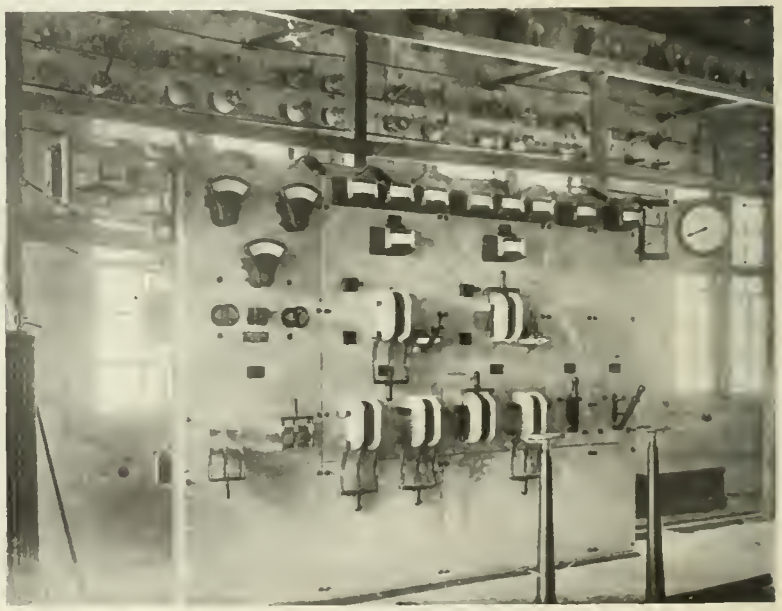


FIG. 5.—SWITCHBOARD.

The station is provided with an overhead traveling crane furnished by the Niles Tool Works, electric heaters, telephone switchboard, air compressor and the other small but necessary adjuncts for a complete station.

The three transmission lines are built in the most thorough and substantial manner. On all lines the poles are 30 ft. or more in length and 7 in. in diameter at the top, set 5 ft. in the ground and spread 120 ft. apart. They are each equipped with two cross arms for the twin three-conductor transmission circuits, and one cross arm for the metallic return telephone line. The poles are double-cross-armed and guyed at road crossings or slight angles with special three-pole construction at right angle turns. Special high-tension locust pins with Floy triple petticoat glass insulators are used for the high-tension lines. The cross arms are braced and bolted to both the poles and braces.

In order to determine whether copper or aluminum conductors are the more satisfactory, there has been installed on each transmission line one circuit consisting of three hard-drawn No. 6 copper conductors and another circuit consisting of three No. 4 seven-strand aluminum conductors.

A novel and what seems unusually satisfactory method of introducing the bare transmission line conductors within the building has been adopted. A gallery overhangs the tail race making a separate room used as a lightning arrester house which extends across the entire south side of the main building. Each bare wire of the 10,000-volt transmission line enters the building first perpendicularly through the floor of the lightning arrester gallery and then horizontally through the wall dividing the lightning arrester room from the generator room. Iron brackets are set both in the floor and dividing wall, so that each conductor is rigidly supported in the center of a circular hole in both the floor and wall. As the conductor slopes downward from the last pole on the transmission line to the insulator below the lightning arrester gallery and at that point turns abruptly upward, rain following the conductors runs to the insulator and so drops off without entering the building. The arrangement permits the naked conductor to pass through the walls of the building, but also prevents any rain or snow blowing in.

Throughout a large part of their length the transmission lines are built across private property in order to secure the shortest route and a right of way which avoids special franchise tax and future controversies. To convey the right to erect, maintain, patrol and operate the transmission lines across such lands there were prepared and used a uniform deed, with spaces left blank for necessary insertion, so that future litigation is forever avoided.

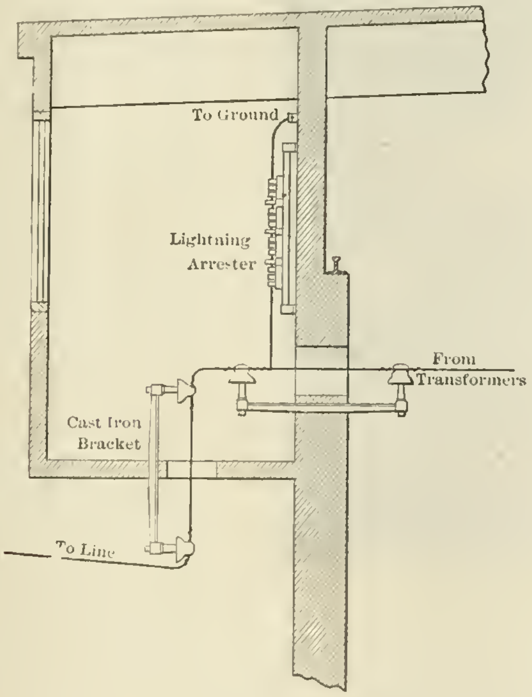


FIG. 6.—SECTIONAL VIEW OF LIGHTNING ARRESTER HOUSE.

The president of the Neversink Light & Power Company is Dr. Henry C. McBrair, of Middletown, N. Y., who first recognized the value of the power purposes of the abandoned canal and with indefatigable energy secured control of the properties and arranged for the completion of the development. The Henry Floy Company, of New York, was the contractor for the improvement, including the earthwork, dam, power house, transmission lines and installation of machinery. Mr. W. A. Gordon, as resident engineer in charge of the work, should be mentioned for the very creditable way in which the details have been carried out and the engineering difficulties overcome. Mr. C. E. Breckenridge, of the same company, has had charge of the installation of the transmission lines, which are more than usually substantial and well built.

The Monument to Galileo Ferraris in Turin.

By Adolfo G. B. Hess.

On February 27, 1897, Prof. Galileo Ferraris died suddenly in Turin, Italy. The genuine sorrow which was felt at his untimely death, not only in Turin and all Italy, but in other lands, can hardly be expressed in words. It was the grief of a whole nation, which sighed at the passing away of one of its greatest celebrities, of a scientific world losing one of its most brilliant and beloved apostles, and the sorrow of youth generally who saw disappear from their midst a master and a father for whom they entertained the most profound veneration.

The object of this article is to present some of the reasons for this sincere affection for Ferraris, in order that the deep significance expressed in the monument recently raised to his memory in Turin can be readily understood. This monument is the creation of the young and talented sculptor, Luigi Contratti, of Brescia, and has been erected in the center of the Piazza Castello, where the population of Turin were wont to see the genial, pensive and sympathetic face of the discoverer of the rotary field.

GALILEO FERRARIS.

Galileo Ferraris was born on the 30th of October, 1847, in Livorno Vercellese, Piedmont. The desire for knowledge manifested itself in his early youth. At that time there were no public kindergartens, and children under seven years of age were not admitted to the public schools of the city. One day when little more than six years old, the child took a number of books, such as he was able to find at his home, and without telling anyone of his purpose, went to the public school and took a seat, without asking, in the fourth class. The master naturally inquired what he wanted, and received the quick reply: "I do not want to become a donkey" ("Non voglio mica diventare un asino io!"). He was permitted to remain and was assigned to a class.

When in the High School (Gymnasium) he began to show his preference for physics and mathematics. Graduating from the engineering course in 1869, the subject of his thesis was: "Hirn's Telodynamic Transmission," thus demonstrating his interest even at that time in the problem of transmission of energy over great distances. Later he became assistant professor of physics in the Royal Industrial Museum of Turin. In 1872 he read an important paper on the subject of "The Theory of the Conduction of Electricity in Homogeneous Solids," and soon after one entitled "The Cardinal Properties of Dioptrical Instruments," followed by one on "The Intensity of Telephone and Induced Currents." In 1878 he was elected professor to the chair which he had filled so well as assistant, and a little later he became instructor of physics at the Superior Military Academy. In 1881 he was appointed representative of the Italian Government at the International Electrical Exposition at Paris; in 1882 he went to the International Electrical Conference in Paris in the same capacity and in 1883 to the International Exposition at Vienna.

At the International Electrical Exposition at Turin in 1884, Gaulard brought his transformer before the public, which had previously been experimented with in England by Dr. John Hopkinson. Ferraris at once saw the importance of this apparatus, and it led to his taking up the study of alternating currents. At the Turin Exposition and later in his laboratory, he made this transformer the subject of experimental and theoretical study, which formed matter for a paper entitled "Theoretical and Experimental Researches on the Gaulard and Gibbs Secondary Generator." Shortly afterwards he experimented with a Ganz transformer. These studies led to the conception of the magnetic rotary field, which was arrived at through analogy by considering two polarized luminous rays displaced in phase and which combine elliptically in one ray. He proved the correctness of his theoretical views by experiments in the laboratory of the Industrial Museum of Turin in August, 1885. Although these results were known to friends and to the pupils who followed his lectures at that time, they were not published until the beginning of 1888 in a paper read before the Academy of Sciences of Turin.

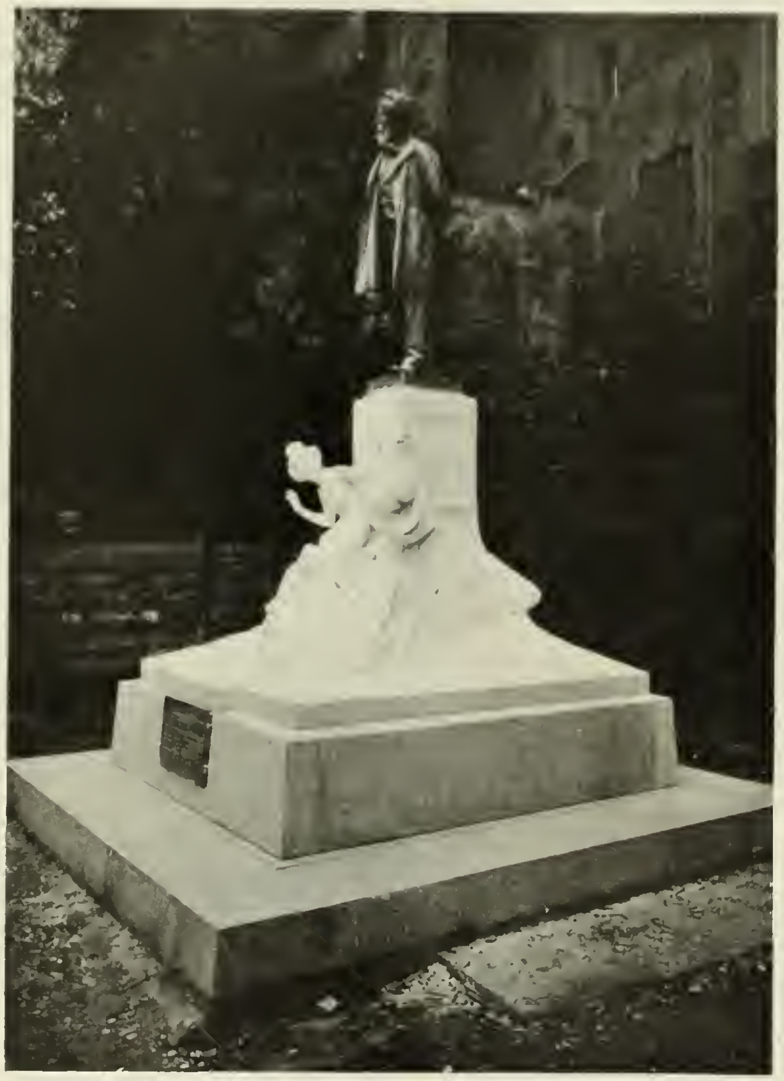


FIG. 2.—FERRARIS MONUMENT IN TURIN.

In 1888 an electrotechnical high school which he proposed was authorized. At the exposition at Paris in 1889, Ferraris could have seen two applications of the principles which he laid down—the motors of Tesla and Rankin Kennedy. The first important and conclusive demonstration of his principle which he witnessed was, however, at Frankfort in 1891, when electrical energy was transmitted from Lauffen to Frankfurt, a distance of about 110 miles. The reception accorded him by the electrical engineers gathered at Frankfurt could not have been more flattering, by whom he was acclaimed the discoverer of the rotary magnetic field, or "Drehfeld," or "Ferraris-Feld," as it was called at that time.

Prof. Ferraris was named a delegate to the World's Columbian Exposition at Chicago in 1903. Prof. Carhart, in an article published in the ELECTRICAL WORLD AND ENGINEER (February 15. 1897), speaks very highly of the part which Ferraris took in the congress, and Ferraris expressed himself enthusiastically about the warmth of the reception which was accorded him in America. On August 22 he wrote from Chicago to his intimate friend, Candellero, to whom he had sent a number of the ELECTRICAL WORLD, containing his biography, as follows: "And all that which you can gather from the treatment accorded me by the journal, is exactly what I would tell you, if I wished to describe to you all the courtesies and signs of distinction of which I was made the object in America."

At the Chicago Exposition, Ferraris was elected a vice-president of the congress, together with Mascart, of Paris; Preece, of London; Voigt, of Munich; Weber, of Zurich, and Elihu Thomson, of Boston. A few days later he gave Candellero an account of the work done at the congress: "The value of the international ohm and all units of measurement related to it were definitely defined. The definition of the joule and the watt were formally and officially sanctioned; a name was finally agreed upon for the unit of measurement of electromagnetic induction, accepting with great satisfaction to the American people the name of "Henry," which had been proposed by the American Institute of Electrical Engineers some time before. Not much that was new was accomplished as far as magnetic measurements were concerned, however, one very important feature was that there were officially and definitely buried multifarious and strange propositions which had popped up and had been accorded a reception worthy of a better cause . . . . ."

"So much for the congress. As for me, I must inform you that I am very much pleased that I came here, and that I am satisfied with the good reception which was accorded me, as well as the part which I was able to take in the discussions. I shall never forget the impression made on me by the flattering attention with which the colleagues of the congress listened to me and the fervor with which they accepted the propositions and observations which I put before them."

On another occasion he spoke very enthusiastically about what he was able to see in America: "There," said he, "labor, production and the useful circulation of matter and energy are the climax of all thought. Seen from there, the dreadful dangers which appear to threaten the Old World dwindle to ordinary controversies of no moment. A young people, in an enormous country, on rich and virgin soil, alone and secure, a people temperate in the battle of life, free from any bondage and embarrassment due to past prejudices and armed with all means with which modern mechanics enlarges the field of humanactivity. . . . . . "

His artistic and pensive soul reveals itself when he also says: "A life entirely absorbed in business, no matter to what extent it may be embellished by wealth and domestic comforts, is not worth more than one less successful, less wealthy, but more reposeful, and allowing of some time for the enjoyment of the beautiful and the abstract. I prefer a bed, not so soft, and a room not so profusely decorated, if I have a volume of Horace, Virgil, Beethoven or of Wagner on my table. Furthermore, taking everything into consideration, it seems to me that an education which does not include the beautiful in literature and the beautiful in the pure sciences cannot be called perfect."

Comm. Eng. G. B. Maffiotti, director of the Royal Industrial Museum at Turin, writes: "Without being a poet or artist in the strict sense of the word, Ferraris loved and understood poetry and art, as is shown by the idealism expressed in all his utterances and writings. He was blessed with an excellent memory which was nothing more than one of the phases of his multifarious and thoughtful intelligence, enabling him to repeat even during the last years of his life many poems which he learned at the Lyceum. . . . . . . He could draw with taste and expression. Among his papers there were often found memoranda on which appeared algebraic formulas and diagrams of electrical apparatus, intermingled with sketches which may have been put in at intervals, during the moments when, his mind overtaxed with scientific research, he loved to take a rest by allowing it to wander off into the cheerful fields of art.

"His artistic genious was particularly revealed in music, which was his chief recreation during the short periods of time he allowed for repose, and his comfort in moments of sorrow. But in music, as well as in science, he loved to soar. That explains his passion and enthusiasm for Wagner's music, of which he knew every note. He used to say jokingly that it would be sufficient to call him back to life, should he lie dying."

I will always hold as a most pleasant recollection several days spent at Courmayeur, the region which may be called "Italian Switzerland," at the foot of Mont Blanc. Galileo Ferraris also visited this region in order to strengthen himself in the pure air of the mountains and to divert his thoughts admiring a nature exceptionally sublime. Poet in the bottom of his soul, he felt fully the fascination of the supreme beauty of the glaciers glittering in the sun and cleft by fearful, towering projections of jagged rocks. His constitution, which was not very robust, did not permit him to make actual ascents, but as often as he could, he used to walk several hours' distant from Courmayeur to the points most adapted for the enjoyment of the majestic panorama, of the numerous chains of mountains submerged in an atmosphere of light and colors. Returning to the hotel still under the impressions of the sublime view, he sat down to the piano to express his intense feeling in music.

Among his favorite music was Mendelssohn's "Lieder ohne Worte" (Songs without Words). And it was just while he was playing these songs that I learned to know and to admire his taste for music—in a few words, to love him and to wish that I would be fortunate enough to have him as my master as soon as I were ready to take up the study of electricity. Unfortunately, it was a vain desire on my part; he passed away too soon!

Galileo Ferraris was an effective speaker, and impressive and efficient in speech from his clearness and exactness of expression and from the logic of his reasoning. He also was possessed of the practical sense of an engineer, and by coupling theory with the practice, he succeeded in making the science popular while enabling his pupils to grasp the most abstruse electrical problems.

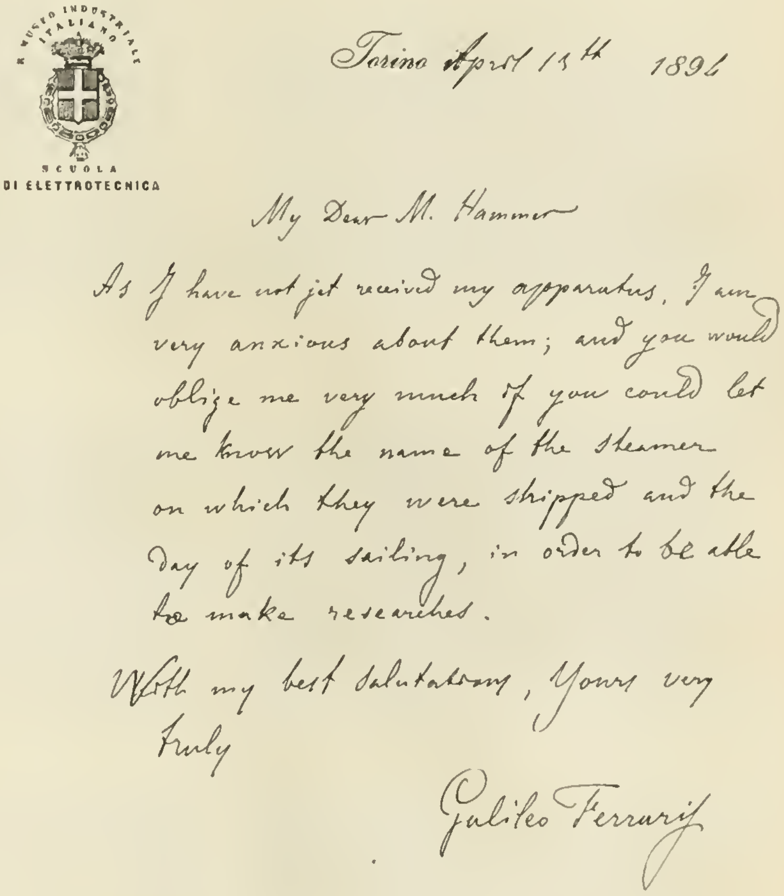
He wrote considerable during his active life. Among his papers are the following: "A Method for the Treatment or Rotating Vectors," "On a Synchronic Electric Alternating Motor," "Theorems Regarding Distribution of Constant Electric Currents," in which he deduced the principle of Ohm from the principle of "maximum work." as a consequence of the law of Joule. Later he wrote the paper above referred to on "Theoretical and Experimental Researches with the Secondary Generator of Goulard and Gibbs" and "On the Displacement of Phases of Currents, on the Retardation of Induction and on the Laws of Energy in Transformers." In 1896 he made known a new system of electrical distribution of energy by alternating currents, which he worked out with Prof. Arno, his assistant, and consisting in deriving from a monophase circuit, a polyphase circuit by means of a monophase asynchronic motor (Brown type). He published a lecture on "Transmission of Electrical Energy," and after his death a work was published on "The Geometrical Theory of Vectorial Fields."

At the end of 1896 he was elected Senator of the United Kingdom. This dignity, which gave him much pleasure, brought him new duties and new labors, adding to those of professor, municipal counsellor and consulting engineer. The increased work killed him little by little. On February 1, 1897, while lecturing, he became ill and said: "The engine is broken down; I cannot continue." These were the last words which he uttered to his pupils. Six days later he was no more.

Maffiotti writes of him: "Electrician of worldwide fame at a time when electrical industries developed themselves with an impetus never before experienced, through his ingenious discoveries he gave to them an added impulse and a new vigor. In him one can say the electrical science was personified in Italy. He could have easily amassed riches, but shrank from all utilitarian speculations. He cultivated science for the sake of science, thinking that its priests must not ask from it more than intellectual satisfaction. These sentiments he expressed in his lectures, in his writings, everywhere and always.

"Pondering over the life of Galileo Ferraris, over what he did and could have accomplished, over his early death and the causes which provoked it, we are almost led to complain that he lacked that selfishness which is a condition of our self-preservation and which we could excuse in one whose life was so precious to science. But the intellect and heart of Galileo Ferraris formed such an exquisite whole that parts could not be modified without destroying the admirable harmony which existed between them and which rendered the personality of this apostle so fascinating. He was only of medium stature, of slight physique and his features, though not classical were sharply defined. He possessed a penetrating glance, his broad forehead betrayed the presence of genius and his smiling lips gave proof of the unlimited riches of his heart. Worn out by that interior fire, his body now reposes free from any mortal fatigue. Long live the spirit, long live the cultivation of his spotless memory; long will live his useful, fruitful, educational work."

Preece said of him: "I had the pleasure of the personal acquaintance of Galileo Ferraris, and a more charming companion I never met. His scientific work was thoroughly appreciated in England and his labors are bearing practical fruit every day. Electrical progress owes a deep debt of gratitude to Ferraris." And Elihu Thomson says: "Dr. Ferraris was a man of the highest scientific attainments. To meet him personally was to discover in him those lovable traits of character which endeared him to all. Such truth and gentleness leaves memories which are not defaced by time. It is needless for me to attempt to estimate the great value of his researches, so well are they known."



R. MUSEO INDUSTRIALE ITALIANO
SCUOLA
DI ELETTROTECNICA

Torino April 15th 1894

My Dear M. Hammer

As I have not yet received my apparatus, I am very anxious about them; and you would oblige me very much if you could let me know the name of the steamer on which they were shipped and the day of its sailing, in order to be able to make researches.

With my best salutations, Yours very truly

Galileo Ferraris

FIG. 3.—REPRODUCTION OF FERRARIS LETTER.

Through the courtesy of Mr. W. J. Hammer, the writer is enabled to give some further details relating to the visit of Prof. Ferraris in the United States. In a letter to his intimate friend, Signor Candellero, Prof. Ferraris said: "At New York I was received by Consulting Engineer William J. Hammer, who gave me four full days of his time, accompanying me everywhere and introducing me to a great number of men of science. With him I went to Llewellyn Park, where Edison has his residence, and where I was received with singular courtesy and distinction, and was conducted by Edison, in person, through his laboratory." Mr. Hammer was chairman of the World's Fair Committee of the American Institute of Electrical Engineers at Chicago in 1893, and secured from Prof. Ferraris the loan for exhibition at the Institute headquarters, of the apparatus with which the principle of the rotary field has been demonstrated. Shortly after having been notified that the apparatus was shipped, a cablegram was received from Prof. Ferraris saying that the steamer to which it had been consigned had sunk in the harbor of Genoa, and asking if the apparatus should be sent on if it were recovered. Mr. Hammer having cabled in reply an urgent request that the apparatus be forwarded, this was done and it formed perhaps the most interesting historical electrical exhibit at Chicago. There having been some delay in returning the apparatus owing to custom house regulations, Prof. Ferraris exhibited a solicitude natural in view of his previous experience. As a specimen of Prof. Ferraris' writing and his knowledge of the English language, a letter to Mr. Hammer on this subject is reproduced to accompany this article. Mr. Hammer relates that during the afternoon spent in the Edison laboratory at Orange, Mr. Edison asked, "Prof. Ferraris, how did you first conceive the idea of the rotary field principle?" With a laugh, Prof. Ferraris replied, "Oh, I guessed at it mathematically." He then explained his various experiments in polarized light, which he said led him to feel that certain of the fundamental principles of optics were also applicable to electromagnetism, and that he built his experimental models to demonstrate the correctness of this view

The work of the sculptor, Contratti, the monument recently unveiled in Turin needs little description, the illustration reproduced here, showing clearly its nature The artist has caught and reproduced in bronze the thoughtful face of Galileo Farraris The statue is placed on a pedestal of marble at the base of which lies a large winged sphinx, on which a nude female figure reposes, representing physical truth seeking the mysteries of nature while listening to the mysterious voice

At the two sides there are bas reliefs, hardly indicated in the illustration, recalling the first experiment in transmitting electrical energy from Lauffen to Frankfort, and the reception given by Edison on the occasion of his visit to America.

On the plate fastened to the base of the monument is written:

To
GALILEO FERRARIS,
From Admirers, Disciples, Friends.

Born in Livorno P., Oct. 30th, 1847
Died in Torino, Feb. 7th, 1897.
The Admirable Discovery of
The Rotary Field
Opened to Science, to Industry, to Civilization.
New Paths.

This Proclaims the Glory
Of the Great Electrician.

The monument is about 22 ft. high. The jury for the choice of the prospective monument, composed of three well-known artists, Belli, Bistolfi and Reduzzi, complimented Contratti by choosing his project, and confirmed the promise which the young artist had given when he moved from his birthplace, Brescia, to Turin, and exhibited in the Exposition of Art, his first works: "Impressioni dal Vero" and "Il Vaso." Other well-known works of his are: "Bust of Napoleon," "Monument of Giacinto Pacchiotti," "Memorial to Brofferio."

Effect of Series Resistance in the Primary Circuit of a Transformer.

By H. A. Pikler.

It is well known that if a sine wave e.m.f. is impressed upon the terminals of a transformer, the other side of which is open, the hysteresis loop, or more correctly, the change in the permeability in the iron during one cycle of magnetism, will distort the exciting current wave. In other words, if we want to get a sine-shaped e.m.f. wave at the terminals of the transformer, we have to excite it by a current, the wave form of which is correspondingly distorted.

The intention of this article is to show that by *sending a sine wave exciting current through the transformer we get the e.m.f. wave distorted.* This distorted e.m.f. wave will be of exactly the same shape as the distorted current wave in the former case, when the impressed e.m.f. wave was a sine curve.

On consideration it will be seen that the e.m.f. curve in this case has interchanged with the current curve. This is exactly what happens if we use a series resistance in the primary circuit of the transformer for controlling its terminal voltage.

In order to test electric apparatus for dielectric strength, almost all testing rooms or laboratories use the following equipment: A sine wave generator, a high-voltage step-up transformer, the low-voltage primary side of which has a series regulating resistance, generally a water rheostat.

A similar arrangement is sometimes used for measuring the core loss on transformers. That is, a sine wave generator and a variable series resistance in the circuit in order to obtain the desired voltage across the transformer terminals. See Fig. 1.

If we want to determine the core loss of a transformer, this should be measured at a sine-wave shaped e.m.f. curve, flat curves giving a considerably higher, peaked curves a lower, core loss at the same effective value of the curve; that is, at the same voltage measured at the terminals of the transformer by an ordinary voltmeter. If we test an electrical apparatus for dielectric strength, we assume that the tested material is subjected to a sine-wave e.m.f.; that is, the maximum potential is $\sqrt{2}$ times the effective value, indicated by the voltmeter Now, using a series resistance in the transformer circuit, neither mentioned demands are fulfilled nor correct results derived

The effect of the series resistance is to change the exciting-current wave form The more the energy consumed by the ohmic series resistance comparatively to the energy consumed by hysteresis in the transformer, the less will be the distortion of the current wave, it will become more and more sinusoidal But if the transformer gets a sinusoidal magnetizing current, its induced e.m.f. wave will be distorted; and assuming as a limit a perfect sine-wave shaped exciting current, the induced e.m.f. wave of the transformer will have exactly the same shape as the exciting current curve has, when the current drawn from the sine wave generator is only that due to the transformer, the secondary of which is open.

These statements are confirmed by experiments as shown in curves (Figs. 2 to 10). The testing arrangement is the same as shown in Fig. 1. The curves were taken with the aid of an oscillograph, and are here reproduced direct from the record.

Fig. 2 shows the e.m.f. wave form taken at the terminals of the generator, when it was excited to 80 volts effective terminal voltage Fig. 3 shows at the same time the current wave in the circuit, its effective value being 25 amp. Fig. 4 shows at the same time the e.m.f. wave at the terminals of the transformer, the effective value being 55 volts. The core loss of the transformer measured at the same time 300 watts. The amount of the regulating ohmic resistance has not been measured.

Fig. 5 shows the e.m.f. curve at the terminals of the generator when excited to 182.5 volts effective pressure; more resistance has been put in the circuit to obtain again the same volts at the transformer terminals. Fig. 6 shows the current wave, the effective value of which being now 16.8 amp. Fig. 7 shows the wave form of the transformer terminal voltage, its effective value being again 55 volts—core loss of the transformer 253 watts. Then the generator was excited to 225 volts, and still more resistance was put into the circuit in order to obtain again 55 volts at the terminals of the transformer.

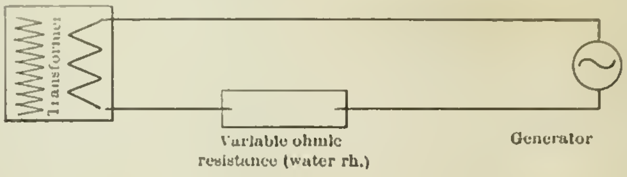


FIG. 1.—DIAGRAM OF CONNECTIONS

Fig. 8 shows the wave shape of the generator voltage, Fig. 9 the wave shape of the current at the same time, the effective value of which went down now to 15.3 amp. Fig. 10 shows the e.m.f. wave at the terminals of the transformer, the effective value being again 55 volts as measured by a Weston voltmeter, the core loss being 238 watts.

It is not necessary to go further. If we compare the wave forms of the generator voltage in the three cases, we find that they are almost alike. The current curves, which are all to the same scale, are always less and less distorted when using more resistance in the circuit. The higher harmonics at the lowest value of resistance in the circuit are shown up in a marked manner by the increased exciting current, which is 25 amp., whereas at a higher resistance, as in Figs. 8, 9 and 10, they get weakened and the current consumed is only 15.3 amp.

The change in wave form at the terminals of the transformer is what interests us mostly. All three curves, Figs. 4, 7 and 10, are represented on one scale. Their effective value is the same, 55 volts. But their shape and their maximum is different. Fig. 4 is more symmetrical, nearer to a sine wave, comparatively flat. Fig. 7 is more peaked; note the assymetry in it. Fig. 10 is entirely distorted; it shows the tendency to take the shape of current curve, Fig. 1.

The maximum values of these three transformer e.m.f. curves are as 1: 1.105: 1.182. The table on next page gives a comparison of results.

From all these curves and results it follows: 1. When using series resistance in the primary circuit of a step-up transformer for controlling its terminal voltage in order to test electrical apparatus for *dielectric strength* by that transformer, the wave form of the applied voltage will get peaked, the maximum of the curve being more than $\sqrt{2}$ effective. If we determine the testing high voltage by a voltmeter connected to the terminals of the transformer, the tested apparatus will get a higher *maximum* voltage than we assume. If we use an air-gap curve for determining the desired voltage, then the tested apparatus is subjected to a lower *effective* pressure than desired, because the break-down of the air-gap is rather due to the maximum pressure.

Generator voltage.	Transformer terminal voltage.	Current consumed by the circuit.	Watts (core loss) consumed by the transformer.	Comparative maximum of E.M.F. wave curve at the transformer terminals.	Comparative maximum of current wave curve.
80	55	25	300	1.	1.
182.5	55	16.8	253	1.105	.72
225	55	15.3	238	1.182	.656

2. When using a series resistance in the circuit of a sine-wave generator in order to control the voltage at the terminals of a transformer being tested for *core loss*, the e.m.f. wave form at the terminals of the transformer will be peaked, and the obtained core loss will be less than at an impressed sine-wave e.m.f. of the same effective value.

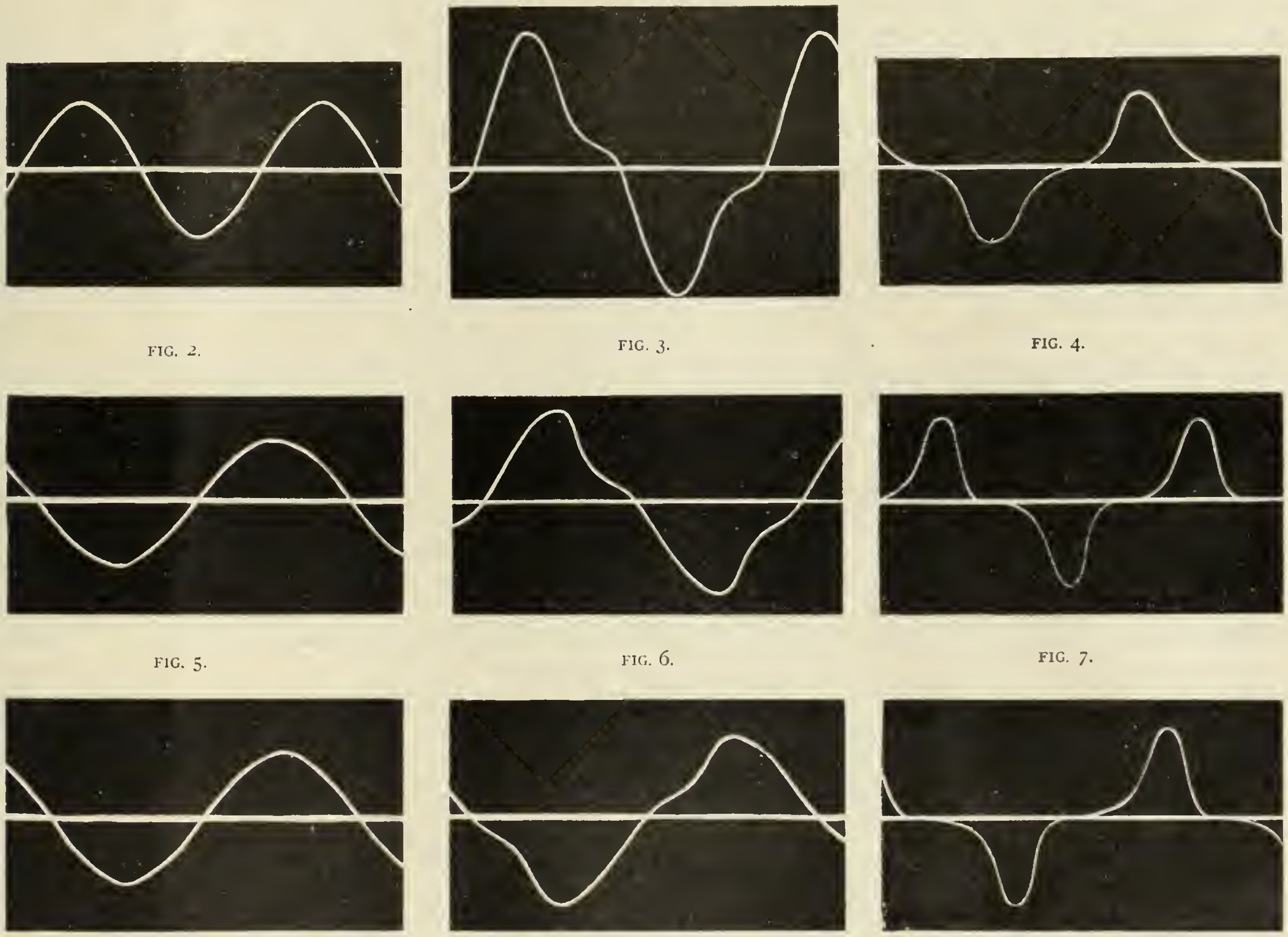


FIG. 2. FIG. 3. FIG. 4.
FIG. 5. FIG. 6. FIG. 7.
FIG. 8. FIG. 9. FIG. 10.

FIGS. 2 TO 10.—CURVES TAKEN BY MEANS OF AN OSCILLOGRAPH.

On this account the voltage on the transformer under test should not be controlled by a resistance in series, but the test transformer should be connected directly to the generator or to a step-down transformer whose primary is directly on an alternator of known wave shape; the necessary voltage control being obtained by controlling the alternator itself. If the step-down transformer employed is of good design, with low magnetizing current, the effect of its presence on the wave form will be negligible.

The form factor of the distorted e.m.f. curve at the transformer terminals depends upon the saturation of the iron and upon the completeness of restoration of the current wave due to the energy consumed by the series ohmic resistance.

◆

Plotting of Speed Time and Speed Distance Curves From the Acceleration Speed Curve.

BY L. A. FREUDENBERGER.

THE following article is a continuation of a communication on the plotting of speed-time curves from the tractive effort-speed curve, which appeared in the issue of July 18, 1903. A typical run between stations was taken, showing the effect of grades and curves and the speed-time curve constructed in conjunction with the speed-distance curve.

Having given the ordinary performance curves of a motor (the horizontal tractive effort and speed for different currents) the curve giving the relation between the horizontal tractive effort and the speed may be plotted. Subtracting from the horizontal tractive effort, at any speed, the train resistance at the same speed, will give the net tractive effort (expressed in pounds per ton), which will be available for accelerating the car. The value of the rate of acceleration will be $a = 0.01098\, f$, where a is the rate of acceleration in mi/hr seconds and f is the net tractive effort in pounds per ton. Thus the rate of acceleration (dv/dt) is known for different speed values (v).

$$\text{Since } a = \frac{d\,v}{d\,t}, \text{ then } d\,t = \frac{1}{a}\,.\,d\,v.$$

$$\text{Also } v = \frac{d\,s}{d\,t}, \text{ then } d\,s = v\,.\,dt, \text{ or } d\,s = v\,.\,\frac{1}{a}\,.\,d\,v = \frac{v}{a}\,.\,d\,v.$$

$$\text{Therefore, } \int d\,t = \int \frac{1}{a}\,.\,d\,v, \text{ or } t = \int \frac{1}{a}\,d\,v \qquad (1)$$

$$\int ds = \int_0^v \frac{v}{a}\, dv \quad \text{or} \quad s = \int_0^v \frac{v}{a}\, dv \qquad (2)$$

From (1) if values of $1/a$ are plotted on a speed base, the area included between the curve and the speed base will represent time values corresponding to different speeds. From (2), if values of v/a are plotted on a speed base, the area included between the curve and the speed base will represent distance values corresponding to different speeds. Values of $1/a$ and v/a may easily be obtained by means of the ordinary slide rule.

Fig. 5 gives rates of acceleration for different speeds. Curve *M* represents gross rates of acceleration and to a different scale of ordinates will represent gross tractive effort (in pounds per ton) for various speeds. Curve *R* similarly represents train resistance (during acceleration). Curve *N* is obtained by subtracting ordinates of curve *R* from ordinates of curve *M*. Curve *Q* similarly represents train resistance (while drifting) and includes the effect of the friction of the gears and bearing. Curve *B* represents negative rates of acceleration while braking. The accompanying table gives the data upon which the curves are constructed:

Portion of run.	Length in miles.	Total length in miles.	Per cent. of grade. Up grade.	Per cent. of grade. Down grade.	Track curvature in degrees.	Net equivalent acceleration in mi. hr. sec.
O-A	0.107	0.107	0.540		4°	0.158
A B	0.347	0.454	0.900		tangent	0.198
B C	0.521	0.975		0.364	tangent	0.080
C-E	0.567	1.542	0.433		tangent	0.095
E-G	0.183	1.725		0.122	tangent	0.027
G-H	0.065	1.790		0.302	2°	0.046
H-I	0.063	1.853		0.122	tangent	0.027

Curves *M*, *R*, *N* and *Q* were taken from Fig. 9, page 1060, of "Notes on the Plotting of Speed Time Curves," by C. O. Mailloux, *Transactions* of the A. I. E. E., Vol. XIX. The braking curve was derived from Fig. 3, page 1040, of the same article. This curve was expressed as an equation of the form, $t = 10.35 - 0.986\, v + 0.02016\, v^2$, where *t* represents time in seconds and *v* the velocity in mi/hr. The equation becomes $t^1 = 82.05 - 2.5988\, v^1 + 0.02016\, v_1^{\,2}$. $v = v^1 - 40$. That is, the speed ordinates were increased by 40 mi/hr. The equation becomes $t^1 = 82.05 - 2.5988\, v^1 + 0.02016\, v^{1^2}$ Differentiating with respect to time (*t*), we have

$$1 = -\,2.5988\,\frac{dv}{dt} - 0.04032\, v\,.\,\frac{dv}{dt},$$

$$\text{or } \frac{dv}{dt} = a = \frac{1}{0.04032\, v - 2.5988}$$

The braking curve, *B*, Fig. 5, would, of course, in actual practice, be replaced by a braking curve obtained experimentally. No other braking curve at high speeds was available, however, and the braking curve was used to illustrate the principles outlined above.

A concrete case was taken (the data being given on Fig. 5) and the speed time and speed distance curve plotted. The run is substantially the same as service run No. 7 of Mr. Mailloux's paper, except that some of the grades were changed.

The method of plotting the speed distance curve is shown by Fig. 1 and Fig. 2. Fig. 2 is construsted by taking values of the rate of acceleration (*a*) at different speeds from Fig. 5. The value of v/a is then known for that speed and may be plotted as the curve in Fig. 2. The area included between the speed base and the curve (Fig. 2) will represent distance values corresponding to the different speeds. The curve is cut off at *A* (Fig. 2), corresponding to a distance of 0.107 mi. The speed value at a distance of 0.107 mi. is 37.25 mi/hr. At *A*, for instance, the net traction would be (curve *N*) 2.049 mi/hr. sec. This traction is diminished by an up-grade of 0.540 per cent. and a 4° curve to 2.049 — 0.158 = 1.891 mi/hr. sec. The value of v/a would be 19.7 and would be plotted as the abscissæ at the point *A*, Fig. 2. From *A* to *B* the grade changes from an up-grade of 0.540 to an up-grade of 0.900 per cent. without any curve.

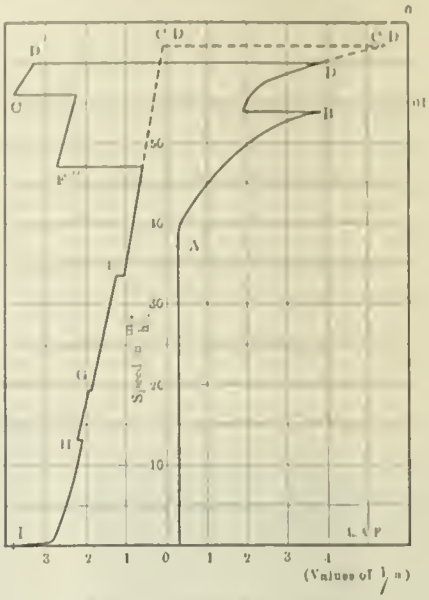
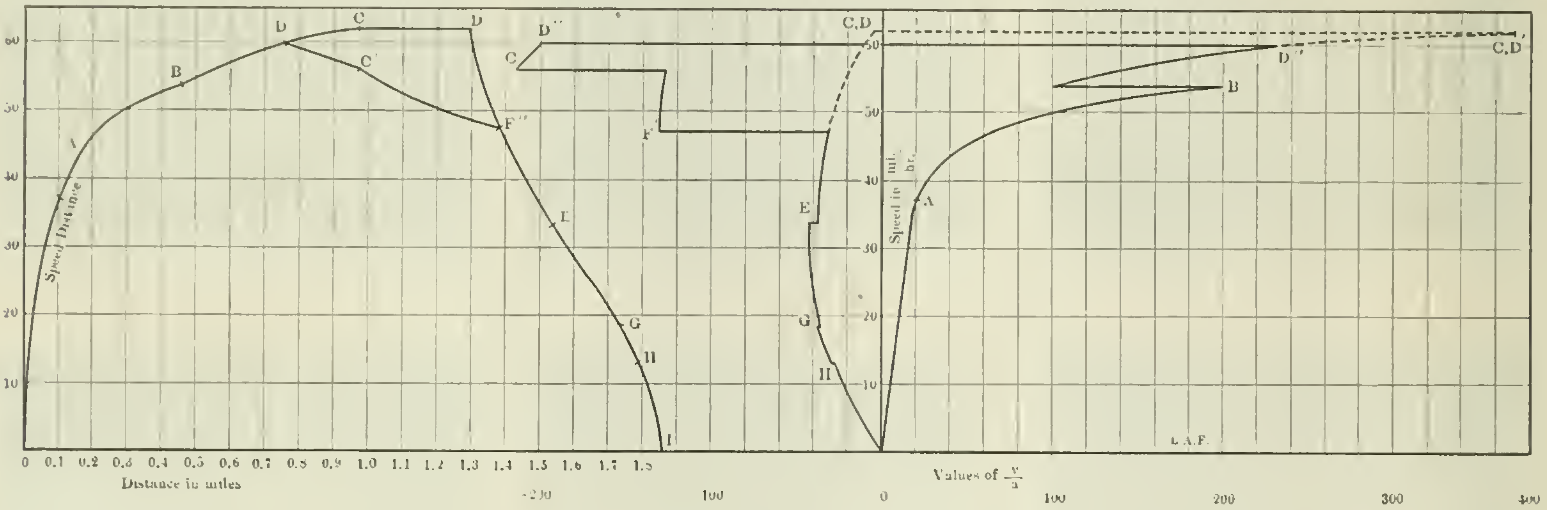


FIG. 3.—BRAKING CURVE.



FIGS. 1 AND 2.—CURVES OF SPEED DISTANCE.

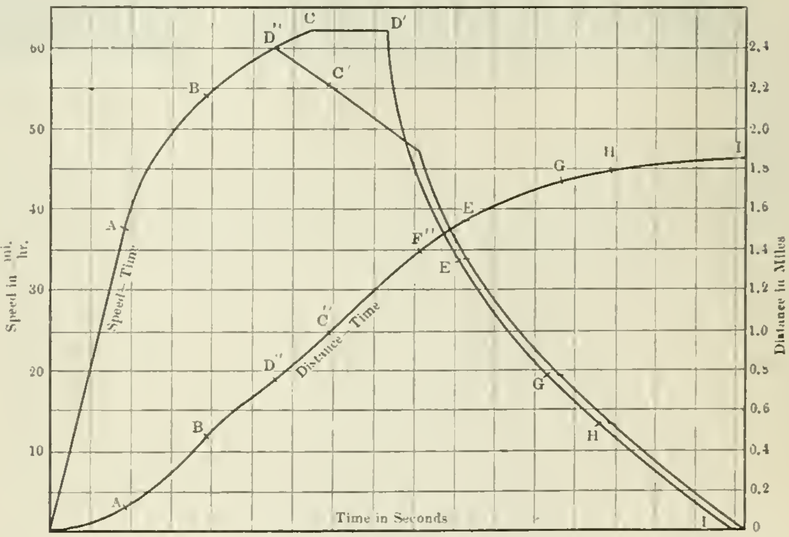
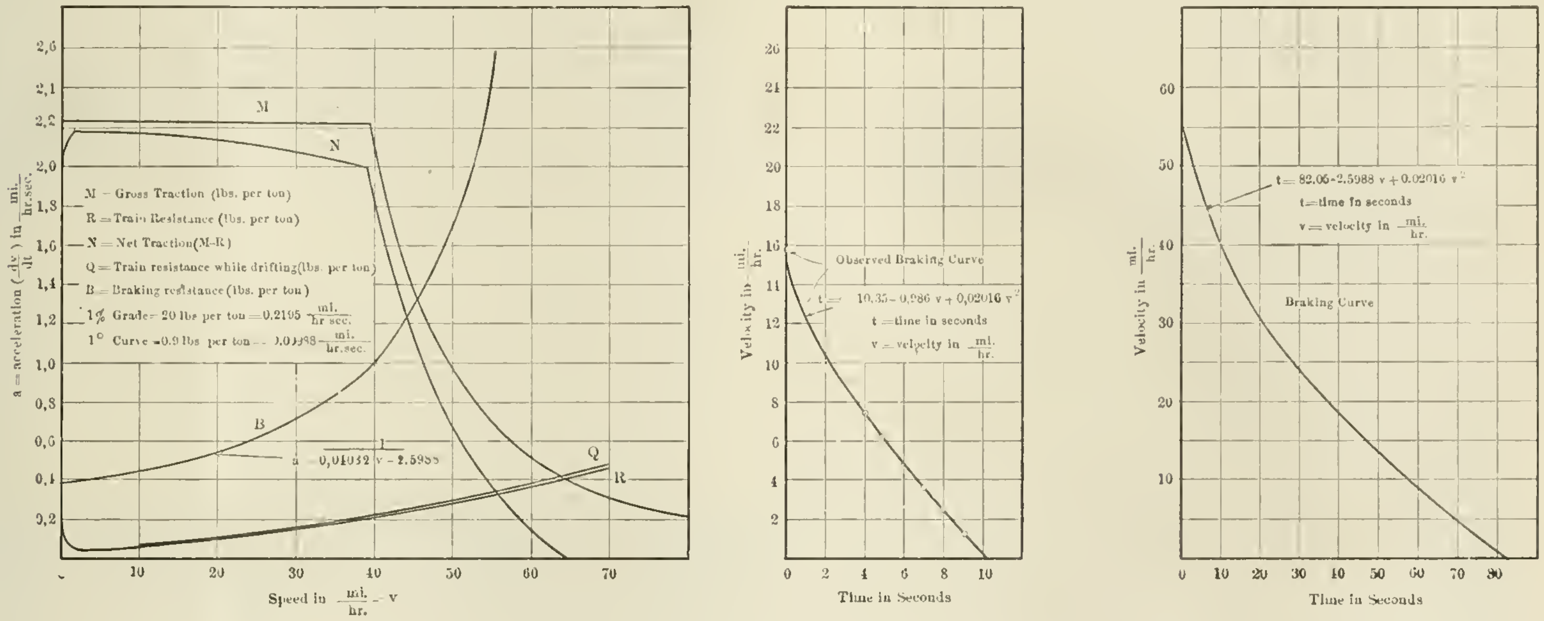


FIG. 4.—SPEED AND DISTANCE CURVES.

The rate of acceleration (at a speed of 37.25 mi/hr) would be 2.049 -- 0.198 = 1.851 mi/ hr sec. The value of v/a would be 20.13, so that there is an abrupt change in v/a at the point A due to a change in grade. This is seen better at the point B (distance of 0.454 mi). The points B and C are determined in a manner similar to A.

At C (speed 62.25 mi/hr) the net traction is approximately balanced by an up-grade of 0.433 per cent., and the speed remains constant at 62.25 mi/hr. It becomes necessary at this point to anticipate braking, and the speed distance curve is started from the end of the run (distance of 1.853 mi), until it cuts the line $C\,D'$ at the point D'. Such a run would consist of an acceleration cycle from O to D' and at D' the brakes would be immediately applied. This would give the minimum time of making the run, but the energy consumption would be a maximum. In practice the car would be allowed to "drift" during a portion of the run before the brakes were applied, thus increasing slightly the time required to make the run, but decreasing the energy required to make the run, and giving the motorman a chance to make up lost time by continuing the acceleration up to the point D' and then immediately applying the brakes. It is evident that the drifting portion may be made anything we please. For we might start the drifting run from the end of the run (1.853 mi), intersecting the acceleration curve somewhere near the point A, Fig. 1. This would give a minimum consumption of energy, but the time required to make the run would be so great as to be entirely out of the question. Usually for express service very little time can be allowed for drifting. If the car starts drifting from the point C, Fig. 2, the time required to cover the distance will be increased by only 0.12 sec.



FIGS. 5, 6 AND 7.—BRAKING CURVES.

The drifting curve was started from the point D'' (speed 60 mi/hr), thus increasing the time required to make the run by only 2.8 sec.

The speeds corresponding to the points A, B, C'', D'', F'', E, G and H, having been determined from the speed distance curve, the speed time curve may be plotted from Fig. 3. This integration may be performed (as also in deriving the speed distance curve, Fig. 1 from Fig. 2) by means of a planimeter, point by point, or better, by means of an integraph, giving the integral curve directly. For instance, the area included between the speed base (Fig. 3) and the curve from O to A (Fig. 3) will represent a time value of 18.6 sec., and is plotted at A (Fig 4). The speed time curve and speed distance curve would usually be plotted together. The time required to go from C to D' cannot be determined from the line $C\,D'\,C\,D'$, Fig. 3, since the speed is constant. It can, however, be easily obtained from the speed distance curve, Fig. 1. The distance from C to D' is 0.319 miles, at a speed of 62.25 mi/hr will require

$$\frac{0.319}{62.25 \times 3600} = 18.45 \text{ seconds.}$$

The points A, B, D'', C'', F'', G and H, are known from the speed values on Fig. 1.

The distance time curve is plotted from the speed time and speed distance curves. For instance, a speed of 50 mi/hr corresponds to a distance of 0.284 miles (Fig. 1) and a time of 31.1 seconds (Fig. 4).

The author desires to acknowledge his indebtedness to Mr. Mailloux for many valuable practical suggestions while prosecuting the above investigation.

◆

The Associazione Elettrotecnica Italiana Excursion to the United States in 1904.

The general council of the above-named association, at its meeting on April 26, approved the suggestion of the president to organize an excursion of the association to the United States in September, 1904, on the occasion of the Exposition and the International Congress of St. Louis. The president, Prof. M. Ascoli, having personally consulted a number of members, has already received a sufficient number of acceptances to secure the success of the proposed trip. The excursion will take about 50 days and the itinerary will be approximately as follows: Genova and Naples, New York, Boston, Niagara, Chicago, St. Louis, Pittsburg, Baltimore, Washington, Philadelphia, New York. Departure is fixed for about the middle of August.

In consideration of the importance of the trip, Prof. Ascoli has requested those who intend to take part to give him prompt notice, without assuming definite obligations, as it is necessary to know the approximate number of those taking part in order to prepare an exact estimate of the cost of the trip. It is expected that the cost, including everything, will not exceed 1,700 francs per person; but this estimate may be reduced when it is possible to decide upon a definite programme with the assistance of their American colleagues and of the committees of the Exposition of St. Louis.

Only members of the Associazione Elettrotecnica Italiana and their ladies will be allowed to join the party. The entire sum which is necessary for the trip must be paid to the cashier of the Associazione Elettrotecnica Italiana at least one month in advance of the day which will be fixed for the departure. Any sums deposited with the cashier will be returned in case the member cannot accompany the party or in case the excursion does not take place. It is certain that our Italian friends will receive a warm welcome on their arrival, and it may be hoped that a large party will come.

◆

Electrical Manganese Works.

Final arrangements have been completed for the establishment of electrical manganese works at Shawinigan Falls, Que., by the Electrical Manganese Company, of which Mr. B. E. Kingman, of New York, is the president. The company has secured some twelve acres of land on the line of the Great Northern Railway, at Shawinigan, and has contracted with the Shawinigan Water & Power Company for the delivery of 5,000 hp. According to contract, about 1,200 hp is to be delivered the Manganese company for its plant by August 15. It is the intention of the company to enter, at a later date, upon the manufacture of different kinds of steel, and it is on this account that such a large contract for electric power has been made. This is the first electrical manganese plant to be erected in Canada.

Telephone Exchanges.—VII.

By Arthur V. Abbott, C. E.

POLE PIECES AND DIAPHRAGM.

MATERIAL for pole pieces and the diaphragm should possess diametrically opposite magnetic qualities to those described for permanent magnetic. Formerly the softest and best annealed charcoal iron has been found the best material for the purpose, as it possesses the great permeability and small coercive force.

In Fig. 13 a $\mathcal{B}$ — $\mathcal{H}$ curve is given for sheet steel and for ferro type metal. The latter has in the past been almost exclusively used for diaphragms, and while it shows a very high ultimate permeability with intense fields ($\mathcal{H} = 30$), it is less sensitive than soft iron or sheet steel. Further, its hysteretic losses are considerable, and its coercive force high. In these respects sheet steel shows itself the peer of any metal save some of the more unusual iron alloys. But with improved metallurgical processes other alloys of iron showing themselves to be superior to the older charcoal brands. Thus the researches of Barrett, brown and Natfield show irons containing 2½ per cent. of silicon, and 2¼ per cent. of aluminum, that are respectively 33 per cent. and 45 per cent. more permeable than the best of charcoal irons. The magnetic characteristics of these alloys compared to charcoal iron are shown in Fig. 22, while table V exhibits additional tests of some such alloys as compared with the best annealed Swedish iron. The sample 898E by analysis gave iron, 97.3 per cent.; silicon, 2.50 per cent. No. 1178H had a composition of iron, 97.33 per cent.; carbon, .24 per cent.; aluminum, 2.25 per cent.; silicon, .18 per cent.

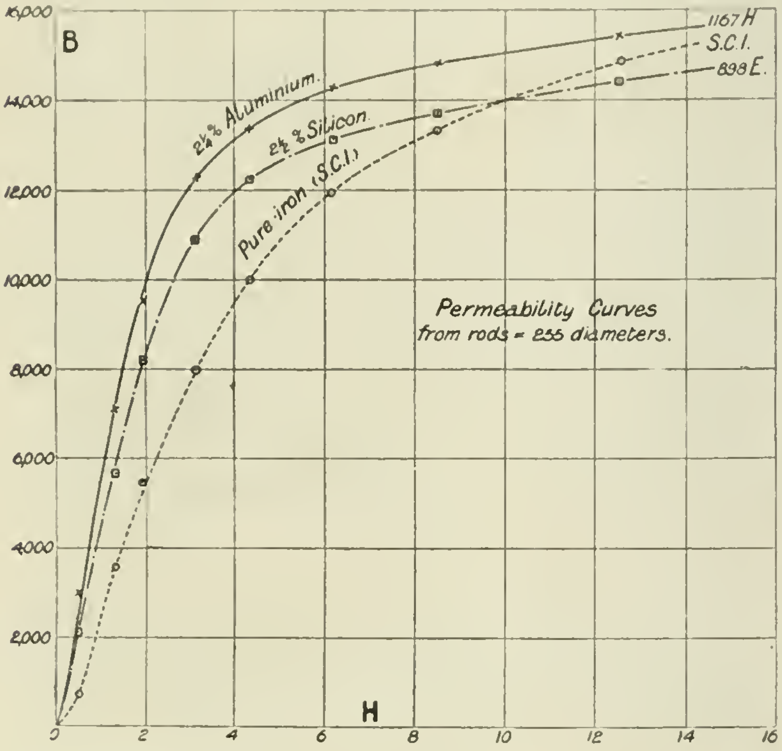


FIG. 22.—CURVES FOR SPECIAL IRONS.

TABLE V.

Magnetic Qualities of Silicon and Aluminum Irons.

H	Charcoal iron.		898 E Silicon iron.		1167 H Aluminum iron.	
	B	w	B	w	B	w
2	7,400	3,700	10,200	5,100	12,000	6,000
4	11,150	2,790	12,300	3,075	13,800	3,450
6	12,600	2,100	13,400	2,233	14,500	2,416
8	13,600	1,700	13,800	1,725	14,900	1,862
10	14,300	14,300	14,200	1,420	15,200	1,520

It appears well worth the while for receiver manufacturers to secure samples of such alloys and see whether some improvement in receiver construction could not be accomplished by their employment for diaphragm and pole pieces. Finally to avoid the eddy currents which are inevitably set up whenever a change in magnetic field occurs, it is from a theoretical standpoint advisable to laminate thoroughly the permanent magnets, the pole pieces and the coil spools (if constructed of metal). That this refinement would undoubtedly add considerably to the cost of the receivers, is unquestioned, and whether the "game would be worth the candle" can only be determined by experiment. But it is certainly a move in the right direction, and the time is rapidly approaching when in all departments of telephony it will not be the *cheapest apparatus*, but the *best apparatus* which will alone be tolerated, and it is only those who are foresighted enough to see that the best is always in the end the cheapest, who will be able to survive in the competition which daily grows more and more fierce.

One of the best methods for investigating the magnetic properties of a telephone receiver system is to examine the field by means of iron filings, making a so-called *phantom*. Such a picture of the magnetic field only indicates the distribution of the flux in one plane, and by no means can be considered an accurate quantitative measure of the magnetic system, but if some precautions are observed the relative fields of two instruments may be compared with considerable accuracy. It is best to prepare the iron filings by sifting them through two sieves of nearly the same sized mesh; for example, one sieve of No. 40 and one of No. 50, namely 1,600 meshes and 2,500 meshes per square inch, accepting for the purpose only those filings which are retained by No. 40 sieve and passed by No. 50 sieve. A definite amount of filings, measured preferably by weighing, should be selected, and the same quantity used for each test. This quantity of filings should be carefully and evenly distributed over a photographic plate by sifting them through a slightly coarser sieve, say No. 35. In this way each plate used is uniformly covered with amost exactly the same number of filings and consequently the density of the filings per unit area is about the same in all cases.

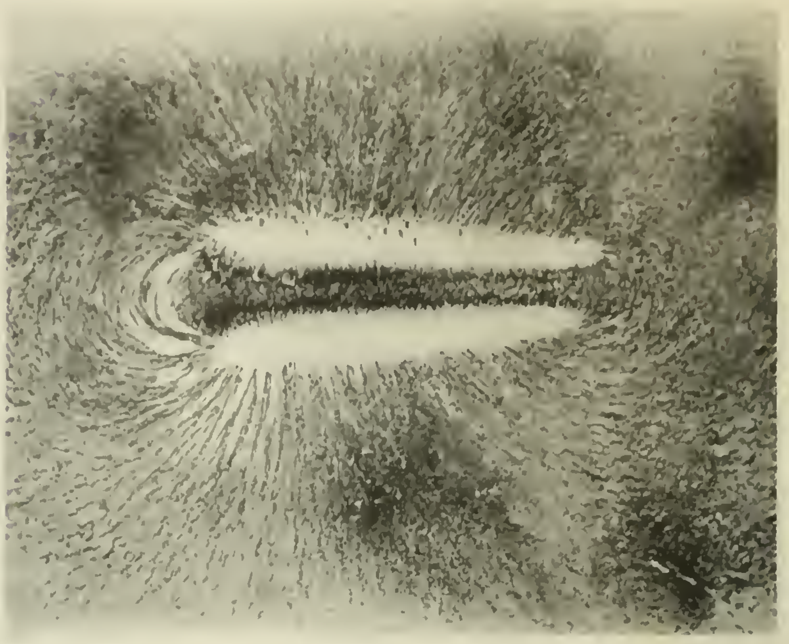


FIG. 23.—RECEIVER PHANTOM; POLE PIECES DETACHED.

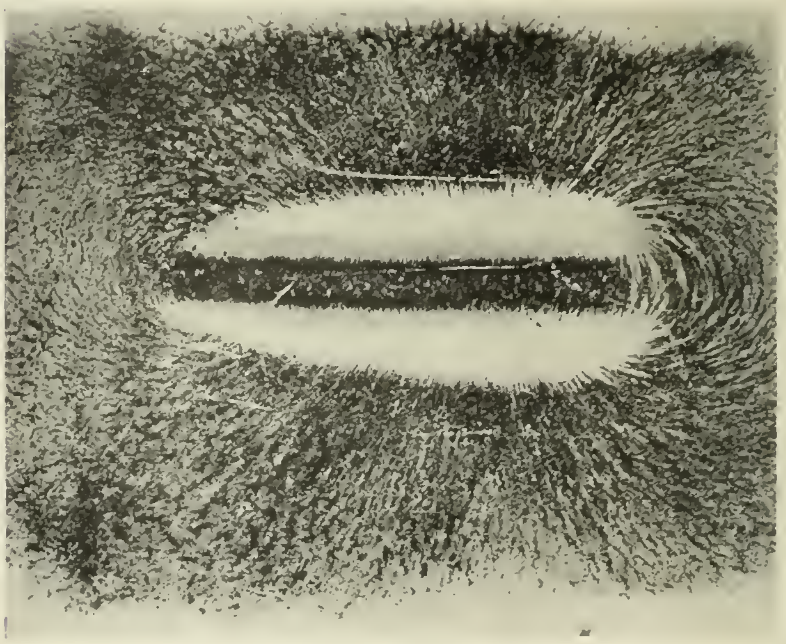


FIG. 24.—RECEIVER PHANTOM; POLE PIECES IN PLACE.

The best plate for the purpose is a celluloid film, because it is much thinner than the ordinary glass plate. After the filings are properly deposited on the celluloid it should be gently laid in proximity to the magnet under investigation and tapped. In each case the same number of blows of the same intensity should be given in order that equal liberty shall be given to the filings to arrange themselves in the field. For this purpose an electric bell, provided with a heavily weighed clapper, to retard its motion, is an excellent device. Some results by this method of study of the magnetic system of a receiver is shown in Figs. 23, 24 and 25. The receiver selected for the purpose was a Stromberg-Carlson.

In Fig. 23 the field of the permanent magnet is shown with the pole pieces detached. Here the fanning out of the lines of force across a gap usually occupied by pole pieces is conspicuously shown. In Fig. 24 the pole pieces occupy their normal position. A noticeable change in the field is shown as it is denser, with fewer leakage lines between the limbs of the magnet and the leakage across the gap pole pieces is less marked. In Fig. 25 the diaphragm has been put in place and here the change in the field is exceedingly conspicuous. The leakage across the poles is much reduced. The field around the magnet bar is very much higher and the lines of force in the surrounding field markedly reduced. In this way a valuable analyses of the behavior of the magnetic systems of receivers may be obtained and estimates formed as to the relative proportions of the magnet, the pole pieces and the diaphragm, and by making a series of such diagrams of a number of such instruments valuable deductions may be drawn as to the relative desirability of the various designs employed.

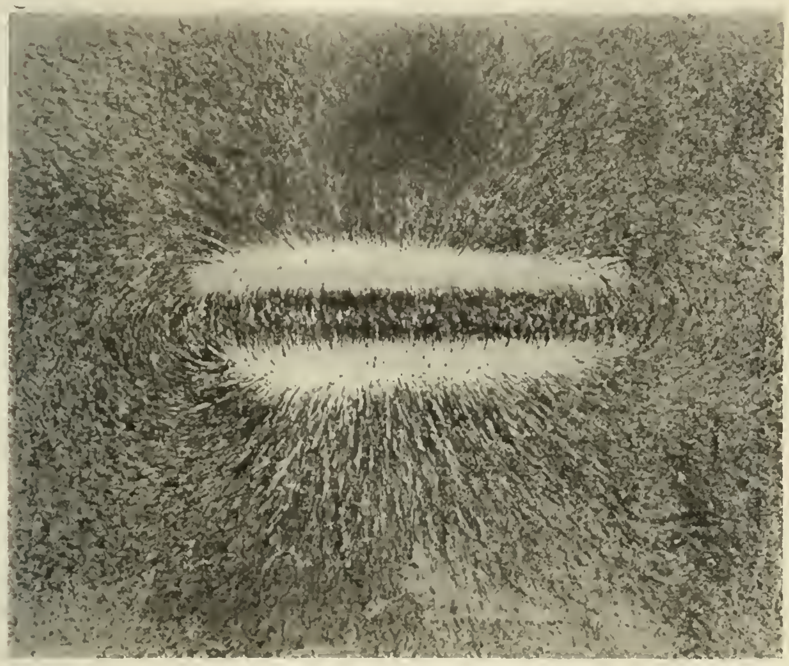


FIG. 25.—RECEIVER PHANTOM; DIAPHRAGM IN PLACE.

Storage Battery Efficiency.

In a supplementary communication in discussion of the Niagara paper presented by Mr. Frank L. Sessions on storage battery locomotives, Mr. Edgar H. Berry states he has taken up the question of battery efficiencies at different discharge rates with a well-known company which has had a wide experience in the manufacture and maintenance of storage batteries, and whose records contain a considerable fund of information in regard to the actual performance of their cells. This company states that "Assuming the efficiency of 75 per cent. for the 8-hour charge and discharge rates to be correct, the amount of energy required to re-charge after a discharge at the 5, 3 and 1-hour rate, would be exactly proportionate to the amount taken out—so long as the charging was done at the normal rate."

Mr. Berry says that on this basis all the figures in a table in Mr. Sessions's paper, excepting those applying to the 8-hour rate, should be eliminated, and the figures for the 8-hour rate should be taken as applying to the one-hour and all other rates considered. He does not for a moment wish to advocate the deliberate selection of a high discharge rate, but he does insist that the objections to such a course do not arise from an increase in the watt-hours per unit of work, necessary for charging. The penalties imposed by a high discharge rate are similar to those incurred when any piece of apparatus is worked very near its ultimate limit of endurance. A high discharge rate means a low factor of capacity, and a considerable increase in the risk of injury to the plates when handled by unskilled persons. These are the considerations that must be set against the increased cost of the larger battery, in determining the proper size to give the highest ultimate commercial efficiency.

Burnett Luminometer.

In response to the need of an instrument for measuring illuminators as contrasted with intensity of source, a number of devices have been proposed. One of these, the luminometer of Messrs. Houston and Kennelly, consists of a movable screen cut-off to various degrees, the light entering a box through a translucent glass and illuminating some printed characters. The measure of the lighting is indicated by the point at which the characters became blurred and indistinct. More recently Mr. W. D. A. Ryan has brought out a somewhat similar instrument; the observer carries the device away from the lamp which is the source of the light, until printed characters become blurred and indistinct, and at that point the illumination is said to reach the minimum serviceable amount. This latter instrument, therefore, does not in any way define the amount or variation of the illumination, but merely defines the limit of the useful area. It is chiefly useful in determining the area or distance illuminated by a lamp in street lighting, and is not suitable for measuring the amount of interior illumination.

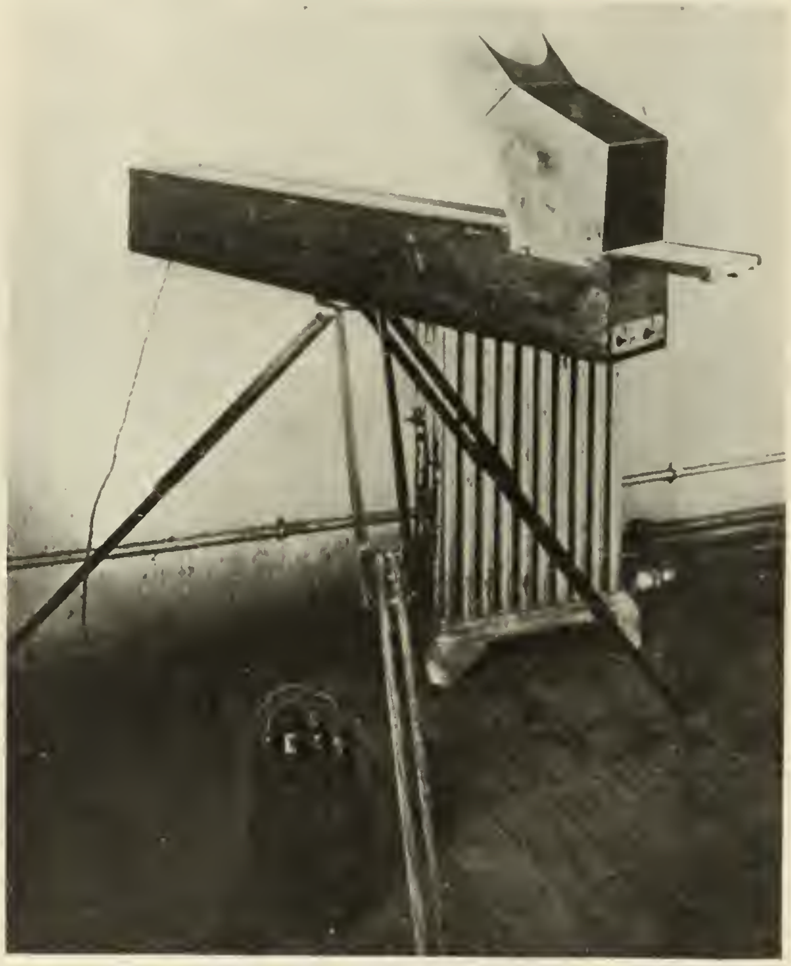


FIG. 1.—LUMINOMETER.

The device shown herewith is the invention of Mr. Douglass Burnett, and is designed to furnish a simple method of defining the amount of illumination at any point, in either direct sunlight, or artificial light, or where there is merely diffused light. It is based on scientific principles, is claimed to secure results with at least commercial accuracy, and works with the eye in its normal condition and without any change or adjustment of the light by means of mirrors or lenses.

A white surface is exposed to the light of a room, for instance, and is viewed by the observer, who also views at the same time a similar surface (Ritchie wedge) within the box or tube, the second surface being illuminated by a standardized lamp. The illumination on the shielded screen is made equal to the illumination on the exposed surface, by moving the lamp towards or away from it. The result expressed in candle-feet is measured by the candle power of the lamp divided by the square of its distance from the illuminated screen, the necessary correction factor being introduced to account for any reflection from the interior blackened walls of the instrument. In the particular apparatus shown in the illustrations, the range is from 10 to 0 candle-feet, with a 6-cp. lamp, to 0 to candle-feet with a 1-cp. lamp, a special thick filament lamp having been secured as a portable standard.

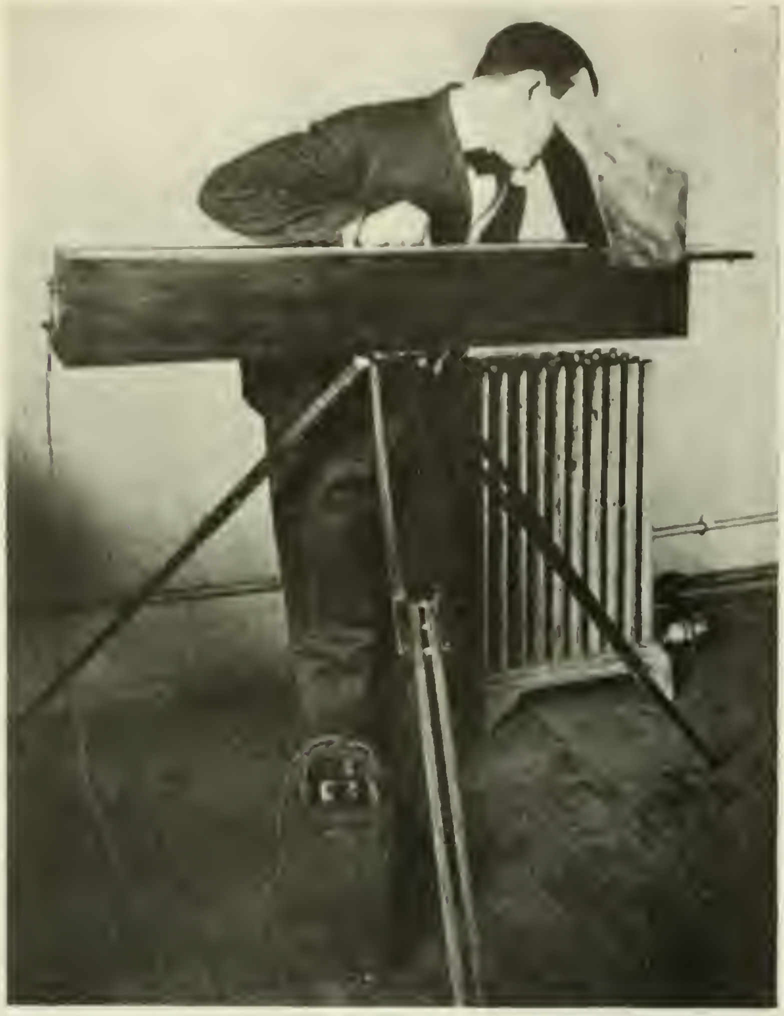


FIG. 2.—LUMINOMETER.

Just as a surveyor prepares a topographical map showing surface contour lines, it is expected that with this portable device a map or chart may be prepared showing the distribution of natural or artificial lighting, or both, in any room or open space, by means of illumination contour or "isophotal" lines. Data of this kind should be of the greatest importance in defining what are the actual conditions of illumination, and in assisting central station companies, for instance, to maintain lighting conditions at certain standards.

The Mercury Vapor Lamp in Photography.

In spite of the disagreeable color of the mercury vapor light, it has been found very effective in quick and clean-cut photography; and as our pages have already proved, excellent portraits can be taken with its aid. One of the best pictures of Lord Kelvin, for example, was that which we reproduced recently from a photograph of himself, taken in London with Mr. George Westinghouse, by means of a Cooper Hewitt lamp.

In New York City one of the artistic and original photographers of the new school, Mr. Pirie Macdonald, has been experimenting lately with the same lamp, in his studio on lower Broadway, and some of the photographs he has secured are among the most striking of his successes. It would be hard to characterize exactly the special quality of the new work, but it is the fact that in all the examples we have inspected, the values are admirable, involving a softness that is extraordinary when one recalls the harsh yellow-green of the mercury arc.

Mr. Macdonald uses three of the tubes. He has no "top light" in his studio, securing his light from two large north windows side by side. In the jamb separating these windows is his light. The three tubes take 114 volts and 2.8 amp. He estimates the combined power of light at 750 candles.

"I believe I am the first photographer to use this lamp," said Mr. Macdonald. "A bright, glaring light does not give any delicate modeling on faces, and that tone quality is what I am after. My best light here is about 11 o'clock. After that the smoke of the city closes in and it is all over. Unfortunately, I work with the men, who cannot all happen in here at 11 o'clock. Even if they did, I could not handle more than one of them in the hour of good light. They like to get here about 4 o'clock, and then I have all kinds of difficulty in getting the light I want, and my lengths of exposure stretch out to eight and ten seconds, when it ought to be two and four. I needed something to help out my daylight, and I have found it in the Cooper Hewitt lamp. At 11 o'clock I need no extra light. At 2 o'clock I turn on one tube and bring the quality of my light back to 11 o'clock. At 4 o'clock I turn on another tube and am again back to 11 o'clock, and at 6 o'clock I use the third tube and my light all night is equal to 11 o'clock A. M. light. With it I have to expose only the short time that I desire and by turning it off and on can control the amount of light with the same accuracy as I may my chemicals used later in developing my plates. For artistic portrait work it is all that I can desire; it is ideal. It is so soft that it does not affect the expression of the face and yet so powerful actually that it is equal to daylight. It is an epoch-maker.

"The ordinary electric light, incandescent or arc, is apt to be unstable, and it is hard. The flashlight is too gross to be considered. The field of this new light is broad. It can be used to illuminate theatres because the tubes can be protected for transportation by being placed in boxes, and all you have to do is to attach the electric wires to have your lamps working. We have sufficient light in the flash lamp for all practical purposes in theatrical work, but heretofore we have not had a single light which would aid the artistic photograph. No one knows exactly what the exact property of the light is. I know that it has no red rays in it and that it reduces the image on the ground glass to a black and white, so that I can form beforehand an accurate judgment of the resultant monochrome. As the light is constant in quality and quantity it is a simple matter to standardize the exposure and to control that most difficult thing called 'texture.'

"In portraiture texture is as individual as form, and until now the most expert photographers have been able only to suggest variety in complexional texture because of the changing light. If one uses the lamp alone without daylight there is possible the steady lighting of Rembrandt or the soft, mellow handling of Reynolds without destroying the characteristic pose, because the light and not the sitter is moved."

Recent Electrochemical Developments.

MANUFACTURE OF LEAD PEROXIDE.

A patent for the direct conversion of lead oxide litharge, red lead, etc., into lead peroxide was granted on July 28 to Mr. E. Quedenfeldt, of Duisburg, Germany, assignor to the Chemische Fabrik Griesheim-Elektron. He forms an emulsion of lead oxide with a concentrated solution of an alkali chloride, and electrolyzes the mixture, which is held in constant motion, at about three volts, with an inert anode of platinum or carbon, and a cathode of any metal, separated from the anode by a diaphragm. A brisk disengagement of hydrogen takes place at the cathode without any appreciable deposit of spongy lead. No trace of chlorine is evolved at the anode. The lead oxide, which is kept in constant motion, becomes gradually brown and toward the end of the process turns black-brown. The conversion to peroxide is said to take place quantitatively.

MERCURY CATHODE CELL FOR THE ELECTROLYSIS OF SODIUM CHLORIDE.

The different commercial types of cell employing a mercury cathode in the electrolysis of sodium chloride, are in general intended to give chlorine and caustic soda. In a patent granted July 28, Messrs. Chas. E. Baker and A. W. Burwell, of Cleveland, Ohio, propose to use a mercury cathode cell for the production of metallic sodium. The sodium amalgam, produced in the electrolytic cell at the cathode, is delivered to a retort which is heated to a temperature sufficient to volatilize the mercury but not the sodium. The mercury vapor is delivered to a condenser to be liquefied and returned to the electrolytic cell. The sodium remaining in the retort is removed by an outlet at the bottom.

BASKET FOR HOLDING TIN SCRAPS.

A patent was granted on July 28 to Messrs. M. Laernoes and J. Dunn, of Streator, Ill., for a basket for holding tin scraps, for use in the electrolytic recovery of tin from scraps. The purpose is to construct the basket so that the fuses can be renewed with great facility and to render the basket in general more durable. The basket is made of perforated sheet iron or steel with reinforcing angle irons at the corners, which are extended in the shape of yokes over the side walls of the basket and provided with laterally extending handles. One handle serves as the conductor for the current, and is bolted to the yoke-shaped angle iron, but separated therefrom by means of layers of tin or tin foil, which are interposed between the shank of the handle and the yoke-shaped iron, and which act as fuses.

BATTERY INVENTIONS.

A number of patents have recently been granted relating to storage batteries and primary batteries. Mr. Ralph N. Chamberlain, of Depew, N. Y., assignor to the Gould Storage Battery Company, patents a construction specially adapted for a storage battery which has to give a high potential but comparatively small current. For such a purpose the capacity for high discharge rate is of comparatively small advantage; what is wanted is a construction of cell which enables one to assemble a great number of cells in series with a minimum of trouble; the cells should also be as much as possible free from liability to injury by buckling or short-circuiting. For this purpose the inventor provides the vessel with a rib dividing its lower portion into separate pockets; electrode plates of opposite polarity are arranged in these pockets, which are of a character to catch and retain material dropping from the plates.

An invention of the late S. A. Rosenthal, of Waltham Cross, England, consists in the use of urea sulphate as a binding agent for the active material of electric accumulator plates where finely-reduced oxides of lead—such as litharge, minium or red lead, but preferably litharge—are used.

Mr. Louis Chronik, of New York City, assignor to the United States Battery Company, of Brooklyn, patents an improvement of the form of battery in which the secondary element is formed of a number of corrugated lead plates firmly clamped at right angles around a central vertical pillar or stem. The inventor also proposes an element formed of a plurality of plates having a stem or pillar cast in suitable openings in the plates. The same inventor patents a form of connection between storage battery plates and external conductors, which is essentially a binding post construction with a brass screw and socket embedded in non-corrodible lead, to protect the screw and socket from corrosion.

Mr. L. A. Lammerts, of Rotterdam, Netherlands, patents a detail of construction of small portable accumulators which are carried in the pocket or fixed to bicycles in connection with an incandescent lamp. The electrodes and pole terminals are usually connected by straight wires, passing through a chamber, into the lower part of which insulating material is cast, while the upper part, from which atmospheric air is shut out by a lid or cover, contains a gas intercepting device. With such a construction the connecting wires are liable to relatively rapid destruction, as the joint between them and the sealing mass is not sufficiently tight to prevent moisture from attacking the wires. The inventor, therefore, forms these wires in the shape of cylindrically-coiled helical springs, which is claimed to insure a tight fitting.

Mr. Joseph Appleton, of the Electric Storage Battery Company, of Philadelphia, patents an improved end cell switch suitable for adding to or cutting out from a circuit any desired number of cells without interfering with the operation of the circuit. The most efficient place for operating such a switch is at the switchboard: for this reason the inventor provides a suitable driving motor for the switch and means for controlling the action of the motor from a distant point, such as the switchboard. The motor may be run with current from the batteries themselves. The conductors which furnish the current to the motor include a make-and-break device situated at the switchboard, and the inventor also locates there a reversing switch in order to change the direction of the current in the armature so that the switch may be moved in either direction desired. The patent specification is very voluminous and is accompanied by no less than 32 sheets of illustrations.

Messrs. C. T. Richmond and M. H. Moffett, of Cleveland, Ohio, patent certain details of construction of a galvanic cell with a cylindrical zinc electrode, and an inner carbon electrode in the form of a hollow cylinder having external longitudinal grooves.

Mr. H. Csanyi, of Felsoe-Dobsza, Hungary, patents a primary cell, of which one electrode is of carbon immersed in nitric acid of 40° to 50° Baume, and the other electrode of zinc in an alcoholic solution of 5° to 15° Baume of pernitrate of mercury and potassium cyanide. A porous diaphragm is, of course, provided.

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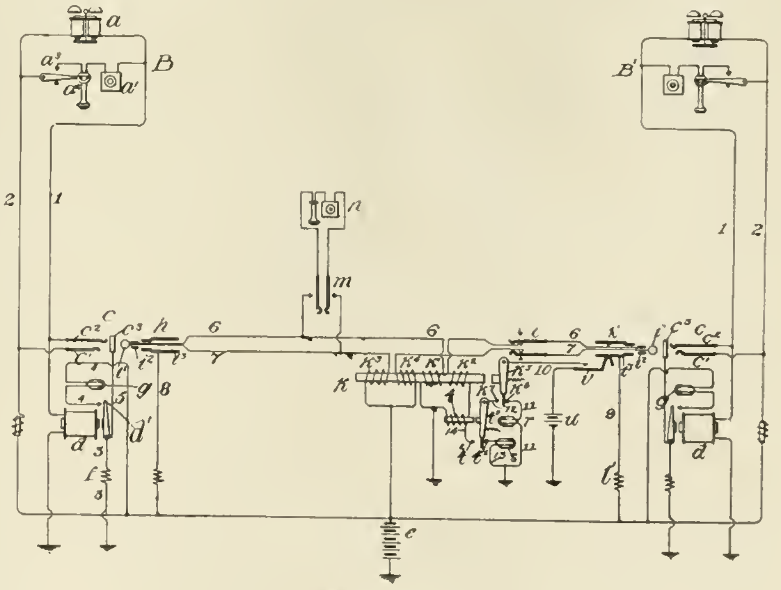
New Telephone Patents.

SUPERVISING CIRCUIT.

In large telephone exchanges it is a matter of great simplicity to provide means for secretly supervising the various operators to ascertain their efficiency. With small exchanges, where during a large part of the time the chief or manager in authority must be absent from the immediate premises, this is not so easy a matter. An apparatus and circuit for this purpose, designed for use at the residence of the manager and as an attachment to his regular telephone line, is the subject of a patent issued to W. W. Woodruff, of Winchester, Ky. With this system, an auxiliary induction coil is wired in the circuit of each operator to be supervised, the secondary winding of which is connected to contact points of a selector switch. The sweep contacts of this switch are wired directly to the chief's telephone line. The selector switch is under the control of the chief through the agency of a contact button connected in a pair of auxiliary wires extending to his premises, and an electromagnet operating a pawl and ratchet. Between each two working contacts upon the selector, intermediate dead points are left, that by one push of the contact button the chief's line may be reduced from its listening condition to that of a regular subscriber. It is a considerable disadvantage that no tell-tale device is provided to show the chief the exact position of the selector switch at any instant, for with the proposed present arrangement he must depend upon recognizing the voices of the operators in order to determining which one he is supervising. It is quite possible that the operators may notice the presence of the chief upon their circuits, as the closing of the secondary of the auxiliary induction coil will undoubtedly cause some change in the side tone of the operator's set, which may in time be recognized as a "danger signal."

COMMON BATTERY CENTRAL OFFICE SYSTEM.

Mr. Charles E. Scribner, of Chicago, has obtained a patent for a common battery switchboard circuit and system wherein, although only the usual number of signal lamps is required, each of these has but one significance. Thus, there are provided the usual line lamp as a calling signal, and the usual two connecting cord lamps. Of these latter one signifies that the called party has not yet answered, while the second signifies that the conversation is completed and disconnection is desired.



SCRIBNER SWITCHBOARD.

A connection between two subscribers is shown in the accompanying diagram. Herein *g g* are the line lamps, *s* is the answering signal controlled by relay, *t*, connected in the called subscriber's battery supply lead, and *r* is the disconnection signal controlled by the repeating coil relay—a distinctive feature of this system. The extinguishment of the line signal is caused by the plug shunt, *l*, in combination with the common resistance, *f*. The action of the cord signals is in direct response to the relay contacts, as is easily traceable. The presence of the plug socket switch controlling the cord lamp battery supply is a very objectionable feature, as all who have had experience with such devices can undoubtedly testify.

SHORT TRANSMITTER ARM.

An adjustable transmitter arm especially designed to bring the transmitter close to the back board has been patented by Mr. William Kaisling, of Chicago, the patent having been assigned to the Stromberg-Carlson Company. The base plate of the arm forms a socket let into the back board, in which the arm proper is pivoted. The pivot pin turns with the transmitter, and the stiffness of the joint may be regulated. The arm is finished with a spherical end in a manner such that the base socket is sealed in all possible positions of the transmitter.

CURRENT NEWS AND NOTES.

ENGLISH ELECTROCHEMICAL JOURNAL.—The *Electrochemist and Metallurgist*, an English electrochemical journal, which ceased publication several months ago, has been revived and will hereafter be published as the organ of the Faraday Society. It will contain all the papers and discussions before that society, in addition to other matter relating to electrochemistry.

A WIRELESS TELEGRAPH BLOCKADE.—A cable dispatch from Berlin of July 29 says: The combination of German wireless telegraph systems professes its ability to frustrate every attempt of Marconi agents to receive transatlantic messages in England by erecting a strong station on the German coast and propelling electric waves in the direction of the Marconi current.

DESTRUCTION OF LIGHTING PLANT.—How far strikers will go sometimes is evidenced by the following dispatch from Denver, Col., of July 29: The large electric plant of the Sun and Moon Company, near Idaho Springs, was destroyed with dynamite late last night. The watchman saw sparks of fire on the hill above the building, heard men running, challenged them and receiving no reply fired several shots. A moment later kegs of dynamite, which had been ignited and rolled down the hill, exploded, wrecking the big electric building and throwing the watchman fifty feet. The explosion shut off most of the lights in Idaho Springs, shook the city as well as mine buildings for miles around. Twenty-one leaders and officers of the local union were at once captured, and put in jail by the sheriff and indignant citizens.

ELECTRICITY AT DALNY.—The new Russian city at the Pacific terminus of the Chinese Eastern Railway Company is better equipped electrically than many an old or new world town. It has been created in the last three years. The electric light and power station, which is considered the finest electric plant east of Singapore, was finished over a year ago. This plant, which is a model in every detail, is fitted with three Ganz generators, with a total of 1,000 horse-power, and has a reserve space for additional machines to double its present capacity when required. There is a dry dock 380 ft. long, 50 wide and 18 deep, which is emptied by electric pumps in less than two hours. The harbor repair shops, etc., are all lighted and driven by electricity. The city is all lighted electrically, and there are telegraph and telephone offices.

TRAINING MOTORMEN.—In an open letter sent to Governor Bates, of Massachusetts, by Mr. W. H. Wheeler, of Worcester, it is suggested that the Legislature to see to it, first of all, that no motorman shall be employed on a country trolley line until he has had two years' experience, and has, besides, proved to a State licensing board that he is able to do the right thing in an emergency as well as to manage his car when no dangers are in sight. In the next place, Mr. Wheeler would have the State pass a law forbidding one rapid transit car to follow another at a less distance than 100 yards, and ordering the equipment of all such cars with a double set of air brakes, so that one could be used in case the other failed. Lastly, he would have it declared a criminal offense, even when no accident results, to "steal a switch," that is, for one car to pass the place appointed for meeting another. This act, he says, is often committed, sometimes with the approval of the passengers, who would rather take large chances than to endure prolonged delays, and therefore he would have rewards offered to those who betray the offenders.

ELECTRICAL ENGINEERING STANDARDIZATION.—The British Engineering Standards Committee has taken up the matter of electrical engineering standardization, four sub-committees having cognizance of this department. One—on generators, motors and transformers—is collecting evidence as to how far standardization can be introduced in the construction of these apparatus and their component materials. Another—on temperatures—is conducting experiments to determine the ability of different insulating materials to withstand heat, and also the deteriorating effects produced by their exposure to heat over long periods. A third is considering the standardization of cables and of underground conduits other than railway conduits, and is engaged in drawing up standard tables to cheapen the manufacture of cables. The fourth is occupied in the preparation of standard tables and specifications for wires and with other matters directly affecting the construction of telegraphs and telephones. The British Standards Committee has already established standards for structural steel sections, and has organized subcommittees for all the more important departments of engineering. The various government departments have representatives on the committee, which has just received a grant of $14,598 from the state.

BUCKET SHOP WAR.—There has been a sharp renewal down South of the bucket shop war, and a special dispatch from New Orleans of July 31 says: "A. S. Baxter & Co., incorporated in New York, and having offices here, have served out an injunction against the Western Union Telegraph Company and Gold and Stock Telegraph Company to prevent the telegraph companies from removing instruments from the firm's offices and requiring the companies to continue to furnish the plaintiffs with the quotations of the New York Exchange. Judge King signed a temporary order. At a meeting of the New Orleans Cotton Exchange resolutions were adopted in which the Exchange refused to sign the agreement for New York quotations. The New York Exchange, as stated in the resolution, required the New Orleans Exchange to sign an agreement against bucket shops and refused to treat with the New Orleans Exchange regarding New York quotations, except through negotiations with telegraph companies. The telegraph companies have said that unless the agreement is signed service from New York will be discontinued. Resolutions adopted declare that the New Orleans Exchange will refuse to negotiate other than with the New York Exchange direct." This situation affects a large volume of telegraph business.

LETTER TO THE EDITORS.

Increase of Traction Magnetically.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of June 27 I read with much interest the article entitled, "Magnetic Increase of Traction," in which was described an invention of Mr. A. A. Honey, of Chicago, recently patented for magnetically augmenting the weight of a car or locomotive so as to produce a greater tractive effort. The device consisted of a pivoted arm upon which was wound a coil of wire, while the outer free end carried an idler wheel to run on the rail when the coil was energized, and afforded a closed magnetic circuit from the arm to the car journal, the car wheel, the rail, the idler wheel and back to the arm. The whole scheme is ideal, if practicable, and ought very shortly to place the sand box in exile. However, upon investigation, I am forced to doubt its practicability, for among the experiments conducted was one, the results of which I cannot credit upon the basis of the data there presented.

The test was made, Mr. Honey tells us, at Seattle, Wash., on a double-truck car, which was equipped with two 50-hp motors. Not being familiar with Pacific coast practice, I assumed the total weight of the car to be that of the Brill Company's standard type, using two 50-hp motors, i. e., 30,000 pounds. To be brief, it was stated that the tractive effort without the use of the device was 1,500 pounds, and with it 5,250 pounds. Since the tractive effort varies as the downward pressure upon the rails, this implies that the equivalent weight of the car was increased to 105,000 pounds, from which, subtracting the weight of the car, 30,000 pounds, there remains 75,000 pounds as the amount added by the four magnetic devices, or 18,750 pounds by each one. Now, allowing a flux density in the magnetic path of say, 100,000 lines per square inch (a very high degree of saturation for that grade of iron) an attraction of about 130 pounds per square inch will result. This requires an area of 144 square inches in the smallest cross-section of the magnetic link, which cannot be greater than the cross-sectional area of the rail. To the best of my knowledge there is no car rail made, standard or special, with a cross-sectional area equivalent to 1 square foot.

In conclusion, I would say that this letter is intended, not as a criticism, but rather as a plea for enlightenment, and if these assumptions are incorrect, I shall be grateful to Mr. Honey or anyone else, who will point out the error, or show any other way in which such a great attraction could be made possible.

East Orange, N. J. H. R. C. Leigh.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

New Single-Phase Motor.—Schueler.—An illustrated article, in the first part of which the author discusses the principles underlying the construction of the repulsion motor. He then describes his improvement in its construction, which consists therein, that the transition of the motor from repulsion to rotating field, i. e., the direct short-circuiting of the armature, does not take place all at once, but that certain points in the armature winding are first connected through resistances, which are then gradually short-circuited. After short-circuiting has taken place, the commutator loses its current automatically, as a much easier way is furnished for the current through the short-circuited windings than through commutator and carbon brushes. The author states that the advantage thus gained is two-fold. First a rotating field motor has a considerable torque even at a lesser number of revolutions and with less consumption of current, if its rotor is short-circuited by suitable resistances. Secondly, the repulsion torque is utilized, till the resistances are completely short-circuited. The motor, therefore, works during a time as repulsion and rotating field motor. Tests were made by the author with a 5-hp motor, which had three slip rings and a commutator; the slip rings were connected with three places in the armature winding, which were 120° apart. The slipping brushes were connected with a three-phase controller, and the torque and the current strength dependent on the number of revolutions, were noted, and such a position of the controller as was most favorable for each number of revolutions was sought for. It was found that the motor has double the normal torque at the moment of starting, and can exert at the minimum 1.4 times the normal torque during the whole starting period. The starting current amounts at the moment of starting to not quite twice the normal value, and decreases gradually with increasing number of revolutions, until it reaches the normal current. The disagreeable kick of the older forms of repulsion motors is entirely avoided in this construction. As the motor exerts a considerable torque at all speeds, its speeds can be regulated by the insertion of resistances into the slip ring circuit over wide limits, exactly as with rotating field motors. When resistance is inserted into the slip ring circuit, part of the current takes its way automatically through the commutator; the motor works then at the same time as repulsion and as rotating field motor. In its practical form the motor becomes simple; the armature winding is an ordinary direct-current winding, which is connected in the way usually adopted in converters, with commutator and three slip rings. The commutator can be kept very small, because it is only traversed by current in the starting period. The motor can be reversed by arranging two sets of brushes. This is stated to be of great advantage in railroad work with high pressures, as the high potential with this construction does not need to be taken into the controller at all. It is stated that there are no difficulties in building a 50-hp traction motor for 10,000 volts. The exciting winding has no crossed coils, and therefore can be easily and safely insulated; one end of the winding is earthed, therefore only one high-potential wire has to be taken through a unipolar main switch and permanently connected directly to the collector, which is of course like the line wire, only unipolar. The controller and starting rheostat work only with low pressure. As far as safety of running at high pressure is concerned, the single-phase repulsion motor should be not inconsiderably superior to the polyphase motor.—*Elek. Zeit.*, July 16.

Induction Machines and a New Type of Polyphase Generator.—Eborall.—A paper illustrated by diagrams and cuts, in which the author gives an account of a new type of polyphase generator designed by Heyland. The generator is stated to be new; first, because, although synchronous and of nearly standard construction, the operation of the field system is of the nature of that of asynchronous machines, the principle involved being applied, however, in a new manner. In the second place, the machine is self-exciting and properly compounded or overcompounded, not only with regard to the magnitude of the current, but with regard to its phase difference. The principles of Heyland's method of compensating induction motors with regard to their wattless magnetizing currents, are first described. The complete diagram of connections and circuits of a new type of 20-kw self-exciting and compounded three-phase generators are shown in the adjoining figure. Here *A* is the main winding of the stationary armature, having main terminals, T_1, T_2 and T_3. *E* is the exciting winding on the armature, provided with the three-legged regulating resistance, *R R R*. *FM* is the four-circuit winding of the rotating six-pole field system. *C* is a 36-part cross-connected commutator with brushes, *B B B*, for the commutation of the exciting and compounding currents. The field winding of the new type of polyphase generator, consists of a number of parallel circuits (usually four are amply sufficient), connected together and to the commutator, as shown in the figure, where the field poles are numbered I to VI, inclusive. The rest of the connections and arrangements are exactly similar to those of the compounded asynchronous generators. Instead of the special star-connected winding, there is a revolving magnet wheel wound and connected up in an entirely analogous manner. The machine described, being wound for a low pressure, is not provided with transformers for furnishing the compounding and exciting currents. The former are provided by the armature winding itself, the common function of the three

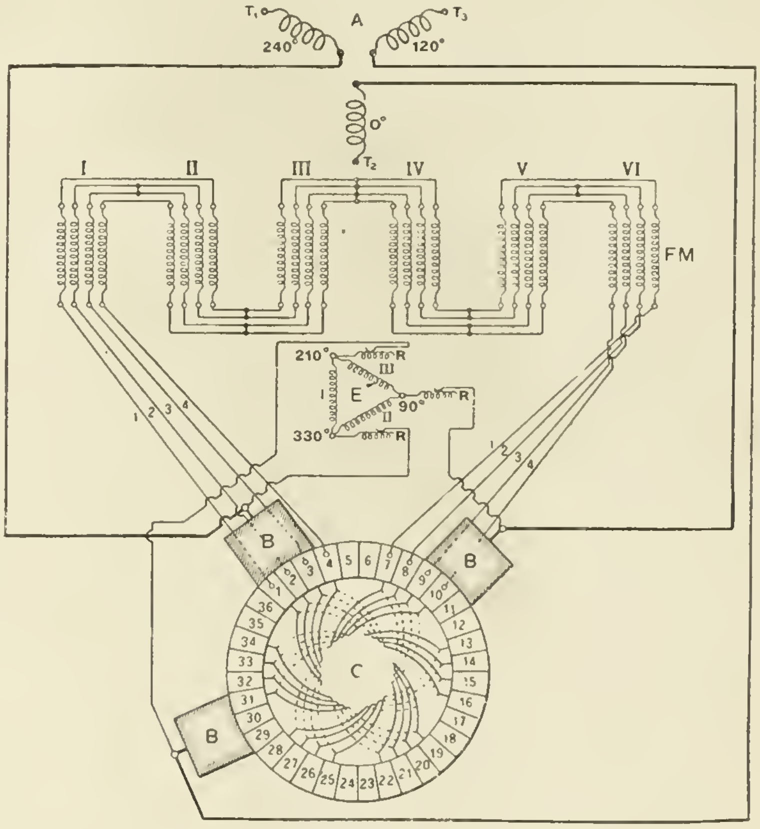


DIAGRAM OF POLYPHASE GENERATOR CONNECTIONS AND CIRCUITS.

phases being made at the commutator, while the latter is provided by a small auxiliary mesh-connected winding on the armature. Exactly similar means would be provided for furnishing the compounding and compensating currents for a low pressure non-synchronous generator. The regulating resistances in the exciting current circuit and the commutator cross-sections are shown in the above figure. The current in the field windings is always a direct current, and the increase of excitation required for the load is provided by the compounding current led into the commutator from the armature. The commutator is stated to work as smoothly and sparklessly as an ordinary slip ring. The interconnections between the parallel field windings (which windings, together with their interconnections, constitute in reality a class of three-phase winding) perform two important functions. They prevent an interruption of the circuit when the commutator segments that are not connected at all, pass under the brush, and, on the other hand, when the brush short circuits the two sections, the effects of the short circuit are damped out. During the period in which one circuit of the winding is withdrawn from the circuit, owing to one of the segments to which it is connected leaving the brush, the current takes the alternative path through the circuit in parallel with it, and the self-induction of the winding thus withdrawn is cancelled by the mutual induction of the circuit-carrying current, and hence sparking is entirely prevented. The action in this respect of the multiple circuit winding is entirely analogous to that of the six-branches star winding referred to above, the commutator to which the former is connected being, however, virtually a two-part commutator, with each part subdivided into a number of segments of the same polarity, corresponding to the number of parallel circuits of the field winding. The actual pulsations in the field strength are, on account of the nature of the field winding, quite insignificant, the pulsations being nearly completely damped out by reason of the induced currents produced by them in the closed circuits of the field coil. A table of compounding tests given in the article shows that such machines can be made self-regulating for constant terminal pressure, or can be overcompounded, without any difficulty whatever. Thus a series of tests showed that the terminal pressure at no load was 247 volts, at 39 amp. ($cos\ \phi = 0.11$), 270 volts, and at 30 amp. ($cos\ \phi = 1.0$), 255 volts, the speed being constant. Thus, under these circumstances, the machine overcompounds to the extent of about 10 per cent. on a load of a power factor of 11 per cent., and about 4 per cent. on the non-inductive load, with a fixed adjustment of the field-regulating resistance. Between these two power factors the amount of overcompounding is simply dependent on the actual power factor of the load for the same currents. The author states that it should be specially noted that this variation in the amount of overcompounding for a given current is just what is wanted in practice, for the drop in the feeders, transformers, etc., is dependent upon the power factor of the load, being a minimum, when the load is non-inductive. A power station laid out with such machines could consequently be made to be nearly self-regulating for constant pressure at the receiving end of the transmission line, no matter what the magnitude of the load or the nature of its power factor happens to be. Apart from the great advantages which the above method of exciting and compouding polyphase generators possesses from the point of view of adaptation to the standard armatures and field carcases of ordinary synchronous alternators, the author states the following additional ones: The otherwise necessary exciter disappears and a very simple arrangement takes its place. The design of the generator becomes electrically better, for the air-gap length is fixed solely by mechanical considerations, and hence a large saving in field copper results (25 to 30 per cent.) compared with the ordinary alternator.—Lond. *Elec.*, July 10.

POWER.

Electricity in Factories.—An editorial giving an abstract of the annual report of the British Electrical Inspector of Factories, issued by the Factory Department of the home office. The inspector states that the general tendency is toward greater safety to the workman, as turbines and engines, of which all the moving parts are entirely closed, are very generally increasing in favor. Developments in steam practice point to the probable increasing use of steam superheated to a very high degree, up to as high as 800° F., tests of engines showing a marked economy in steam consumption under such conditions. The last division of the report details the precautions to be taken against accident, and the inspector supplements his remarks by a summary of some of the conditions, often met with, which have been the cause of accident, or offer unnecessary risk in electrical stations. This, in the opinion of the editors, is perhaps the most valuable part of the whole report, and is deserving, they say, of the closest study by central station and other engineers, who have charge of electrical generating stations or electrical distributing systems.—Lond. *Elec. Eng.*, June 26.

Electric Coke Measuring Machine.—An article on the coke handling in French gas works, containing among other matters a description and illustration of a new electrically operated machine, which is used for taking the coke from the heap, measuring it and putting it into sacks. It consists of a bucket elevator mounted at one end of a platform, the machine being made easily transportable over the yard. The elevator is worked by an electric motor, supplied with current through overhead wires, the motor of 3½ kw and the transmission shaft being suspended on the frame plates, near the rear axle. The coke is delivered from the buckets into a hopper, which acts also as a screen. Three chutes communicate with the hopper and take the coke to three skips for measuring and filling the sacks. The motor being placed in the rear of the machine, increases the stability. Feeding centers for the current supply are put down at various points in the yards, in order to reduce the length of overload wires to a minimum. The machines are very rapidly started and their output varies from 825 to 1,240 bushels (whether per hour or per day is not stated), according to size of coke. A continuous platform, 210 ft. long, for the purpose of drying the coke after quenching, is also operated by an electric motor of 11 kw.—Lond. *Eng'ing*, July 17.

REFERENCES.

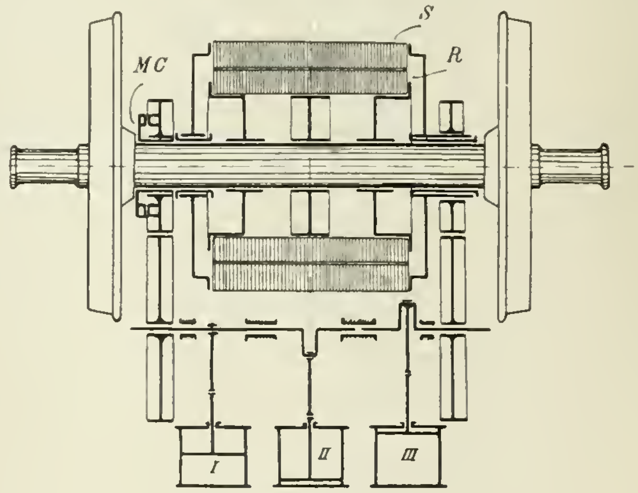
Electric Crane Experiences.—WILLIAMS.—An article giving the writer's experiences with electric cranes in actual operation, from a mechanical standpoint. He gives a number of instances where mechanical troubles occurred and describes how they were remedied.—*Am. Mach.*, July 23.

Electric Hammer.—An illustrated description of a hammer driven by a flexible shaft from a small portable electric motor placed in any convenient position.—*Scien. Am. Suppl.*, July 18.

Electricity in the Service of Agriculture.—BUDERUS.—An article, enumerating in a popular way the various existing and possible applications of electricity on farms and the advantages accruing therefrom. It is stated that it has been proved experimentally that the efficiency of the threshing machines under similar conditions is about 10 to 15 per cent. greater with electric drive than if driven by a locomobile. He gives examples of a number of installations put up in Germany, where various operations are performed by electric motive power.—*Elek. Rundschau*, July 1, 15.

TRACTION.

Single-Phase Road with Pneumatic Acceleration.—BLANK.—An illustrated description of the Arnold system for utilizing single-phase current for traction purposes. The principle consists in the suitable combination of a single-phase induction motor with a mechanical accumulator, consisting of air receivers and compressor cylinders. The arrangement is shown in the adjoining figure. The rotor, *R*, of a single-phase induction motor is in fixed connection with the driving axle of the car, while the stator, *S*, can rotate freely around the axle and moves the compressor piston, *III*, by means of suitable



PNEUMATIC ACCELERATION.

gearing. Cylinder *III* is connected by piping to a compressed air cylinder located under the car. In the same manner a compound compressed air engine, *I* and *II*, with cranks 90° apart, is in connection with the compressed air receptacle. The engine can drive the motor axle by means of cogs during the period of acceleration, but is cut out after the car reaches its normal speed, by means of the magnetic clutch, *M C*. All three cylinders have valves actuated by electricity, which make it possible in the same cylinder either to produce compressed air through the mechanical motion of the piston or to do work by introducing compressed air into the cylinder. If the cylinder furnishes compressed air, the suction and pressure valves act like normal pump valves; that is, they are worked automatically at one side by the pressure acting there. But if the cylinders are to furnish work by the introduction into them of compressed air, these valves are actuated by a solenoid the core of which is in connection with the valve seat. This takes place by means of a commutator on the crank shaft, which commutator allows of regulation for different degrees of admission of air with the help of a suitable controller. The running of the car takes place in the following phases: 1. Standing still in the station. Rotor as well as piston *I* and *II* stand still, while the stator possesses the full speed opposite to the direction of motion of the car, and transfers its work to piston *III*, thereby furnishing compressed air up to 10 atmospheres in the cylinder. 2. Starting. The compressed air thus obtained is introduced into the cylinders *I* and *II* with 90° admission, which allows a start in every position of the car. Thereby the rotor velocity decreases, while that of the stator decreases by the same amount. As the speed of the car increases, the controller is gradually regulated to lesser amounts of admission, until the speed of the rotor has increased to 100 per cent., when the stator stands still. When the rotor or the car axle has reached full speed, compressed air is introduced into cylinder *III*, to furnish a cushion for the reaction pressure of the stator. At the same time the admission of air to cylinders *I* and *II* is cut off, and the magnetic clutch, *M C*, is released, thus cutting out the compound engine *I* and *II*. The motor now furnishes all the power. If the speed of the car is to be increased above the synchronous speed of the motor, compressed air with a certain degree of admission is introduced into cylinder *III*. The direction of rotation of the stator is the same as that of the rotor, thus producing an increase of speed of the rotor. A lesser speed than the synchronous can be produced by rotating the stator in the opposite direction.—*Elek. Zeit.*, July 16.

Surveys for Electrolysis; their Results.—MAURY.—A paper read before the recent meeting of the American Water Works Association dealing with the subject from the standpoint of the water works manager. After remarking that at least five important electrolysis suits are now before the courts and that many people are awaiting the decision in order to start similar ones, the author proceeds to give suggestions as to how the flow of current from rails to the pipes, along the pipes and from the pipes back to the rail, may be traced, in order to prove its origin and fix the responsibility. The first step is the reading of the difference of potential between hydrants and rails at various parts of the system with a doube-scale voltmeter, having the zero in the middle of the scale. This is for the purpose of getting a general idea of the normally positive and negative areas, so as to locate the best places for afterwards exposing the mains for inspection. The author states that pitting is not found only in the territory in the neighborhood of the power station, where current leaves the pipes to return to the rails, but that it will usually be found that at the extreme dead ends of the car tracks the mains will be strongly negative to the car rails when cars are using current near by, and slightly positive to the rails at all other times. He says that unless supported by the actual measurement of current flow and inspection of the pipes themselves, the voltmeter readings show insufficient evidence on which to base a suit, and their importance has been too often exaggerated. After these voltmeter readings the next step is to expose the mains at a number of places, where they are normally positive or negative, or where they are alternately positive and negative. The current is measured by the author by the drop of potential method, by filing bright spots a certain distance apart and measuring the drop of potential with a millivoltmeter. The author gives a couple of tables for wrought-iron and cast-iron pipes of different diameter, in which he has calculated the current for 1 millivolt drop for various distances between measuring points. The author then discusses the injuries caused to the mains and service pipes by currents which leave their outer surface wherever they are positive to the adjacent earth. He states that the last two piping systems examined by him showed an average depreciation all over the entire system of mains and due only to outside pitting on the mains of between 21 and 23 per cent. The other class of injury, namely that caused by pitting inside the mains near the joints or on the outside of spigot ends under the lead at the joints or inside the sockets of bells over the lead or on the lead itself, is considered by the author as the most serious. The injury goes on most rapidly where the mains are carrying most current, and the territory in which worst joint pitting is found is a zone surrounding the location of the power station and the return feeders, but at a considerable distance from them. This is explained by the fact that the water mains gather current at their outer ends up to the point where at the instant there is no difference in potential between mains and rails, and lose it from this point in towards the power station, thus carrying the greatest current at about this temporary neutral point. The author then goes on discussing the various remedies which have been proposed and comes to the conclusion that there is but one real remedy, and that is the complete removal of the current from the ground. He believes that a conviction that this would be the best policy is shared by not a few of the fair-minded and far-sighted railway men. But, he says, if the street car companies do not voluntarily make the change, then they should certainly be compelled to do so.—*Eng'ing News*, July 23.

New System of Automatic Car Control.—A description illustrated by diagrams, of an interesting demonstration of a new system of car control. The car on which the new apparatus was installed was a four-wheel double-decker, weighing about 9 tons and equipped with two Brush motors. The alterations in the electrical equipment are as follows: *a.* The field windings have been changed from series to shunt with the addition of an auxiliary series winding; *b.* The motion of the power handle has been limited to the series notches; *c* a speed control lever has been added, interlocked with the power lever; *d* an automatic switch has been introduced into the emergency circuit to cut out resistances when the line current fails. No change has been made in the armatures or their connections. It is stated that the net saving in energy obtained over a large number of trial runs appears to be about 30 per cent., as measured on the car. Instead of 140 amp. the maximum demand on the line is reduced to 80 amp. per car. Regeneration takes place automatically on a descending grade, or by pulling back the speed lever quickly. In descending hills the regenerative effect is usually 40 amp., sometimes rising to 50 amp. There are two handles on the controller, one for the field winding and the other for the armature. The latter cannot be moved until the former is at the notch for maximum excitation of the field, but it can then be advanced to any position. Resistance is gradually inserted into the field circuit to increase the speed by advancing the lever controlling the field resistances. Should it be desired to decrease the speed or to cause the motors to generate and return current to the line, it is only necessary to move this lever backward, thus cutting resistance out and providing an exceedingly strong field. When this lever reaches the position in which all resistance has been cut out, the armature lever flies back and breaks the circuit unless it is purposely held forward. Owing to shunt motors being employed, current is returned to the line automatically when the car descends a gradient. If the trolley comes off the line, the motorman has merely to press a small handle attached to the field resistance lever, which switches in a series winding, consisting of many turns of fine wire, and short-circuits the motor. It is perfectly immaterial as to what position each lever is in when this operation is performed. The effect is exactly the same whether the car goes forward or commences to run backward; immediately after the auxiliary series winding is connected, the car is pulled up almost to a standstill and may be brought to a dead stop by means of hand brakes.—Lond. *Elec.*, July 17.

Des Moines City Railway.—A description of the road with plans of the new power station and car house. A novel method of laying a return feeder on the bed of the river is described. When the river was frozen a rail, with cast-welded joints, was laid on the ice, and when the ice melted the rail sank and the company had a permanent feeder from one side to the other.—*St. R'y Jour.*, July 11.

REFERENCES.

Traction Company in Texas.—An article describing the system of the Northern Texas Traction Company. The system is 37 miles long and includes the city system in Fort Worth. The track construction and power station are thoroughly described. Originally oil was used as fuel in the station, but a test was made showing that 1 pound of coal equaled 0.66 pound of oil, and coal is therefore far more economical. Tests were also made to determine the efficiency of the generators, rotaries and transmission line; full particulars are given.—*St. R'y Jour.*, July 18.

Recent Improvements in Canal Engineering.—Fitz-Gibbon.—A paper read before the Engineering Conference in London. The author discussed several systems of electric traction.—Lond. *Elec.*, July 3.

Electric Railroad Statistics for Germany.—A table covering 18 large pages, giving the following data of all the electric railroads in operation and in course of construction in Germany, viz.: location and name of company, date of opening, system of current distribution, length of track and road, gauge of track, highest grade, number of motor cars, number of trailers, number and normal capacity of car motors per car, current, whether obtained from own power station or from another central station; total power in kilowatts of electric machines used for traction, including reserve; capacity of the storage batteries used in the power houses for traction purposes in kilowatts, and other remarks.—*Elek. Zeit.*, July 9.

Railway Power Station in London.—An article describing the power station of the underground electric railways of London. The station is being erected to operate the Yerkes system of underground railways, and will have a capacity of 57,000 kw. The power equipment will consist of ten 5,500-kw steam turbines, each directly connected to a three-phase generator wound for 11,000 volts and 33⅓ cycles per second. Plans and sections of the station are given. —*St. R'y Jour.*, July 18.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

New Electricity Works at Manchester.—The conclusion of the well-illustrated serial previously noted in the Digest. The present installment describes the generating station at Bloom Street, mainly supplying power to tramways. The boiler house contains 11 tubular boilers, each of a total heating surface of 5,140 sq. ft., working at 160 pounds per sq. in. The customary equipment of economizers, feed water heaters, etc., is provided. The generating plant consists of four steam dynamos, each giving normally 1,800 kw at 75 r.p.m. The engines are of the vertical compound type, with the dynamos between the cranks. Each engine has a fly-wheel of 125 tons weight, and teeth are provided in the wheel's periphery for the electric barring gear. Each generator has a capacity for 25 per cent. overload continuously or 50 per cent. for short periods. The commutator and armature diameters are 10 ft. and 12 ft. respectively. The commutator is constructed of 900 segments, carbon brushes are used and each holder is bolted to a central ring, connected through suitable gearing, to hand wheels at each end of the machine. The field frame contains 20 poles. The machines are designed for 75 r.p.m. and supply current either at 410 to 440 volts for lighting or 500 to 550 volts for traction. For the former they are connected as shunt-wound generators, for the latter as compound-wound, the change being effected by a switch pillar at the side of each machine, with interlocking gear to prevent the possibility of an error made in changing over. The switchboard arrangements are also described.—Lond. *Elec. Rev.*, July 17.

Rand Central Electric Works.—A well-illustrated article, describing the largest central power station in British South Africa. The generating plant consists of four 1,000-hp triple-expansion condensing engines, directly coupled to four 800-kw, three-phase alternators, generating electricity at 800 volts with 50 cycles per second. The engines are frequently called upon to furnish 1,200 hp. The steam pressure is 175 pounds per sq. in. Regulation is performed by means of a special motor-driven regulator. The generators are of the Siemens-Halske stationary armature type, wound on the star system; the rotating fields are excited from dynamos carried on the ends of the main shafts. The exciters are of the internal field type with external commutator, and supply current at a pressure of 120 volts. Regulation is effected by means of field and main current rheostats, which are also operated by a small motor controlled from the switchboard, the electrician in charge thus having complete and instant control over both the excitation and the governing of the generators. The boiler house contains eight multitubular boilers, each of 500-hp capacity and a heating surface of 3,300 sq. ft., generating steam at 180 pounds per sq. in. There are sixteen 200-kw transformers, which raise the pressure from 800 to 12,000 volts. The line consists of 28 miles of conductors, running along the veldt to Johannesburg and supplying power to the various mines on the way. The cables are three double bare wires of 140 sq. mm. cross sectional area for double wire, supported by steel poles 28 ft. high, the distance between poles being 90 ft. To overcome self-induction and atmospheric effects, the insulators are so arranged as to give a continuous helical twist to the line, the original position of the insulators recurring at every sixth pole. A high line efficiency is obtained; the loss by leakage, in resistance and in transformers, has been found to be only 7 per cent. during the time of maximum load. Each mine is supplied with a separate transformer station, where the pressure is reduced to 120 volts for lighting and 250 or 500 for power purposes. The station furnishes 800 kw at a pressure of 2,000 volts, which must be kept within 2½ per cent. The current is furnished to a sub-station, one compartment of which contains the company's transformers, etc., which step the pressure down to 2,000 volts and deliver the current to the 2,000-volt bus-bars in the municipality compartment. The transformer chamber contains eight 100-kw, three-phase transformers, five of them air-cooled and the rest of a new oil-insulated type. Two regulators are provided, one of a transformer type, arranged to add or deduct from the bus-bar pressure to the extent of 250 volts. The other type, recently installed, is in the shape of a small induction motor, the small motor being placed on top. This, through worm gearing, operates a crank turning the rotor, which moves through two right angles. This alters the pressure of the circuit by raising or lowering the power factor of the transformers. The highest maximum load on the works is 2,200 kw, the average maximum load 1,600 kw.—Lond. *Elec. Rev.*, July 10.

Condensing Plant for Central Electric Stations.—Summerfield.—The first part of an illustrated article. The author thinks that in many cases in power stations the total quantity of fuel or water used is so small that the value of the amount saved by any extra appliance is not equal to the amount of the interest and depreciation on and cost of working that appliance. In the case of a condensing plant, for instance, before any real saving can be effected by it, the author comes to the conclusion that unless an average day and night load of about 150 hp is obtained, there will be no practical saving in condensing, while below that a direct loss is soon incurred. A condensing plant is usually installed on the separate or the central plan, in the former case each engine being provided with its own condenser and air and circulating pumps, so that each unit is complete by itself, while in the latter case a common air main is used, with a connection to each engine exhaust chamber. Unless ejector condensers or some other simple form of condensers are used, however, the first cost of a separate condensing plant is too great to allow of its adoption except for large engines, say of 1,000 hp and over, in which cases it is no more expensive than a central plant and has greater advantages. Several types of surface and jet condensers are illustrated.—Lond. *Eng'ing*, July 17.

WIRES, WIRING AND CONDUITS.

The Arrangement and Control of Long-Distance Transmission Lines.—Cowan and Andrews.—The first part of a paper read before the Manchester section of the Institution of Electrical Engineers. After a brief review of the different current distribution systems, the authors say that the maximum pressure for three-phase alternating-current distribution actually in practical operation is 80,000 volts. There is, they say, no reason why this should be the limit, as transformers have been worked well above 100,000 volts, and with liberal spacing of the overhead wires the electrostatic leakage can be sufficiently reduced. After touching on the line capacity current, the loss in conductors, poles, etc., the authors describe the winding and arrangement of an improved variable induction transformer, which is also illustrated in the article. Instead of the secondary winding being wound entirely upon the ring, it is wound half on the movable core and half on the ring; the primary winding is wound on the movable core. The result of this arrangement is that in a certain relative position the magnetic lines induced by the primary winding cut the half of the secondary wound upon the movable core in a positive sense, and the half of the secondary on the ring in a negative sense; the resultant e.m.f. in the secondary, is therefore, *nil.*

When, however, the movable core has been rotated through an angle of 180°, and the magnetic lines cut both the secondary windings in a positive sense, the resultant e.m.f. is the sum of the two, and, therefore, a maximum. In intermediate positions intermediate secondary pressures are obtained. There is practically no magnetic leakage between the primary winding and the half of the secondary winding on the movable core, and the number of secondary turns on the iron ring being half of the total, the tendency for magnetic leakage to occur at the air-gap is proportionately reduced. The result is that there is a total drop of only 6 to 7 per cent. on the secondary between no load and full load. A further improvement consists in fixing shading coils on the moving core at certain positions, which neutralize the inductance of the secondary circuit when the movable core is in intermediate positions. The slots in the ring which contain the secondary coils are so placed that the area of gap between the movable core and the ring is as large and as equal as possible in all positions, thereby keeping the magnetizing current as low and as constant as possible.—Lond. *Elec.*, July 10.

Moisture in Conduits.—Murdoch.—An article in which the author comes to the following conclusions: *a.* Seamed conduit or socket-jointed conduit, should never be buried in plaster, at least never in walls, which are subject to the action of the weather, especially if these are of solid brick or stone. *b.* Water tightness should be aimed at, at any rate, when the conduit is laid on sweaty walls, under plaster or stone floors, and in draughty situations. *c.* Conduits, with insulating lining will probably be slightly less subject to rapid variations of temperature, and consequently condense less. For extremely damp situations and high voltages, the conduit does not appear to the author to be particularly applicable. It is also doubtful if the metallic continuity could be relied on in an emergency. The lead-covered, water-tight systems appear here to have a great advantage over the conduit, although even lead is subject to corrosion by water. The author thinks that wiring in damp places has hardly yet received the attention its importance warrants, and it ought to interest fire insurance people especially in view of the higher voltages now becoming common. He cites a case where water dripped upon a wire, which became gradually corroded and finally heated up and caused a fire.—Lond. *Elec.*, July 10.

Electro-Physics and Magnetism.

Radioactive Gas from Metallic Mercury.—Strutt.—An article giving the results of a series of experiments by the author, from which he draws the following conclusions: 1. A radioactive gas or emanation can be obtained by drawing air over hot copper or by bubbling it through hot or cold mercury. 2. By repeated circulation through mercury very considerable activity can be obtained, activity of quite a different order from that of metals as ordinarily observed. 3. The mercury emanation deposits radioactive matter on the walls of the vessel containing it. This deposit remains after blowing out the gas, and possesses at first perhaps $\frac{1}{6}$ of the activity of the latter. This induced activity falls to half its value in 20 minutes. 4. The emanation itself decays in activity according to an exponential law, falling to half value in 3.18 days of 24 hours each.—*Phil. Mag.*, July.

Rotation of Liquids Under the Action of a Magnetic Field.—Urbasch.—A contribution of Prof. Nernst to the discussion repeatedly mentioned in the Digest, between the author and Prof. Drude, as to whether a magnetic field could produce rotation in an electrolyte. The author referred the question to Nernst, and the latter now finds that the rotation actually takes place under the right condition of experiment. The sense of rotation of the liquid is reversed, when the magnetic field is commuted.—*Zeitsch. f. Electrochem.*, June 25.

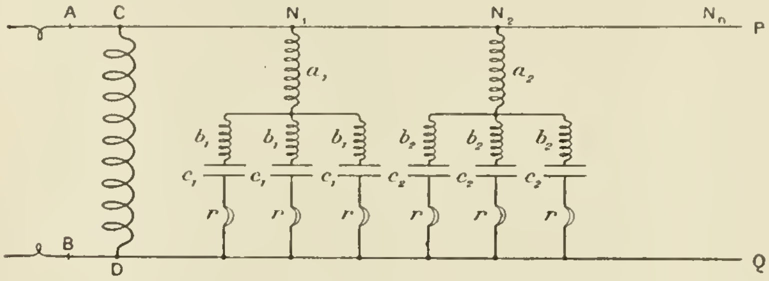
REFERENCES.

Recent Developments in the Study of Radioactive Substances.—Merritt.—A paper read before the Cornell Section of the American Chemical Society, containing a clear and comprehensive review of the present state of our knowledge on the subject of radioactivity.—*Science*, July 10.

Cathode and Röntgen Rays.—Dastre.—A long historical article, describing the properties of these rays. Translated from the *Revue des Deux Mondes* for the Smithsonian Report and reprinted in *Scien. Am. Supp.*, July 4.

Electro-Chemistry and Batteries.

Production of Nitric Acid by Electric Discharges.—Kowalski.—In a paper read before the Soc. Intern. des Elec., Paris, the author describes his method for the production of nitric acid from the nitrogen of atmospheric air. He claims that for a maximum yield there must exist a certain relation between the intensity of the current which produces the arc, the difference of potential at the electrodes, between which it is struck, and the frequency of the current. A maximum of nitrous vapors has been obtained by the author with a current of about 0.5 amp., a difference of potential of 50,000 volts and a frequency between 6,000 and 10,000 periods per second. With ordinary air 52 to 55 grams of nitric acid have been obtained per kw-hour. If about 50 per cent. of oxygen is added, this yield can be nearly doubled. The apparatus is shown in diagrammatic sketch in the adjoining figures. *A* and *B* are the terminals of the secondary of a high-tension transformer. *A P* and *B A* are two parallel conductors. The conductors are connected by groups N_1, N_2, each consisting of a self-induction coil, *a*, in series with three coils, *b*, connected in parallel, each of the latter being in series with a condenser, *c*, and arc, *r*. The coil, *a*, is for the purpose of preventing the oscillating discharges from reacting upon the transformer; it is calculated in such a way that its resistance is very great for the high-frequency currents which are produced by the charge and discharge of the condensers, and is relatively small for currents of ordinary frequency coming from the transformer. The whole system produces a phase lead, the compensation of which is effected by arranging a self-induction coil, *C. D*, between the terminals of the transformer. One of the most difficult parts of the apparatus was the condenser, for which, as dielectric, small glass tubes silvered on both sides, have been found to give the best results. The energy loss in these condensers is not more than one per cent.—*Bull. de la Soc. Intern. des Elec.*, June.



PRODUCING NITRIC ACID BY ELECTRIC DISCHARGES.

Chlorine Smelting, with Electrolysis.—Swinburne.—The first part of a paper read before the recently formed Faraday Society in England. The author gives an outline of a process in which he proposes to substitute a chloridizing process for the ordinary metallurgical roasting and subsequent reduction processes. The ores are thus converted into salts of the metals, which can be electrolyzed easily and cheaply. In the case of a sulphide ore, for instance, the ore is treated with chlorine so as to displace the sulphur and absorb all the chlorine. The chloride is then electrolyzed to get the metal and recover the chlorine. In the case of pure galena the material is treated with hot chlorine so as to form lead chloride and sulphur. The sulphur is condensed as brimstone, and the lead chloride is electrolyzed in the fused form, producing lead and chlorine. If silver and gold are present the fused chloride of lead is treated with metallic lead. This replaces any gold or silver there may be and the precious metals alloy with the remaining lead, so that ultimately a bullion is produced as rich as may be desired, the only limit being its melting point, which must not be too high. The cost of the desilvering by the ordinary process is thus stated to be saved. Mixed ores, such as Broken Hill slimes, which contain zinc, lead, iron, silver and gangue, are treated in the following manner: Hot treatment with chlorine converts the whole of the metals into chlorides, producing a broth of mixed, fused chlorides and gangue. The silver is extracted by substitution of lead, the lead is extracted by substitution of zinc and the iron is thrown out as ferric oxide, not as metal, zinc oxide being used as substitute. The gangue is gotten out by filtration. There is then nothing left but zinc chloride, and this is electrolyzed to yield zinc and chlorine. The author states that the process is cyclical with regard to chlorine; the formation of chloride of sulphur would be fatal to the process for the reason that both sulphur and chlorine would be lost. It has been discovered that sulphide ores can be treated on a large scale by chlorine and give off sulphur only. It is said also that the electrolysis of zinc chloride was supposed to be very difficult or impossible, but that all difficulties have now been overcome. The electrolytic vats are internally heated as in the case of aluminum. The cathode is fused zinc and the anode is carbon The vats are kept under light suction, so that if there are any leaks, air is drawn in instead of chlorine leaking out. The zinc chloride is made anhydrous in a series of preliminary vats, which are fitted out with inexpensive carbon anodes, which gradually are consumed The anhydrous zinc chloride from these vats is then taken to the final electrolysis vats. The vats are stated to be very simple, merely iron cases filled with firebrick. With a vat on which a 3,000 amp. current was run, the voltage amounted to 4 volts. The current efficiency is practically unity. Lond. *Elec.*, July 10.

Electricity in Coal Mines.—A long editorial, dealing with the use of electricity in coal mines and discussing the best system to be adopted for distribution. The three-phase induction motor is considered the simplest solution of the problem, in view of its absolute safety, as it cannot spark. Though it was shown that continuous-current motors protected in a proper manner with gauze, etc., were practically harmless, when sparking in a highly explosive mixture, the three-phase is considered safer than such an elaborate system of protection, which though efficient at the beginning, may not remain so. After all, efficiency is not such an extremely important point, when human life depends upon safety and reliability, and moreover a saving of 5, 10 or even 20 per cent. is not of great moment to a mine owner who gets his fuel at the minimum figure It is not so much in first cost and working costs that money is saved by the adoption of electricity in mines, as in time and convenience. There is room for considerable extension in the application of electricity in mines, and the subject is one to which coal owners and engineers should give their utmost attention.—Lond. *Elec.*, July 10.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Motormeters on the Ferrari Principle.—BUSCH.—A paper read before the recent annual meeting of the German Electrotechnical Society on some new constructions of instruments by the author. He lays down the principle governing the construction of meters in general and gives a detailed explanation of the action of the Ferrari meter. The meters are constructed for loads free of induction and for loads of any kind. The construction of a meter of the latter type is shown in the accompanying figure. The shunt stator, *a*, is formed as a choking coil, nearly enclosed in iron. About 90 per cent. of the lines of force of the coils travel through the slots, *d d*, while only a small number pass through the disk-former rotor, *b*. On account of this arrangement the phase difference of the shunt field, which corresponds to the potential, is about 75°, and the component, which effects the movement, is almost just as large as if the phase difference were 90°. The choking coil can stand, with suitable winding, loads up to 250 volts, and wastes hardly one watt. A four-pole main current stator is arranged opposite to the three-pole shunt stator, the two inner poles of which are provided only with coils for a meter for loads free of induction. The construction is such that the secondary shunt currents take place in the main current field, and the secondary main currents in the shunt field. On account of this the action is a very powerful one in spite of the comparatively weak fields The loss in the main current amounts to about one watt. In the meter for inductive loads all four poles are provided with a coil and the coils on the inner poles act exactly in the same way. The coils of the two outer poles are provided with an iron circuit, *g*. Both windings are connected in parallel, but opposite to each other The coils on the outer poles generate many lines of force because they are surrounded by an iron circuit, while the coils on the inner pole generate only few lines of force, because large air-gaps are present in the path of the lines of force. Therefore, the current divides itself into two components, one acting for the greater part and one only to a small extent on the disk. On account of this, the resulting main current field can be so arranged that it is vertical to the direction of the shunt field. The exact regulation of the desired phase difference is obtained by introducing into the circuit of the component a small piece of resistance wire, *w*, which can be short-circuited more or less, as desired. By arranging an air-gap of the right dimensions in the path of the lines of force of the inductive circuit, the diagram of the distribution of current over the whole range of measurement is the same, so that the meter gives correct indications with all current values, and any difference of phase in the circuit, where the current is consumed. The loss in the main current windings at full load amounts to about 4 watts. The additional torque, which is influenced by the pressure, is effected by a sheet of aluminum, *h*, arranged movably between the disk and the main current stator. Provision is also made to prevent the instrument from registering when no current is flowing.—*Elek. Zeit.*, July 2.

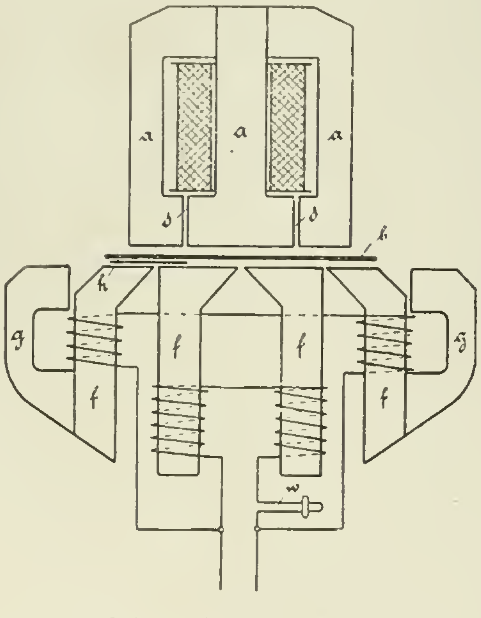


DIAGRAM OF MOTOR METER.

Friction Losses in Electric Machines.—An article illustrated by diagrams. The author describes a method by which the amount of friction caused by the air and by the journals, can be found separately, instead of being determined together as usual. The method is based on the fact that the resistance of the air varies proportionately to the square of the velocity and the coefficient of bearing friction varies proportionately to the square root of the velocity. Curves are given in the article, showing the values of air and fricton losses in the case of a 100-hp, three-phase motor. It was found that the journal friction is far surpassed by the air friction even at a moderate velocity. At 600 revolutions the latter amounted to 1,660 watts, or over 2 per cent. of the effect of the machine.—*Elek. Zeit.*, July 9.

MISCELLANEOUS.

REFERENCE.

Notes on Balata.—TERRY.—The author describes the gathering and further treatment of Balata gum. He thinks that balata has very little application, if any, for insulating purposes, to replace gutta percha. This he thinks is not due to its scarcity, but to its unsuitability, in so far as it contains a large amount of resinous matter, 40 to 50 per cent. being often found in the better quality, whereas the best gutta percha contains only 20 per cent.—Lond. *Elec.*, July 10.

New Books.

STORAGE BATTERY ENGINEERING. A Practical Treatise for Engineers. By Lamar Lyndon, B. E., M. E. New York: McGraw Publishing Company. 382 pages, 178 illustrations and 4 plates. Price, $3.00.

There are few engineers who would not approach the subject of the storage battery with the greatest circumspection. There are several reasons for this. The development of the storage battery in practice is recent. The theory of its action is far removed from the field of electrical engineering, is extremely complicated and imperfectly understood. The manufacture of the storage battery has been hedged about with an almost impenetrable fence of secrecy, and its history is a history of patent litigation.

Therefore, when a book on this subject appears it is likely to be merely an agglomeration of advertising pamphlets, or else it has been rigidly censored by one or another of the manufacturing companies. Such engineering data as have been published are out of date—not because of any rapid strides in development and design, but were antiquated at the time they were issued to the interested public.

The book before us, "Storage Battery Engineering," by Lamar Lyndon, is a delightful departure in this field of engineering literature. It is the most important work that has been written on the storage battery, and is of vast interest to any one who has to do with this useful piece of electrical apparatus. In this volume the subject has been treated in a concise and clear manner. The data are accurate and modern, and the formulæ deduced in a manner logical and inceptive. There are one or two very ingenious mathematical examinations, particularly the problem of the line batteries on page 348. There has been, so far as we know, no adequate solution of this perplexing and important application. Line batteries have been installed according to the dictates of experience, and the result has often been wasteful in energy and lacking in results. Of course, this formula, like all formulas, must often be modified by practical conditions, but its solution is a maximum toward which the result of the actual installation must approach as closely as the conditions will allow.

As Mr. Lyndon tells us, this book was written around a very interesting series of articles on "Storage Battery Auxiliaries" that appeared in the Electrical World and Engineer some time ago. We have several times had occasion to make use of that work, and the elaboration of the inquiry which appears in the book will be found of use and value.

The treatment of the general subject is well developed. The chapter on general theory is valuable insomuch as it does not pretend to go into an extended and useless discussion of the chemical action of the storage battery. Such a discussion could only be theoretical and perplexing, and belongs more properly to the realms of chemistry. Whether the molecule of lead possesses six or twenty-six atoms, the action of a storage battery at the point of fuel charge is not in the least effected thereby, and the engineer needs to know only enough of the interior action to give him a reasonable grasp of the anatomy of the creature he seeks to train—enough to physic it when sick and mend it when broken. If he wants to go further, he must use a microscope, and the probabilities are ten to one that he will arrive at results reached before by no one else.

What we require to know is not how a given action takes place. We must know briefly what takes place or what may take place, and this information Mr. Lyndon gives us. The subject of the battery proper is broken up into several heads of voltage, active material, electrolyte, internal discharge, influence of temperature, capacity, resistance and efficiency.

We believe that 80 per cent. commercial efficiency is too high a figure. We should prefer to use 75 per cent. watt-hour efficiency for storage, where discharge begins, at or near the end of charge. A battery on regulation service usually works at an efficiency of between 85 and 90 per cent. A new battery, in proper working order, will, of course, give a different figure from one that has been in service some time, and is, therefore, likely to contain more or less sulphating loose active material, etc., etc. Efficiency varies also between types of cell, as does ampere-hour efficiency—particularly the latter. But both watt-hour and ampere-hour efficiency are inextrably tangled up with capacity and life, so that often mechanical strength with low capacity is preferable to high capacity and short life. Every particular problem, however, has its own solution.

An interesting chapter on diseases and their remedies is given, and one on care and management. Somehow a storage battery seems to require a particular kind of genius to nurse it through its many vicissitudes. Its diseases are often so masked and hidden behind myriad phenomena that brains and experience alone is the proper antidote. A storage battery does not, like a generator or engine, cry out when in pain; it will stand a dreadful amount of ill use in silence, and this very silence is often the cause of an engineer's undoing. The battery will stagger along away from sight, hidden securely in some out-of-the-way nook, where it was placed because the space was so inaccessible that nothing else would fit. And then of a sudden it begins to lose its charge, it won't keep its voltage, it does a thousand peculiar things—the engineer cusses it up hill and down dale, the owner catches the infection, and then out goes the battery, and up go the coal bills. A storage battery requires as much —even more—care, than is given to the engines or to the generators. It is a mistake to believe that a battery may be added to a plant and then be left alone. It is often worth its weight in gold when intelligently and properly handled. Otherwise it is worth the price of scrap lead.

Probably the most interesting part of storage battery engineering and consequently the most interesting chapters of the book are those on switches, booster systems and other auxiliary devices so necessary for the operation of the battery. The design of boosters is a particularly interesting and difficult branch of electrical engineering. For troubles and crankiness a booster is as bad as a rotary, and its important relations to battery operation make proper design imperative. Ample material, large cross-sections, heavy commutators, well-designed brushes—these are the first requirements. The field of experience that a reading of storage battery engineering displays speaks worlds for Mr. Lyndon's work.

Directory of Electrical Societies, Etc.

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

American Order of Steam Engineers. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York.

American Street Railway Association. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa. Next meeting, Thousand Islands, N. Y., September 8, 9 and 10, 1903.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, Indianapolis. Ind., third Wednesday in June, 1904.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., 1904.

Engine Builders' Association. Secretary, F. P. Ide, Springfield, Ill.

Electrical Contractors' Association of New York State. Secretary, Wm. J. Davis, Ithaca, N. Y.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September 2, 3 and 4, 1903.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky.

Iowa Telephone Association. Secretary, C. C. Deering, Des Moines, Iowa.

National Electric Light Association. Secretary, Ernest H. Davis, Williamsport, Pa.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, Utica, N. Y.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association. Secretary, E. W. Pichardt, Huntingburg, Ind.

The Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street New York. Board of Directors meets second Friday of each month

Municipal Electricians.

The Association of Municipal Electricians which will hold its next meeting September 2, 3 and 4 at Atlantic City, has chosen a delightful spot for its convention. In going to the Hotel Rudolf, it is enabled to hold its transactions in the hotel itself, containing 450 rooms and fronting the ocean. Special rates are to be made for the meeting, and a large attendance is expected.

American Street Railway Association.

The twenty-second annual meeting of the American Street Railway Association will be held at the Grand Union Hotel, Saratoga Springs, New York, Wednesday, Thursday and Friday, September 2, 3, 4, 1903. Papers will be presented on the following subjects: "Steam Turbines," "Electric-Welded Joints," "The Evils of Maintenance and Champerty in Personal Injury Cases," "Train Orders and Train Signals on Interurban Roads," "Freight and Express on Electric Railways," "The Manufacture and Distribution of Alternating Curents for City Systems," "Comparative Merits of Single and Double Truck Cars for City Service," "The Right of Way."

The headquarters of the association will be at the Grand Union Hotel. The annual dinner will be held at the Grand Union Hotel, Friday evening, September 4, when the officers-elect will be installed.

Additional interest is given to the occasion by the fact that not only will the Street Railway Accountants' Association hold its meeting at the same time, but the first annual meeting will be held of the new American Railway Mechanical and Electrical Association formed last year at Detroit. A very large and fine exhibit of street railway apparatus is expected. The usual rules as to one-and-one third railway fares will apply.

* * *

Duplexing Trains on a Single Track.

By Philip K. Stern.

Multiplexing a railway would perhaps not be quite as intelligible to those familiar with the same term in its application to telegraphy, though its significance is applicable in transportation, as well as in the communication of intelligence. The writer presents here with a system involving the principles whereby a line of railway may be at least duplexed. The accompanying photographs represent a model of two electrical cars adapted to duplex traffic over a single line of railway, and the objective system is designed to be operated as an amusement feature at seaside resorts, railway parks and the like.

The linear dimensions of the model car are approximately 1-15 of that of the equipment, which they represent, or of a scale of about ¾ of an inch to the foot; the model approximates these proportions in some respects, though in others the dimensions are quite disproportionate, and as a result the models are excessive in weight. The photographs (Figs. 1 and 2) show the two cars as they move upon the same track, and in opposite directions, pass each other by one of them changing its plane.

Fig. 3 illustrates the manner in which one of the cars remains upon the main track, while the other takes a superimposed position in passing over a vertical switch, and is returned to its original plane after conjugation. The model is constructed so as to operate continuously on a track 16 ft. in length, and is provided with means for reversing the direction of the cars as they reach the terminus of the road. Pneumatic buffers are disposed over the roadbed at the terminals to take up the impact due to the inertia of the conveyances.

Since the running gear of the model cars was not designed on engineering principles and was appropriated to toy electrical railways, complete data as to the performance of a system of this character designed on the principles of present practice could not be readily attained. The dimensions of the model, however, may be of interest, and are as follows:

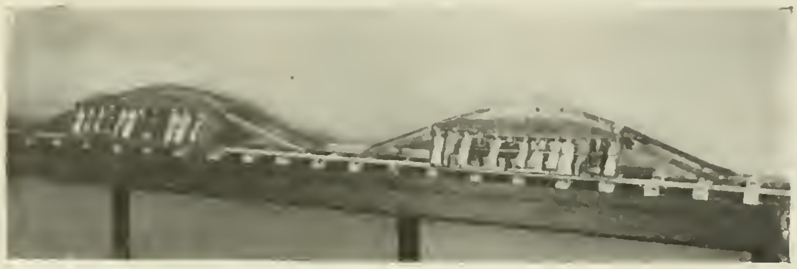


FIG. 1.—TWO CARS APPROACHING EACH OTHER.

The running gear is of the single truck girder type, modeled somewhat on the lines of the modern electric motor four-wheel car-truck. The length of the wheel base is 9 inches, and the traction wheels two inches in diameter of the double-tread type, with a central flange adapted to run on two different gauges, the larger gauge of 4½ inches involving one of about 3½ inches. The wheel tread is about ⅜ of an inch in width, and fits the gauge of the rails to within ⅛ of an inch, 1/16 of an inch being allowed on opposite treads for end play, as an adjustment for inequalities in the gauge of the track as well as for slight curvature. Upon each of the traction wheel axles, a single reduction gear of 96 teeth is mounted, meshing into 13-toothed pinions carried by the armature shaft of the motors. The latter are of the series wound rear suspension type weighing 2 pounds. The speed of the armature shaft without load is about 1,200 r.p.m.

When the cars are running at normal speed or approximately 150 ft. per minute, the motors consume about 24 watts at about 6½ volts, and during the operation of the cars at the speed stated, the current consumption appears to be approximately 48 watts per car. The weight of the cars, including figures, is a trifle under 12 lbs. The amount of current consumed as one car is moving over the other is slightly in excess of that taken up by the motors when running on a level, but the current falls off considerably at the instant the superimposed car leaves the gradient and is running down grade to the main track. In this connection it appears that the total work done by the six cells of accumulator employed to drive the two cars is about the same as that when the cars are going over the gradient or running on the level.

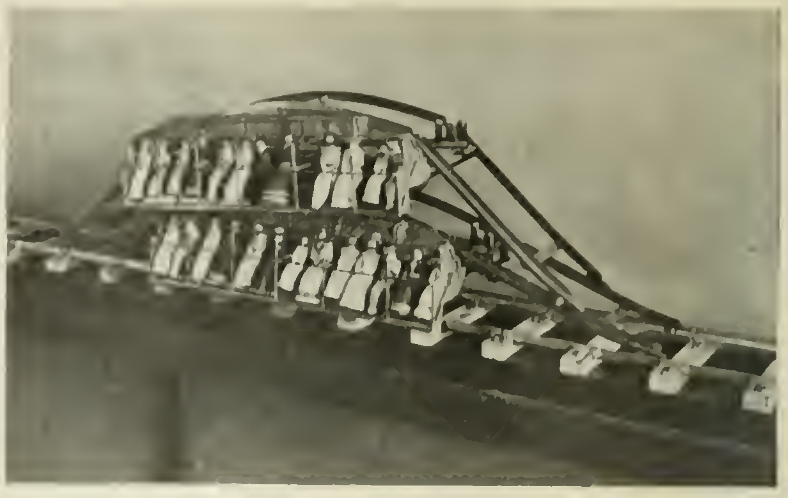


FIG. 2.—CARS "PASSING."

Four motors, two for each car, are connected up in multiple arc and make an electrical rolling contact through the wheels with the track which is likewise connected in multiple arc with the storage battery. A section of each terminal of the track extending for about 33 inches toward the center is insulated from the remaining portion of the track by open spaces, and the two sections are cross-connected in series; it is the terminals of each of these sections that are provided with pneumatic buffers.

The superstructure of the cars comprises an overhead switch above referred to, registering with the narrow-gauge system of rails and the inner tread of the traction wheels. This consists of a sinusoidal curved track supported by columns from the car sill, so as to elevate the summit of the grade 4½ inches above the roadbed. A chord of this curve, 16 inches in length trisects it so as to cut off from both the extremities about 8 inches of the inclined ends. These are

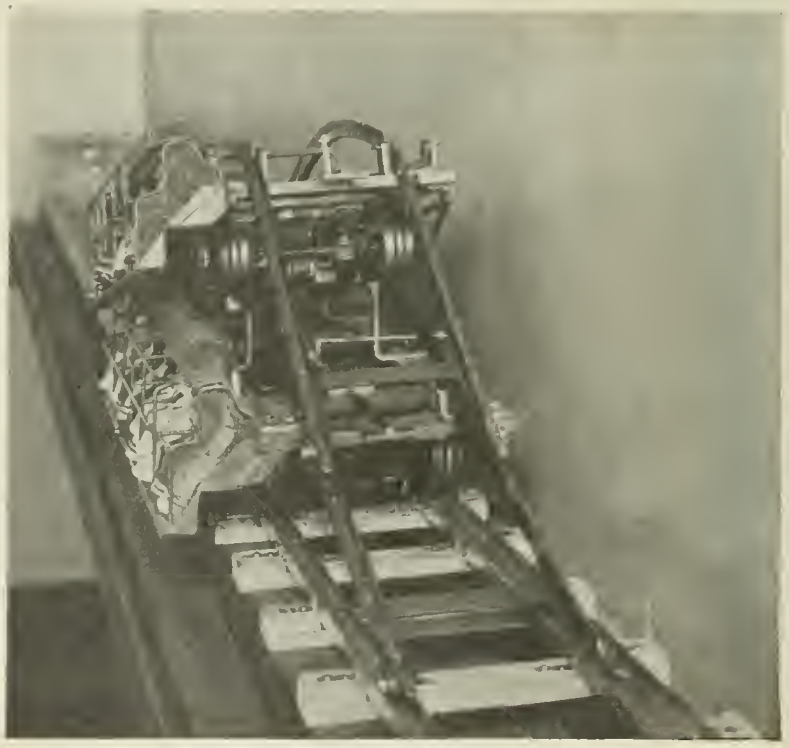


FIG. 3.—CARS "PASSING."

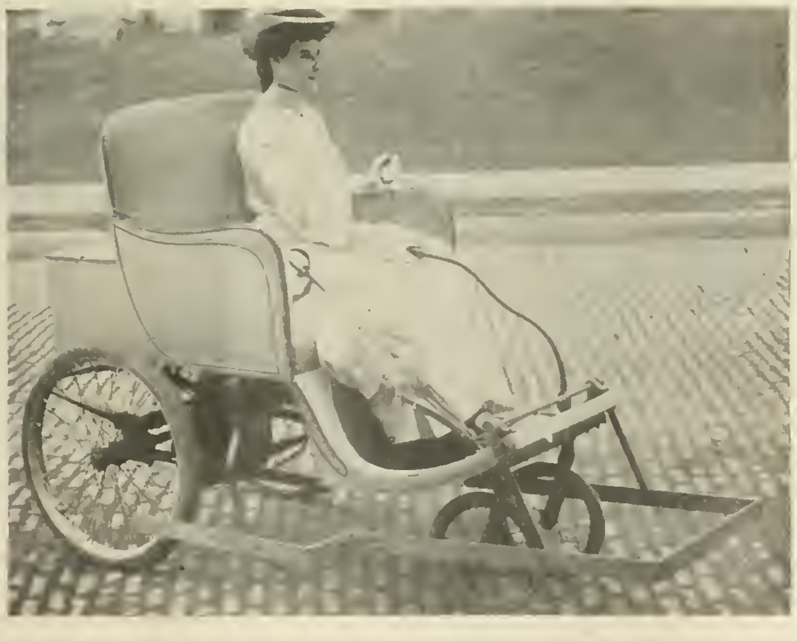
jointed to the extremities of the crest of the curve by gimbals carried by the car sill. These jointed portions serve the purpose of respectively pilots on the one hand to guide a mounting car when it strikes the overhead switch, and on the other hand, as skids when the superimposed car is descending the gradient of the subtended vehicle. The total length of the superstructure or overhead switch is 34 inches, thus the average grade is approximately 25 per cent.

Electrical communication between the superstructure and the main track is effected by a rolling contact between the jointed extremities or pilots of the bridge work through double-treaded pilot wheels measuring ¼ of an inch in diameter at the tread and ⅜ inch extreme. These revolve on axles ⅛ by ½ inch secured to brackets carried by the pilots. At the instant of conjugation of the two cars, the mounting pilots which are permanently elevated above the plane of the subtending pilots of the opposing car, take the gradient and establish electrical communication between the superstructure of the subtending car through the pilots and motors of the one mounting.

A remarkable feature in the operation of the model may be here mentioned, and that is the apparent jumping of one car over the other when they are brought into apposition from a state of rest; as soon as the battery switch is closed and the current is turned into the track, the mounting car immediately climbs the gradient of the subtending conveyance at approximately a normal starting speed.

Electric Automobile Chairs for St. Louis Exposition.

Electric automobile chairs will be one of the features of the World's Fair at St. Louis in 1904, Semple S. Scott, of St. Louis, having recently obtained the concession to operate them during the Exposition period. The chairs, which are the invention of Mr. Scott, will have a uniform speed of three miles per hour, the operator having no control over the speed. The same rate is maintained uphill, downhill, or on the level. The chair takes the form of a low phaeton without a cover. There are two large rear wheels and two small ones under the foot rest. All are pneumatic-tired. The seat is upholstered in cane like the seats on street cars and in summer railway cars. Behind the seat is a box which contains the batteries to operate the machine. If two visitors desire to occupy the chair and the service of a guide is wanted, the latter can sit on an adjustable seat at the rear.


ELECTRIC AUTOMOBILE CHAIR.

On the inside of the chair, attached to the arm, is a lever, which puts the chair in motion or stops it at the will of the rider. A long lever attached to the front truck has its handle directly in the center of the chair within easy reach of the driver. A gentle pressure guides the machine in the desired direction. A feature of the machine is a "sensitive rail" which surrounds the chair on all sides save at the rear. This prevents any accidents, for when the rail comes in contact with any object, even though it weighs but a pound, it presses against a device that locks the wheels and brings the chair to a dead stop.

General Electric's Exhibit at Detroit.

The General Electric Company occupied the largest space in the Light Guard Armory, where the electrical exhibition was held during the convention of the National Electrical Contractors' Association at Detroit. The space was brilliantly illuminated by Meridian lamps of both 120 and 60-watt sizes. Display boards of miscellaneous supplies, including the new enclosed fuses, were shown. A comprehensive line of small motors were shown in operation, including alternating and direct-current sewing machine outfits. A number of the company's convertible type fan motors were to be seen as well as some of the small exhaust fans. An interesting collection of portable and pocket instruments was also displayed. The entire space was handsomely decorated with palms and smilax and comfortable reception quarters, characteristic of the General Electric Company's recent exhibits, were provided. Those in attendance were J. H. Livsey, Detroit; P. L. Clark, Chicago; W. H. Hand, St. Louis, and F. H. Gale, Schenectady.

GENERAL ELECTRIC COMPANY'S EXHIBIT.

Development of National Steel Foundry Interests at New Haven, Conn.

The National Steel and Wire Company, with its customary progressiveness, has taken active and successful steps to associate with it as a subsidiary company, the new National Steel Foundry Company, recently organized by prominent local interests in New Haven. This move should prove of the greatest mutual advantage, for with a large and varied line of the finest steel castings to add to the present production of all kinds of high-grade specialties in rods, wire, wire fencing, wire rope, telegraph and telephone wire, etc., the National Steel and Wire Company can reasonably expect a greatly increased volume of business. The National Steel Foundry Company, on the other hand, has been able to purchase a part of a most advantageous 50-acre site owned by the National Wire Corporation (also a subsidiary company of the National Steel and Wire Company), having both railroad connections and dockage capable of accommodating ocean-going steamers of large tonnage. Furthermore, the Foundry Company will be able to re-melt in its open hearth furnaces all of the waste from the wire and rod mills of the National Wire Corporation, and thus much of the scrap necessary to make steel castings will be always provided for and freightage thereon saved. The National Steel Foundry Company was originally organized to supply the trade of New England and New York, throughout which section there has been the greatest scarcity of steel castings. This union of interests, however, immediately opens the broadest possible field, as the National Steel and Wire Company maintains selling departments in Chicago, Kansas City, San Francisco, and De Kalb, Ill., as well as in Boston, New York and New Haven.

The capital of the National Steel Foundry Company is $300,000, and the plant which is being erected is in every way up-to-date and thoroughly equipped to turn out 35 tons of finished product per day. The main building, which will contain the moulding and casting departments, is 408 ft. long by 100 ft. wide, with two 25-ton acid open hearth furnaces of 25 tons capacity each, and one 40 and three 30-ton traveling cranes. Aside from this the necessary pattern storage, power house and gas producers will be erected immediately. All the buildings are so arranged as to permit of ready extensions from time to time as an increased business may require. It is confidently expected to pour the first heat by January 1, 1904.

The directorate consists of Henry L. Hotchkiss, president, L. Candee & Co.; president, Union Trust Company; president, Shoe Hardware Company; president, New Haven Web Co., etc.; Frank L. Brown, vice president and treasurer, National Steel and Wire Company; H. Sanborn Smith, vice president and secretary, National Steel and Wire Company; Frederick B. Farnsworth, president, McLagon Foundry Company; treasurer, Eastern Machinery Company; H. Stuart Hotchkiss, vice-president and secretary, L. Candee & Co.; Eugene Buckman and M. Sims, of New Haven. The officers are Henry L. Hotchkiss, president; Frederick B. Farnsworth, vice-president; H. Stuart Hotchkiss, treasurer; Eugene Buckman, secretary; M. Sims, manager. The company has issued a very interesting little pamphlet on the art and uses of steel castings.

Automatic Switches.

The General Incandescent Arc Light Company's experience with automatic switches in the last three years has demonstrated that such a switch can be made and can be installed with the assurance that it will give absolute satisfaction under the most severe conditions incident to any service to which they may be applied. These switches are made either one, two or three-pole, for service on voltages up to and including 250 volts, and to carry currents up to 200 amp., as shown in the accompanying cut herewith.

The demand of the day, however, has necessitated the design of larger capacity switches for these voltages, and the above company has now installed automatic switches, which are designed to carry continuously as much as 2,500 to 3,000 amp. Naturally the design for the larger size switches is different from that of the smaller size, and they are so made that the amount of current that can be handled is not limited within any commercial requirement.

In these days when central stations are being almost exclusively equipped for automatic remote control of all the apparatus, it is not surprising that similar applications are being made to other generating plants. Switches for the latter are of the smaller size and are specially suited to installations where it is desired to cut the entire lighting system of a building or a house by the mere pushing of a button, from one or more points distant from the switch. It is very desirable to have the lighting system cut off from the street service in case a building gets on fire, and by some it is considered equally desirable to cut the entire lighting systems off from a residence in case of a thunderstorm, or during the night.

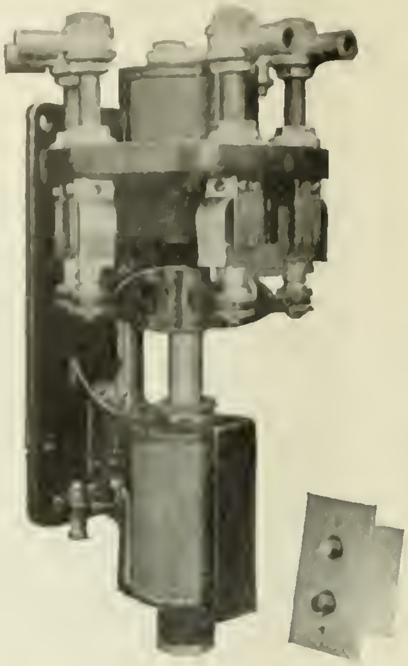
These instances are only a few of the cases where individual switches could be installed to great advantage, but too much stress cannot be laid on the fact that in lighting large public bulidings, such as the sky-scrapers that daily shoot up in New York City, enormous savings could oftentimes be made in the cost of wiring and the labor of installing it, by the use of automatic switches placed throughout the building. In one case it was estimated that $20,000 could be saved by using automatic switches of this kind, instead of following the usual methods of wiring.

In central stations, of course, the use of automatic switches is almost indispensable, especially in the case of a high-tension plant, where the apparatus is designed for remote control. In such plants the low-tension exciter systems oftentimes can be installed with low-tension automatic switches to great advantage, thereby carrying out the general scheme with consistency and at a considerable saving in the original cost.

Automatic switches have been used to great advantage in connection with other devices, such as pressure gauges, which are so arranged that when the pressure becomes excessive in any receptacle into which air or water is being forced by a motor, the pressure gauge closes a contact at such a time, opening the automatic switch and thereby stopping the motor.

The few instances here noted show that the application of an automatic switch such as is here illustrated, is almost limitless; and perhaps the reason why they have not been more often applied is that manufacturers in attempting to produce an article that can be sold at a low price, have been content with a design so light and flimsy that it would not stand up and do the work for which it was intended

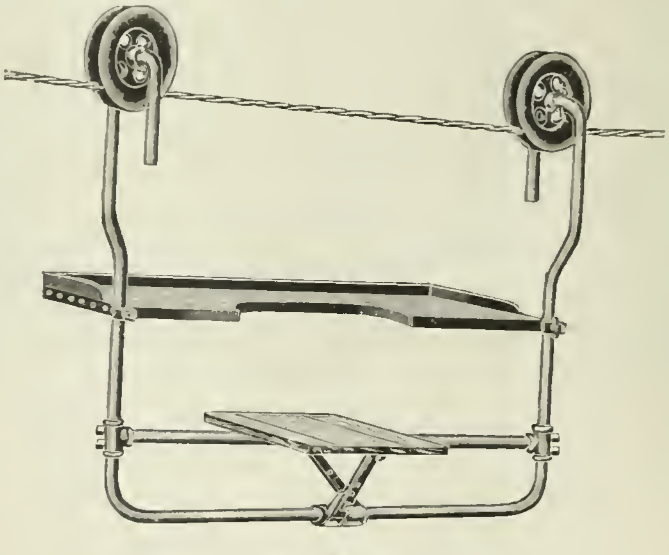
These "G. I." automatic switches are built on an iron frame, which is very substantial and strong, and which also serves to produce a strong magnetic field for the operating solenoids, as will be seen by a glance at the illustration. The switch is intended to be used in a vertical position, so that gravity tends to open it. The opening of the switch is accomplished by a hammer blow, the core in the lower solenoid having lost motion, which is thus taken up before the burden of opening the switch is thrown upon it. This insures the switch opening at all times, as a large factor of safety is thereby introduced.



AUTOMATIC SWITCH.

New Cable Car for Linemen.

A new design in cable cars, which provides a table on which an electrician can lay his tools and material while making a splice, has been appreciated by all who have seen it. The cable car is the one made by the F. Bissell Company, Toledo, Ohio, as shown in the accompanying illustration. This car consists of one continuous piece of pipe without joints except where the short end of pipe is attached at the trolley. The trolleys are of malleable iron, are very light and unbreakable, but still very strong.



LINEMAN'S CAR.

The seat is of wood, dove-tailed to prevent warping, and can be adjusted up or down or to the right and left to suit the size and convenience of the man using it. The table has been added without any addition to price. These tables can also be attached to cars of this make already in use.

Electrical Equipment for Chilean Nitrate Plants.

A complete electrical equipment has been ordered for installation in one of the largest Chilean nitrate plants, and orders for two other outfits will be placed by J. K. Robinson, of Iquique, Chile. The Westinghouse contract, just placed, calls for a 130-kw. plant. There will be an 85-kw. engine type generator, direct connected to a 11-in. by 19-in. by 11-in. compound condensing engine; also a 45-kw. generator direct connected to an 8-in by 13-in. by 8 compound condensing engine. The boiler capacity will be of 375 hp. in three units. Two will be of Babcock & Wilcox manufacture, and the Stirling Company secured the order for the third unit. There will be fifteen Westinghouse motors varying in capacity from two to 40 hp. Eight pumps, to be electrically operated, have been ordered from the Goulds Manufacturing Company, to have a capacity of from 3,000 to 15,000 gallons per hour.

The equipment is intended for the Oficina Victoria, a British concern, which operate extensive nitrate deposits near Iquique. The plant is to be built at Junin, the principal port for the nitrate export.

Two Baldwin-Westinghouse electric locomotives have also been ordered, to be used for hauling the nitrate at the port. These engines will mark the introduction of American electric ones on the west coast of South America. The trolley wire, feeders, etc., have been ordered from the Standard Underground Cable Company.

Automatic Gear Cutting Machine.

Hardinge Brothers, Chicago, have added to their extensive line of machine tools a gear-cutting machine thoroughly adjustable and capable of doing the most accurate work with the greatest rapidity.

All of the movements of the machine are positive and follow each other as closely as possible, thus avoiding lost time. The index plates are interchangeable; separate ones are used for each number of teeth, for it is considered that any job worth putting into an automatic gear-cutting machine is worth providing with a special index. The spacing half of the index plate is enclosed within a case, *D*, which prevents any dust or dirt from getting into it; and it is revolved by the exposed half of the index plate, being parted below the bottom of the spacing notches. The raising blocks, *M M*, are by ½-in. steps. The spindle can be raised and lowered ¾ in., thus covering all sizes of work. Fig. 2 shows the divided hand nut, *H*, reading to thousandths of an inch.

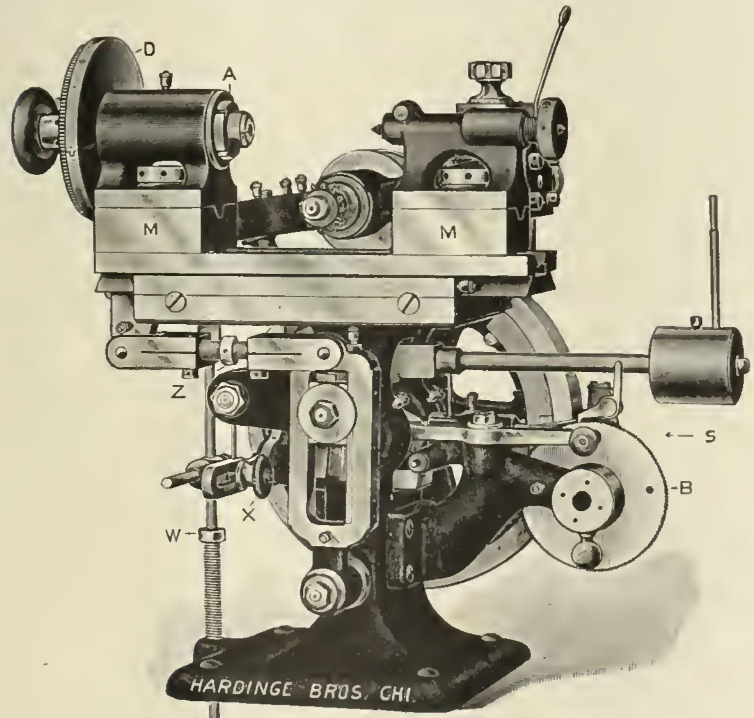


FIG. 1.—GEAR CUTTER.

The side movement for getting the cutter central is accomplished by loosening four screws on clamp, *G*, and revolving the cutter spindle bracket bearings, *I*. This moves the entire cutter spindle and bracket to the right or left, but does not alter the adjustment or solidity of the spindle bracket bearings. The front end of the bracket has hardened bushings fitted at *J*, which pass over a tempered parallel arbor and require no care or adjustment while moving the cutter to the center with spindle.

The indexing arrangement is simple and positive and has every adjustment required, whether fine or coarse. Every revolution of the main wheel, *U*, cuts one tooth; about 7/16 of the time is used in spacing and 9/16 in cutting. This movement is irregular in speed, according to the changing of the fulcrum of the bracket. The main slide travels faster when the crank pin or bolt is nearest the bottom, or when the cutter is disengaged, although when the cutter is in action the variation of the cutting feed is not perceptible.

An adjustment for spacing is provided by the sliding nut, *X*, and also by a screw, *F*, which raises or lowers a cam. This cam comes in contact with the roller wheel, *K*, when a retaining latch is raised out by a clip. The adjustment for time is given by moving a simple device in or out of the frame to the exact position in time with the spacing cam, the stroke of the main slide, and the cam which raises and lowers the cutter spindle and bracket.

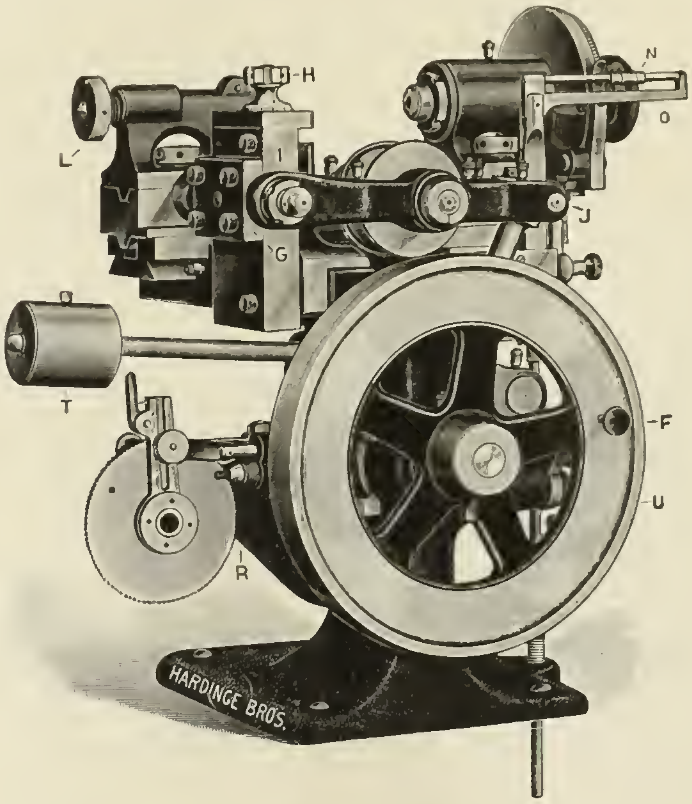


FIG. 2.—GEAR CUTTER.

The weight, *T*, regulates the tension of the belt for the cutter, thus keeping a contact with the main cam, which raises and lowers the cutter by use of the rod at *J*. Thus, when the slide is about to return, this cam on the main shaft lowers the cutter out of the tooth, allows the spacing, and returns the cutter to position at the end of the stroke. This main cam also acts in connection with the automatic stop for the cutter, *R*, though it does not affect the spacing mechanism. This will be understood from Fig. 1, with reference to the ratchet, *B*, showing the hole in same. Every revolution of the main wheel, *U*, which revolves the main cam that raises and lowers the cutter, also works the ratchet, *S*; and as this ratchet coincides with the index plate spacing, it will move tooth for tooth. As the hole, *B*, passes under the lever shown under the ratchet click, *S*, this lever drops into *B* and disengages the main cam, thus stopping the raising and lowering of the cutter, and also the indexing of this ratchet wheel with the hole, *B*. It does not, however, stop the revolution of the cutter spindle or the main index plate. This method keeps the cutter spindle at a positive temperature, and avoids any trouble in spacing from the expansion or contraction of the metals in the spindle and machine under varying temperature.

The head spindle has a ball bearing thrust at *A*, which enables the use of a variable tail stock pressure, but does not affect the turning of the head spindle or the indexing. Any desired stroke can be given to the slide by the movable crank pin or bolt, thus effecting a great saving of time; and the adjustment of the head position obtained by means of the right and left-hand bolt, *Z*, which can be securely locked. Every provision is made for adjustment for wear, and the oiling devices are the most complete. The cutter spindle and bracket spindle are hardened and ground. The head spindle has hardened and ground chuck socket and ball race. The cutter spindle revolves in phosphor bronze adjustable journals.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money showed a tendency towards easier conditions, and a business of moderate size was done. The closing rates were 4½ to 5 per cent. for 60 to 90 days and 5 to 6 per cent. for four, five and six months. The stock market was dull but steady, at a recovery in the decline resulting from the recent failures and the attending enforced liquidation of collaterals. There was a good deal of investment buying by bargain hunters, and large interests were understood to have given support to various specialties, the strength of standard stocks being particularly noticeable. Some irregularity, however, was caused by declines in specialties and neglected industrials, owing to the disfavor with which such issues are regarded in connection with loans. All of the electric and traction stocks showed greater activity and improvement, with one exception, this being Westinghouse preferred, which dropped to 165, representing a net loss of 5 points on the week's trading. Westinghouse common made a net gain of 4 points, closing at 170—the extreme prices being 160, the lowest, and 172½, the highest. Nine hundred and twenty-five shares of this stock were sold. General Electric showed some firmness, rising from 153, the lowest, to 163½, the highest, and closing at 162, a net gain of 5 points. Western Union closed at 84, being ¾ of a point gain. American Telephone & Telegraph closed at 131½, which was the ruling price throughout the week, and 1½ points net gain. Brooklyn Rapid Transit was active, 43,143 shares having been sold. It closed at 45¼, thus gaining 3¾ points. Metropolitan Street Railway made a gain of 6 points, the closing price being 119, the highest and lowest quotations being 121 and 112, respectively. Manhattan Elevated closed at 132¾, being a gain of ⅓ of a point. Following are the closing quotations of August 4:

NEW YORK.

	July 28.	Aug. 4		July 28.	Aug. 4
American Tel. & Cable	77	77	General Electric	162	157
American Tel. & Tel	131	130	Hudson River Tel	..	..
American Dist. Tel	25	25	Metropolitan St. Ry	117	116½
Brooklyn Rapid Transit	44¾	42⅛	N. E. Elec. Veh. Trns	..	..
Commercial Cable	..	149	N. Y. & N. J. Tel	..	..
Electric Boat	15	15	N. Y. E. V. T. Co	4½	4⅜
Electric Boat pfd	35	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1⅜	1¼	Western Union Tel	83½	83⅛
Electric Vehicle	6½	5	Westinghouse com	171	163
Electric Vehicle pfd	8	8	Westinghouse pfd	172	165

BOSTON.

	July 28.	Aug. 4		July 28.	Aug. 4
American Tel. & Tel	131¼	150	Western Tel. & Tel. pfd	80	83
Cumberland Telephone	..	..	Mexican Telephone	1⅛	1⅛
Edison Elec. Illum	237½	.	New England Telephone	124	120*
General Electric	164½	..	Westinghouse	..	85
Western Tel. & Tel	12	13	Westinghouse pfd	..	85

PHILADELPHIA.

	July 28.	Aug. 4		July 28.	Aug. 4
American Railways	..	.	Phila. Traction	94½	91⅛
Elec. Storage Battery	52	57	Phila. Electric	5⅝	5½
Elec. Storage Battery pfd.	.	58½*	Pa. Electric Vehicle	..	..
Elec. Co. of America	7⅞	7¾	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	July 28	Aug. 4		July 28.	Aug. 4
Central Union Tel	.	..	National Carbon pfd	90	90
Chicago Edison	147	142	Northwest Elev. com	..	..
Chicago City Ry	170	165	Union Traction	4	3½
Chicago Tel. Co	..	120	Union Traction pfd	30	30
National Carbon	21	23*			

*Asked.

ELECTRIC ELEVATED EARNINGS.—It is stated that earnings of the Boston Elevated are showing up handsomely. For June and July gross earnings will be well over $1,000,000 per month. June this year was a poor riding month, and compared with a good month last year, Boston Elevated gross earnings amounted to $1,040,000, and during that month there was a total of 3,987,000 car miles run as compared with 3,958,000 car miles run in June, 1902. For nine months of the Boston Elevated Company's 1903 fiscal year, there was a total of 35,158,000 car miles run, as compared with 33,774,000 car miles for the same period the previous year. The earnings of the Manhattan Elevated are increasing $4,000 per day, as compared with last year, and the outlook now is that the company will earn 10 per cent. this fiscal year, making a very handsome surplus to go to the lessees, who have put up $4,000,000 to secure the Manhattan's lease rental. Brooklyn Rapid Transit earnings are making larger gains than Manhattan. For the first 25 days in July, Brooklyn Rapid Transit gained $161,000 over corresponding period a year ago. The 26th day being a good Sunday, there was the astonishing record of a $13,000 gain for one day over a year ago, making the average gain for the 26 days above $6,000 per day. The company is earning more than 4 per cent. upon its share capital. Earnings for the first six months of the Chicago Metropolitan Elevated of this fiscal year promise to be the largest in the history of the road. This is due partly to the good traffic and also to large economies. The road will earn fully 2 per cent. for the six months. The traffic on the Aurora line and the Suburban Electric line is unusually heavy. Last fiscal year the company earned $10,000 over 3 per cent. after paying $15,000 extra for coal, besides meeting other unusual expenses, which would have brought the earnings close to 4 per cent. for the year.

BOSTON EDISON EARNINGS.—The business of the Boston Edison Electric Illuminating Company in the fiscal year ended June 30 was very satisfactory. After charging off an increase of from $70,000 to $80,000 in cost of coal over normal years, the surplus, after dividends, was practically the same as that of a year ago, which was $116,008. The company does a gross business of about $2,500,000. During the past year the company increased its capital $1,570,200 by the issue of 7,851 new shares at $200 a share, making its present capital stock outstanding $8,635,500. Mr. J. P. Morgan is the largest individual stockholder in the company, being credited with 3,099 shares.

BIG TRACTION COMBINATION.—According to the Los Angeles *Times* a large holding company may be organized within six months to merge all the interurban electric lines tributary to Los Angeles with a capital of $50,000,000, as hinted at when Huntington secured a vital interest in the Los Angeles Traction Company through its purchase by the Southern Pacific interests. It is possible with the organization of a holding company that Messrs. Clark and Sherman, with their extensive interurban interests to Hollywood, Santa Monica and other points, will join with Messrs. Huntington and Harriman.

CAPITAL STOCK INCREASES.—The capital stock of the United Electric Light Company, of Springfield, Mass., has been increased from $600,000 to $800,000. The capital stock of the Hudson River Telephone Company has been increased from $4,000,000 to $5,000,000.

ELECTRIC STORAGE BATTERY.—It is stated that the net earnings of the Electric Storage Company for the six months ending June 30 were $1,200,000, the largest for any similar period in the company's history.

Commercial Intelligence.

THE WEEK IN TRADE.—Seasonable conditions prevail in trade, though, as *Bradstreet's* points out, an irregularity and weakness in some staple prices reflect readjustments proceeding from enlarged production. A seasonable volume of trade in the Northwest is indicated by late advices. The corn crop in the Middle West and Southwestern States has been improved by much-needed rain, and in the Northwest prospects for a fair to good spring wheat crop are still noted. Returns from the winter wheat harvest are, however, less satisfactory. Cotton crop reports are quite as favorable as at any previous time, rains in the Gulf States having proved beneficial. Iron and steel buyers are still backward, and this trade is affected sympathetically by the decline in the stock market. The industrial situation is improved. The railroads are having all they can handle, and talk of congestion is again heard. Many thousand building hands have resumed work at New York, though some unions still persist in holding out. Copper was inactive and weak. The leading sellers are quoting a price about ¼c. per pound under the quoted rate of 13¾c. for Lake and electrolytic, as named by the metal exchange. Prices are about ⅛c. lower. The closing "official" prices are 13¾c. for Lake and electrolytic, and 12¾ to 13c. for casting stock. There were, during the week ending July 30, 190 business failures, according to *Bradstreet's* summary, against 183 the previous week, and 168 the corresponding week last year.

THE EDISON STORAGE BATTERY.—Last week Mr. Edison was quoted here as to some recent tests of his battery. He also said in a recent interview about it: "We cannot put the new battery on the market in any quantity as yet. The best we can do now is to make one a day. By October we will make at least six daily, and about Christmas we will be in shape to meet any demand. The trouble has been that special machines had to be built, but the last of these will be completed next week. Another disadvantage I have to contend with is paying 40 per cent. duty on a certain sheet steel that must be imported from England or Germany, and then in only limited quantities. By Christmas three rolling mills will be able to make it for me here in this country, and then the present high price for the batteries will be reduced. As to charging stations, in the last month forty-five new ones have been installed in the New England States alone, and this is going on all over the country. Another thing, the battery will be made in four sizes, so that when fully charged it will run 25, 50, 75 or 100 miles, and if wanted they will be made any size larger or smaller. Of course, the running power of the battery will depend to a certain extent on the work it is called upon to do. If the roads are rough and there are many hills, a charge will last a shorter time than if the conditions were such as are found in the city. But taking the maximum of bad going, the battery will only be exhausted about 25 per cent. sooner than it would be under favorable conditions."

HARRISBURG ENGINE CONTRACTS.—Mackenzie, Quarrier & Ferguson, Incorporated, 114 Liberty Street, New York, has secured a contract from the Davies & Thomas Company, Catasaqua, Pa., for a tandem-compound Harrisburg engine of 300 hp for direct-connection to a 200-kw Sprague generator for both light and power. The Pennsylvania Cement Company, of Bath, Pa., has contracted for a 80-hp Harrisburg standard engine for direct-connection to a 50-kw General Electric generator for lighting. The village of Greene, N. Y., is to be furnished with a 90-hp Harrisburg standard engine to be belted to a 60-kw alternating-current Westinghouse generator. The boiler will be built by the Watertown (N. Y.) Engine Company. This equipment is intended for the village lighting plant. The United Verde Copper Company, 59 Wall Street, New York, has requisitioned for a Harrisburg standard engine of 25-hp capacity for direct-connection to a 150-kw General Electric generator, to be used for both light and power in its Jerome, Arizona, plant. The Manufacturers' Foundry Company, Waterbury, Conn., has ordered a 45-hp Harrisburg standard engine for direct-connection to a 30-kw Crocker-Wheeler generator for lighting.

MARION INSULATED WIRE INTERESTS.—The Marion Insulated Wire & Rubber Company, of Marion, Ind., has now well under way its new factory for the manufacture of rubber-covered wires and cables. It will make a full line of such goods, including telegraph and telephone cables, and lead-incased varieties. The factory building is 224 x 60 ft., three stories and basement, 150 x 60 ft., with an L 100 x 40 ft., two stories. The mills and washers will be direct-connected to a 450-hp Corliss engine, and all other machinery will be driven by electric motors, with current from the factory plant. Not anticipating any unusual delay, the management expects to be in operation by November. The officers are J. L. Barley, president; C. A. Michaels, vice-president; Hiram Beshore, treasurer, and R. E. Lucas, secretary and general manager. The latter is well known in the electrical field as being for the past eight years secretary of the Indiana Rubber & Insulated-Wire Company at Jonesboro, Ind. President Barley is the president and manager of the Barley-Spencer Lumber Company, and is associated with a large number of manufacturing enterprises at Marion. Mr. Michaels is also connected with numerous enterprises, is proprietor of the Union Cabinet Company, and is largely interested in the local electric light plant. Mr. Beshore is connected with the Grant Trust and Savings Company. The list of stockholders is not a long one, those on it being all well-to-do people.

THE VOUGHT-BERGER COMPANY, of La Crosse, Wis., has recently sold equipments to the following telephone companies: Farmers' Telephone Company, Jesup, Iowa; Farmers' Mutual Telephone Company, Tonkawa, Okla.; Persia Co-Operative Telephone Company, Persia, Iowa; Steele County Telephone Company for their Geneva and Ellendale (Minn.) exchanges; Farmers' & Merchants' Mutual Telephone Company, for their new exchanges at Le Sueur Center and Lexington, Minn.; Stevens County Telephone Company, a 300-drop board for Morris, Minn., and a 100-drop board for its Cyrus exchange; a 100-drop board for the Electric 'Phone Company, at Stewart, Minn.; Franklyn Telephone Company, Franklyn, Minn.; Barnesville & Wolverton Telephone Company, for its Dibley & Wolverton (Minn.) exchanges; also boards and telephones for Clutier, Iowa; Sheldon, N. D.; Ruthton, Minn.

TELEPHONES IN HOTELS.—The New York Telephone Company, F. H. Bethell, contract agent, reports that contracts have just been closed covering long-distance telephone service in all of the rooms and working departments of the following hotels in New York City: Waldorf-Astoria, 1,250 stations; Park Avenue, 410 stations; Majestic, 350 stations; Netherlands, 300 stations; Albert, 268 stations; St. Denis, 250 stations; Normandie, 100 stations. The work of installing these systems is to be completed this summer. The Waldorf-Astoria switchboard equipment will consist of one seven-position switchboard and two one-position switchboards. No fewer than fifty trunk lines will connect the system with the general exchange system.

JANDUS ELECTRIC COMPANY.—We are pleased to welcome as neighbors the Jandus Electric Company. The Eastern business of this company has increased so rapidly that it has had to seek larger quarters for its New York office. Recognizing the advisability of being at the center of things electrical, the company moved its offices a week or so ago to the Engineering Building, 114 Liberty Street. Mr. Nash, the Eastern manager, is now making his headquarters here. Mr. Organ is to be congratulated upon the growth of the business under his management. We understand that this increase is apparent both in its fan and its arc light business.

MESSRS. F. BERG & CO.'S new hat factory at Orange, N. J., will be run entirely by electricity, an isolated plant now being installed for this purpose. A recent contract with the Westinghouse Electric & Manufacturing Company calls for twenty-seven alternating-current, two-phase motors, twenty of which will be belted to shafting to run the machinery used in the process of making hats; the remaining seven are each to be provided with an extended shaft eight inches long and will be direct-connected to blowers used for collecting the fine felt used in the process of manufacture.

ELECTRIC PUMPING OUTFITS FOR JAPAN.—Francis A. Cundill, 90-96 Wall Street, New York, American representative for the British firm of L. J. Healing & Co., of Yokohama, is in the market for a number of electrically-operated pumping equipments and for installation in Japanese mines, etc. The pumps will be used to lift at the rate of thirty cubic feet per minute to an altitude of 200 ft. They will be mounted on trucks. Three single-cylinder automatic cut-off engines of 65-hp capacity each and two of 125 hp each, will also be purchased.

TELEPHONE EQUIPMENTS.—The Oceana Telephone Company, of Hart, Mich., is installing a 200-capacity generator call visual switchboard of the Stromberg-Carlson make at Hart. The Citizens' Telephone Company, of Grand Rapids, Mich., is installing a generator call visual signal switchboard of 140 lines at Fremont, Mich. The Stromberg-Carlson Company is also installing intercommunicating systems for the following Chicago firms, namely: Brunswick-Balke-Collender Company, Library Bureau, and Brown & Sharpe.

LARGE ANDERSON SWITCH CONTRACT.—The New York Edison Company has placed a contract for station switches, which is claimed to be the largest individual requisition for such apparatus filed. The switches which will be manufactured by the Albert & J. M. Anderson Manufacturing Company, of Boston, are intended for installation in all the various stations of the Edison Company. More than 50 tons of copper will be utilized.

AFTER JAPANESE TRADE.—The Hamburg Commission house, of N. Joachimson, which handles considerable American machinery for shipment, principally to the Far East, is about to engage through the New York offices, 6-9 Hanover Street, the services of a special representative who will proceed shortly to Japan with a view to securing contracts for water power plants and various other electrical equipment and supplies.

LARGE FLOUR MILL TO BE ELECTRICALLY OPERATED.—The Washburn-Crosby Company, 112 Broad Street, is to construct a large plant in Buffalo for the manufacture of flour. All the machinery will be electrically operated. The initial equipment will not be less than 2,000 hp. The boiler contract has already been awarded to the Heine Safety Boiler Company for four units of 500-hp capacity each.

SOME HEINE BOILER CONTRACTS.—The Heine Safety Boiler Company, of St. Louis, has secured the contract for boilers to be installed in the new plant of the East St. Louis & Suburban Railway Company. One thousand horse-power will be put in. There will be four units. Two 350-hp Heine boilers have also been ordered by the Citizens' Light, Heat & Power Company, of Montgomery, Alabama.

THE ASTORIA STEEL COMPANY, Astoria, New York City, expects to be in active operation for the manufacture of steel castings about October 1. It is equipping the plant with the most modern and up-to-date apparatus and will have a capacity of 100 tons a day. Mr. P. J. Ryan, formerly of the Penn Steel Casting Company, is sales manager.

MONTANA CONTRACTS FOR LIGHTING.—The Wagner-Bullock Electric Manufacturing Company has recently, through its district agents, Gilbert Wilkes & Co., Denver, Colo., closed contracts for complete installations of light and power plants with the cities of Bozeman, Lewistown and Dillon, Mont.

LINE MATERIAL WANTED.—The Catawba Power Company, of Rock Hill, S. C., is to begin construction of 29 miles of pole line about September 1 and is now in the market for poles, cross arms, insulators, galvanized braces, bolts, etc. Mr. W. S. Lee, Jr., is chief engineer.

General News.

THE TELEPHONE.

CORONA, CAL.—The Corona Home Telephone and Telegraph Company has been organized to make use of the franchise recently sold by the city to W. M. Nichel, of Long Beach.

DOWNEY, CAL.—P. I. Spencer has been granted permission to operate a telephone system in Los Nietos and Downey townships. A similar grant has also been made to the Covina Home Telephone Company.

SANTA ANA, CAL.—The Home Telephone Company has incorporated here with a capital stock of $100,000, of which amount $10,000 has been subscribed. The directors are F. I. Graves, John Van Liew, F. W. Wachter, Charles L. Zahn and Arthur Wright, all of Los Angeles.

LOS ANGELES, CAL.—The San Pedro Home Telephone and Telegraph Company, of San Pedro, has been incorporated with a capital stock of $100,000, of which amount $5,000 has been subscribed. The directors are Charles T. Sutton, J. C. Brainerd and Don C. Porter, of Pasadena; Charles L. Zahm, of Los Angeles; W. L. Porterfield, of Long Beach.

WAYCROSS, GA.—The Southern Bell Telephone Company has begun the work of improving its system at Waycross and will expend about $15,000.

COLUMBUS, GA.—The Southern Bell Telephone Company has purchased a site for a new exchange building at Columbus, to be used as an exchange for three cities.

ELBERTON, GA.—The Southern Bell Telephone & Telegraph Company is extending its lines out from Elberton to a number of nearby towns. A line to Abbeville, S. C., has been completed.

KEWANEE, ILL.—The Kewanee Home Telephone Company has been incorporated with a capital stock of $125,000. Among the directors is J. L. Dunn.

SCOTTSBURY, IND. The Scott County Telephone Company operates an American 200-drop board.

NEW ROSS, IND.—The New Ross Co-operative Company operates a Eureka 100-drop board and has 82 subscribers. The membership fee is $5, and 25c. per month.

MIDDLEBURY, IND.—The Elkhart County Telephone Company has a 100-drop board which gives good service to 175 subscribers. There are 50 miles of toll line. The rates $1 per month.

RIDGEVILLE, IND.—The Ridgeville Telephone Company operates a Stromberg-Carlson 100-drop board and has 140 subscribers. Several farm lines will probably be built this season.

SHERIDAN, IND.—The Central Indiana Telephone Company operates a 300-drop board; has 400 subscribers and 40 miles of toll line. Several improvements and additions are projected this summer.

MARIETTA, IND.—The Marietta & Bengal Telephone Company operates a 100-drop board, 84 of which are in use, and 125 subscribers. There are 25 miles of toll line and many improvements are projected.

WINAMAC, IND.—The Winona Telephone Company has just put in 2500 feet of cable and intends building more toll and farmers' lines. It has a 300-drop board, 250 subscribers and 75 miles of toll line.

NEWTOWN, IND.—The Newtown Telephone Company uses 50 drops of a 100-drop board, has 118 subscribers and 20 miles of toll line. It is owned by the farmers and merchants of the community who use 45 telephones and rent the rest.

STONE BLUFF, IND.—The Shawnee Telephone Company operates a 100-drop board with 240 subscribers and 40 miles of toll line. This is a farmers' exchange with an average of four subscribers on a line. Kellogg telephones are used.

RICHMOND, IND.—The Richmond Home Telephone Company has exhausted its switchboard and cable capacity and will increase the plant at once. It now operates a 1600-drop board and has 1800 subscribers, with 75 miles of toll line.

LOGANSPORT, IND.—The Wabash Traction Company has just completed a telephone system along its line between this city and Peru. The telephones are placed in iron boxes, at every switch, and each conductor has a key, which will open the boxes.

CARMEL, IND.—The Carmel Mutual Telephone Company has 260 subscribers, its switchboard capacity being 200 drops. It has 135 miles of metallic circuit toll lines. Its rates are $12 per year. Several of its party lines have six to twelve subscribers on a line. Mr. A. Newlin is secretary.

WINCHESTER, IND.—The returns for taxation show that telephone development has been rapid in Randolph County during the past year. At present the Eastern Indiana Telephone Company, with principal office here, has 96 miles of poles with 289 miles of wire in actual use; the Ridgeville Telephone Company has 16 miles of line in this and Jay County; the Farmland Telephone Company 57 miles of poles and 237 miles of wire; the Parker Telephone Company 42 miles of poles and 225 miles of wire and the Central Union Telephone Company, 309 miles of wire, while other companies have 35 miles of wire or more, making a total mileage in the county of at least 1,000 miles of wire.

SOUTH McALESTER, I. T.—The South McAlester-Eufaula Telephone Company is about putting in a full central energy system at Eufaula to cost $3,000. There is a 400-drop board here with 450 subscribers and 250 miles of toll line.

CADDO, I. T.—The Choctaw Telephone Company operates exchanges at Coalgate, Lehigh, Atoka and Caddo, with boards, two of 200 drops, one of 50, and one of 300. There are 700 subscribers at all places. It has 195 miles of toll line and more are projected.

SANBORN, IA.—The Sanborn Telephone Company operates a 200-drop board with 145 subscribers.

MANLY, IA.—The Manly Telephone Company has a 100-drop express type switchboard and 300 subscribers.

WATERLOO, IA.—The Cedar Valley Telephone Company has 3,000 subscribers and 1,000 miles of toll line.

JOICE, IA.—The Citizens' Mutual Telephone Company, with a capital stock of $10,000, has recently been organized by G. G. Hanner and others.

CLEAR LAKE, IA.—The Clear Lake Independent Telephone Company uses a Kellogg switchboard of 200 drops capacity and has 130 subscribers.

STUART, IA.—The Lincoln Mutual Telephone Company proposes putting in an exchange at Greenfield, Ia. It has 150 subscribers and 75 miles of toll line.

WOODWARD, IA.—The Wells Telephone Company gives service to 150 subscribers from a 200-drop board. There are 100 miles of toll line and more are planned.

CRESCO, IA.—The North Orleans Telephone Company is of recent formation, among the directors being W. F. Morton. The company has a capital stock of $800.

WILTON JUNCTION, IA.—The Wilton Telephone Company has recently built 13 miles of toll line, making in all 100. There are 140 subscribers and a 200-drop board.

GALVA, IA.—The Galva Telephone Exchange Company has a switchboard of 100 drop capacity, 80 being in use. There are 160 subscribers at $1.25 per month for telephones.

STATE CENTER, IA.—The State Center Telephone Company is operated in connection with the Boone & Marshall toll line. It has a 200-drop board and 150 town subscribers and 200 farmers.

BLANCHARD, IA.—The Blanchard Com. & College Springs Mutual Telephone Company has 112 subscribers and 18 miles of toll line at 10c. a message. The town service is to be enlarged.

MOUNT VERNON, IA.—The Mount Vernon Telephone Company is connected with the Cedar Rapids and Marion toll lines. It has a 240-drop board and the same number of subscribers. A new switchboard is to be put in.

CHARITON, IA.—The Chariton Telephone Company has 275 subscribers. Its board capacity is 400 drops, and its system includes 30 miles of toll line. Seventy-five subscribers are of recent addition. Its subscription rates are $1, $1.50 and $2.00. W. D. Boydston is secretary of the company.

JEFFERSON, IA.—The Green County Telephone Company has a total of 1,400 subscribers in towns and rural districts. Its switchboard capacity is 925 drops, the apparatus used being of the American Electric Telephone Company and Swedish American Telephone Company make. The toll line is 65 miles in length, the country service being free. Mr. P. C. Cockerill is secretary and manager.

SABETHA, KAN. The Sabetha Telephone Company has a 300-drop board and 400 subscribers at $1.25 per month.

GARDEN CITY, KAN.—The Garden City Telephone Exchange has a 100-drop switchboard capacity and 90 subscribers.

LINN, KAN.—The Linn Telephone Company is now re-organizing for the purpose of taking in farmers' lines and making improvements.

COUNCIL GROVE, KAN.—The Council Grove Telephone Company operates a 500-drop board, has 300 subscribers and 200 miles of toll line. The company will soon double its capacity.

ELLSWORTH, KAN.—The Ellsworth Electric Light Company operates the telephone system here, and has a 200-drop board with 190 subscribers and 75 miles of toll line.

LYONS, KAN.—Mr. A. Long is the owner of the Lyons Telephone Exchange which supplies service from a 300-drop board to 220 subscribers. There are 98 miles of toll line and 14 of farmers' lines.

SMITH CENTRE, KAN.—The Exchange Telephone Company operates one exchange at this place and one at Lebanon. It has 210 subscribers and 102 miles of toll line. Some rural lines will be built.

INDEPENDENCE, KAN.—The telephone line here is operated by Messrs. Hickman & Pontius, who contemplate several additions this year. They have a 500-drop board, 425 subscribers and 50 miles of toll line.

STOCKTON, KAN.—The Stockton Telephone Exchange has a switchboard capacity of 150 drops, of which 132 are installed. The apparatus used is of the Stromberg-Carlson Company. Mr. H. W. Loomis is the manager.

OTTAWA, KAN.—The Ottawa Telephone Company has a 1100-drop board, 1,060 subscribers and 100 miles of toll line. The company has built up a most successful business in spite of active opposition and is firmly established now.

SENECA, KAN.—The Seneca Telephone Company reports a great demand for lines and many are to be extended. It operates a 250-drop board, 175 being installed for city subscribers. These, including farmers, number 375. There are 290 miles of toll and farmers' lines.

AUGUSTA, KAN.—The owner of the exchange here is Mr. T. Sexton. He uses 106 drops of a 200-drop board and has 90 subscribers. He is also interested in the Butler County Telephone & Electric Company, which has about 175 miles of toll line and in other Kansas exchanges.

MARION, KAN.—The Southwest Telephone & Electric Company operates exchanges in Marion, Peabody, Florence and Burns of 200, 200, 100 and 50 drops respectively. It has 450 subscribers and 120 miles of toll line. The plants are comparatively new, and rates have been raised, but without causing any loss of business.

CHETOPA, KAN.—The Chetopa Telephone Company has recently installed a new Kellogg board of 300-drop capacity. It now has 125 subscribers, and operates 55 miles of toll line. Its rates are $12 per year for residence instruments and $24 for business. It is expected that an addition of 100 more telephones will soon be made. Among the recent improvements to the service is the installation of 3,000 feet of dry paper cable, having 50 pair of wires.

LOUISVILLE, KY.—The Ghent Telephone Exchange Company, of Carroll County, with a capital stock of $5,000, is of recent organization.

HOWARDSTOWN, KY.—The New Haven Telephone Company operates a nine-mile line and connects with the exchange of the Cumberland Telephone & Telegraph Company at New Haven, Ky.

COVINGTON, KY.—The North Kentucky Telephone & Telegraph Company has been organized with $10,000 capital stock by S. P. Kineon, F. K. Ludlow and M. M. Durrett, of Covington.

LONDON, KY.—The London Telephone Company is rebuilding, and in a few months will have a first class system with a number of new subscribers. It operates a 200 drop board, has 123 subscribers, and 100 miles of toll line, which is to be extended.

PADUCAH, KY.—The People's Independent Telephone Company has a 1,200 drop switchboard, with 1,000 subscribers, and 500 miles of toll line. This company has just commenced operations, and judging from its list of subscribers, is carrying everything before it.

ALEXANDRIA, LA.—A company has been organized here to build a telephone line to Monroe. Its capital stock is $50,000.

ALEXANDRIA, LA.—The Cumberland Telephone and Telegraph Company has made great improvement and has a 600 drop board with 438 subscribers, and 30 miles of toll line. Rates are $1.50 to $2, and $2.50 to $3.50.

VAN BUREN, ME.—The St. John Valley Telephone Company has 25 subscribers at $25 per year. It is expected to connect this system with the New England Telephone Company at Caribou, a distance of 22 miles.

LISBON FALLS, ME., has been the scene of a vigorous telephone fight, the New England Telephone Company seeking to extend its service in several streets where it is not now permitted to enter. The grant was opposed before the selectmen by the independent Northeastern Telephone Company. As a result of the hearing, the petitioners have been given leave to withdraw. Many of the property holders objected to the new pole lines.

SANDY SPRING, MD.—The Enterprise Telephone Company operates three exchanges and has metallic lines, all radiating from central. There is a 50 drop board and 170 subscribers, and short lines are to be built to take on more.

FALL RIVER, MASS.—The Fall River Automatic Telephone Company's switchboard has a capacity of 1,050 subscribers and 969 subscribers. Fourteen miles of toll line are now being built.

MORELIA, MEXICO.—A new telephone exchange is being established here. La Compania Noruega Mexicana, of the City of Mexico, can give information in regard to the enterprise.

CONCORD, MICH.—The Concord Telephone Company operates a 100-drop board and has 160 subscribers.

WOODLAND, MICH.—The Woodland Telephone Exchange operates a 100 drop board and has 150 subscribers at $12 per year.

FREMONT, MICH.—The Citizens' Telephone Company belongs to the Citizens' Company of Grand Rapids, Mich. It has a 140-drop board and 114 subscribers.

REED CITY, MICH.—The Reed City Telephone Exchange has 10 miles of toll line, but farmers' lines are very much needed in the district. Its board capacity is 200 drops and it has 190 subscribers.

ONAWAY, MICH.—The Onaway Telephone Company supplies service to Onaway and Rogers City, having switchboard capacity of 135 and 100 drops, and 160 and 100 subscribers in the two places respectively. There are 130 miles of toll line and 50 more are projected; seventy new subscribers are on the waiting list. Rates are $12 and $20 and 1c. per mile, unlimited.

ADRIAN, MINN.—The Midland Telephone Company operates an eight-drop board and has nine toll stations besides farmers' lines. Rates are 25c. per message.

ELBOW LAKE, MINN.—The Grant County Telephone Company has five exchanges and 350 subscribers. There are 125 miles of toll line, and farmers' lines are to be improved.

NEW SWEDEN, MINN.—The Nicollet County Telephone and Telegraph Company has two boards of 100 drops each, and 140 subscribers. There are 50 miles of farm and party lines. The company has now more applications for rural service than it can fill this season.

DODGE CENTER, MINN.—The Dodge Center Telephone Exchange contemplates building farmer lines West and North. It is now operating a Stromberg-Carlson 100-drop board and serves 60 subscribers. It is operating 15 miles of toll line jointly with the Hayfield Exchange. Its rates are $1 per month for residence instruments and $1.50 for business.

OXFORD, MISS.—The Oxford Telephone Company has sold out to J. W. Clark and F. L. Toale, of Hamilton, Ohio, and the new owners have taken charge.

OXFORD, MISS.—The Tabalubby Telephone Company has a franchise to construct a telephone line connecting Oxford, College Hill and other Mississippi towns. The stockholders are principally farmers.

HALE, MO.—The Missouri Midland Telephone Company has 60 miles of toll line and six subscribers.

DADEVILLE, MO.—The Farmer Telephone Company has a 50-drop board, 30 of which are installed, and over 300 subscribers at $1 per month.

GRANT CITY, MO.—The Grant City Telephone Company has a switchboard capacity of 200 drops and uses apparatus of the Williams-Abbott Electric Company. The charge is $1 per month for each instrument.

BROOKLYN, MO.—The Harrison County Mutual Telephone Company operates five boards varying in capacity from 25 to 50 drops. The company operates between 250 and 300 miles of party lines; it has no strictly commercial lines at present. Its charges are 15 cents per message and $12 a year rent for telephones. A large increase in capital stock will be made. Mr. W. E. Blakeman is secretary.

NORWOOD, N. Y.—The Norwood Telephone Company is about to construct 50 miles of toll line.

GENEVA, N. Y.—The Geneva Telephone Company has a Century board of 1,500 drops with 591 subscribers.

GOWANDA, N. Y.—The Gowanda Telephone Company operates a 280-drop board; has 350 subscribers and 150 miles of toll line.

FRANKFORT, N. Y.—The Schuyler Telephone Company has a 200-drop board and 163 subscribers. The rates are $12 per annum.

ITHACA, N. Y.—The Ithaca Telephone Company has a 600-drop board and 750 subscribers, and 100 miles of toll line. A large increase is contemplated.

CLINTON, N. Y.—The Clinton Home Telephone Company has a 100-drop board and 200 subscribers with 10 miles of toll line. It has connection with Utica, and is busy filling orders for farm lines.

LYNDONVILLE, N. Y.—The Lake Side Telephone Company, of Lyndonville, has been formed with a capital of $100,000. Directors: W. A. Tuttle and Grant Spaulding, Lyndonville; S. A. Coe, Yates.

GRANVILLE, N. Y.—The Granville Telephone Company operates one board of 200 drops; two of 100 each and three of 10 each, of Eureka and Chicago make. It has 700 subscribers and 100 miles of toll line. New lines are projected.

BROCKPORT, N. Y.—The Brockport Telephone Company has recently added 100 subscribers to its service, the total number now being 350. Its switchboard capacity is 200 drops. The apparatus used includes Kellogg and Williams telephones and a Sterling board. Its rates are $9 and $12 for residence service and $15 for business.

FAYETTEVILLE, N. C.—The Fayetteville Electric Supply Company is constructing a number of rural telephone lines in its section of the State.

WHITEVILLE, N. C.—C. D. Weeks has been appointed receiver for the Columbus Telephone Company, of Whiteville. The property will be sold to satisfy creditors.

CHARLOTTE, N. C.—The Bell Telephone Company has started work at Charlotte, placing wires underground, building a new exchange and overhauling the entire system at a total cost of $60,000.

ASHEVILLE, N. C.—The Asheville Telephone & Telegraph Company, with an authorized capital of $300,000, has been chartered by C. R. Craig and others. The company will have both preferred and common stock. A statement has been issued showing conclusively that the Asheville Telephone Company has lost heavily for several years. This is a report in the fight against a proposed merger with the Southern Bell Company and is said to mark perhaps the beginning of the end of the opposition to the merger.

WOODSFIELD, OHIO.—The Woodsfield Telephone Company has increased its capital stock from $10,000 to $15,000.

DAYTON, OHIO.—The Combination Telephone Company has been incorporated here with a capital stock of $100,000. Among the directors is W. C. Marshall.

JACOBSBURG, OHIO.—The People's Telephone Company has increased its capital stock from $1,000 to $2,000. M. R. Hart is president and Oscar Glidden, secretary.

NORWALK, OHIO.—The Local Telephone Company has received its new switchboard from the Kellogg Switchboard & Supply Company, of Chicago. The board will replace the one now in service.

MT. GILEAD, OHIO.—The Morrow County Telephone Company has closed a contract with the Stromberg-Carlson Telephone Company for a new switchboard and a large number of new telephones. The company was organized five years ago with $30,000 capital stock and it is without bonded debt. A. A. Whitney is president and Charles Dombaugh, general manager.

OTTAWA, ONT.—The Grand Trunk Railway Company is using the telephone in connection with the telegraph in the handling of its traffic. The combination system extends from Montreal to Coteau, Cornwall and Brockville. The system, it is stated, is giving satisfactory results, and it is the intention to extend it along the entire railway system.

PORTLAND, ORE.—It is stated that 1,000 telephones will be ordered out by the members of the numerous trade unions in order to aid the striking line men of the Pacific States Telephone & Telegraph Company. Thousands of dodgers have been scattered through the city asking the public to refuse to patronize the company on account of its hostility to union labor. At the next meeting of the City Council a petition will be submitted, asking for a franchise for an independent system.

FACTORYVILLE, PA.—The Factoryville Telephone Company, with a capital stock of $5,000, is of recent incorporation.

GEORGETOWN, S. C.—The Georgetown and Sampit Telephone Company has been organized, with a capital of $500.

BIG SPRINGS, TEX.—The Western Telephone Company has been organized here with a capital stock of $15,000. The incorporators are C. L. Alderman, Robert H. Kemp, Philip Pettit, E. B. Kemp and J. R. Compton, all of Big Springs.

PETERSBURG, VA.—The Petersburg Telephone Company is preparing to build a line to Manchester.

MECKLINSBURG, VA.—The Mecklinsburg Telephone Company has been incorporated with a capital stock of $5,000, by W. H. Elam and others.

GREENBUSH, WIS.—Mr. J. E. Dender and others have formed the Pulls Crossing Farmers' Telephone Company, the capital stock being $500.

ELECTRIC LIGHT AND POWER.

CLAYTON, ALA.—J. Williams, Mayor, writes to the effect that the contract for constructing water works and an electric light plant has been awarded to J. D. Grubbs & Co., of Clayton, for $11,898.

SEARCY, ARK.—The City Council has granted a franchise to P. I. Miller, of Chicago, Ill., to install and operate an electric light plant.

CORONA, CAL.—F. C. Cooper's franchise for an electric light plant and M. W. Findley's franchise for a gas plant form the basis of a consolidated gas and electric company here, to be known as the Corona Gas and Electric Company, which has been organized with a capital stock of $50,000, fully subscribed. The directors are M. W. Findley, president, F. C. Cooper, vice-president, F. A. MacGillivray, George Brown and M. B. Hutt.

BOULDER, COLO.—The Boulder Denver Water Power Company is encountering opposition in its effort to secure a franchise for the construction of a dam and the installation of a $1,000,000 electrical plant near this city. Many people object to the construction of the dam on account of the alleged danger of a flood. The plant, it appears, now, will probably not be installed, unless the company is granted the temporary use of city water for generating purposes.

LAKELAND, FLA.—The question of constructing water works and an electric light plant is under consideration here. For further information address D. H. Sloan, Secretary Bond Trustees. Bids for $35,000 water works, electric light and improvement bonds will be received on Sept. 12.

HARTWELL, GA.—The citizens have voted to issue bonds for electric lights.

CARROLL, IA.—The citizens have voted to grant a twenty-year franchise to the Carroll Electric Light & Power Company.

EMMETT, IDA.—The City Council has granted to W. H. Davis, of this city, a franchise to operate an electric lighting plant.

EMMET, IDA.—W. H. Davis, of Emmet, writes that he has a water power and will construct an electric light plant to cost $20,000. Bids for supplies will be received in about 60 days.

BERWYN, ILL.—Plans and specifications for a municipal electric light plant have just been completed by Charles Whitney Carman & Co., the consulting engineers of Chicago. Bids for the construction of the same are desired.

MARSAILLES, ILL.—The Marsailles Land & Water Power Company is increasing the capacity of its hydraulic plant from 2,000 to 5,000-hp, and is also constructing an electric light plant of a capacity of 1,000-hp, which will be equipped with steam auxiliaries. The new installation consists of 62-inch wheels of Leffel make, working under a 10-foot head. Hayes Bros., of Zanesville, Wis., are the contractors, and A. F. Crane, of Chicago, is the consulting engineer.

NEW ALBANY, IND.—It is reported that the United Gas & Electric Company will erect a large addition to its power house.

WINONA LAKE, IND.—The Winona Electric Light & Water Company has been formed, with a capital of $100,000, by Thos. Kane, Sol. C. Dickey and others, to supply Winona Park and Warsaw with light and water.

TERRE HAUTE, IND.—The Terre Haute Electric Company has purchased a lot on the river front and will soon erect a new power plant. The new location will enable the company to build a much larger plant than the present one.

SOUTH BEND, IND.—F. M. Gray, of Niles, Mich., is reported to have purchased a controlling interest in the water power of "west race." The 2,000 horse power will be converted into electrical energy, the power to be transmitted to South Bend.

INDIANAPOLIS, IND.—The Winona Electric Light and Water Company has filed articles of incorporation. The capital stock is $100,000. The directors for the first year are: S. C. Dickey, E. A. K. Hackett, H. P. Townley, Thos. Kane, E. F. Yarnells, C. H. Worden and H. W. Johnson.

CRAWFORDSVILLE, IND.—An ordinance has been introduced providing for the appointment of a board of electric light trustees to take charge of and manage the municipal lighting plant. The present scheme of municipal management is not satisfactory, and the leakage is entirely too great. If controlled by a board of trustees it will be more independent and free from the political element which enters into present management.

RICHMOND, IND.—The first annual report of the municipal light plant has been made to the City Council. The receipts for light and power aggregate $18,362.21, in addition to which there was received in loans from the city of $17,900, and from sales of supplies $410.32, making a total of receipts $36,672.53, of which $18,362.21 was earned. The total cost of meters, wire and equipment of every kind was $18,204.02. The actual maintenance, which includes coal, pay-roll, repairs, etc., was $17,170.70. The total expenditure shows a deficit over actual receipts of about $17,300. The friends of the municipal plant claim this was to be expected, because of the extension of lines, etc. Those not friendly to the system say the plant is being operated at a loss, and the debts are accumulating. The Richmond Light, Heat & Power Company has let the contract for an addition to its power plant that will practicaly double its capacity. It is freely predicted by some that the private company will in time purchase the municipal plant.

MONROE, LA.—Bids are wanted Aug. 17 for direct-connected engine and alternator, arc light transformers, etc. Address C. A. Downey, Mayor, pro. tem.

NEEDHAM, MASS.—The Greendale Chemical & Electric Lighting Company, of Needham, has secured the contract for street lighting for five years, commencing Oct. 1, at $10 per light per year for the first 500 lights, all above 500 to be $9 per light.

MONTEMORELOS, MEXICO.—R. A. Votaw, of San Antonio, Tex., contemplates the establishment of an electric light and power plant here. About $175,000 will be invested in the enterprise.

CITY OF MEXICO, MEXICO.—Andres Lefevre has made application to the Federal Government for a concession for the establishment of an electric power plant on the Tulancingo River, in the State of Vera Cruz.

ACAMBARO, MEXICO.—A large water power plant is being constructed on the Lerma River at this place. The promoter of the enterprise is George Braniff, of the City of Mexico. The plant is to be used for generating electrical energy for lights and power to be used in this section, and for irrigating a large tract of land situated along the Lerma River.

EL ORO, MEXICO.—Las Dos Estrellas Mining Company, of which Jose J. Reynoso is general manager, has obtained a concession for the utilization of the waters of the Cienega River in the District of Tlalpujahua for industrial purposes. A large electric generating plant will be established there. The power will be transmitted to the company's mines here.

MORELIA, MEXICO.—The Iguaran Copper Mining Company, which operates large copper mines in this State, is constructing a large power plant near its properties. The plant is situated at Mata de Platano, a distance of six and one-half miles from the mines. The power is obtained from mountain springs. The head of water is 930 ft., and the volume is about 80 litres per second. It is expected that 200 hp. will be obtained for delivery to the mines.

RIVER ROUGE, MICH.—The proposition to issue $28,000 electric light bonds has carried.

TAWAS CITY, MICH.—The question of constructing water works and an electric light plant is reported to be under consideration. The plant will cost about $15,000.

FARIBAULT, MINN.—It is stated that the Polar Star Electric Light Company will construct a power house to cost $50,000.

BROOKLYN, N. Y.—An iron smokestack, 125 feet in height, which had just been raised into place at the new electric power plant of the Museum of the Brooklyn Institute of Arts and Sciences, at Eastern Parkway and Washington Avenue, fell recently and narrowly missed crushing half a dozen workmen to death. The damage to stack and power house is estimated at $1,000.

BROOKLYN, N. Y.—The statement is made that large water pipes in the Brooklyn Navy Yard have been attacked by electrolysis and that the government may sue the Brooklyn Rapid Transit as a result of the investigation now being made.

CHARLOTTE, N. C.—The S. B. Alexander, Jr., Company, of Charlotte, has the contract for installing an electric light plant for the town of Winnsboro, S. C. The General Electric Company will furnish the electrical material.

TONOPAH, NEV.—The Owens River Water & Power Company, which was recently organized to supply Tonopah, Nev., with electric light and power, has been incorporated in San Francisco, with a capital stock of $3,000,000. Among the incorporators are W. H. McClintock, of Sonora; John Landers and Eugene S. Watson, of San Francisco. Leon M. Hall, who has offices in the Hayward Building, is the company's electrical engineer. The company has secured water rights on Owens River, Inyo County, Cal., which are capable of developing 10,000 hp. for transmission 90 miles to Tonopah. A local electric lighting plant in Tonopah is owned by the same capitalists. The initial installation will probably consist of three 1,500-kw three-phase 25-cycle generators, direct connected to impulse waterwheels. By adopting 25-cycle apparatus the company will save considerably in the number of transmission lines required, when the capacity of the plant is increased. This will be the first long-distance transmission line on the coast to adopt 25 cycles. The new electric power plant of the United Railroads in San Francisco is now generating current at 25 cycles, one unit consisting of a marine type vertical engine and two three-phase General Electric generators being in operation.

JAMESTOWN, N. D.—The Western Electric Company was organized in 1902 with $25,000 capital. Its president is Mrs. J. H. Canham. The company furnishes 20 city and 15 commercial arcs and 4,000 incandescent lights.

ATHENS, OHIO.—The citizens are reported to have voted to issue electric light bonds.

HUBBARD, OHIO.—This village will issue $10,000 bonds for an electric light plant. J. Edward Schreiber is Village Clerk.

OBERLIN, OHIO.—The Oberlin Gas & Electric Company has increased its capital from $30,000 to $75,000. The plant will be improved.

PAYNE, OHIO.—The Payne Electric Light & Power Company, of Payne, has been incorporated, capital $10,000. Incorporators: Wm. Roose, W. S. Phillips, H. H. Roose and others.

CELINA, OHIO.—Bids will be received and opened at 9 a. m., Aug. 6, at Celina, for boilers, engines and alternators. Ten thousand dollars has been appropriated for this improvement. The plant is controlled by the village of Celina. H. L. Canfield, of Delphos, Ohio, is the enigneer.

MARIETTA, OHIO.—A strong organization is being formed in Pittsburg for the erection of a large power plant for the supply of electrical power to a large number of manufacturing plants in the Ohio Valley. Gen. A. J. Warner, of Marietta, is at the head of the company. He has recently purchased large coal fields in West Virginia, and it is the plan to utilize the coal and slack for the generation of gas and converting it into electrical power through the use of gas engines.

TORONTO, ONT.—The Retail Merchants' Association, of Toronto, has indorsed the Stark electrical system, by which power, light and conversation will be conveyed over the same line. Telephones will be given at $6 each, plus 1 cent a call, the yearly cost not to exced $45 for business telephones and $25 for house telephones. Light will be given at 8 cents per kw-hour, and power at 4 cents per kw.-hour.

SPARTA, ORE.—Work has been commenced here on the construction of a large power plant, which will be installed at a total cost of $2,000,000. The purpose is to furnish power for Baker City, Union, La Grande, Sumpter and for numerous mines. About 170 miles of wire will be required. A flume three miles long is now in course of construction, and will have a capacity of 10,000 hp. The plant, it is stated, will be in operation by January 1, 1904.

MIDDLETOWN, PA.—There is a municipal plant at this place under the superintendence of Mr. F. P. Stauffer. It operates 67 arc lamps of 2,000-cp and 3,000 incandescents.

SHAWINIGAN FALLS, QUE.—The Shawinigan Water & Power Company has closed a contract with the Sorel Electric Company to deliver electricity in the city of Sorel, Que., for the purpose of light, heat and power. The Sorel Company has been formed by prominent business men of that city, and will put in a complete system of lighting for supplying both the city of Sorel and private consumers. The delivery of power, under the contract, calls for the building by the Shawinigan Company of a 20-mile transmission from Joliette, on its main transmission line, through the village of Lanoraie to Sorel. From Lanoraie, the line will cross the St. Lawrence River by means of a submarine cable.

BROWNSVILLE, TEX.—Local citizens contemplate establishing an electric light and power plant here. Hon. James B. Wells can probably give information in regard to the proposed enterprise.

VICTORIA, TEX.—The Victoria Manufacturing Company has been organized here with a capital stock of $200,000 to supply electric light and power, gas, heat and water. The incorporators are John J. Welder, H. E. Rathbone, F. E. Sibley, Theodore Buhler and F. C. Proctor, all of Victoria.

CEDAR CITY, UTAH.—A franchise for the operation of an electric lighting plant has been granted to Charles M. Lang, of this city, by the City Council.

SALT LAKE CITY, UTAH.—It is stated that the Utah Light & Power Company will construct an addition to the Jordan power plant, to cost about $200,000.

NEWPORT NEWS, VA.—The Consumers' Light, Heat & Ice Company is stated to have issued $250,000 bonds to enlarge its plant here.

MARINETTE, WIS.—It is reported that the Crawford Lumber Company, of Marinette, will install a 300-light electric lighting plant at Cedar River.

JANESVILLE, WIS.—P. H. Korst, general manager of the Janesville Electric Company, writes that the proposed improvements in the company's plant will cost about $30,000, and will be let separately as follows: four turbines, shafting, boilers and building a new power house. The engineers are D. C. & W. B. Jackson, of Madison, Wis.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—It is reported that the Birmingham Railway, Light & Power Company is figuring on the construction of several new lines.

MADERA, CAL.—Articles of incorporation of the Madera Railway Company have been filed. The company has a capital stock of $50,000. The directors are J. C. Campbell, R. W. Campbell, A. C. Towne, J. H. Tate and F. C. Drew.

APALACHICOLA, FLA.—The City Council has granted a franchise to citizens of Apalachicola for a street railway.

MOLINE, ILL.—At a recent meeting of the Dixon, Rock Falls & Southwestern Electric Railway Company G. T. Shaw, of Dixon, was elected president; A. C. Stanley, vice-president; R. L. Leitsch, secretary; O. E. Maxson, treasurer and H. L. Sheldon, attorney, all of Rock Falls.

MONMOUTH, ILL.—The Western Illinois Traction Company has commenced work on the Galesburg line. The officers and promoters of this company are W. B. Young, president; G. W. Gale and W. W. McCullough, vice-presidents; W. H. Woods, treasurer. The company was incorporated with a capital stock of $500,000. The total cost of the road will be about $400,000.

WABASH, IND.—The contract for the building of the interurban railway between this city and Marion has been awarded to J. G. White & Co., of New York. The length of the line is 20 miles. Contracts for the steel and ties have been placed, and other equipment is now being contracted for.

INDIANAPOLIS, IND.—A novelty in interurban railway construction in Indiana will be introduced by the Indianapolis & Martinsville Railway on its extension from Martinsville to Bloomington by the construction of a tunnel through the hills in the northern part of Monroe County. The tunnel will be about 1,500 feet in length. It will be constructed through solid sandstone, and will involve an expenditure of between $75,000 and $100,000.

LAFAYETTE, IND.—The promoters of the electric railway which will connect Lafayette with Tipton, Frankfort and Attica, have elected officers as follows: Col. J. G. Clark, of Frankfort, president; Samuel Clark, of Attica, vice-president; Hez M. Cohee, of Frankfort, secretary; M. Epstein, of Frankfort, treasurer; W. R. Dunham, of Tipton, auditor; J. G. Clark, J. H. Fear, J. C. Shanklin, of Frankfort; Samuel Clark, T. M. Green, of Attica; W. R. Dunham, George Shortle, of Tipton, directors.

DAVENPORT, IA.—The Davenport & Clinton Traction Company will be the name of the interurban railway which has been promoted under the name of John U. May. The company is capitalized at $500,000, with the privilege to increase the capital stock to $3,000,000. Ulysses D. Eddy, president of Flint, Eddy & Company, of New York, will be president; John U. May, vice-president and treasurer and Herbert T. Beatty, secretary.

LOUISVILLE, KY.—The directors of the Louisville & Cincinnati Interurban Electric Railway Company have elected the following officers: President, George W. Lewman, of Louisville; vice-president, Louis Hartmann, of New Albany; secretary and treasurer, John F. McCulloch, of Charlestown township, Ind.

ELKTON, MD.—The Cecil & Kent Light, Power & Railway Company has taken steps to construct the proposed electric railway between Elkton and Chesapeake City. A committee was appointed to make a contract with the Tennis Company, of Philadelphia, to build the road.

HAGERSTOWN, MD.—It has been officially announced that the Hagerstown Electric Railway Company will build an electric railway across South Mountain from Boonsboro, to Myersville, thus connecting Frederick and Hagerstown by trolley. The distance is 5 miles. The cost will be $50,000.

CUMBERLAND, MD.—The Frostburg & State Line Electric Railway, Light & Power Company has been incorporated with $120,000 capital. The incorporators are William A. Wood, Joseph W. Reynolds, Pittsburg; Robert R. Henderson, William H. Cole, Cumberland; George G. Townsend, Frostburg. It is part of the system to connect Cumberland and Johnstown, and companies will be organized in Pennsylvania to fill several gaps. The consolidated company is incorporated under the laws of New Jersey, with $8,000,000 capital.

MARLBORO, MASS.—The Marlboro Street Railway, including a power house, together with cars and equipment, was sold at public auction July 25, to William A. Quigley, of Boston, for $102,775. Mr. Quigley represented the Boston & Worcester Street Railway Company.

ALLENDE, MEXICO.—A street car line is to be constructed between this place and Zarazoza, and it is the intention of the promoters to eventually extend the line to Ciudad Porfirio Diaz. Messrs. Mackin & Dillon, of Monterey, may be able to give information in regard to this enterprise.

BUTTE, MONT.—The Salmon River Electric Railway Company has filed articles of incorporation, the incorporators, all of whom are residents of Billings, are P. B. Moss, H. W. Howley, M. A. Arnold, I. B. O'Donnell and O. F. Goddard. The articles state that the company will construct an electric railway system from this city to a point on the Salmon River in Idaho, a distance of 187 miles. A survey for the line has been made. The estimated cost of the system is $2,000,000.

ALBANY, N. Y.—The Newburgh, Highland & Poughkeepsie Traction Company has been incorporated. The capital stock is $100,000. Among the incorporators are Joseph A. Duffy, Thomas G. Hinds and others of Jersey City, N. J.

BROOKLYN, N. Y.—It is unofficially stated that the Brooklyn Rapid Transit Company, to conform with the new law which compels the abolition of grade crossings of steam roads within the city limits, has decided to elevate the tracks of the Brighton Beach Railroad. This projected improvement will cost fully $1,000,000. The line runs over a private way, which the company owns in fee, but the trains pass through the most aristocratic suburban section of the borough.

MARION, OHIO.—J. G. Webb, president of the Marion Railway, Power & Lighting Company, states that the company will build a $350,000 power and lighting station in Marion.

MARION, OHIO.—The Marion & Findlay Railway Company has been incorporated, with $10,000 capital stock, by J. W. Scott, R. M. Shute, Charles E. Watson, W. K. Stanley and R. B. Oliver.

COLUMBUS, OHIO.—The Lancaster, Logan & Nelsonville Traction Company has applied to the State Commission for a lease for fifteen years, of 34 miles of the bed of the abandoned Hocking canal, for right of way for its line.

CLEVELAND, OHIO.—The Mansfield & Eastern Traction Company has filed a mortgage for $600,000 to the Central Trust Company, of Cleveland, covering a bond issue for the same amount. The road is being built between Mansfield, Mifflin and Ashland, and will furnish heat and light, as well as operating freight and passenger cars. William J. Pentz is president and J. W. Galbraith, secretary of the company. The offices are at Mansfield.

MARION, OHIO.—The formal consolidation of the Marion Street Railway Company and the Marion Electric Light & Power Company has been effected, under the name of the Marion Railway, Light & Power Company. The company has $500,000 capital stock, and is owned by the parties who control the Columbus, Delaware & Marion Railway. It will be operated on close terms with the interurban road. It is announced that the city system will be extended, and that the car equipment will be increased.

HAMILTON, ONT.—The Hamilton Cataract Power, Light & Traction Company has secured an act of incorporation, confirming the purchase of the Hamilton Electric Light & Cataract Power Company, which owns the Hamilton Street Railway, the Hamilton Radial Electric Railway and the Hamilton & Dundas Railway.

MOUNT UNION, PA.—It is stated that an electric railway will be built from Mt. Union to Chambersburg.

LANCASTER, PA.—The Lancaster County Railway & Light Company has leased the line of the Lancaster & Rocky Springs Railway Company.

GETTYSBURG, PA.—Engineers have begun the preliminary surveys for the proposed electric railway between Mount Holly Springs and Gettysburg via Biglerville and Bendersville.

HARRISBURG, PA.—A charter has been granted to the Gettysburg & Mt. Holly Street Railway Company, capital $300,000. The officers are Charles H. Mullin, president; Lyman D. Gilbert, Patrick Russ, Benjamin C. Warnick and R. W. Woods, directors.

GETTYSBURG, PA.—It is said to be the intention of the new owners of the Gettysburg Transit Company, operating the battlefield trolley line, to extend the line to Littlestown and Westminster, Md. C. Taylor Leland, of Philadelphia, and Thomas V. Cooper, of the Westinghouse Company, recently secured almost the entire stock issue of the company.

HARRISBURG, PA.—At a meeting of the incorporators of the new Central Pennsylvania Traction Company, Frank B. Musser was chosen president. B. F. Myers was chosen vice-president; W. J. Calder, secretary and treasurer, and the fifteen directors of the Harrisburg Traction Company were continued as directors of the new company. Arrangements were also made over the lines of the Harrisburg Traction Company.

MILFORD, UTAH.—An electric railway will be constructed between this city and Dixie, a distance of 130 miles. George E. Lane, of Milford, is at the head of the enterprise. He states that the necessary funds have been arranged for, and that the total cost of the system will be in the neighborhood of $3,500,000.

MOUNT VERNON, WASH.—George M. Stewart and others propose an electric light plant and electric railway, the latter to extend 100 miles.

SPOKANE, WASH.—The Spokane Traction Company has issued bonds to the extent of $1,000,000. This money is to be spent in Spokane for extensions and improvements of its new street railway system.

CHARLESTON, W. VA.—The Ohio Valley Street Railway Company, of Chester, has been incorporated by J. A. Gardner, F. C. Pitcairn, John W. Bailey, George H. Walmer and others.

GRAFTON, W. VA.—The Taylor County Electric Street Railway & Supply Company has organized by electing directors as follows: A. J. Wilkinson, George L. Jolliffe, James W. Holt, L. F. Ward, Dr. A. S. Warden, B. F. Bailey and T. J. Joyce.

HUNTINGTON, W. VA.—A street railway syndicate, headed by James Truby, J. W. Leete and Elliot Northcot, backed by eastern capital, has been organized to build an electric railway from Central City, through Huntington. An application has also been filed for a franchise.

EAU CLAIRE, WIS.—The Chippewa Valley Electric Railway Company is planning extensive improvements to its system.

NEW INDUSTRIAL COMPANIES.

THE STANDARD CONTRACTING COMPANY, of Wilmington, Del., has been incorporated to maintain and operate telephone and telegraph lines and electric railways; capital, $100,000.

THE LINCOLN STREET CAR & HEATING COMPANY, of Jersey City, has been incorporated with a capital of $110,000. Incorporators: Louis B. Dailey, Warren N. Akers and H. O. Coughlan.

THE ELECTRIC BRICK & FUEL COMPANY, of Aledo, Ill., has been incorporated with a capital stock of $100,000. The incorporators are Benjamin Townsley, Charles W. Smith and John Kerns. It is proposed to manufacture brick, coal, electric light, gas, tile, etc.

THE MEXICAN ELECTRICAL CONSTRUCTION AND SUPPLY COMPANY, of the City of Mexico, has been incorporated in Illinois. The company will do a general electrical construction business, erecting telephone, light, heat, power, railway and signal systems.

THE GRANITE CITY-VENICE ELECTRIC COMPANY has been incorporated at Granite City, Ill., with a capital stock of $500,000. The incorporators are Rufus C. Dawes, Henry C. Wood and Edward Clifford. It is the purpose of the company to engage in a general electrical business.

LEGAL.

FRIGHT FROM TELEPHONE POLES.—In the appeal case of Missouri & Kansas Telephone Company v. Vandevort, before the Supreme Court of Kansas, it was held that in an action to recover for injuries resulting from alleged negligence in placing two telephone poles on the side of the highway in such a way as to frighten horses, and where the location, condition, color and appearance of the poles, and all of the circumstances surrounding them, could have been easily described by witnesses, the opinions of experts as to whether the poles were calculated to frighten horses were not admissible.

NEGLIGENT ELECTRIC LIGHT LINEMAN.—In the case on appeal to the Supreme Court of Nebraska, of the New Omaha Thomson-Houston Electric Light Company vs. Johnson, the opinion of the court is summarized as follows: Evidence held not to support a finding that plaintiff's intestate came to his death from accidentally stepping upon scrap iron electrically charged from the wires of the electric light company. Evidence held to show that, if fatal contact was with defendant's guy wire, such contact was voluntary, and after warning on deceased's part. Defendant company held to be under a duty to exercise all reasonable precaution against passing a dangerous current of electricity through a guy wire attached to a pole on a vacant and uninclosed lot in a densely peopled part of a city. Where there is very slight evidence of intoxication, it is not error to refuse an instruction telling the jury that contributory negligence, caused by intoxication, would be a defense; the court having fully instructed as to what would constitute contributory negligence. The case was remanded to the lower court.

RIGHTS OF A TELEPHONE COMPANY.—A case was decided recently by the Kentucky Court of Appeals between the Cumberland Telephone & Telegraph Company and the Louisville Home Telephone Company. There were in fact two suits. The Court held: 1. Where a foreign corporation had spent nearly $500,000 in the construction of a telephone system in a city in the State under a franchise granted by the city, it had a right to sue in the courts of the State to protect its rights; and the fact that all of its incorporators but one were residents of the State, and that the evident object of forming the corporation elsewhere was to obtain the benefit of less rigorous laws, could not defeat that right; it appearing that the State was not complaining. It also held: 2. Where a telephone company had been granted a permit to erect its poles on the same side of a street with the poles of another company, having a prior, but not exclusive, franchise, and the old company, whenever the new one started to put in poles of a certain height, immediately changed its own poles, and made them of such a height as to prevent the new company from proceeding, an injunction was issuable.

TELEPHONE POLES ON STREETS.—In the suit of the Northwestern Telephone Exchange Company vs. the Twin City Telephone Company before the Supreme Court of Minnesota, on appeal, it was held that, in the absence of positive regulation by statute or ordinance controlling the construction of telephone lines in a municipality, the party first lawfully installing its lines acquires superior rights in the erection of poles and wires in streets which forbids a subsequent occupant for the same purposes to interfere therewith. The prior lawful occupancy of urban streets by a telephone company will not necessarily create a monopoly of all the aerial space which it appropriates, but may give such occupant such substantial rights in the conduct of its business as may be required in the growth and extension of the same to meet the immediate demands of the public service subject to the right of the courts to restrain another telephone company from unnecessary interference therewith. Under privileges granted by the city of Minneapolis, the plaintiff, in 1878, placed its poles and wires in its highways, and has from time to time maintained and extended the same to meet the necessary requirements of its business. In 1898, by authority of a charter from the city, the defendant crossed the lines of plaintiff upon poles at street intersections and placed its wires immediately thereunder, in such a manner as to interfere with the prior occupant in the necessary use of its franchise. It was held that such erection and maintenance of its poles and wires by defendant was an illegal impairment of the plaintiff's rights, which could be restrained by injunction.

INTERRUPTING TELEPHONE LINES.—In the suit before the Court of Civil Appeals of Texas, between the Southwestern Tel. & Tel. Company and Priest et al., when a rehearing was denied, the opinion stated that under Pen. Code, art. 784, it was an offense to wilfully interfere with the transmission of messages along a telegraph or telephone line, and it was held that, to constitute an offence under such article, there must be a breaking, cutting, etc., of some wire, post, machinery, or other necessary appliances, so as to interfere with the transmission of messages. The telephone company offered a reward for the conviction of any person guilty of cutting, pulling, tearing down, or misplacing its telephone wires, posts, or machinery, or unlawfully obstructing the transmission of messages in violation of article 784. It was also held that, in an action against the company to recover the reward because of the conviction of one for cutting a wire, the fact that the wire cut was a dead one, and did not come within the offer, and that plaintiff had personal notice that the reward did not apply to such wires, was properly pleaded as a special defense. A constable who arrests a person for misdemeanor in the discharge of his duties as an officer is not entitled to recover a reward offered for the conviction of any one committing such misdemeanor. In an action to recover a reward offered for the conviction of any one committing certain misdemeanors, two other persons beside plaintiff, who claimed the reward, were made parties, and defendant appealed from a judgment dividing the reward between all the claimants. A claimant, not having appealed from the judgment, could not file an assignment of error, and have the judgment below reversed, and judgment rendered in the appellate court in his favor for the entire amount.

TELEPHONE FRANCHISES.—The case of Mahan v. the Michigan Telephone Company before the Supreme Court of Michigan, resulted in the following: 1. The city ordinance authorizing a telephone company to construct lines and transact business in the city provided that, if the company should transfer its rights to any other telephone company, the company acquiring such rights should be subject to the terms of the ordinance, and that all the obligations imposed by the ordinance should apply to any assignee or successor of the grantee. This ordinance was accepted in writing, and was held to constitute a contract between the grantee in the ordinance and the city. 2. A company purchasing all the tangible property of the grantee in the ordinance, and its rights under the ordinance, will be considered as having purchased with notice of the conditions of the ordinance, and bound by all the obligations of the assignor. 3. An ordinance granting a telephone company the right to operate a telephone system in a city provided that, if the company should assign its franchise, the assignee should be bound by all the obligations of the assignor. Another telephone company, which operated an exchange in the same city, purchased the property and franchise rights of the grantee in the ordinance, and, for a considerable time after the purchase, gave the subscribers of the assignor company access to the subscribers of the assignee company. It was held that such action constituted a construction of the ordinance granted to the assignor company, and an acknowledgment of the assignee's obligations thereunder, which the assignee was not thereafter at liberty to repudiate. 4. Where a telephone company refuses a subscriber connections through its exchange, when he is properly entitled thereto, his right to such connections may be enforced by mandamus.

FRANCHISE FOR LIGHTING.—An interesting action has recently been decided in the Kentucky Court of Appeals between the People's Electric Light & Power Company and the Capital Gas & Electric Light Company, both of Frankfort. The following points summarize the decision: 1. Where the exclusive franchise to furnish light to a city has been granted to a gas and electric light company, and another company also claims such right, thereby casting a cloud on the title of the first company to the right claimed by it, injunction to restrain the second company from setting up such exclusive right is the proper remedy, though the first company is not in possession of the streets. 2. In an action by a gas and electric company, claiming that the exclusive franchise to light the streets had been granted to it, to restrain another company from setting up a claim to a similar exclusive right, a plea of champerty by defendant, on the ground that it had the exclusive right to furnish light at the time the plaintiff's franchise was granted, was demurrable. 3. A plea denying that the sale of the franchise to appellant was advertised, or that bids were publicly received therefor, or that the franchise was sold to appellant as the highest and best bidder, stated a good defense. 4. Where the charter of a gas company did not authorize it to furnish any other light than gas, and it had no facilities for so doing, a franchise granted by a city to such company, giving it the exclusive right to use the streets to furnish gas and "other illuminating light," was void as to "other illuminating light." 5. A city contracted to deed its gas plant and grant an exclusive franchise to furnish gas and other light to a company whose charter gave it no right to furnish any light but gas. The deed was made to an assignee of this company, and the assignee's charter provided that it should furnish gas and electric light. The deed imposed no obligation on the grantee to furnish any other light than gas. *Held*, that the deed did not give the grantee an exclusive right to furnish electric light. 6. Contracts made by the grantee with the city with reference to furnishing electric lights, which did not impose on the company any duty to furnish such light, did not give the company an exclusive right to furnish electric light. 7. Under Const. § 164, providing that, before granting any franchise for a term of years, a city shall receive bids therefor and award the same to the highest and best bidder, a city cannot enlarge a franchise already granted, except by award to the highest and best bidder.

PERSONAL.

HENRY J. HALLBERG.

MR. HENRY J. HALLBERG, who as already announced in these columns, has been appointed general superintendent of the electric lighting department of the Cincinnati Gas & Electric Company, was born at Falkenberg, Sweden, July 22, 1874, and received his early education in that country. He arrived in America in October, 1890, and entered immediately the large machine shops of the Ottumwa Iron Works at Ottumwa, Ia., as an apprentice in the machinist trade. His work in that line extended over a period of three or four years and was confined to the construction, installation and testing of steam engines and mining machinery. After completing this mechanical course, he entered into the electrical field as the Iowa representative of the Walker Electrical Mfg. Company, of Cleveland, Ohio, Kohler Bros., of Chicago, and the Smith-Hill Electric Elevator Company, Quincy, Ill. He superintended the erection of several street railway, lighting, power and elevator plants for these companies, and discontinued this work when the manufacturing companies were absorbed by some of the larger electrical interests; after which he became attached to the sales engineering staff of the Electric Appliance Company, of Chicago. In the fall of 1896 he accepted an appointment as designing electrical engineer with the Standard Thermometer and Electric Company at its works in Peabody, Mass., having entire charge of the electrical manufacturing department. He continued in this office until Sept., 1899, when he was offered a position as electrical engineer with the General Incandescent Arc Light Company, which he has held up to the present time. During his connection with the two latter concerns he has designed and perfected a large number of electrical appliances, and has had charge of several of the largest engineering contracts in this country and Canada in which these companies have been engaged. One of the most important equipments which he designed was the apparatus for the arc lighting plant installed on the banks of the Cornwall Canal in Canada. This installation is under Government control and the installation of that system involved many new and important engineering problems, as the arc lighting circuits are unusually long, comprising 120 lamps in series, and are operated at the extremely high potential of approximately 10,000 volts. This plant has now been in operation for more than two years and its success has been clearly demonstrated. One of his other important steps in the engineering profession was the design of the new street lighting system installed in Cincinnati. It is not generally known that this lighting system is the largest in the world with low amperage lamps. Aside from his technical and practical connection with the electrical engineering profession above referred to, Mr. Hallberg has contributed a number of articles to the electrical press, and has presented and discussed papers before the various electrical and mechanical societies in this country. He has taken out more than 15 American patents, and has at the present time about 10 more patents applied for, both in America and in five European countries. Mr. Hallberg and his wife will remove to Cincinnati at once, as his new duties begin there August 15, when a large extension of the new lighting system is to be effected.

VICE-PRESIDENT HART, of Hart & Co., is on an extended trip to Europe, where he will look after his company's business.

MR. S. W. MOON, well known through various prominent positions held in the telephone manufacturing industry for many years, has recently become secretary and general manager of the Illinois Electric Specialty Company.

MR. G. J. YUNDT, it is stated, will be appointed electrical engineer of the Southern Bell Telephone Company at Atlanta, Ga., to succeed E. H. Bangs, resigned, who has accepted a position with the Central Union Telephone Company.

MR. O. H. ENSIGN, of Los Angeles, Cal., has been elected president of the Electrical Engineering Club of Southern California, which has been organized with the ultimate purpose of affiliating with the American Institute of Electrical Engineers.

LIEUT. COMMANDER JOHN B. BLISH, U. S. N., formerly in technical charge of naval electrical work, is the author of a paper entitled "The Navigator's Prism," printed in the current issue of the *Proceedings* of the U. S. Naval Institute.

MR. EMILIO DYSTERUD, chief engineer and general manager of the Monterey Electric Light & Power Company, is now in New York. Down-town he may be found at the offices in the Washington Life Building of the Federal Electric Company.

MR. AND MRS. C. J. GLIDDEN, of Boston, started, on July 29, from Copenhagen in an automobile, intending to cross the Arctic circle. If they succeed they will be the first persons who have ever reached such a northerly point in an automobile.

MR. A. J. DE B. CORRIVEAU, of Montreal, who has been agitating the subject of an automobile exhibition and a run from New York to that city, has a favorable communication from Mr. John McDougall, of the customs department, as to measures of a liberal character to meet the occasion.

MR. I. S. HOFFMAN, for a number of years manager of the Mansfield, Ohio, Telephone Company, has resigned to accept the presidency and general management of the Mexican Electrical Construction & Supply Company, of Mexico City, a new organization recently incorporated in Illinois.

MR. ROBERT A. BYRNS has taken up the agency for Eastern territory of the Northern Engineering Works, with offices at 120 Liberty Street, and will push their dynamo machinery, motors, etc., vigorously. Mr. Byrns is a young electrical engineer who has a wide acquaintance and an excellent experience in the electrical field.

MR. F. L. DAME, for the past two years general manager of the Union Electric Company, Dubuque, Ia., has accepted the position of engineer of the Local Companies' Committee of the General Electric Company. It is expected that Mr. Dame will assume his new duties with headquarters at Schenectady, N. Y., about the middle of August.

MR. T. A. EDISON denies the stories as to his own serious injuries from Röntgen ray experiments, but admits that the Dally brothers, who have been associated with him in this work have sustained burns that have cost the amputation of limbs. Clarence Dally began Rontgen ray work with Mr. Edison some years ago, and was with him at the electrical exhibition in 1896.

MR. MANNING WHITE, who has charge of the lighting department of the Savannah Electric Company, of Savannah, Ga., is visiting the North. He has lately worked out and has shown us an ingenious and simple device which without adding very much to the cost of a plant should serve to check the theft of current pretty thoroughly. He hopes soon to have it on the market.

MESSRS. ED. L. VAN NIEROP & COMPANY, well known merchants in Kobe, Yokohama and Moji (Japan), have recently started an engineering department. This department, under the management of Mr. André Schmidt, mechanical and electrical engineer, who has been during many years with several European concerns, engaged in the designing and constructing of complete power and lighting plants, factory and mining installations. Mr. Schmidt is at preset in Europe for business arrangements and will visit some of the principal cities of this country on his through trip to Japan.

ADMIRAL MELVILLE, Chief of the Bureau of Steam Engineering of the Navy, will be retired this week on Aug. 8, when his commission of chief of bureau expires by limitation. He reached the statuatory age for retiring on Jan. 10 last, but was continued on the active list under his command as chief of bureau as an acknowledgment of his distinguished services in the navy and his great efficiency as head of the Bureau of Steam Engineering, a position which he has filled for sixteen years. In that period the navy has been practically re-created with ships of every type, the machinery for which has been constructed under his supervision. Admiral Melville's first appointment as chief of bureau was made by President Cleveland on Aug. 8, 1887. He filled the position for a longer period than any of his predecessors. During his incumbency the Engineer Corps has been advanced in reputation and numbers, and to-day stands second to no corps of its kind in any of the navies of the world. A number of his protégés and best men have come into the electrical field where they have taken leading positions, and he has also a great many other personal friends in the electrical profession.

EDUCATIONAL.

ROSE POLYTECHNIC INSTITUTE.—President C. L. Mees, of the Rose Polytechnic Institute, Terre Haute, Ind., reports the following as the graduates this year from the electrical department, and the positions they have secured: F. V. Aguilera, General Electric Co.; J. S. Brosius, Westinghouse Electric Co.; C. L. Chamberlain, Wagner Elec. Mfg. Co.; Graham Davies, Western Electric Co.; W. D. Ingle, Oakland Mining Co., Oakland, Ind.; B. C. Jacob, Western Electric Co.; H. S. Kellogg, General Electric Co.; C. J. Kiefer, General Electric Co.; H. W. Palmer, Western Electric Co.; H. B. Pettit, Western Electric Co.; R. J. Schefferly, Automobile Dept., Standard Wheel Co., Terre Haute, Ind.

UNIVERSITY OF TENNESSEE.—The University of Tennessee Press, Knoxville, has issued a neat little vest-pocket book for engineers, a copy of which we have received. The primary object in publishing this book is to bring directly to the attention of the men of affairs of the South the value of technical training in schools and colleges. Aside from a small amount of matter about the engineering departments of the University the editors have endeavored to collect a large amount of information useful to engineers and business men. That they have succeeded, at least fairly well, in getting just the desired information in a convenient form, is shown by the fact, it is stated, that they have demands for this little book from every part of the civilized world.

Trade Notes.

RADIUM. Admirably adapted to the general reader, and intensely interesting, is the description of the new element, Radium, given by W. A. Shenstone in *The Cornhill Magazine*, and reprinted in *The Living Age* for July 18.

CHARLES E. MILLER, the automobile supply man, etc., will open a branch store at once in "Automobile Row," at 127 West 38th Street, New York City, where a full line of material and supplies will be carried.

THE STROMBERG-CARLSON TELEPHONE MFG. COMPANY, of Rochester, N. Y., and Chicago, Ill., has recently sold a 300-capacity switchboard together with telephones and a complete equipment to the Rushville Telephone Company, of Rushville, Ill.

DIXON'S INDEX is a very handy and shrewd little book of advice to users of lead pencils, classifying them and giving pointers in each case and category as to the best pencils of Dixon make to be employed for specific work. The pamphlet is prettily got up and contains a lot of interesting information.

THE SWEDISH-AMERICAN TELEPHONE COMPANY, 88 West Jackson Boulevard, Chicago, reports that the party line selective apparatus recently put on the market by it is meeting with great favor and that it is booking orders for this equipment daily. It will be pleased to furnish prospective buyers full particulars upon application.

BERRY ELEC. & MFG. COMPANY.—The Berry Electric & Mfg. Company, of St. Joseph, Mo., has started the manufacture of electric signs and is now turning out quite a number of them. Most of them are equipped with electric battery. The company's new telephone catalogue is ready for distribution.

THE VOUGHT-BERGER COMPANY, of La Crosse, Wis., is about to put on the market a new and very attractive telephone for party line work. It is said to be unlike any instrument heretofore built, either by it or any of the telephone factories. The company looks forward to an unusually heavy sale of its new No. 45 telephone and believes it will open up an entirely new field in country telephony. The new instrument will be ready for sale about the middle of the month. Pamphlet No. 45, descriptive of this instrument, has been published.

GENERATOR CALL TELEPHONES.—Bulletin No. 4, just issued by the Stromberg-Carlson Telephone Mfg. Company, of Chicago, is devoted to generator call telephones and is a most interesting and valuable brochure on magneto apparatus, including both series and bridging instruments. Each page illustrates a set and gives full data for the advice and guidance of the intending purchaser. A variety of details are gone into very carefully, such as divided circuit or two-party selective lines and the "central checking telephone," where all the party stations call through one central point. Several interesting pages are also allotted to telephone parts such as ringers, induction coils, lightning arresters, generators, "triplets," transmitter arms, hook switches, receivers, transmitters, etc. The pamphlet is handsomely gotten up and well printed.

PRECISION LATHES.—Pratt & Whitney Company has just issued one of its standard 6 x 9 booklets on its bench lathe, 10-inch tool makers' lathe, 13-inch engine lathe and 14-inch gibbed carriage engine lathe. The book contains 67 pages and is fully illustrated with excellent half-tone plates. The first 37 pages of the book are taken up with a description of the 7 x 32-inch bench lathe. This machine is described in detail and illustrations are given of more than 30 of the various attachments which may be furnished. The 10-inch tool makers' lathe is also carefully described, and illustrations are given showing the application of the collets and split step chucks to the spindle. There are two views of the 14-inch lathe. A number of important attachments for this are illustrated and described, including the relieving attachment for relieving straight, taper and spiral taps and milling cutters, draw-back collets, step chucks and closers and expanding arbors. While these lathes perhaps are not applicable to rough shop use, any one who cares for good machines or who has to do accurate work will appreciate them.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 28, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

733,970. TRANSMITTER-ARM; William Kaisling, Chicago, Ill. App. filed April 6, 1903. (See page 226.)

734,099. TELEPHONE-SWITCHBOARD; Charles E. Scribner, Chicago, Ill. App. filed Sept. 25, 1896. (See page 225.)

734,386. TELEPHONE EXCHANGE; William W. Woodruff, Winchester, Ky. App. filed Sept. 3, 1902. (See page 225.)

734,499. ELECTROLYTIC APPARATUS FOR RECOVERING METALS FROM THEIR COMPOUNDS; Charles E. Baker and Arthur W. Burwell, Cleveland, Ohio. App. filed Nov. 11, 1902. (See page 224.)

734,511. POLE CHANGER AND CROOKES TUBE CONTROLLER; Fred Cedergren, Chicago, Ill. App. filed March 16, 1903. Details.

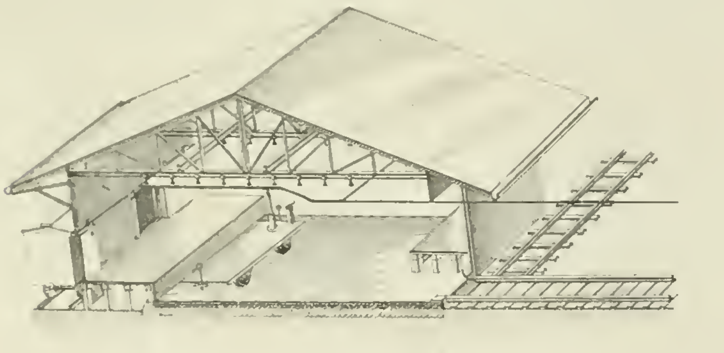
734,610. RAILWAY TRANSFER APPARATUS; Henry H. Porter, Jr., Chicago, Ill. App. filed March 5, 1902. A freight house has a conducting floor and a conducting ceiling connected respectively with a track and a trolley wire, so that a car can pass from the track into the freight house and move about therein in any direction.

734,655. SYSTEM OF ELECTRICAL SIGNALING FOR RAILROADS; Cyrus Barber, Keene, N. H. App. filed March 14, 1902. An arrangement of conductors on a third rail, and collecting devices carried by the train, for signalling purposes between trains and between trains and stations.

734,674. SELF-WINDING ELECTRIC CLOCK; Charles M. Crook, New Britain, Conn. App. filed Oct. 16, 1902. The structure of the magnet and the armature are combined in a peculiar manner with the frame of the clock.

734,689. VIBRATORY TELEGRAPHY; Stephen D. Field, Stockbridge, Mass. App. filed Dec. 18, 1902. An arrangement whereby a vibratory receiving reed will open the local circuit and hold it open while its vibration continues, instead of creating a break at each vibration.

734,699. ELECTRIC ARC LAMP; Frederick W. Gore, Dorchester, Mass. App. filed May 24, 1902. Air chambers are arranged at the upper and lower ends of the lamp and co-operate with the carbon carriers to regulate their movement.



734,610.—Railway Transfer Apparatus.

734,724. MEANS FOR CONTROLLING ELECTRIC MOTORS; Robert Lundell, New York, N. Y. App. filed March 12, 1903. A controller operating in connection with two compound wound motors and adapted to change the electro-motive force applied to the individual armature circuits and to keep the current from the power circuit uninterrupted through one of the motors while the electromotive force applied to the armature of the other motor is being changed.

734,778. ELECTRICAL HELIX; Richard Varley, Providence, R. I. App. filed Feb. 4, 1903. A helix built up of a number of spirals of flat wire, placed side by side upon a common axis, with adjacent inner and outer ends connected, and the alternate spirals being wound in opposite directions, so that current entering the beginning of the first spiral will flow in the same direction throughout the helix.

734,791. TRANSFORMER; James L. Adams, Jr., Springfield, Ill. App. filed July 5, 1902. The core and magnet casing are so constructed and arranged as to provide for a considerable magnetic leakage at full load, which leakage in conjunction with the impedance in the primary coil serves to limit the current consumption of the primary and the output of the secondary, while at the same time preventing injury to the parts by overheating.

734,793. CIRCUIT CONTROLLER; William W. Alexander, Kansas City, Mo. App. filed July 14, 1902. Details.

734,826. ELECTRIC BATTERY; Henry Csányi, Felso-Dobsza, Austria-Hungary. App. filed March 4, 1903. (See page 225.)

734,876. CLUSTER SWITCH; Harvey Hubbell, Bridgeport, Conn. App. filed Nov. 21, 1902. A rotary switch operated by a chain and mounted in the center dome from which the lamps of the cluster project.

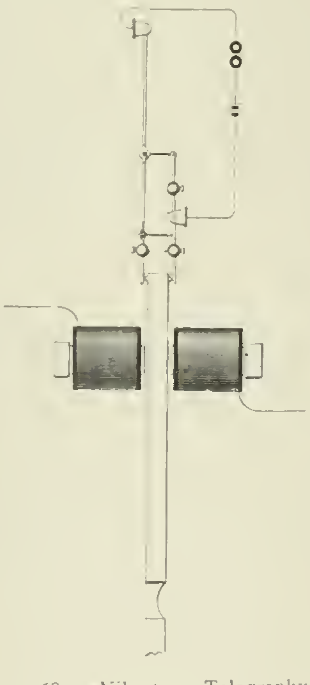
734,894. BASKET FOR HOLDING TIN SCRAPS; Martin Laernoes and John Dunn, Streator, Ill. App. filed Nov. 25, 1902. (See page 225.)

734,896. PORTABLE ELECTRIC ACCUMULATOR; Lambertus Alphonus Lammerts, Rotterdam, Netherlands. App. filed June 20, 1902. (See page 225.)

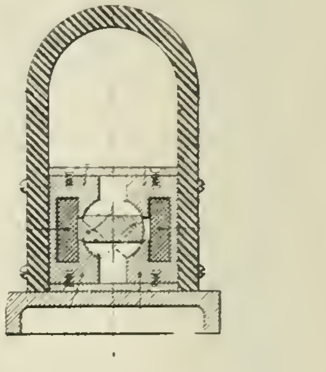
734,905. CIRCUIT CLOSER; Thomas A. Long, Sparrows Point, and George W. Cofran, Baltimore, Md. App. filed Jan. 7, 1903. A pivoted lever held in normal position by a fusible block, the destruction of which permits the lever to move and close an alarm circuit.

734,906. FIRE ALARM MECHANISM; Thomas A. Long, Sparrows Point, and George W. Cofran, Baltimore, Md. App. filed Jan. 7, 1903. An annunciating apparatus operative in connection with the circuit closer of the preceding patent.

734,920. TROLLEY CATCH; George W. Maxwell, Los Angeles, Cal. App. filed March 25, 1903. A cord attached to the dash board at one end passes over a pulley near the top of the pole and thence downward to a suspended weight which permits the pole to rise and fall with the irregularities in the wire, but when the trolley wheel leaves the wire, it releases a dog that grips the rope, thus preventing it from running and holding the pole stationary.



734,689.—Vibratory Telegraphy.



734,955. Electric Ignition Generator.

734,950. MANUFACTURE OF PEROXID OF LEAD; Erwin Quedenfeldt, Duisburg, Germany. App. filed June 25, 1901. (See page 224.)

734,955. ELECTRIC IGNITION GENERATOR; Benjamin P. Remy, Anderson, Ind. App. filed July 5, 1902. Current is generated by means of an oscillatory inductor moving within a stationary armature.

734,967. ELECTRIC BURGLAR ALARM; Solomon Schwarzschild, Rochester, N. Y. App. filed Feb. 20, 1902. The alarm circuit closer closes the local telephone circuit in the same manner that the lifting of the receiver from the hook operates; central office then getting no answer reports the occurrence to police headquarters.

734,969. FUSE BLOCK OR CUT OUT FOR ELECTRIC CIRCUITS; Lewis C. Scrymser, New York, N. Y. App. filed Oct. 4, 1902. A porcelain base having a number of parallel grooves each containing a fuse; the fuses are all connected together at one end and at the opposite end a plate carrying thumb screws is arranged so that any screw can be worked inward to contact with its respective fuse and throw it into circuit.

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ELECTRICAL WORLD AND ENGINEER.

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Electricity in the Navy.

The introduction of the electric light in United States naval vessels dates from 1883, when a 150-light Edison dynamo was installed aboard the *Trenton*. Two years later a 100-light plant was placed in the *Omaha*, and as an indication of the progress during the following eighteen years, it is interesting to note that the horse-power of the electrical plant on the latest type of battleship is just equal to the maximum power developed by the propelling machinery of the *Omaha*. The ratio of electrical to propelling horse-power has since 1883 increased from less than ½ of 1 per cent. to 6 per cent. in the *Connecticut* class. Of late years the most interesting development in naval electrical engineering has been the growing use of electric motors. As will be seen in the article appearing elsewhere describing the electrical equipment of the *Connecticut* class, 192 motors for 21 different classes of service are installed, not including 59 fan motors ranging from 1/12 to ¼ horse-power. Every part of the electrical equipment for these vessels appears to be well selected and skillfully applied, with perhaps the exception of the engine and helm telegraphs, which are decidedly crude in design, though possibly satisfactory in service.

In view of the fact that in the design of a war vessel every ton of weight and every cubic foot of space subtracted from the propelling equipment, armament and armor, entails a sacrifice of fighting qualities, the advisability of a duplicate electrical generating equipment seems questionable. By one of those strange perversions occasionally found in military organization, electrical engineering in the navy does not come under one of the two naval engineering departments—those of Steam Engineering and Construction—but under a Bureau having otherwise no cognizance of matters bearing any relation to engineering. As a consequence of this bureaucratic situation, the electrical generating plant aboard ship is installed in compartments separate from those assigned to the main propelling machinery, and forms a department in charge of a separate staff. We venture to say that if the proposed plan of consolidating under one bureau everything relating to engineering is carried out, a place for the electrical generating plant will readily be found in the main machinery compartments, thus rendering available for other purposes the valuable space now occupied in two different portions of a vessel. If installed with the main machinery, the electrical generating plant could well be allowed to take its chances with the propelling machinery with respect to danger of disablement in battle, thus obviating complete duplicate plants and consequent sacrifice of weight and space.

As pointed out in the article here referred to, there is still further opportunity for the advantageous application of electric motors aboard warships. For example, there appears to be no reason whatever for holding to the steam engine for the operation of ash and anchor hoists and for steering. On the other hand, it is still a question whether it would be wise to substitute the electric motor for the steam engine for driving forced-draft fans and the main engine pumps. The former are rarely used and require considerable power, the demand for which in action would come when the maximum load was on the generating plant, thus involving a further increase in the size of the generating plant. The same would follow the substitution of electricity for steam for operating the main engine pumps; moreover, these latter are so near the steam supply that one of the greatest advantages of the use of electric motors does not apply, while the danger of interruption of service would be increased by the interposition of the additional stages between the source and point of application of the power.

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THE LIGHT AND POWER INDUSTRY.

Statistics from the United States Census Office were published in these pages last week giving a number of interesting details about the central station industry in the United States. A total of just over $500,000,000 was shown for the investment, with a yield of about 6 per cent for the private companies, 2,804 in number. These figures follow closely upon those for street railways, for which 987 companies returned data, with a total "investment" of $2,308,000,000, or nearly five times the capital obligations of the lighting industry. It is, however, to be borne in mind that in street railway work there are no isolated plants; and thus far there are no municipal plants to bother about. Including isolated plants, the electric lighting industry in America is probably somewhere around the billion dollar mark, or to be more explicit, reaches $1,000,000,000. But even that figure is more than doubled by the trolley development, evidencing how heavy is the capitalization necessary for hauling all the people all the time. This larger capitalization hardly goes, however, into power plant, as the horse-power dynamo capacity for lighting is 1,015,480 horse-power, while that for street railway work is 1,204,238 horse-power. In other words, track and rolling stock would appear to represent a very large part of the difference between the two capital accounts.

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THE EARTH AS A CONDENSER.

In the Digest appears this week an abstract discussing the rôle of the earth in wireless telegraphy, in which two interesting points are brought into prominence. One of these is the small electrical capacity of the earth, and, therefore, the improbability of its playing any part, as has been suggested, in the transmission of large quantities of electrical energy by utilizing it as an element in a resonant circuit. The author calculates a special case, assuming conditions that might be approximated in practice—though a vertical conductor extending 2,700 yards in the air is scarcely a practical assumption; with resonance established, the maximum current rush would then not exceed 15 amperes, and the total flow of current would be only .0009 coulomb. An important conclusion of the investigation is, however, that in wireless telegraphy the capacity of the earth may be utilized to great advantage. If the premises of the author are correct, the conditions of resonance can be satisfactorily met without great difficulty by proper design of apparatus, in which case sending signals half around the earth could be as readily accomplished as sending them over short distances. In the past ideas relating to the earth as an electrical factor have been extremely vague, and not infrequently it has been assigned electrical properties solely to bolster up a personal speculation or to conceal limitation of knowledge. In resonance the earth can only enter as a capacity, and this determined, the limit of its rôle in any given case is subject to definite calculation. The line of study indicated is one which we hope will be continued by others.

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ELECTRIC CONDUCTIVITY OF SELENIUM.

An interesting communication has recently been presented by M. Van Aubel to the French Academy of Sciences on the change in the electric conductivity of selenium effected in the presence of bodies treated with ozone. It is now more than twenty years since the discovery was made that selenium altered its resistance when exposed to ordinary daylight. Selenium enjoys a relatively high but fairly steady resistivity. An attempt was made to produce high-resistance prisms of selenium for industrial purposes as compact standard resistances. These were placed in a closed box after the fashion of ordinary wire resistance coils. It was discovered that when the lid of the box was withdrawn, so as to admit of adjusting the connections, the resistance of the selenium underwent marked change, and that the original resistance became practically restored after closing the box. In the present instance it appears that caoutchouc which had been subjected to a current of dry ozone for twelve minutes acted towards selenium like a feeble illuminant. When exposed to the ozonized caoutchouc the selenium resistance fell seven per cent. in fifteen minutes, and the original resistance was restored after the radiation from the caoutchouc was intercepted. A few years ago the world remained in blissful unconsciousness of the existence of radiations other than those of heat and light. Now the difficulty is to find a location which is not constantly permeated by all kinds of radiations and undulations other than those of ordinary light.

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COHERERS AND ANTICOHERERS.

A long paper by M. Hurmuzescu has recently appeared in *L'Eclairage Electrique*, in which the author reviews the history of this subject and describes experiments of his own made to elucidate some of its intricacies. When coherers are studied superficially, and in their simplest forms, their theory of action seems readily apparent. But when studied more deeply, and with a full regard to all the phenomena presented, the theory becomes very complex. In the last analysis the theory must include chemical, thermal, electrical and molecular forces. When two conducting surfaces are brought into such a degree of proximity as corresponds to the conception of a light contact, there is known to be a surface layer of gas between them, such as air, in a specially condensed form. The electrical resistance of this gaseous or liquid layer of non-conducting material is necessarily very large. Any cause which will expel this layer and bring the two surfaces into closer contact, will reduce this contact resistance. When the active cause is vibratory pressure, the arrangement becomes a microphone. When the active cause is electrostatic attraction or electrostatic puncture, the arrangement becomes a coherer.

It is a remarkable fact that essentially the same apparatus which produced the marvellously sensitive microphone transmitter for revealing the presence of sound-waves in the atmosphere, should also produce the delicate coherer for revealing the presence of etherwaves in the atmosphere. The nature of the action taking place in coherers is the subject of a number of rival theories. The purely electrostatic theory, as suggested by Lodge, contemplates electrostatic attraction between the ions in the adjacent opposing surfaces, whereby the electric difference of potential between the terminals of the coherer is enabled to draw the outlying pickets of the two surfaces more closely together, and effect a diffusion of the matter of one into that of the other. Another theory is that the electric potential-difference between the opposing contact-surfaces produces a disruptive discharge of molecular dimensions through the gaseous intervening layer, and that this discharge effects a minute weld with improved conduction. Yet another theory contemplates a change in surface tension over the opposed surfaces consequent upon electrification, and a partial expulsion of the gaseous layer in consequence, thereby reducing the surface resistance. It is quite possible that all of these conditions may occur simultaneously and that the reduction in resistance may, therefore, be attributable to the combined action of several causes.

The ordinary phenomena of the coherer contemplate only the original condition of non-conduction and the sudden change to conduction, under the influence of applied potential-difference. This is the case of the coherer that requires to be tapped or agitated in order to restore the original condition of non-conduction. The phenomena of the self-restoring coherer, or of the coherer that supplies its own internal agitation after the conduction has occurred, are more complex. They are presented only in special combinations of electrode-metals, such as carbon with carbon, carbon with another metal, or iron with mercury, etc. The fact that auto-decoherence is a property restricted to particular chemical associations, suggests the hypothesis that the restoring action is a secondary effect of the current which passes during the moment of coherence. The current seems to trip a molecular circuit-breaking mechanism, which destroys the contact effected electrostatically. It is suggested that oxidation accompanying minute sparking might account for the property. The oxidation might inject a thin film of oxide between the surfaces, as a substitute for the original atmospheric layer.

The property of auto-decoherence is apparently allied to the property of anti-coherence, in which the resistance of a contact, originally low, suddenly increases as soon as an electric impulse or discharge crosses the contact. Any satisfactory theory of auto-decoherence might, therefore, be expected to furnish a theory for the action of an anti-coherer. Nevertheless, it is quite possible that the principle of some particular anti-coherer might be quite different from the principle of some particular coherer in the action of automatic restoration. Finally, in the automatic restoration of an anti-coherer from the high-resistance to the low-resistance condition, entirely different causes must be invoked, such as absorption. Thus, if a layer of oxide injected between the surfaces on the passage of the discharge should be the cause of increase of resistance in an anti-coherer, any chemical action which rapidly and automatically reduced or removed this oxide would account for the automatic coherence, or restoration to the original condition. A wide field for useful research lies in the further analysis of the complex physical, chemical and electrical actions manifested in coherers and in anti-coherers.

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MODERN ILLUMINANTS.

The properties of recent illuminants form the subject of two articles abstracted in this week's Digest. One of the papers in question deals exclusively with the Nernst lamp, which the author subjected to an exhaustive spectro-photometric study with the purpose of settling definitely the quality of the light under various conditions. The results, while not differing widely from those previously reported, are in some particulars rather striking. It was found that integrating all the radiation by means of the spectro-photometer, the actual color of the light from the Nernst lamp at rated normal current strength is very closely similar to that of the Hefner standard. At subnormal current strength the former is more reddish than the latter, but at currents above normal becomes whiter, rapidly approaching the color of the acetylene flame. This result appears at first sight most curious, since to the eye the Hefner standard is decidedly reddish, while the Nernst glower appears almost white. There is no going back of the returns to be allowed, however, and the changed appearance of the two lights to the eye must be set down to the sensory imperfections of that useful but erratic organ. The cause is doubtless the extreme difference in absolute brilliancy between the Hefner light and the Nernst, the strong red component of the latter being, as it were, drowned out by the intensity of the other components and their more active stimulation of the retina. In the step-by-step comparison with the spectro-photometer this effect disappears. It is a good example of the unusual and annoying difficulties that turn up in photometry. Another interesting fact brought out by the experiments was the absence of any noticeable selective radiation in the glower, contrary to the general impression regarding it.

The second note deals with the general view of some modern illuminants from the standpoint of current British practice. An interesting fact here brought out regarding the Nernst lamp is that it has been extensively used in Buckingham Palace for the last year and has there effected a saving in current of about 50 per cent. The Nernst lamp is generally credited with materially higher efficiency than the ordinary incandescent, but a difference of 50 per cent. would argue either poor incandescents to start with, a more efficient Nernst lamp than is found in American practice, or skill in the plan of the substitution of the one for the other. It is not an easy thing to compare the relative current taken by two lights used in succession to illuminate the same space, and figures obtained in this way are somewhat unconvincing. The author then considers the mercury arc, which he believes has a great future before it. This may be so, but some method of avoiding the color difficulty must first be found. Mercury arcs worked at unusually high intensity are to the eye less offensive than others on just the same principle noted with respect to the comparison between Hefner and Nernst lamps, but no amount of increased brilliancy will put into the mercury spectrum rays that are not there. In spite of the color question, however, the mercury arc may find a very considerable application where cheap light is the first consideration. The low-ampere, high-voltage enclosed arc is nearly or quite as offensive in color as the mercury arc, yet it has come into large commercial use, and that, too, in places where one would expect some sort of care in the quality of the illumination. Out of doors in certain classes of street lighting especially there seems no good reason why the mercury arc should not be freely used, at least so far as its color is concerned.

In spite of the work which has been done on the Nernst lamp, it has thus far made slow progress in American practice. The mercury arc is in a frankly experimental stage from which it may be expected to emerge albeit perhaps somewhat slowly. Meanwhile work on vacuum tube lighting proper goes on slowly and with somewhat indecisive results. Another promising line of investigation, on arcs between pencils in which carbon enters in part or not at all, is being vigorously pursued, but still with the promised land just a few days' march ahead. After all the research of the last five years or so, the incandescent lamp holds the field against all comers in spite of its manifest limitations. The enclosed arc has pushed its way into extensive use in this country, but is little used elsewhere on account of the large energy consumption of the device as a whole. American requirements demand the saving of labor as of prime importance, and no device that increases this item can make its way except by overcoming extreme inertia. The added labor in cleaning and renewals is one of the factors that tends against the Nernst lamp as against the incandescent. The mercury arc ought to be helped by this consideration unless the renewals should prove to be heavy. Technically the situation is extremely interesting, with four or five forms of high-efficiency lamps far advanced in the experimental stage and already beginning to find place in commercial practice. Eventually a device which is technically good is bound to make its way in the world, but sometimes very slowly against the pressure of competition. In the present instance it may be regarded as certain that some of the newer illuminants will come into considerable use, but which it would be rash to predict. No one of them seems to have, however, the elements of success to the point of revolutionizing the general art of illumination.

Terrible Disaster on Paris Underground Road.

A very serious disaster occurred on the Paris underground electric road on August 10, by which, according to the official estimate, 100 persons lost their lives, 84 bodies having already been found. The causes of the accident are engaging the attention of the officials. Several versions of the disaster have been reported, but the main facts which have been cabled are the following: "Train No. 43, which caused the accident, came from Porte Dauphine, at the entrance to the Bois de Boulogne, in the western part of Paris, and, passing under the Place de l'Etoile, where the Arc de Triomphe stands at the crest of the Champs Elysees, circled the northerly quarter of the city. In this northern quarter—a manufacturing section—the train picked up numbers of workmen, who, after their day's work, were returning to their homes in the populous eastern arrondisements of the city. On reaching the neighborhood of the Cemetery of Père La Chaise, the motor failed to act properly, and the train waited at the station of Les Charonnes until the arrival of a second train, which pushed the crippled train forward, making a total of sixteen coaches.

"After proceeding about 200 yards towards Menilmontant station, the damaged motor set fire to the engine of the first train. The fire burned fiercely, raising quantities of smoke. Simultaneously the electric lights on the trains went out, leaving the passengers in total darkness, except for the light of the burning engine far ahead. This impeded the progress of the trains toward Menilmontant.

"The terror-stricken passengers got out and tried to grope their way back to Les Charonnes. The current which continued in the rails is believed to have stunned or killed many. A number of the passengers managed to reach Les Charonnes station, but the main body of the passengers was overcome by the heat and smoke. A terrible panic occurred among those behind, and the horror of the situation was increased by a third train crashing into the fiery mass, and adding another crowd of panic-stricken passengers to those seeking an outlet. Owing to the dense suffocating smoke, few passengers escaped, and it was some hours before rescuers could penetrate into the tunnel."

It is believed that the conditions in New York, with fire-proof cars in the subway will not allow such an accident to occur there. In London elaborate precautions have been taken to minimize the danger in the tube system. A cable dispatch from Berlin of August 11 says: "The tunnel disaster on the Paris Metropolitan Railroad has caused the management of Berlin's new electric road, which is partly underground, to make a speedy investigation into whether a similar accident was possible here. Experts, after carefully examining to-day the cars, motors and the three underground stations, concluded that no danger exists, and that it is unnecessary to change the construction of the cars."

The Curability of Cancer.

Considerable attention is being paid in this country to the treatment of cancer by the Röntgen ray and much hope has been entertained as to some of the results. Work has also been going on in Europe, and some results are now reported from England by cable. One report was made on August 7 by eminent bacteriologists, who have been engaged entirely in the last six months in research work at the laboratory of the Royal College of Surgeons, under the auspices of the cancer research fund. Drs. Murray and Bashford, who were among those appointed investigators, declare that nothing is being neglected by the committee, and consequently much research has taken place with respect to incipient cancer in lower animals, yet the causes of cancer in these animals are often of an entirely different nature from those in man. The parasitic conditions are different, while the treatment which would be adopted and proves successful in the cases of animals, could never be applied to human beings. The cancer cure, said one of the physicians, will never be discovered by one man. When it is found it will be by the continuous efforts of every one engaged. One little clue leads to another and nobody hides anything or tries to hide anything from his colleagues. Moreover, there is not the slightest intimation in the report presented a week ago to the first annual meeting of the Cancer Research Fund Committee that any definite results from the experiments are imminent.

Prof. Duguet, an eminent Paris physician and professor in the French Academy of Medicine, declares that the experiments hitherto made have revealed nothing on which to base scientific treatment. He says: "We are still groping in the dark with regard to the reported cures by the X-rays. My long experience in the largest hospitals in Paris has made me most sceptical. Believe me, these 'cures' are not definite." The Middlesex Hospital in London is the pioneer in cancer research in Great Britain. It receives suggestions of cures from all parts of the world weekly. Many are fairly tried, but hitherto without success. The Middlesex Hospital doctors authorize the positive statement that, while they do not assert that they have effected anything like a cure by means of the X-rays and Finsen light treatments, yet the pain has been minimized.

Results of the International Telegraph Conference.

The German Chamber of Commerce has received the following notice from the German Post Office Department:

The International Telegraph Conference in London has resolved to abstain from the compulsory introduction of the official vocabulary for cipher telegrams, issued by the Berne International Bureau of telegraph administrations. Instead of such a limitation, a considerable increase in the number of words permissible for cipher telegrams has been approved. According to the resolutions passed in London (which still require the approval of the various governments and presumably will not go into effect prior to July 1st, 1904), there may be used besides those heretofore permissible all such words, no matter whether actual or artificially constructed, as are so constituted that their syllables may be pronounced in the German, English, Spanish, French, Dutch, Italian, Portuguese or Latin languages. Cipher words may contain, as heretofore, up to ten letters, according to the Morse alphabet.

This provision embraces the entire vocabulary issued by the International Bureau of Telegraph Administrations at Berne, and all word constructions whose syllables show such a change of vowels and consonants as to be utterable in accordance with the usage of any of the foregoing languages. On the other hand, such cipher words are prohibited as contain a group of consonants and vowels not enunciable in the languages. In all such words, each five letters would count as a word.

A combination of two or more open words will not be permissible in cipher telegrams.

The object of the resolutions is to render more lenient the rules governing cipher words without encumbering telegraphing by word formations that are apt to prevent the rapid comprehension and transmission of the characters.

Development of High Speed Traction.

A cable dispatch from Berlin, Germany, of August 11 says: "A statement is published here to-day, evidently from information given by Privy Councillor Rathenau, managing director of the Allgemeine Elektricitäts Company, regarding the object of his forthcoming visit to the United States. According to the statement he will conduct negotiations for the delimitation of the spheres of interest of the Allgemeine Elektricitäts Company and the General Electric Company in neutral countries, thus avoiding mutual competition. His visit also has reference to the exchange of experience, designs, patents, etc. Herr Rathenau will examine the situation in the United States, with a view to the utilization there of the experiments which the German electric companies have made during the past two years in electric high-speed traction on the standard-gauge road from Berlin to Zossen."

"The statement intimates that American capitalists are ready to undertake a broad-gauge long-distance electric road with the co-operation of the great Berlin companies, and that the latter are more than ready to place the results of their experiments at the disposal of the American exploiters, since it is considered that such a course would be the quickest way of inducing the government authorities here to undertake the application of the same system on German soil.

"Although the Zossen experiments demonstrated the possibility of 100 miles an hour, the experimenters believe that it will be a long time before the government and the legislators can be persuaded to inaugurate the system of high-speed transit between the chief cities of the empire. The statement concludes: "The sooner the practicability of the German experiments is proved in the United States, the sooner can we expect the introduction of electric high-speed trains in our own country. This would insure a new period of prosperity for the electrical industry."

The Electric Installation on Board U. S. Battleships Connecticut and Louisiana.

By R. M. Klein.

The *Connecticut* and *Louisiana*, the two 16,000-ton battleships now under construction, the former at the New York Navy Yard, the latter at the works of the Newport News Shipbuilding & Dry Dock Company, represent a new type of battleship, greater in displacement than any heretofore designed for our navy and carrying heavier armament than any warship now afloat, either in our navy or abroad.

The main battery consists of four 12-in., eight 8-in. and twelve 7-in. breech-loading rifles. The 12-in. guns are mounted two each in a forward and after turret, the 8-in. guns two in each of four turrets arranged one at each corner of a rectangle, or what is commonly known as quadralateral turrets, the 7-in. guns are each in a separate armored compartment on the gun deck. The secondary battery consists of twenty 3-in. (14-pounder) rapid-fire guns, twelve 3-pounder, seven automatics, and numerous guns of smaller calibre.

The use of electricity aboard modern naval vessels is so extensive that to interrupt the supply during action would mean certain defeat for a vessel were she matched against any vessel which approached her equal. Realizing the importance of the above, these battleships have been designed to carry two complete and independent electric plants each capable of handling the entire load which may be required in action.

The electric applications aboard ship are divided into three distinct classes: (1) Illumination, (2) power for driving auxiliaries, (3) signaling or communication.

The lighting system is installed as two distinct systems, each having separate feeders and mains and known as the "Battle Service" and "Lighting Service." The battle service comprises all lights below the protective deck, including those in engine and fire rooms, magazines, store rooms, and the like; all lights at guns, ammunition hoists, winches, cranes and other auxiliaries whose operation may be required during action; signaling lights, the ship's running lights and only sufficient other lights in passages to afford convenient access to the various portions of the ship. When necessary to install a light in a location which might render it visible by the enemy, a "battle lantern" is used, this lantern being fitted with a sliding screen which allows the light to shine only over an arc of about 90°, and can be entirely screened if required, this feature being identical with that of the ordinary bull's eye or dark lantern.

The battle service will efficiently light all parts of the ship subject to access during action, and all other auxiliaries whose manipulation and operation during action is essential, but at the same time to shield all lights against external visibility.

The lighting service includes all lights not included in the battle service, such as lights in state rooms, offices, mess rooms, crews' spaces, and the like, and also supplies current to the desk and bracket fans in officers' quarters. To efficiently light each of these vessels requires the use of eleven hundred fixtures, of which about 730 are on the battle service, the remainder being on the lighting service.

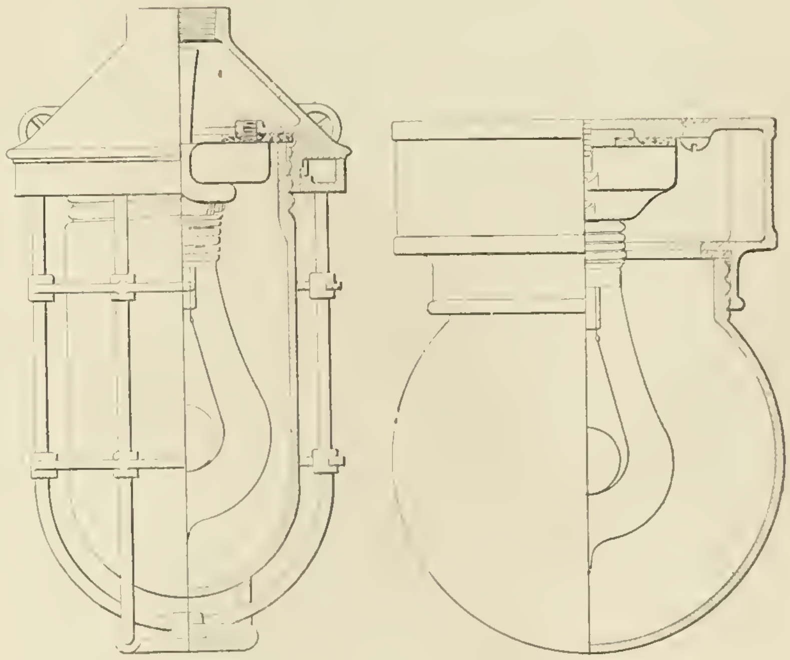
The fixtures used are simple in design and neat in appearance, the types most used being the steam tight globe (Fig. 1) and the ceiling fixture (Fig. 2). These consist of a casting which has a boss into which the conduit carrying the wires taps, and a knuckle thread into which the glass globe screws, the lamp socket being secured to the casting by machine screws, a rubber gasket intervening. The steam-tight globe is protected by a stout metal guard, as shown in the illustration. This type of fixture is made in three types, differing only in the method of support: that shown in Fig. 1 is the bulkhead type and is secured by a bracket cast in one with the conical-cap, the other types being the drop type, which is supported by the conduit alone, and the deck type, in which the conduit enters the fixture from the side instead of the top, the fixture being supported by a bracket cast across the top of the conical cap.

The ceiling fixture is used in passages around the officers' quarters, in reception cabins, mess rooms, and the like, and is the standard overhead light for all locations, in which the fixture is not liable to injury. The steam-tight globe is used in engine and fire rooms, ammunition passages, store rooms and is the standard fixed light for all locations where the fixture is subject to injury.

Six 30-in. hand-control projectors, or searchlights, will be installed. These will be located, one on a platform at the base of the fore topmast, two on the flying bridge, one on a platform at the base of the main topmast, and two on a platform on the mainmast well above the after bridges. Each projector will be equipped with a horizontal lamp designed for both hand and automatic feed. Specifications require each projector to project a beam of light of sufficient intensity to render plainly discernible on a clear dark night a light-colored object 10 x 20 ft. in size, at a distance of not less than 6,000 yards. Each light will operate on a 125-volt circuit in series with a regulating rheostat, and require a current of about 80 amp. with 60 volts across the arc.

Motors will be used for the following purposes: (*a*) To drive ventilating fans and blowers, (*b*) carrying ammunition from magazines to hoists, (*c*) hoisting ammunition, (*d*) turning turrets, (*e*) elevating and depressing guns, (*f*) ramming shells into the breech of guns, (*g*) to operate deck winches, (*h*) to operate boat cranes, (*j*) to whip ammunition from the main deck to the bridge and military tops, (*k*) for laundry machinery, (*l*) for driving tools in machine shop, (*m*) for operating automatic power doors, (*n*) for operating fresh water pumps and sanitary pumps.

The ventilating system comprises thirty-three fixed fans, varying in size from those requiring a fraction of a horse-power each for their operation, to 80-in. steel plate fans requiring 11 horse-power each. Each of the above fans will be driven by its own independent shunt-wound electric motor, direct-connected, the control panel containing the usual starting resistance fitted with automatic overload and no voltage release. All fans are designed to deliver their specified amount of air at a pressure of 1 oz. when running at normal speed, but are capable of being driven at about double normal speed, in which case the air is delivered at a pressure of 1½ oz. The speed control is effected by varying the resistance except for the smaller fans, in which case resistance in series with the armature will control the speed.



FIGS. 1 AND 2.—BATTLESHIP FIXTURES.

In addition to the above, each ship will be supplied with six small portable electric fans, each consisting of a ¼-hp series motor mounted on a common shaft with an exhauster which it drives at a speed of about 2,200 r.p.m., causing a delivery of about 500 cu. ft. of air per minute (free exhaust). These sets are very compact, the overall dimensions being about 18 x 18 x 12, and weigh approximately 100 pounds. They are used for temporary ventilation when necessary to work in such localities as are not reached by the main ventilating system, such as double bottoms, inside of boilers and the like. Each of these sets is supplied with two 25-ft. lengths of canvas hose with couplings permitting of attachment to inlet and outlet of exhauster or to attach together, forming a 50-ft. length, which can be connected to either the inlet or the outlet of the exhauster.

The officers' quarters, wardrooms and the like are liberally fitted with desk and bracket fans, the former being 12 in. in diameter, rated at 1/12 hp, the latter 16 in. in diameter rated at ⅙ hp. Forty-five of the former and eight of the latter will be installed on each vessel.

At a comparatively recent date a ship's ventilating system consisted of a few large-sized blowers, generally located in pairs with large main ducts having many turns, bends and with branches leading to the various compartments. This system required an excess in air pressure at the fan in order to maintain a certain head at the discharge outlet, owing to the loss by friction of the pipes and to the indirect leads of the main ducts. Many of the principal water tight bulkheads were pierced by the ducts and this necessitated the use of valves so installed as to be of convenient operation, which could be closed in an emergency to maintain the water tightness of the various compartments below the water line. All leads through the protective deck required armored bars or gratings in the openings.

The ventilating systems of the *Connecticut* and *Louisiana* are so designed as to minimize the number of leads through the protective deck, and in no instance is any one of the principal water tight bulkheads pierced by a ventilating duct. The flexibility of this system employing a number of small units as compared with a few large ones, possesses many advantages which are at once apparent, and the installation of such a system is only rendered possible by the use of the electric drive.

Conveyor motors are used for carrying ammunition from the magazines, along the passages to the base of the ammunition hoists. Four conveyors will be installed, two leading aft from the forward magazines, one on the port side and one on the starboard side, and two leading forward from the after magazines, one port and one starboard. Each conveyor will be about 80 ft. long and will consist of two endless sprocket chains with metal aprons and stiffeners at suitable intervals. Motors, one to each conveyor, will be shunt wound, reversible, of about five hp, and will drive through gearing.

Twenty six endless chain ammunition hoists, each driven by a 3 hp motor, will deliver the ammunition from the lower passage to the 7-in. guns and secondary battery. These are in addition to the ammunition hoists for the turret guns. All the main battery guns will be supplied by hoists leading direct from the lower passages, but certain guns of the secondary battery are so located as to require the ammunition being hoisted first to the berth deck, then carried along to other hoists and raised to the upper deck at the gun locations.

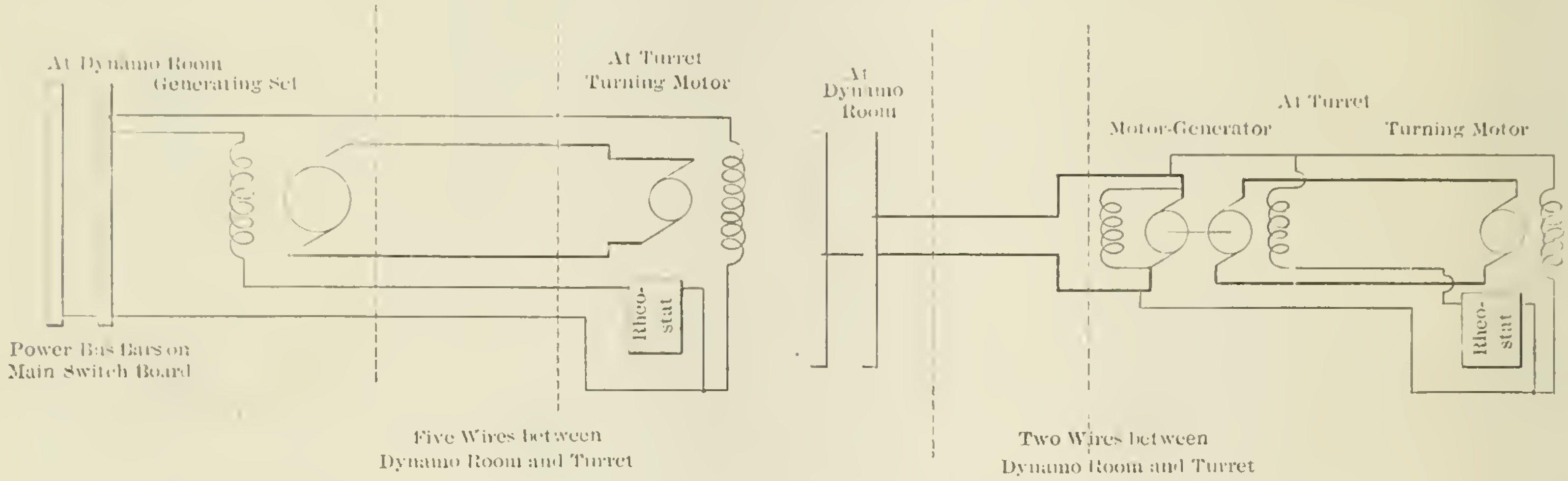
The new arrangement of the main broadside battery, wherein by means of a center line armor bulkhead on the gun deck and suitably located transverse armored bulkheads, each of the twelve 7-in. guns is located in a separate armored compartment, renders imperative a separate ammunition supply for each gun. On former vessels the main broadside battery was installed in a more or less open compartment, which would render possible the supplying of ammunition to more than one gun from the same hoist. The new arrangement in which a gun would be temporarily rendered *hors de combat* by a failure of its individual ammunition hoist adds to the importance of this electrical application and the reliance which must be placed in the electric motor and in the ability of the ship's plant to furnish the necessary power under any and all conditions.

Each ammunition hoist motor will be shunt wound, reversible, enclosed, dust and moisture tight, with suitable openings (fitted with water-tight covers) to allow inspection and adjustment to brush rigging and the like. Motors will be geared to the ammunition hoist sprockets, each armature shaft being fitted with a solenoid brake, which will set automatically and prevent turning of the armature in case of failure of the line voltage.

Each of the six turrets with its respective pair of guns will be equipped for electrical rotation. This will be done by fitting each turret with two motors of equal capacity, either one of which will be capable of operating the turret in case of failure on the part of the other, although normally they will both operate in parallel. For the 12-in. turrets two motors of not less than 25 hp will be installed in each, and for the 8-in. turrets, two motors of not less than 15 hp will be installed in each. As in previous battleships, the Ward Leonard system of control will be used, but a modification of former naval practice will be introduced for the operation of these auxiliaries which renders possible a material reduction in the capacity and number of generating units in the ship's electric plant.

Reference to Fig. 3 will show the method of applying the Ward Leonard system of control to turret turning, as installed on many ships of our navy, and which up to the present time has been standard practice for this electrical application.

A separate generating set is required especially for each turret, it being further necessary to render the generator a shunt machine and separately excite its field before it is available for turret turning. The generator terminals are led direct to the turning motor, terminals, the field of the generator being led through a variable resistance, the latter being controlled by the turret operator. It will be readily seen that the motor, having a separately excited field, will run at a speed proportional to the impressed armature voltage, the latter being dependent on the field current of the generating set, which is controlled by the turret operator; and furthermore, the motor speed will be definite for any fixed position of the controller handle, and that speed will be maintained against any and all variations of load, due to friction, listing of the ship, the impact of a shell, up to the point where a fuse blows or a circuit-breaker is thrown.



Figs. 3 and 4.—Circuits of Turret Motors.

While the above adaption of the Ward Leonard principle attains the desired result, viz.: a precise, definite and, if required, constant speed of rotation of the turret, it is only acquired at the expense of a large number of units in the generating plant and a certain amount of complication on the switchboard and in the ship's wiring. These drawbacks grow more marked as the number of turrets in the ship increases. On ships of the *Virginia* class, each of which has four turrets, the electric plants consist of two 100-kw and 50-kw generating sets. Of these, five 50-kw sets (four in operation and one in reserve) must necessarily be assigned to the turret turning system. Not only a large number of sets must be used, but a total of 250 kw of the plant is used up in the turret-turning system, whereas not over 65 kw will be consumed in operating the turrets, considering all of them in operation at full load at the same time, the latter supposition being most highly improbable. Smaller units than 50 kw could not be installed, as the system of interchangeability prevalent in naval installations would be marred by the inability of the small units to handle either the lighting or the searchlight load of the ship, should emergency so require.

The *Connecticut* and *Louisiana*, each with six turrets, would require a rather cumbersome electric plant if equipped on the above outlined scheme. Instead, a motor-generator designed for comparatively high speed and consequently compact and not over heavy will be installed in the barbette of each turret. The motor end will be connected direct to the main power bus-bars of the main switchboard, the connections between the generator end and the turning motors being identical with those used in the former scheme, embracing individual generating sets. This latter scheme not only allows the operation of all the turrets on one generator or set of generators in parallel, but presents the advantage of subtracting from the reserve power of the plant only such energy as is actually consumed in turning the turrets. This scheme is shown diagrammatically in Fig. 4.

It is estimated that under the severest service conditions the combined power used in turning the turrets will not exceed 60 kw. Furthermore, in the individual generating set scheme (Fig. 3), although the operation of a turret at a variable speed would call for a variable amount of power to be supplied from the dynamo room, the current flowing in the circuit would be practically constant for all speeds of rotation, as in this system the voltage is the variable function in the power equation. This requires the circuit between the dynamo and turret-turning motors to be designed (considering heating of conductor) on a basis of carrying full load current throughout the time of operation of turret. In the latest scheme, that involving motor generators, although the generator end of the appliance is furnishing about full load current at variable voltage for the several stages of the turret operation, the motor end is drawing from the line a variable current at constant voltage; consequently the lead between motor generator and dynamo room needs only to be designed (considering heating of conductor) for about half the current carrying capacity of that necessitated by the first proposition.

As the motor generators are located practically adjacent to the turning motors, it will be seen that the lead between turret-turning motors and generating set in scheme 1, is nearly identical in length with lead between motor generator and dynamo room in scheme 2; keeping this in mind, the former paragraph clearly illustrates economy in transmission as well as economy in cost of apparatus, reserve power and weight.

The 7-in. guns of the main battery and all secondary battery guns are trained solely by hand power. Each turret gun, however, is mounted on trunnions and elevated or depressed to the proper angle by means of an electric motor. As the guns are balanced on the trunnions the elevating or gun training motors merely have to overcome the friction load; or in case a shell is inserted in the breech of the gun prior to the elevation of the gun to the proper angle, the training motor is subjected to a load in excess of the friction load if depressing the muzzle, and a load smaller than the friction load if elevating the muzzle. Each 12-in. gun will be equipped with a 5-hp gun-elevating motor, and each 8-in. gun with a 2.5 hp gun-elevating motor. These motors will be shunt wound, reversible, enclosed, waterproof, with the usual hand holes for inspection. Rheostatic control will be used.

For ramming the shells into the breech of the 12-in. and 8-in. guns, a "rammer motor" is installed, one for each gun. These motors are series wound and subject to loads which are largely in one direction. They operate the rammer through a friction drive so adjusted that in case the shell is set home before the motor is stopped, the clutch will slip before the motor draws sufficient current to throw the circuit-breaker. Each 12-in. gun will be equipped with a 7-hp rammer motor and each 8-in. gun with a 5-hp rammer motor.

Each turret gun has its individual ammunition hoist, which works on the principle of cables or hoisting ropes winding on and off a drum which is actuated by an electric motor. The motors will be operated through a controller with a single handle which will allow sudden reversal; the carrying of the load in either direction; the automatic locking of the drum against rotation in either direction, when the current supply is cut off, and the operation of the motor when under any load on each of five speeds. For the 12-in. guns the motors must handle a load of about 3,200 pounds, and will be of about 30 hp each. For the 8-in. guns the motors must handle a load of about 1,000 pounds, and will be about 8-hp each.

Each ship will be fitted with six double-headed winches, two forward on the main deck, two on the upper deck in the waist of the ship and two well aft on the quarter deck. These winches will be used in coaling ship, handling anchors and in stowing cargo. Each winch will be operated by a 25-hp motor. These motors will be series wound, reversible, enclosed, water tight and designed to withstand strains due to increase of speed on sudden removal of the load. The two forward main deck winches must each be capable of hoisting a 2,200-pound load at a speed of 300 ft. per minute, and the same load at a speed of 30 ft. per minute; the two upper deck winches to hoist 2,200 pounds load at a speed of 300 ft. per minute, the quarter deck winches to hoist a 2,200-pound load at 300 ft. per minute, and a 13,200-pound load at 50 ft. per minute. Specifications allow an option between gearing and electric devices for obtaining the necessary speed variations.

Two boat cranes will be used to handle the ship's boats and launches, of which each ship carries a sufficient number to float her entire complement of over 800 men. The cranes will be electrically operated with separate motors for hoisting and for rotating. Crane requirements specify a hoist of 33,000 pounds at a speed of 25 ft. per minute, and a rotation at the rate of one revolution per minute, while carrying the above load and with the ship heeled 10°. Motors will be enclosed, water tight and reversible, the hoisting motor being series wound. Hoisting motors will be about 50 hp each, and rotating motors about 30 hp each. Both motors will be located on a platform which revolves with the crane. The revolution embracing a complete rotation, it will be necessary to lead the electric wires to the crane motors through contact rings and brushes; the former will probably be on the rotating crane, the latter being the terminals of the feeder.

Laundry machinery will be electrically driven by an enclosed motor of about 10 hp. The machinery workshop of each vessel will include a 48-in. extension gap lathe; a 14-in. lathe, a 15-in. stroke column shaper, a vertical drill press, a 16-in. sensitive drill, a universal milling machine, a combined hand punch and shears, an emery grinder with two 12-in. wheels, and a 30-in. grindstone. All the machine tools will be electrically driven, either direct-connected or through shafting and will require from 10 to 15 hp.

All doors leading between boiler rooms, between engine rooms, between boiler and engine rooms, from boiler rooms into bunkers, at the ends of the main ammunition passages and the like, and the main hatches through the protective deck, both fore and aft—in all 42 doors and five armor hatches—will be worked on a power system. Each such door or hatch will be capable of operation on the spot by hand or by power, from either side of the bulkhead or deck, and all must be capable of being closed by power simultaneausly from an emergency station, which will probably be located in the pilot house. If electrically operated doors are used, a 1-hp motor will be installed at each door and hatch, 47 in all. If pneumatic power is used, a motor-driven air compressor will supply the energy. In the latter case the motor will be automatically stopped and started by pneumatic operation of the controller. An indicator at the emergency station will enable the operator to determine whether any door or hatch is open or closed.

Two 2-hp motors driving centrifugal pumps will be used in connection with the fresh water system for circulation between the distiller and the various tanks. Motors will be automatically stopped and started by means of floats operating the controllers. Two 6-hp motors driving centrifugal pumps will be used in connection with the salt water sanitary service or flushing.

Provision will be made for the installation of a wireless telegraph outfit. This outfit will be supplied by the government and installed probably after the vessels are constructed and placed in commission. Pending the selection of the most satisfactory apparatus, in connection with which exhaustive experiments are now being conducted, no definite information on this subject as applied to the case in hand is available. Provision, however, will be made for supporting the aerial wires and sufficient deck space will be reserved for the installation of the apparatus of such system as may be eventually adopted, or as may be installed for experimental purposes.

An extensive application of electrical apparatus will be found in the systems of communication aboard these vessels. About 90 voice pipes will be installed, most of which will be fitted with suitable electric calling devices in the shape of push buttons, bells, buzzers and annunciators.

A liberal disposition of push buttons in the officers' quarters allow the calling of the various pantries, orderlies, messengers and the like, to the various staterooms, cabins, officers and messrooms as required. A telephone system comprising some twenty-five lines, running to a central station, will be installed. In addition several private lines are installed, such as between navigator's stateroom and dynamo rooms, between chief engineer's stateroom and engine room, between surgeon's stateroom and dispensary, and the like.

In the various living spaces of each ship, single-stroke electrically-operated gongs, 12 in. in diameter, are installed. These gongs can be operated all simultaneously, from either the captain's stateroom, pilot house, conning tower or executive officer's stateroom. The circuit closers are automatic in operation and ring the gongs continuously for 30 seconds when set in motion. These signals, known as general alarm gongs, are used for calling the men to quarters.

Located in spaces below the protective deck and at the main hatches leading below this deck, warning signals, or water-tight door alarms are installed. These consist of solenoids operating a plunger in such a manner as to force air through a whistle, which gives forth a shrill sound. These warning signals are all capable of being operated either from the quarter deck or the pilot house. They are used to give the signal for closing all water-tight doors and hatches, which is done when danger from collision or other cause is imminent.

Thermostats are installed in all coal bunkers and magazines and all storerooms containing combustible material. They consist of a helical metal coil having a high temperature coefficient. This coil is mounted with one end free, in such a manner that the torsional effect produced by a slight rise in temperature causes a slight displacement of the free end. This closes an electric circuit, which leads to a drop on an annunciator located under the eye of the captain's orderly. These thermostats are enclosed in a heavy composition case and are sufficiently strong to allow their installation in any portion of a coal bunker. It is customary to install them well down in the bunkers at about the depth which experience dictates is most subject to spontaneous combustion. Coal bunker and storeroom thermostats are set for 200° F., and magazine thermostats for about 100° F. A total of 171 thermostats will be installed on each vessel, of which about 70 will be in coal bunkers and 67 in storerooms, each group being on a separate annunciator.

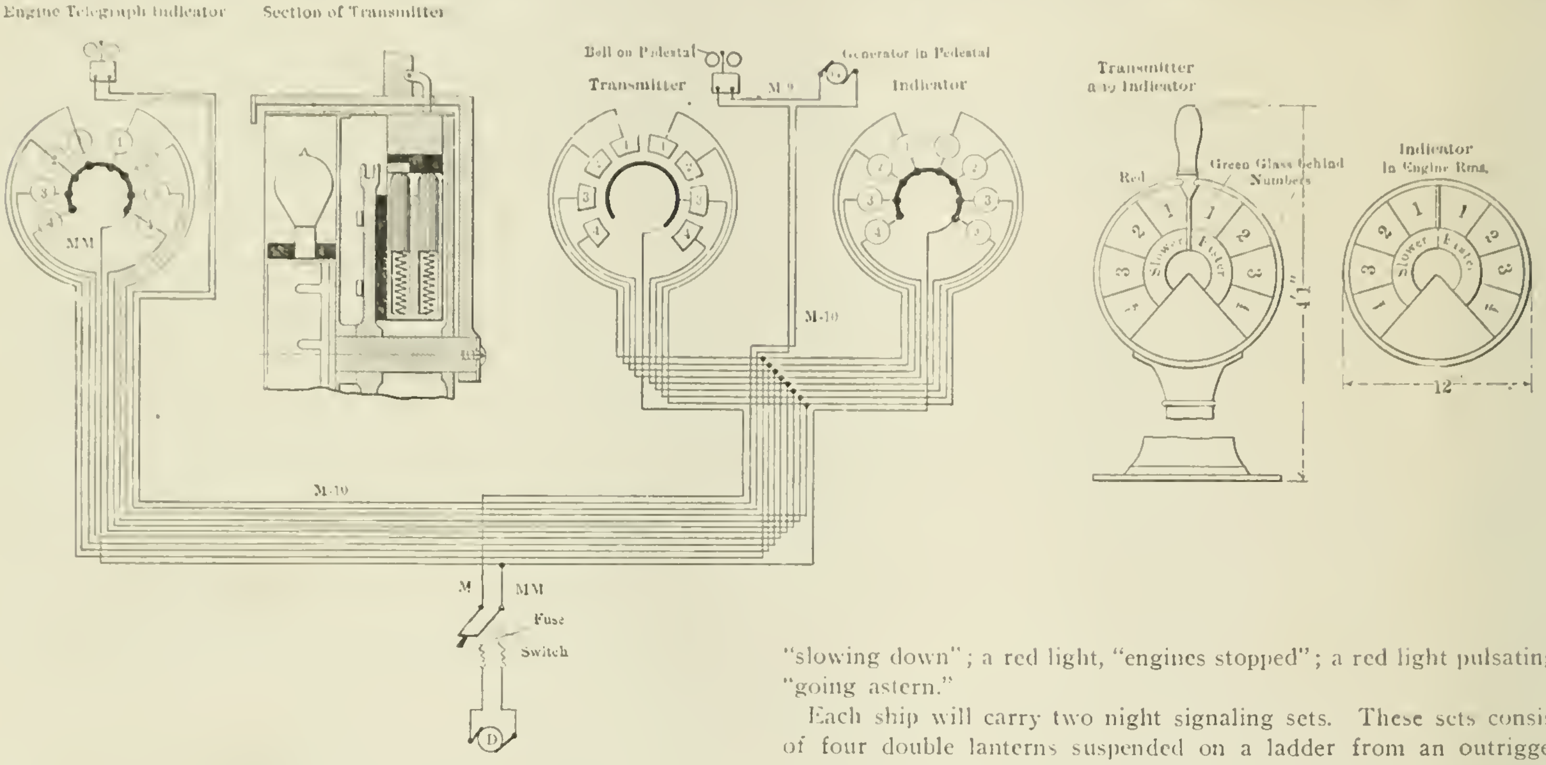


FIG. 5.—ELECTRICAL ENGINE ROOM TELEGRAPH.

Electric revolution indicators will be installed in the pilot house and conning tower for signaling the number of revolutions of each main engine shaft. These indicators will be of the "tick-tack" type, each revolution of the shaft closing the circuit through an electric magnet on the indicators, which in turn draws down its armature and causes a pointer to vibrate through an angle of about 30°. Each indicator has a pointer and magnet for "ahead" and "astern," corresponding to "forward" and "reverse" rotation of the engines.

Electric engine telegraphs located in the pilot house and in the conning tower, with indicators in each engine room, will permit slight variations in speed to be signalled. These instruments are of the "lamp" type, and consist of 5-cp electric lamps arranged in separate compartments, over the face of which are brass templets with the desired order cut through. By illuminating the lamp in any compartment, which is done by closing the circuit at the transmitter, the light shines through the letters or figures on the dial or the brass templet and indicates the desired order. An engine telegraph and indicator with diagram of connections is shown in Fig. 5.

Helm order telegraphs located in the pilot house and conning tower, with indicators at all steering stations, will permit of electrically signalling to the helmsman the desired helm angle. These instruments are similar in construction to the engine telegraphs except that the markings and the number of indications are different.

Electric rudder indicators of the lamp type (Fig. 6) located at all steering stations and connected to a transmitter on the rudder head, will indicate the angle at which the rudder is set and acts as a check in determining if an order transmitted to the helmsman by the helm order telegraph has been carried out.

For each turret ammunition hoist an indicator will be installed which will show the operator in the turret when the ammunition car is loaded and ready for hoisting, and also during the lowering of the car, when it is approaching the lower limit of travel. These indications will consist of lamps in view of the turret operator, which are automatically lighted and extinguished by contacts operated by the passage of the ammunition car.

The top of each mast will be fitted with a double truck light, which consists of two 32 cp lamps mounted one in a red and the other in a white lens. Both truck lights will be controlled by one "double truck light controller" located on the forward bridge. This controller permits the illumination of either light on either truck, which light can be pulsated by means of a pulsator on the side of a controller. These lights are used to signal when cruising in squadron formation. A white light signals "steaming ahead," a pulsating of white light "slowing down"; a red light, "engines stopped"; a red light pulsating, "going astern."

Each ship will carry two night signaling sets. These sets consist of four double lanterns suspended on a ladder from an outrigger near the truck of each mast (Fig. 7). Each lantern consists of two 32-cp lamps mounted in pressed glass Fresnel lenses, one lamp of each double lantern being mounted in a red lens, the others in a white lens. The lanterns will be spaced 12 ft. apart. By means of a suitable keyboard on the bridge, the red or the white light in any or all lanterns or any combination of red and white lights on the four lanterns (only one light on each lantern) can be illuminated. By means of a pre-arranged code of signals, messages can be transmitted to any station within range of visibility of the lights. The use of two night signaling sets, one suspended from the foremast swinging outboard to port, the other from the mainmast swinging outboard to starboard, permits signaling to any station regardless of its bearing to the ship's head; whereas with only one night signaling set the relative location of the ship and the station to which it is desirous of signaling might be such that the mast from which the lanterns are suspended would intercept the path of the light and render the signal indiscernible. The keyboard is mounted on a pedestal and is enclosed in a case with a hinged cover. The apparatus is similar in appearance to a typewriter keyboard, and the depression of a single key displays the desired combination of lights. A cable of 16 conductors running to the lanterns enters the keyboard through a detachable water-tight coupling.

A summation of the electric auxiliaries on each ship with the probable maximum current required by each group, both for "in action" and for "cruising efficiency" is given in the following table. In estimating current required for the various motors, efficiencies varying from 80 per cent. up have been assumed, depending on the size of the motor:

Name of Appliance.	Horse power.	Number in installation.	Number used in action.	Used for cruising.	Amperes: total installation.	Amperes: total used in action.	Amperes: probable used in action.	Ratio: probable to total in action.
Incandescent fixtures	....	1100	800	700	550	400	270	⅔
Arc lamps	....	10	10	10	35	35	35	1
30-inch search lights	....	6	6	2	450	450	300	⅔
Fans, 1-12-H.P.	....	45	....	45	23	....	....	..
Fans, 1-6-H.P.	....	8	....	8	8	....	....	..
Port. vent. sets ¼-H.P. ...	....	6	....	6	18	....	....	..
Interior communications	....	....	....	....	?	....	25	..
Total	....	....	....	....	....	885	630	..
Main vent. blowers	¾ to 10	33	33	33	950	950	630	⅔
Ammunition carriers	4	4	4	....	120	120	120	1
Ammunition hoists, chain..	3	26	26	....	570	570	285	½
Ammunition, turrets, 12" guns	30	4	4	....	800	800	535	⅔
Ammunition, turrets, 8" guns.	8	8	8	....	450	450	300	⅔
Gun elevating motors, 12" guns	5	4	4	....	140	140	70	½
Gun elevating motors, 8" guns	2½	8	8	....	160	160	80	½
Gun rammer motors, 12" guns	7	4	4	....	200	200	*	..
Gun rammer motors, 8" guns	5	8	8	....	280	280	*	..
Turret turning motors, 12" guns	25	4	4	....	670	335	170	½
Turret turning motors, 8" guns	15	8	8	....	840	420	210	½
Smoke blowers	1½	12	12	....	50	50	25	½
Deck winches	25	6	....	6	1000	....	....	..
Boat cranes, hoisting	50	2	....	2	660	....	....	..
Boat cranes, rotating	30	2	....	2	400	....	....	..
Whip hoists	3	6	6	....	130	130	65	½
Laundry motor	10	1	....	1	70	....	....	..
Machine shop motor	10	1	....	1	70	....	....	..
Powder door and hatches ...	1	47	47	....	350	350	120	⅓
Fresh water pumps	2	2	....	2	30	....	....	..
Sanitary pumps	6	2	....	2	80	....	....	..
Total	....	192	176	49	9129	4953	2610	..

* Rammer motors not operative during hoisting of ammunition.

The entire electric equipment of each ship aggregates 9,129 amp., which at the standard voltage of 125 corresponds to 1,141 kw; and the total power required by auxiliaries which are operative in action, corresponds to 885 amp., or 110.6 kw for the lighting and projector load, and 4,955 amp., or 619.4 kw for the power load, making a grand total of 730 kw. As many of the battle auxiliaries are of such a nature as to be subject to intermittent service, the probable maximum battle load is well below this figure, the estimated values being as indicated in the next to the last column, viz.: 630 amp., or 78.8 kw for the lighting and projector load, and 2,610 amp., or 326.2 kw, for the power load, making a grand total of 405 kw.

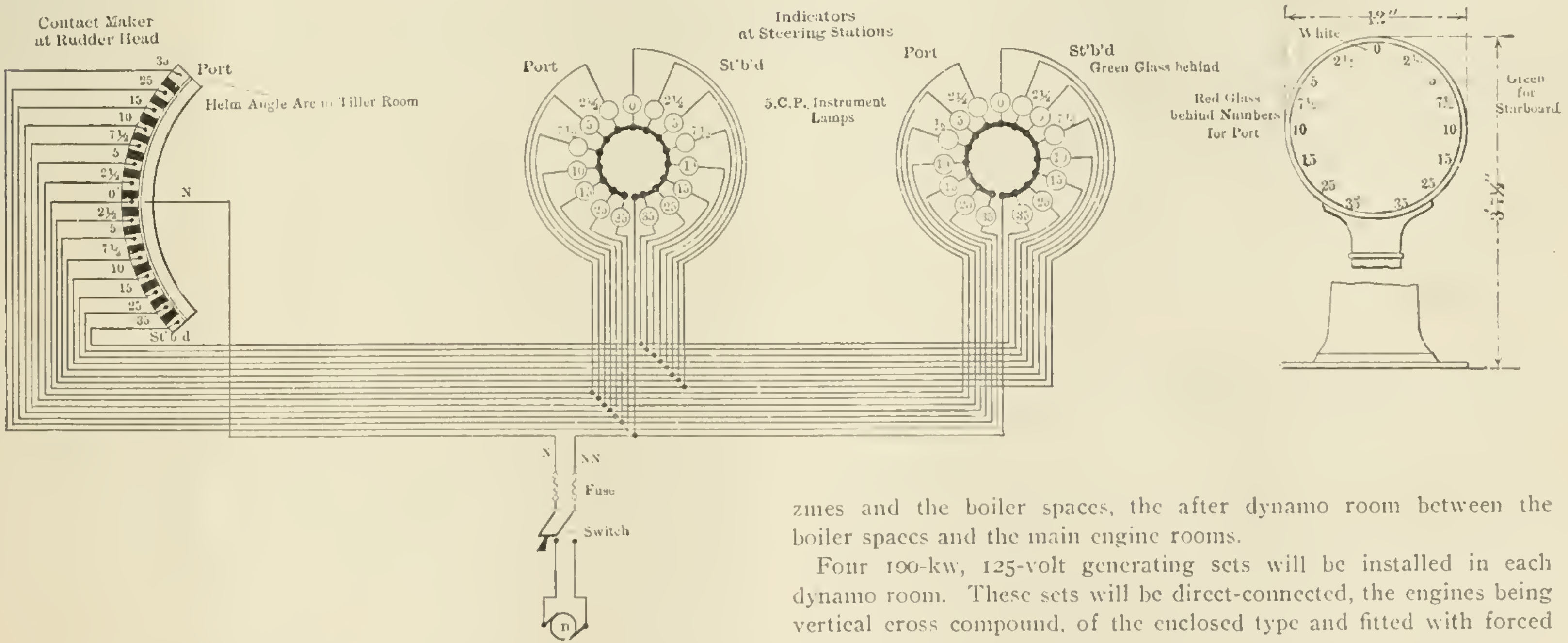


FIG. 6.—HELM ANGLE INDICATOR.

As previously stated, two independent power plants will be installed on each ship, and are designated as the forward dynamo room and the after dynamo room. Both will be located beneath the protective deck on a platform whose level comes between the upper platform and the lower platform, this special platform being necessary to secure sufficient headroom to install the generating sets. The forward dynamo room is located between the forward magazines and the boiler spaces, the after dynamo room between the boiler spaces and the main engine rooms.

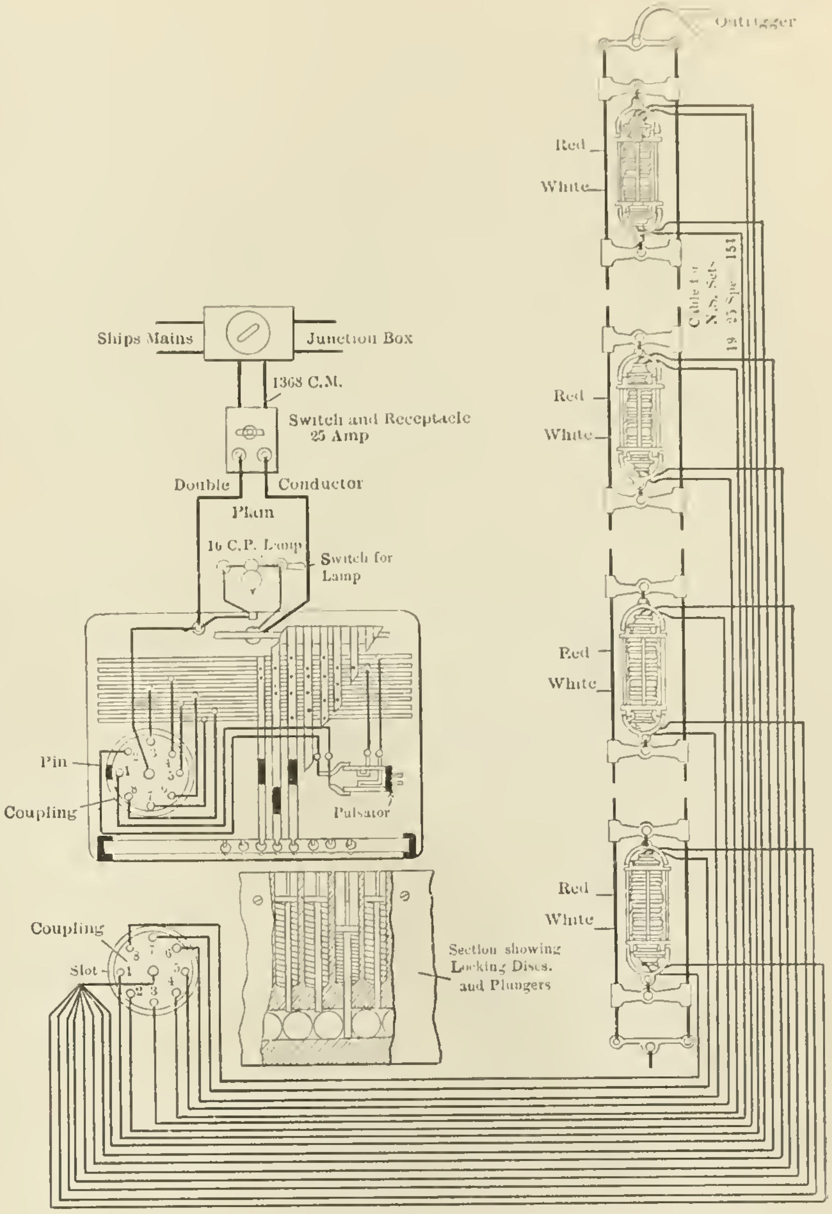


FIG. 7.—NIGHT SIGNAL SET.

Four 100-kw, 125-volt generating sets will be installed in each dynamo room. These sets will be direct-connected, the engines being vertical cross compound, of the enclosed type and fitted with forced lubrication.

Each dynamo room is capable of handling independently the entire battle load. This arrangement was considered imperative in view of the extended application of the electric drive to the important battle auxiliaries and in view of the danger of the electric plant being rendered inoperative from the following causes:

(*a*) Dynamo room rendered uninhabitable by breaking of a steam pipe. (*b*) Dynamo room rendered uninhabitable by flooding of the compartment. (*c*) Generators or engines being damaged by heavy short circuits. (*d*) Damage to compartment by shell from the enemy.

Distribution of energy to all battle service when one dynamo room is out of commission and uninhabitable necessitates either duplicating the wiring to each auxiliary, viz., one circuit leading from each dynamo room with a throw over switch at each auxiliary; or wiring from distribution boards which are located external to and yet capable of electric connection to each dynamo room at will. This latter scheme has been adopted, using two main distribution boards, one adjacent to each dynamo room, and in addition duplicate wiring has been specified for certain of the more important circuits.

Convenience dictates that the switchboards for control of the generators be located in the respective dynamo rooms, and that the distribution boards be located adjacent to the dynamo rooms. These distribution boards are, furthermore, each in its water-tight compartment, these compartments being each provided with a water tight door leading direct into the adjacent dynamo room and with another door permitting access to the compartment independent of the dynamo rooms.

Provision is made for the supply of energy to the lighting system and the projectors from a separate generating set; the ordinary assignment in action with one dynamo room in use would be one generating set to the lighting system and the projectors and three generating sets in parallel on the power system. The arrangement of main switchboards will, however, permit the operation of any or all generators in either dynamo room in parallel on the entire ship's load. On ships so powered as to occasion the assignment of generating sets of 50-kw capacity or less to the lighting system, it has been the custom to make provision for supplying the projectors from a generating set independent of the lighting system; but in the present instance any generating set is of ample capacity to handle the combined lighting and projector load. As the power required by each projector is less than 10 per cent. of the capacity of a generating set, several projectors could be thrown in circuit simultaneously without causing a material "dip" in the intensity of the incandescent illumination.

A diagrammatic scheme of the distribution is shown in Fig. 8.

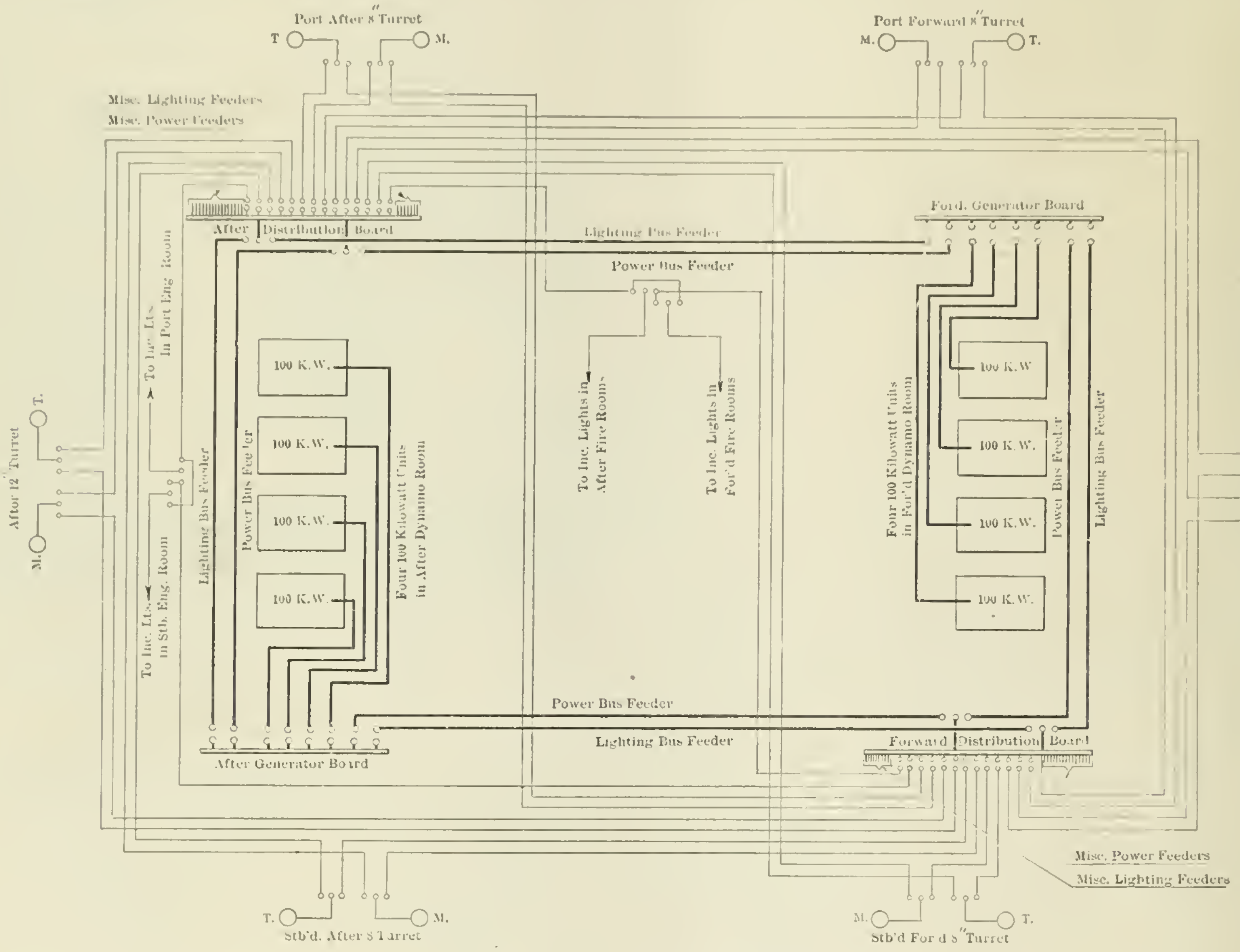


FIG. 8.—DIAGRAM OF SWITCHBOARD CONNECTIONS.

Two main switchboards and two distribution boards are used. Two sets of feeders, one for lighting and projectors, the other for power, are run from each main switchboard to each main distribution board. In general, the forward distribution board supplies all circuits forward of the amidship portion of the vessel, and the after distribution board all circuits abaft the amidships portion of the vessel.

Under normal conditions during action, each distribution board will be energized only from its adjacent dynamo room; but in the event of one dynamo room being put out of commission, throw over switches on its adjacent distribution board will enable this distribution board to energize from the other dynamo room. This provision permits the operation of every electrical auxiliary aboard the ship, although either dynamo room may be out of commission.

As a further safeguard, the feeders for certain of the circuits which are of maximum importance during action will be wired from each distribution board with a throw-over switch on the far end of each feeder, i. e., at the locatioin of the auxiliary which the feeder supplies. This arrangement permits the operation of these auxiliaries even with one dynamo room and the adjacent distribution board out of commission, or with one dynamo room the remote distribution board wrecked, the latter case, however, being highly improbable.

The turning motors of each turret are, as stated previously, operated from a motor generator located in the turret barbette, the motor generator for each turret being supplied and controlled from a panel located in the barbette, this panel containing a throw-over switch and wired with a feeder to each distribution board, as outlined above.

As heretofore stated, each turret is equipped with two ammunition hoist motors, two gun-elevating motors, two rammer motors, and two small smoke-blower motors. These various motors are supplied from auxiliary distribution boards located one in each turret, these boards in turn being supplied with a throw-over switch and wired with a feeder from each distribution board.

The incandescent lights in the engine rooms are wired from two mains, one for each engine room. By means of throw-over switches and a feeder from each distribution board, the lights in either engine room can be supplied from either distribution board. A similar arrangement is provided for lighting the boiler spaces.

All other circuits are wired to but one distribution board, the forward distribution board controlling 41 circuits, this number including one-half the circuits which are wired with duplicate feeders as outlined above. Of these, 9 circuits are for lighting, 3 for searchlights, and 29 for power. The after distribtuion board supplies 42 circuits, 8 on lighting, 3 on searchlights, and 30 on power.

The dynamo leads from the generating sets to the generator will be of 1,200,000 cm run in two cables of 600,000 cm each. The lighting feeders, running from each main generator board to each distribution board will be of 1,000,000 cm each. The power feeders from each main generator board to each distribution board will be of 3,000,000 cm each, run with three 1,000,000 cables.

Generator switchboards located one in each dynamo room and controlling the four 100-kw units in that dynamo room will each comprise a generator panel, a power feeder panel, and a lighting feeder panel. The generator panel will be so arranged that all the apparatus for controlling each unit will be in a vertical line and will consist of a single-pole circuit-breaker, a voltmeter, an ammeter, field regulator, a single-pole switch permitting the connection of one lead of the machinery to the lighting bus-bar, a similar switch for connection to the power bus-bar, and a switch to the common negative bus and a switch to the equalizer bus. The lighting feeder panel will contain a recording ammeter, to measure the entire load on the panel, the feeders, one to each distribution board, each leading through double-pole switches and circuit-breakers. The power feeder panel contains similar apparatus, but of the requisite capacity.

With the exception of certain through leads in the lower passages, the entire installation will be wired in steel enameled conduit. Wiring between generators and switchboards within the dynamo rooms, and the through leads mentioned above will be installed on porcelain insulators, metal strapped and secured direct to hull.

All wire of and under 60,000 cm will be twin conductor; sizes in excess of 60,000 cm will be installed as single conductor, a separate conduit being used for each leg of a circuit.

The installation, exclusive of interior communications, will require approximately 40,000 ft. of conduit weighing 55,000 pounds, and 44,000 ft. of wire weighing 27,000 pounds.

Generally speaking, there remain the following types of apparatus now aboard ships for which steam drive is in use and to which the application of the electric drive is feasible: (1) Steering gear, (2) main engine pumps, (3) ash hoisting machinery, (4) forced draught blowers.

An experimental installation for an electric steering gear is now under way. This consists of a motor supplied with a magnetic control, the same being identical with that now employed commercially with success on many elevator installations. The control will be operated by an attachment to the present type of steam steering gear. The same wheel and wheel ropes will be used as for the steam steering gear. The motor when started will automatically cut itself out of circuit when the helm has been brought over to the desired position. Should this device prove satisfactory, and if the helmsman can be trained to dispense with the time-honored "wheel," we may yet find an apparatus similar in appearance to the familiar street car controller occupying the position of honor in the pilot house and conning tower.

The writer is not aware of any marine installation of electrically-driven main pumps, either in our navy or in the domestic commercial marine. Such an installation has been carried out on a naval vessel built in this country for a foreign power, and has given fair success. It is hoped that this feature will eventually become more popular.

As for ash hoisting machinery and forced draught blowers, the similarity of these auxiliaries to other features aboard ship in which the electric drive has proved an unqualified success is so marked as to warrant the prediction of an early consummation of that which is devoutly to be wished.

That conservatism should predominate in the selection of an apparatus for naval installations is but a justifiable course, and the advocators of new devices and "radical improvements" for the naval service should bear in mind that a battleship is not the place for experimental work, but rather the place for the application of steadfast ideas which have been tried and not found wanting.

Recent Electrochemical Developments.

POROUS DIAPHRAGM FOR ELECTROLYTIC CELLS.

For many electrolytic operations it is necessary to hold the anodic and cathodic departments separated by porous diaphragms in order to prevent any reaction between the anodic and cathodic products of electrolysis, as such reactions mean decreased efficiency of operation. These diaphragms are a detail of great importance and their construction is often very difficult, as they must be at the same time durable, of low electrical resistance and of sufficient density to prevent the solutions from mixing.

A patent was granted on August 4 to Dr. E. A. Byrnes, of Washington, D. C., for improvements in the construction of such porous diaphragms. Many substances of high specific conductivity afford a body of low conductivity when finely divided; such a poorly-conducting granular body may be used as diaphragm, the size of the grains depending on the requisite porosity and conductivity of the diaphragm. These grains may either be mixed with an inert binder (like silicate of magnesium or calcium or ferrous hydrate) and molded into a self-supporting diaphragm, or they may be used without binder and are then enclosed between perforated metal sheets, if used for a vertical diaphragm. For cells with a horizontal cathodic surface a floating diaphragm may be employed. For the electrolysis of brine with a mercury cathode, the inventor places a sheet of amalgamated copper or iron wire gauze upon the mercury, and upon this wire gauze rests the granular diaphragm. In the same way in the electrolysis of molten sodium chloride with a molten lead cathode, the latter is covered with a wire gauze on which the diaphragm rests.

The diaphragm material should be inert toward the electrolyte and its products. For the electrolysis of alkali chlorides and nitrates, whether in solution or fused, diaphragms of magnetite or ferroferric oxide are suitable; ilmenite or chromite are also available. Broken glass or porcelain are suitable in aqueous electrolytes. For the electrolysis of molten sodium chloride with a molten lead cathode, a diaphragm of broken magnetite is suitable. For the recovery of metallic sodium from any of its molten compounds, the inventor proposes to fill a metallic vessel which serves as anode nearly entirely with granular material, a well being maintained at the top by means of a perforated cup placed around the cathode. The sodium rises and floats upon the surface of the electrolyte in the cathode well.

BATTERY INVENTION.

Six patents were granted on July 28 to Mr. Henry Halsey, of New York City, for details of construction of primary batteries. The main feature is the not very novel idea of the use of a small electric motor in connection with each battery of cells for setting up a circulation of the electrolyte. By suitable gearing the motor either revolves one of the electrodes or operates some kind of stirring device to hold the electrolyte in constant motion, in order to bring continuously fresh electrolyte to the neighborhood of the electrodes and thus prevent polarization. This is a return to the well-known principle which, previous to the introduction of the dynamo, was applied in an attempt to utilize the primary battery in lighting and motor work.

A patent was granted on July 21 to Mr. Daniel Drawbaugh, of Eberlys Mill, Pa., well known in telephone litigation, for a dry cell for which as a principal advantage the cheapness of the materials used in it is claimed. The cell has an outer cylinder of zinc, which is one electrode; next to it comes a cylindrical layer of a composition of concentrated caustic soda, with a small amount of plaster of paris or hydraulic cement; then comes a cylindrical diaphragm of paper or other porous material, and in it a pasty composition of coke, plumbago and a small quantity of plaster of paris is contained. In the center of this mass is a carbon rod which forms the other electrode. The cell is sealed at the top by means of a layer of melted pitch or tar.

A patent was granted on July 28 to Mr. David L. Winters, of Chicago, Ill., for details of construction of the terminal connections in galvanic batteries, as used for operating the spark coils of explosive engines or for similar purposes, in order to enable one to change rapidly and readily the number of cells in active use.

Telephone Exchanges. VIII.

By Arthur V. Abbott, C. E.

THE DIAPHRAGM.

THE office of the diaphragm is to vibrate under the impulsion of the changing magnetic field produced by the line current, and by its motion to create the sound waves that shall convey to the listener the words spoken at the transmitter. The diaphragm must, therefore, be considered from two points of view: its ability to respond to field changes, or its magnetic properties; and its ability to produce sound waves or acoustic properties. Its magnetic qualities, at least from the standpoint of the prevailing notions of the magnetic circuit, have been considered, but it remains to examine such experimental evidence as exists that may tell for or against this theory. Unfortunately, such experimental evidence, at least so far as it exists outside the private archives of various receiver makers, is exceedingly meagre.

In 1878 Dr. C. J. Blake described before the Society of Telegraph Engineers (British) a series of experiments on the vibration of the diaphragm, and exhibited curves drawn on smoked glass, showing an excursion of the diaphragm of .02 mm., which seems a large value. In 1882 Salet describes in *Compt Rendus* a similar study, but only shows a vibration amplitude between .0002 mm and .0003 mm. The next investigation was by Fröhlich, published in *La Lumiere Electrique*, in 1887, who found a maximum amplitude of .035 mm. In the *Elektrotechnische Zeitschrift*, of 1890, Franke describes an investigation and concludes that an audible sound could be produced by a diaphragm vibrating .00000012 mm. Probably the most carefully conducted study is that made by Messrs. Cross, Williams, Hayes, Mansfield and Phillips during 1888-1893 at the Rogers Laboratory of Physics, the results of which appeared in the *Proceedings* of the American Academy of Science. Some of the conclusions of these investigators are here summarized.

The apparatus used consisted in a magnetic system composed of a round bar of soft iron carrying a coil of wire connected to a battery, rheostat and ammeter, whereby any desired magnetomotive force could be produced, and a magnetometer with which the actual magnetism developed in the bar could be measured. On the end of the magnet thus formed a coil of fine wire was placed that represented the line coils of the ordinary receiver. To produce the line current an alternating-current transformer, having a frequency within the common range of vocal sound, was employed in some cases, and a powerful transmitter in others, but in all tests the line current was measured with a dynamometer or milliammeter. An exploring coil was also provided so that the results of the motion of the diaphragm in producing electrical waves could be measured by another dynamometer. Finally in front of the magnet a means for holding diaphragms was contrived so arranged that the different sample diaphragms to be tested could be held rigidly at any desired distance from the pole. The apparatus was so designed that the diaphragm could be suddenly mechanically vibrated a definite amount by a falling weight, and thus its action in producing an induced current in the exploring coil measured, also by a microscopic micrometer, the movement of the diaphragm under the action of any desired line current could be measured. By this means the apparatus could be operated either as a *transmitter* (an electromagnetic one) or as a *receiver*.

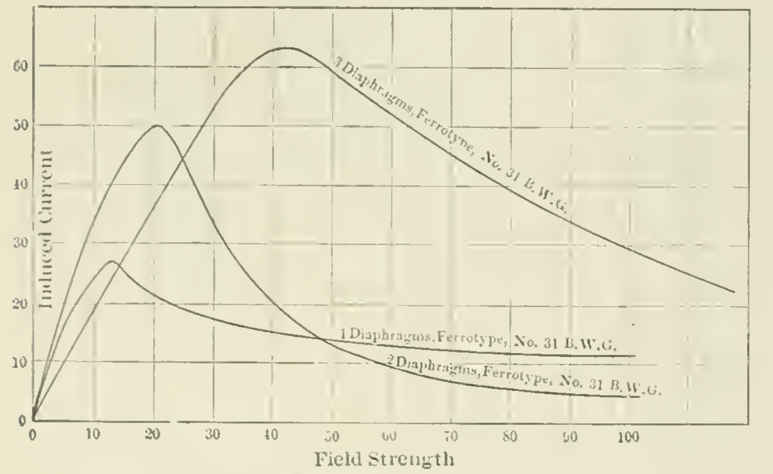


FIG. 26.—RELATION BETWEEN STRENGTH OF FIELD, THICKNESS OF DIAPHRAGM AND INDUCED CURRENT; FERROTYPE DIAPHRAGM.

The first set of tests was made by using the apparatus as a transmitter. The diaphragm was of ferrotype metal .01 in. thick and 2 and 5/16 in. in diameter, set .03 in. from the pole, which by means of the falling weight could be given a vibration of about .01 in. The exciting current of the magnetic system was varied, and the electrical impulses produced in the exploring coil measured. The results are shown by curve 1 (Fig. 26). As the field strength increased from 0 to 14, the induced current rose rapidly to 28, then declined to about 11 and thereafter remained nearly constant. Unfortunately the scales of these results are arbitrary ones and no data is given by which to correlate them with the units now used in connection with the magnetic circuit except that the induced ordinate 100 corresponds to a discharge of about .00000097 coulombs. But nevertheless curve No. 1 shows very plainly that the maximum reaction of the diaphragm takes place in a field that is quite weak, and that as the greatest range of action is a very narrow peak, much care is needed to proportion the field to the diaphragm to secure the best results. Curves 2 and 3 are plotted from similar tests made by using respectively two thicknesses, and three thicknesses of No. 31 B. W. G. gauge ferrotype metal in place of one. In each test the shape of the curve is the same; a sudden rise to a high peak and a slower decline. The relative ordinates measuring the current induced, and the relative field strengths at which the maximum ordinate occurs are very nearly proportional to the diaphragm thickness; so nearly as to be well within the range of probable experimental error. These curves teach that it is the relative magnetic saturation of the diaphragm that controls the line impulse given by its vibration. The thicker the diaphragm, the stronger the field may be, and the greater the impulse, both of the quantities being almost directly proportional to the thickness of diaphragm, finally the necessity of an accurate proportioning of field to thickness is most clearly shown, with the inference that there is a much greater margin in which to work with thick diaphragms than with thin ones.

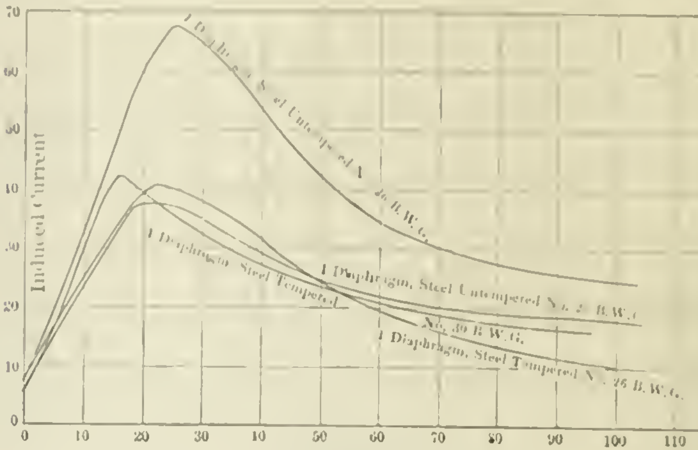


FIG. 27.—RELATION BETWEEN STRENGTH OF FIELD AND INDUCED CURRENT; DIAPHRAGMS OF SOFT AND HARD STEEL.

To further demonstrate the effect of the permeability of the diaphragm trials were made with diaphragms made of steel, both soft and hard. In Fig. 27 curve *I* shows the relation between strength of field and induced current with a diaphragm of untempered steel No. 26 B. W. G. in thickness. No. 26 is 180 per cent. as thick as the No. 31 gauge diaphragm of Fig. 26, hence the maximum ordinate of induced current is higher, reaching 68, but the field strength is 25, against 13 of Fig. 26, showing, as would be expected, that a larger magnetizing force is needed with a less permeable material. The curve, though, is the same shape, but broader, because for steel there is no such sharp bend in the B-H curve as in iron. Curve 2 gives the results on a hardened diaphragm of the same thickness. The peak of the induced current ordinate has fallen to 42, and the field strength to 17. With the decrease in permeability that accompanies tempering, the induced current ordinate would be lower, but it would also be expected that the subsequent portion of the curve would fall off less rapidly than in the case of soft metal, as the B-H curve for hard steel shows no marked saturation point. Such, however, is not the case, for the curve closely resembles in shape those from iron of No. 31 B. W. G.

The curves of Fig. 26 show the results obtained by superimposing two and three thicknesses of iron, one upon the other in making up the diaphragm, but evidently such a mass of separate laminæ would be quite non-uniform, and one might well be distrustful of results.

In Fig. 28 further tests on diaphragms of sheet iron of a number of different thicknesses are given, but here each test is for a solid sheet, and the material is somewhat more permeable than ferrotype metal. In all respects the results are confirmatory of the deductions of the previous tests, and taken in connection therewith form a valuable mass of data well worthy of careful study by those who design and operate receivers.

In the preceding investigation the apparatus was used as if it were a transmitter, for a vibratory impulse was given to the diaphragm, and the resulting electric pulse (as a momentary line current) measured. The conditions were then reversed, a small current, representing a wave from a transmitter, was sent through the line coil, and the effect, as an induced current measured by the exploring coil. In the first trial no diaphragm was used. The results are shown by curve *B*, Fig. 29. The field strength was varied from 0 to 120, electric impulses of constant amount sent into the line coil and the effect on the exploring coil measured. With no diaphragm the induced current commenced nearly at a maximum of 102, remained nearly constant till a field of 20 was reached and then steadily declined. Such a result would be anticipated from the general appearance of a *B-H* curve for very weak fields, for the relative magnetizing effect of a small increment of current is much greater with a weak field than with a strong one. A diaphragm of No. 31 B. W. G. sheet iron was then added and the effect is shown by curve *A*. Here the induced current increased markedly from a field of 0 to one of 10, and then drops with a decidedly greater slope. | The lowest curve in Fig. 29, marked *A B*, is the difference between curves *A* and *B*, and shows the effect on the induced current of the presence of the diaphragm, by introducing into the field a substance of greater permeability. The test apparatus, as is readily seen from the description, was similar to a *single* pole receiver, having an air-gap equal to the length of the magnet. It is to be regretted that similar trials were not made with a double-pole type when the presence of the diaphragm would be expected to produce a much more marked effect.

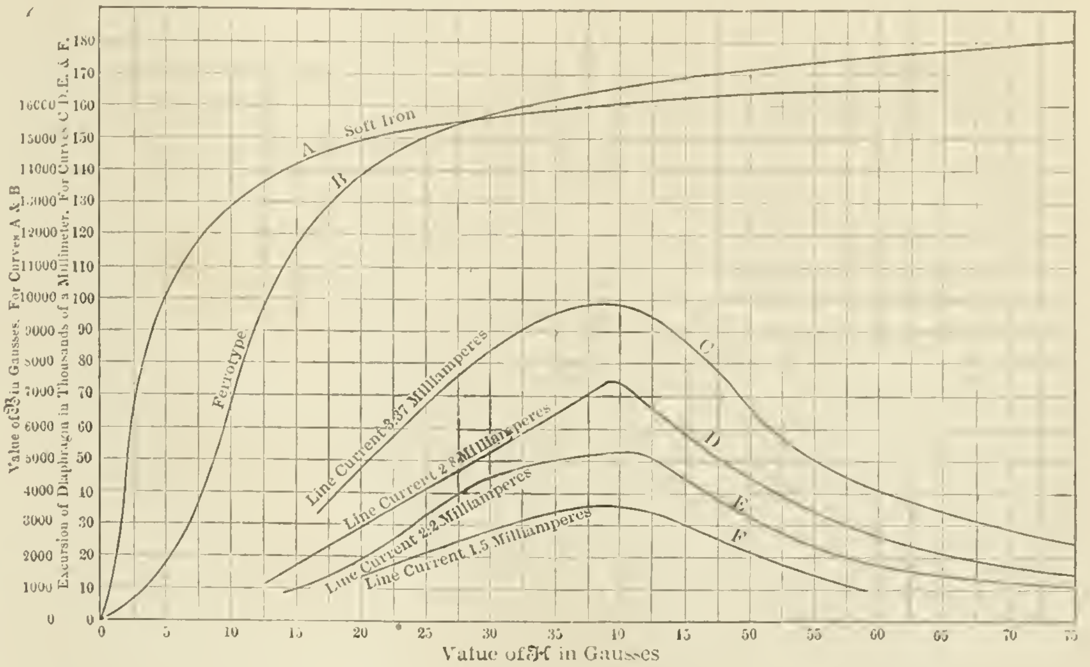


FIG. 30.—RELATION BETWEEN STRENGTH OF FIELD AND MOTION OF DIAPHRAGM WITH VARYING LINE CURRENTS.

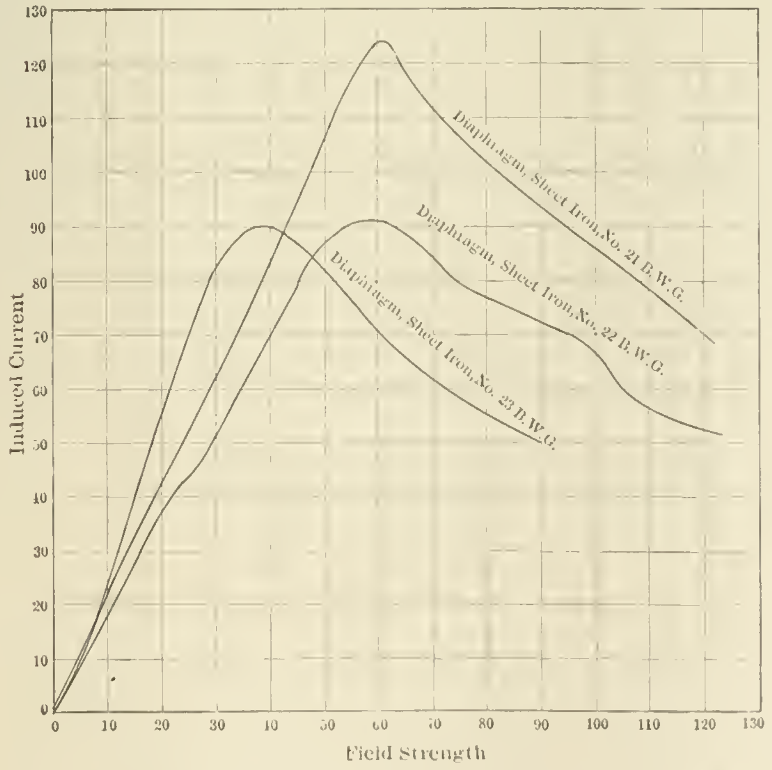


FIG. 28.—RELATION BETWEEN STRENGTH OF FIELD AND DIAPHRAGMS OF VARIOUS THICKNESSES OF SHEET IRON.

Many experiments on diaphragms of different thicknesses were made, those for Nos. 22, 23 and 26 being reproduced in Fig. 29. An examination of these curves show that the induced current rose in value as the diaphragm was reduced in thickness, also that the strength of field similarly increased. A careful examination of the results shows the following values:

Thickness.	Induced current.	Field.
21	131	6
22	132	10
23	137	13
26	142	18

With thin diaphragms the slope of the curve is more rapid than with thick ones, showing a narrower margin with thin diaphragms. Probably the explanation of the greater value of the induced current with thin diaphragms lies in the fact that they are less rigid and move a greater distance in the field with a given change in the line current, thus causing more lines of force to cut the exploring coil.

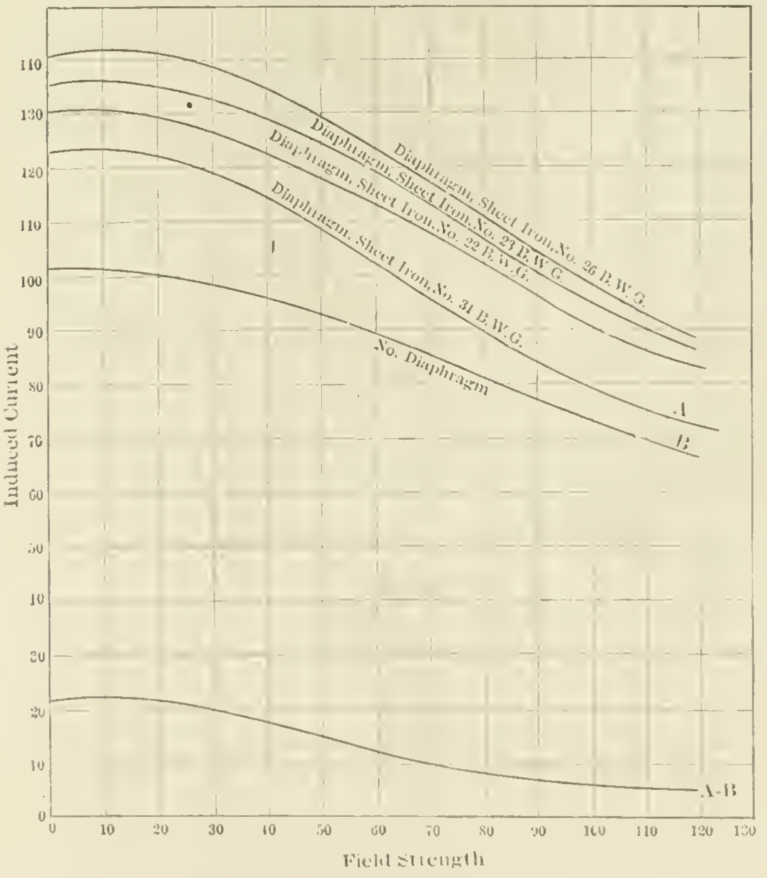


FIG. 29.—RELATION BETWEEN STRENGTH OF FIELD, INDUCED CURRENT AND THICKNESS OF DIAPHRAGM IN A RECEIVER.

The foregoing tests determined the relation between strength of field and induced current produced by a predetermined mechanical movement of the diaphragm, also strength of field and induced current produced by a predetermined line current impulse. It now remains to ascertain the relation between strength of field, and resulting mechanical motion of the diaphragm, with line impulses of varying intensity. The apparatus was similar to that already described; the same diaphragm being used in all tests, set 1/32 in. from the magnet. The line currents were produced by a powerful microphone transmitter, excited by an organ pipe blown by a carefully regulated air blast giving a pitch C. In Fig. 30 the inside scale of the vertical axis gives the moment of the diaphragm in thousands of a millimeter, and the horizontal scale the strength of field. In these tests the ampere turns of the magnetizing coil are given, so it is possible to plot the field in gausses, which has been done. Four curves are shown, *C*, *D*, *E* and *F*, in which the line current was respectively 3.37, 2.80, 2.20 and 1.5 milliamperes. These curves teach four things: First, as the field increases the excursion of the diaphragm increase to a maximum and then decreases to a nearly constant quantity. Second, The maximum excursion ordinate occurs at about the same point for all line currents. These two results would be anticipated from the previous test, and the fact that the same diaphragm was used, placed at the same distance from the magnet. Third, the excursion of the diaphragm varied with the line current and was nearly proportional thereto, for if the line currents be represented by 1, 1.46, 1.87 and 2.24 the excursion will be represented by 1, 1.47, 2.08 and 2.72. Fourth, the maximum excursion was found in a field of about 40 gausses. For comparison, a B-H curve for soft iron, from Ewing, and one for ferrotype metal, from Steinmetz, are plotted on the same sheet. The soft iron is more permeable and earlier saturated, but with a field of 40 the ferrotype shows an induction of 16,600 lines. These results confirm those which precede, and supply the additional numerical data that a ferrotype diaphragm to give the loudest sound should be set in a field of about 40, provided its thickness is such as to give an induction of 16,000 gausses.

The "Production Engineer" and Electricity.

By Howard S. Knowlton.

THE stoppage of leaks in the operation of modern industrial organizations is receiving a great deal of attention these days, so much so in fact, that it has given rise to a new and highly specialized profession—"production," or "modernizing" engineering. Thus far the published records of this new work point chiefly to triumphs gained in manufacturing plants of one kind or another, improvements in processes, methods of cost keeping, sequence of operations, replacement of old machinery by new designs, and such like. That the field of electricity, almost boundless in its variety of applications, offers signal opportunities to the experts in this new branch of applied economies, no one can doubt, if his opinion is of even average intelligence.

The qualifications of a production engineer are so peculiar that he can best be described as a civil, mechanical, electrical and industrial engineer rolled into one, and held in place by a strong endowment of common sense coupled with business ability. Above everything else he must possess the microscopic eye for all forms of waste, and must have in his makeup an insatiable hunger for the elusive losses which abound in industrial life. The sight of two men doing the work of one must move his soul to tears, figuratively speaking, and the presence of an uncovered steam pipe must stimulate his powers to expression in pointed recommendations. He must be an apostle of scientific laziness—if laziness means getting things done in the easiest possible way.

Practically every electrical enterprise of consequence is managed through an office. The chances of leaks here are numerous, but only a few can be mentioned, as an electrical office is run in pretty much the same way as any other. It is now generally realized that small savings go a long way toward furnishing the profits of any business.

One of the first points about an office which occurs to the production engineer is the possible slipshod treatment of the correspondence. In all large concerns, a mailing department is a necessity which should not be omitted, and whether the company has many or few correspondents it should always be possible to immediately locate any letter or copy of a letter which has been received or sent. According to the circumstances of the case, the production expert will thoroughly reorganize the whole system of correspondence and data filing, if he finds it defective. Thus one firm may be led to paste a numbered slip upon each letter or telegram which it receives, stamp upon it the date of reception and the correspondent's number, and in a suitable blank space add the name of the department which is to receive the communication. The work of the mailing department will be completed by recording in a ledger or card index these essential features, and sending it to the particular department to which it is destined. The correspondence clerk of the latter section of the office then stamps the slip with the receiving date of his department and then refers it to the proper employee, first dictating an abstract of its contents to a stenographer, and then passing it to the subordinate through the head of the department. These abstracts may then be typewritten on daily sheets constituting a diary of inward letters, and be most valuable for quick reference.

After the original letter has been answered or disposed of it finds its way into the department filing case. Whenever the volume of business permits, the department head should read the original letter, and in any case, its summary, in order that he may be fully posted as to all the important events which concern his subordinates. When letters are sent out by an employee of a department a copy should always be sent to the department files, and a summary of its contents dictated for an "outward" letter diary. Some firms also take a letter press copy of the final signed letter in the mailing division before it goes out, as an additional check against loss. It is better to refer a copy of the original letter to various people in a large office than the letter itself, in many cases. The time-saving advantages of this system are very great where correspondence is heavy. Of course circumstances vary so much that a good many different systems of filing letters are to be considered before any one is adopted in a particular case, but the foregoing is a suggestion as to the method of the production engineer in the practice of large consulting firms, and is only intended to hint at what may be done. While it is true that an office which spends so much time on letters as is demanded above seems trussed up with red tape, it will be found in actual experience that letters may be located and noted with remarkable speed and accuracy, especially by the aid of the inward and outward diary. The work on the letters is done once and for all when they arrive, and after that it is a simple matter to run through them, actually or by reading the abstracts.

The filing of data is a source of considerable trouble in many concerns. Experience seems to show that no single form of recording device is satisfactory in every case. Generally, some form of card catalogue or drawer file, or removable leaf note and record book fills the bill with tolerable success. In electric railway lighting or power transmission work the card index finds a firm foothold. If the production engineer is to take the drafting department in hand, he will usually insist that every drawing made be recorded on tracing cloth if possible, and numbered, with the date plainly added. There will then be a card index of drawings close by the department chief's desk, with each drawing recorded under its subject title, and a cross reference to its number.

Sometimes it will be found that the employees are using the company's correspondence paper for rough calculations, instead of the cheaper grade which may be provided. There is not always an acute moral sense of the right and wrong of using the company's stamped envelopes, unpaid for—and again, traveling expenses sometimes are lumped in sums which cover a multitude of experiences. Even the use of the company telephones may be abused by clerks who take such occasions to discuss subjects about as far from their proper business as is the moon from Monte Carlo. It would surprise most of us if the sum total of time spent by employees in personal telephone talks during one week could be placed before our eyes for a single large office. All such considerations fall under the observation of the production engineer, and it is safe to say that no detail is too small to be worthy of his attention.

Passing now to the more technical phases of electrical work, we find the modern electric power house to be as full of interest to a modernizing expert as any factory. Here the raw material is first handled at the coal barge or car, and in all the steps from storage bin to switchboard, losses occur which may well be an incentive to the production engineer's highest saving ability. In his study of a great modern plant he must enlist the aid of trained steam, mechanical and electrical engineers—and it is possible, even probable, that in some of the latest designs he will find nothing which he is able to improve. In the vast majority of cases, however, there will be suggestions to make, which will mean greater economy in operation. Thus, in a dark corner there will be a steam pipe whose covering is decayed, in another place a small door cut through the wall will save time, here the coal scales are in an inconvenient place.

and perhaps inaccurate as well, and there the high-tension wiring sags, too near the steel framework of the building—all sources of waste or possible loss.

A thorough study of a power house from such a standpoint means an enormous amount of work. It means more than one day of the keenest observation of every detail of operation. It means the close study of pages on pages of the station record book, reports, records of coal consumptin, water supply, energy output, etc. Everything must be reduced to the unit basis—cost per kilowatt-hour—and graphic diagrams, the slide rule and every possible aid utilized. The processes whereby the potential energy of coal or falling water are finally transformed into electricity are probably as complicated in detail as the processes of many factories whose products are material and visible. Even the very switchboard instruments must be distrusted, just as the production engineer is obliged to distrust the count of a factory's product until it is proven correct.

Transmission and distributing systems open up a field of wide research for the modernizing expert. Even granted that the original design was adequate to the demands of the system in hand, it is always worth while to consider what the status of affairs is after time has gone on and joined the installation to those of the past. Certain it is that many an overhead and underground system is carrying ruinously heavy loads, thus wasting energy which costs money, and is giving poor service to boot; and also it is true that street railway systems may be found in some of our large cities literally overburdened with tons of useless copper, whose fixed charges are eating into the net earnings with no uncertain appetite. To discuss the prevention of fires caused by defective installations of electrical apparatus would lead us into the specialized branch of fire insurance engineering, which is beyond the scope of this article. Suffice it to say that the production and the fire insurance experts walk in the same path as far as loss saving is concerned. The protection of human life by careful wiring, liberal switchboard provisions and the elimination of dangerous features in belting, from prime-movers to generating machinery, all fall within the scope of the modernizing expert.

In the field of operation of electric railway, power and lighting systems the production engineer is in his element. Looking as he does upon a railway as a great machine for the manufacture of transportation, every detail of operation settles into his mind in the order of its relations to the process as a whole, and as a result every defect which can be eliminated may be the means of a financial saving. Thus the handling of trolley cars may invite accidents, and consequent heavy money damages and loss of public goodwill, and its improvement, a saving which cannot be directly calculated. Similarly in lighting and power systems small savings and improvements lead to great economies.

Telephone and telegraph work, electrochemical processes, the manufacture of electrical machinery and the varied applications of storage batteries—these and many other details of electrical industries offer tempting opportunities in business or operating improvements—but as this paper has already outgrown its intended length, the foregoing suggestions will probably be enough to show that among all the fascinating kinds of work which a production engineer can undertake, few if any offer greater opportunity for usefulness than the elimination of wastes at present accompanying the extended applications of electrical energy in modern civilized life.

Combined Gas Engine and Electric Equipment for Automobiles.

The idea of the use of a gas engine as prime-mover on an automobile and the provision of an auxiliary electric equipment intermediate between the gas engine and wheel is not new. An automobile of this type was first built in Europe three or four years ago. At first sight this combination looks rather complicated, but actual tests have shown that it has distinct advantages. The gas engine runs continually at constant load and the electrical equipment offers all the advantages of the flexibility of electric power transmission. A new solution of this problem has been found and has recently been patented by Justus B. Entz, of Philadelphia.

The problem may best be explained by resolving it into two parts. The first is to provide some sort of automatic changeable ratio gearing between the gas engine and the wheels, so that the constant work performed by the engine is represented by a high driving effort at the wheels, together with slow speed when the automobile climbs a hill, and by a low driving effort and a high speed on horizontal road. In other words, the constant horse-power of the engine manifests itself in varying speed and driving effort, and this variation adjusts itself automatically to the condition of the road and to the steepness of the hill which the automobile climbs at any moment. This automatic changeable ratio gearing is provided in the form of the following electric equipment:

On the axle of a pair of wheels the armatures of two electric dynamos are mounted. The field of the first dynamo is driven by the gas engine; the field of the second dynamo is stationary and its exciting current is automatically controlled by a rheostat which is operated by a governor on the engine. The circuits of the two armatures are in series. It is evident that with this arrangement, in which the gas engine furnishes all the power, and in which it runs under conditions of constant speed and constant rotary effort, greater driving effort on the wheels is obtained at the expense of speed. Thus the speed is fixed for any given condition of grade and can only be increased by the addition of power in excess of the power of the engine, and can only be decreased by diverting some of the power of the engine from the driving shaft of the wheels.

This is the second problem and its solution is rendered easy by the intermediate electrical equipment. As mentioned above, the circuits of the two armatures are in series. To increase or decrease the power transmitted from the gas engine to the wheels, it is, therefore, only necessary to insert a storage battery in the circuit of the two armatures; when it discharges it adds power to that of the engine; when it is charged it consumes part of the power of the engine. The gas engine gives continually the average power required at the wheels, and the regulation at any moment to accord to the instantaneous condition of the road, is obtained by including, with the aid of the controller, any number of cells of the storage battery in either direction in the armature circuit.

CURRENT NEWS AND NOTES.

THE METRIC SYSTEM.—An illustration of the length to which opponents of the metric system will go in their blind fury is a statement made before a meeting recently in New York of the Furniture Association of America, namely, that "In France, the country in which the system originated, it is in practical disuse." Anyone who has lived even a short time in France knows how absurdly false is this statement. The press agent of the metric opposition, who brought up the question before the meeting, had the field to himself and was enabled to secure the passage by the furniture men of a resolution condemning the metric system.

CABLE-LAYING NAVIGATION.—In the current issue of the *Proceedings* of the United States Naval Institute, Lieut.-Commander John B. Blish, U. S. N., formerly in technical charge of naval electrical work, gives an interesting account of the refinements in navigation practiced on board cable-laying ships. Aboard the cable-laying steamer *Faraday*, in which Mr. Blish took a trip, no less than nine experienced navigators took sights from early dawn until dark, and half-hourly azimuths. All sights were worked out with seven-place logarithms, and a mean of the various positions was accepted after throwing out any which differed a mile from the mean. Among the navigating appliances was a "distance wire," consisting of a deep-sea sounding wire (No. 20 B. W. G.), which was paid out continuously under a carefully regulated strain, and passing over a measuring wheel recorded the run with an accuracy comparable to that of measuring distances in land survey. Dead reckoning was computed from distance wire records. Notwithstanding the skill of the navigating staff, the exact position of the ship was at times in doubt, owing to uncertainty as to the actual dip of the horizon. This experience led to the invention by Mr. Blish of a navigator's prism, which is described in detail in the paper here referred to. By means of this device the dip of the horizon can be determined with great accuracy, thus eliminating a treacherous element of uncertainty in observations at sea.

SUBMARINE CABLE OWNERSHIP.—According to recent statistics on the telegraph lines of the world, published in Berlin, Germany owns 10,220 miles of telegraph cable, or one twenty-fourth of the entire system of the world, while Great Britain owns two-thirds of the total mileage.

HERTZIAN WAVES IN NAVIGATION.—In a recent patent Hermon W. Ladd describes a means for using Hertzian waves in obtaining bearings at sea when the objects owing to a fog or storm are invisible. This consists of a coherer circuit electrically connected with an upright conductor so shielded that waves are only received from a transmitter on another vessel or at a shore station when a lateral opening of the shield is in proper range radially with the vessel or station. The shield is movable and at its lower end has a pointer moving over a compass card. When the coherer in circuit gives a signal, the range is determined.

INSULATED RAIL JOINT.—A patent was recently granted to John D. Keiley, of New York City, for an improvement in the insulation of the base of rails from the rail chair. Beneath the base of at least one rail two layers of insulating material are arranged; the one next to the base of the chair is of mica material or a sheet of mica, while the other layer, above the former, is thicker, and consists of a tougher material of lower insulation, such as vulcanized fibre. The object of this arrangement is to form a soft surface or cushion for the mica material to prevent injury due to shocks and jars incident to constant traffic over the rails. Another patent granted to George A. Weber, of New York City, relates to details of constructing the above joint.

D'ARSONVAL ON ELECTROTHERAPY.—Electricity will be the sole medicine of the future, according to d'Arsonval. At a recent meeting of the Psychological Institute of Paris, he made an exhaustive address on "The Action of Electricity Upon Human Beings." He spoke of the sudden shocks of electricity, as well as the slow method by which it pervades the human system without the patient being sensible of it. He showed that electric treatment is excellent for certain maladies of the skin, and that electricity has a powerful effect on microbes and accelerated circulation and respiration without fatigue to the person operated on. Moreover, what is most important, it acts strongly on cellular vitality. He added that electricity will bring about a therapeutic revolution.

ELECTRICAL GAMBLING.—The following story is quoted by the *New Orleans Times-Democrat* from a recent visitor to San Antonio, Tex.: "I walked into a big gambling house and was almost speechless for a moment on seeing a number of women seated at a keno table. But I was soon told that it was a very common thing. It was in this place that the game of keno is played by electricity. Two and 300 people can play at the same time by means of the apparatus. The players are seated at two long tables on either side. At the end of the hall is a large rack which is connected by electric wires with a buttonboard or keyboard. As the dealer turns the cards, the operator touches this or that button or key, and a number falls in the rack corresponding to each key or button pressed and to the cards, as they are turned from the deck. The numbers are clearly visible to each player at the two long tables. The advantage afforded is that any number of people can play at the game at the same time. I am told that the system has proven highly satisfactory."

SPEED INDICATOR FOR INDUCTION MOTORS.—It is well known that the load of an induction motor is indicated by its slip. In some cases, especially in cotton or textile mills, a relatively slight drop in speed would produce detrimental effects, and for such purposes it is either necessary to employ larger motors with close speed regulation, or to use small motors and prevent too great a speed variation of the same by regulating the speed of the generators in the power station. The first method is expensive, the second requires the use of an instrument which indicates in the generating plant the speed of the distant motors. Two patents for such a speed indicator were recently granted to Ernst J. Berg. The frequency of the currents in the rotor of an induction motor is proportional to the speed; hence by tapping the windings of the rotor at suitable intervals polyphase currents are taken off of a frequency corresponding to the slip. These currents are transmitted to the switchboard of the generating plant, where they actuate the frequency indicator; if their voltage is too low, a step-up transformer may be employed. The frequency indicator, in the form preferred by the inventor, is a motor of the rotary field type. One member of it is fed with polyphase currents of the same frequency as that fed to the motor whose speed is to be measured, these currents being furnished from the supply mains. The other member is fed with polyphase currents proportional to the slip of the motor in the manner described above.

INSULATING MATERIAL.—The manufacture of a cheap and effective insulating material for electrical purposes is still a promising subject for chemical research. The difficulties involved in the solution of this problem were recently pointed out by Dr. M. von Recklinghausen in an American Electrochemical Society paper in which he defined the desirable and undesirable properties and gave some indications as to the direction in which researches should progress in future. The number of patented insulating materials has recently been increased by a new one of comparatively simple composition, the invention of F. Basenan and A. Cohen, of Amsterdam, Netherlands, and consists mainly of asphalt and petroleum. Of prime importance is the purification of the asphalt, by which all malodorous constituents, especially the volatile sulphur compounds, are removed. For this purpose the asphalt is maintained for some days at a temperature, exceeding its melting point, with the exclusion of air. It is then mixed with a smaller or larger quantity of petroleum, according to the desired flexibility and hardness of the final material. While the petroleum which has been raised to the same temperature is mixed with the melted asphalt, a solution of alumina hydrate in acetic acid is added under constant stirring, and finally some colophony or other suitable resin and alkali is added. These additions cause a violent frothing of the whole mass, whereby an intimate mixture of the materials is produced. The addition of the aluminum aceticum imparts to the material great toughness, while the addition of resin and alkali renders the petroleum semi-solid or gelatinous. The mass is maintained in a decidedly liquid condition by heat under continuous stirring and is subsequently allowed to cool. For the jet black product, thus obtained, the following claims are made: It softens at a moderate temperature, about 70° C., and hardens again rapidly on cooling; it is very flexible, possesses a very high electrical resistance, and is not attacked by strong hydrochloric or acetic acid, dilute nitric or sulphuric acid, ammonia, alkalies and ordinary or salt water.

COOPER HEWITT VAPOR LAMP.—Three patents were recently granted for improvements in details of construction of the Cooper Hewitt lamp. A detail of this lamp is a band or strip of metal near the negative electrode, which is usually called the "starting band." This is generally connected with the positive side of the circuit and its function appears to be that of developing an electric strain in the neighborhood of the negative electrode which assists in the ultimate breaking down of the negative electrode resistance. As this starting band, which is connected with the positive side of the circuit, is in rather close proximity to the lead wire running to the negative electrode, there is danger of sparking between this lead wire and the starting band. In order to avoid this sparking, Dr. Max von Recklinghausen surrounds the lead wire with a tubular extension to a point beyond the sparking distance.—For starting the lamp a main-line switch, one or more inductance coils in series with the lamp, and a snap switch, in shunt between the lamp and its induction coils, are provided. In places where a number of lamps are located near together and subject to the control of the same operator, it is sufficient to have a single main switch and a single snap switch; the latter may then be used to operate the circuit of any one of the group of lamps. For this purpose Stanwood E. Flichtner has devised an adjustable switch.—The same inventor has devised a modification of the ordinary construction of the inductance coil in series with the lamp, which is used for the initial higher potential starting current, and which is also used as the entire series resistance for the lamp during operation. It has been found, however, that in practice the resistance of these lamps increases during the first few weeks of running, so that a coil which is exactly adjusted for a certain lamp on a given voltage will, at the end of several weeks, have too great a resistance, thus causing the lamp to run on too low a current. Mr. Flichtner, therefore, uses two inductance coils in series with each lamp and provides one of the coils with such connections that one or more layers of wire may be cut out of circuit. In this way the increasing resistance of the lamp is compensated for from time to time by cutting out successively several layers of this coil.

INQUISITIVENESS BY TELEPHONE.—A Western newspaper states that a lineman inspecting a rural telephone line in Adams County, Ill., entered the home of a subscriber and found a woman knitting in a rocking chair with her telephone receiver tied to her ear. She was listening to every conversation that passed over the wire.

CABLE TO ALASKA.—A special dispatch from Seattle, Wash., of August 4 says: "The United States cable ship *Burnside* has arrived from Sitka, where she completed the preliminary work of laying the cable between this city and Alaska. She is here to take on board 600 miles of cable. A dispatch from Dawson says that after a work of months American troops have replaced most of the line destroyed by fire in Tanana Basin. Connection from St. Michael to Seattle is daily expected."

CHEAP ELECTRIC LIGHT FOR BERLIN.—An article in the Frankfurter Zeitung states that, commencing on January 1, 1904, the price of electric current in Berlin will be reduced 27 per cent.—from 55 pfennigs to 40 pfennigs (13.1 cents to 9.5 cents) per kilowatt-hour —and that the price for electric light in Berlin will then be cheaper than in any other large city. This reduction was made to compete with gas light. Details are not given as to the scale for large quantities, and the prices here mentioned are considerably beaten by the New York Edison and other American rates.

EFFECTS OF RÖNTGEN RAYS.—A cable dispatch from London of August 5 says: "Two doctors belonging to the staff of the London Hospital have been affected by X-rays in a manner similar to that of the assistant of Thomas A. Edison, and have been compelled to abandon their work. They were engaged for a long time in making examinations of and manipulating diseased parts while X-rays were directed on the patients. When they began to suffer they tried gloves in the backs of which lead foil was sewn, but these impeded the movement of their hands and were discarded. One of the sufferers ceased operating under the rays eighteen months ago, yet his hands have improved little, despite constant treatment.

TELEGRAPHS IN KOREA.—A cable dispatch from Korea of August 6 says that an agreement has practically been concluded between Russia and Korea, whereby Russia acquires 200 acres of land at Yongampho, on the Yalu River, on a ninety-nine years' lease. The application of M. Pavloff, the Russian Minister, for permission to erect telegraph and telephone lines to Yongampho has been refused. Previous dispatches said that werk on the Russian telegraph line between Au-Tung and Yongampho had been abandoned in consequence of Korean remonstrances. Thereupon M. Pavloff objected to the Japanese telegraph line from Seoul to Fusan, which was constructed prior to the Russian line. The Korean Government asked the Japanese Minister to have the line removed, but the minister declined to do so.

GERMAN ASSOCIATION OF INVENTORS.—The Central Association of Inventors "Germania," of Bayreuth, will hold a general exhibition at Nüremberg during September and October of this year for the purpose of facilitating the sale of patents and copyrighted patterns. There are more than 200,000 copyrighted patterns in Germany and over 140,000 patents; one-half of these, however, are not in public use, for the reason that the inventors were not able to exploit their inventions. On account of this the Central Association was formed a few years ago. Its purpose is to assist the members to make their inventions profitable to themselves, as it is a well-known fact that a majority of inventors have not the means to do so. The association furnishes space to inventors without means free of cost and charges no fees for effecting a sale.

LONG ISLAND TROLLEYS.—With regard to the unification of Long Island trolleys noted in these columns last week, it is said that the idea that the purchase by the United States Mortage & Trust of a number of trolley lines on Long Island has been in the interest of the Long Island Railroad Company is incorrect. The deal has been made in the interest of the Interborough Rapid Transit Company, and although not formally sanctioned by the directors of this company, there is no doubt whatever that it will be approved when the proper time arrives. This development is in line with a policy of ultimate consolidation of tunnel, elevated and surface railroads in Greater New York and with ramifications practically throughout Long Island. The concentration into a few hands of a majority of Brooklyn Rapid Transit stock foreshadows something more than results expected from the inauguration of up-to-date methods by the present management on the property as it exists to-day.

ST. LOUIS FAIR AUTOMOBILES.—Last week we gave details as to the automobile chairs for the St. Louis Exposition grounds. It is stated that an organization has been formed under the name of the World's Fair Automobile Company, to operate at least 200 automobiles between the hotels and the union station in St. Louis and the fair grounds. The largest will be tally-hos, to carry forty passengers, and the smallest will be runabouts, to seat two persons. Steam, gasoline and electricity will furnish the motive power. Visitors will be taken direct from their hotels to the entrance to the Exposition or on the grounds, as the case may be. Coupon tickets will be issued entitling passengers to a ride and also to admission to the fair, and those holding such tickets will be deposited at stations provided for collecting and discharging passengers within the grounds. The automobiles will be run through the prettiest residence thoroughfares of St. Louis. It is expected that the proposed automobile service will be popular, as enabling people to reach the fair otherwise than by crowded street cars. The views of the trolley companies on the subject are not cited. The street cars will probably have all they can do.

LIGHTING A FLORAL CLOCK.—The St. Louis Exposition is to have a unique floral clock, and work has been begun by the Johnson Service Company, of Milwaukee. This mammoth clock will be installed on the side of the hill north of the Agricultural building. The dial will be a flower bed 120 ft. in diameter. The minute hand will be 60 ft. long, and the ring at the end, which will be fastened to the machinery, will be 8 ft. in diameter, large enough to support 12 men easily. A hundred persons might promenade on this hand without interfering with the movements of the timepiece. The minute hand will move 5 ft. every minute. The clock machinery will be in an adjacent building. The flower bed will be a masterpiece of the florist's art. The entire dial will be a flower bed, and the numerals marking the various hours will be 15 ft. in length, and made of bright colored coleus, a foilage plant with bright colored leaves that grows dense and may be pruned and kept symmetrical without danger of impairing its growth. In a broad circle, surrounding the dial, will be twelve flower beds, one opposite each hour, each 2 ft. wide and 15 ft. long. These collections will represent various flowers, but each will be so selected that the blossom is open at the particular hour it represents, and at no other. In this way both the hands of the clock and the flowers will tell the time of day. At night the whole vast timepiece will be illuminated with 2,000 incandescent lights.

ECONOMY OF ELECTRIC DRILLS.—Mr. John B. Hobson, general manager of the Consolidated Caribou Hydraulic Mining Company, at Bullion, B. C., in his annual report, gives some interesting figures of costs of operating an installation of electric drills. The plant included four drills with 2-hp. 110-volt, direct-current portable motors, one drill, with 1½ hp. 110-volt direct portable motor, all complete, with seven-foot flexible shafts, adjustable tripods, drifting columns, the necessary flexible cables, working tools and five sets of drills of suitable lengths to drill holes varying from two to eight feet deep. The figures are: Steam power—One cord of cedar wood, delivered, $2.25; one engineer, $4; lubricants for engine and generator, 35c.; total, $6.60. Operating three drills—Three power-drill men at $4 each, $12; three helpers at $2 each, $6; one blacksmith, $4; one helper, $2; three bushels of charcoal at 25c., 75c.; lubricants, 20c.; total, $24.95. Total cost of running three drills 10 hours, $31.55. The duty attained by drills used during the season, in advancing and lowering the bed rock cut, averaged 312 ft. of holes per 10-hour shift. The duty attained by two miners drilling by hand, with 7/8-in. steel and 8-pound hammers averaged about 14 8/10 ft. per 10-hour shift, and made the cost of drilling 312 ft. of holes in bed rock by hand, as follows: Forty-two miners at $2 per day, $84; one blacksmith at $4 per day, $4; one helper at $2 per day, $2; four bushels of charcoal at 25c., $1; total cost of drilling 312 ft. of holes by hand, $91. Saving made in favor of power drills per ten-hour shift, $59.45.

LOSS ON GOVERNMENT TELEGRAPHS.—The British Post Office figures for 1902-3 show the usual loss on the telegraph service. The telegraph revenue was £3,723,866, an increase of £153,820. The expenditure of the telegraph department was £4,317,371, a net deficit of £593,505. If allowance is made for the interest on the capital, £10,867,644, created for the purchase of the telegraphs, the deficit would be £802,305, or about $4,500,000.

DEPARTMENT STORE ENGINEERING.—It is interesting to note that the "department store trust" organized in New Jersey last week as the Cash Buyers' Union First National Co-Operative Society, with an authorized capital of $5,000,000, has among its innumerable objects that of carrying on the business of electrical engineering, associated with hair dressing, gardening, dealing in "fancy animals," printing, and other odd jobs.

AUTOMOBILE LAW.—The American Automobile Association has just issued from its headquarters at 753 Fifth Avenue, New York City, a very neat little brochure, giving the State laws affecting automobiles for New York, New Jersey, Pennsylvania, Connecticut, Massachusetts, Rhode Island, Vermont, Maine, and Delaware. The book contains text and digest. A second pamphlet will embrace the automobile law of the leading Western States.

THE POPE AT THE TELEPHONE.—One of the interesting stories sent from Rome about the New Pope, Pius X, is as follows: "Monsignor Stratimirovich, the Venetian prelate, accompanied him to Rome and up to the door of the Conclave, and, in taking leave, expressed the hope that Cardinal Sarto would be made Pope. The Cardinal replied, laughing: "No. No fear for me. Tell me the number of your telephone and I will let you know who receives that honor." In all of the excitement of his first election he kept his word and went to the telephone personally, and called up the number, only to find that Monsignor Stratimirovich already knew the result of the balloting, and was on his way to the Vatican."

INTERCEPTING WIRELESS MESSAGES.—A cable dispatch from London of August 8 says: "The French Wireless Telegraph Company has replied to Marconi's assertion that his messages cannot be intercepted by informing him that for the past six months every message sent, not only from his station at Poldhu but from any Marconi stations around the British coasts, has been intercepted by the French Wireless Telegraph Company's station at Cape de la Hague, and that copies of these messages are at his service. Marconi has not asked for the copies. When the Prince of Wales recently visited Poldhu station he asked Marconi to send a message across the Atlantic, but the inventor informed him that it would be six months before the apparatus would be ready to carry out that experiment."

BROOKLYN BRIDGE TERMINAL.—Mr. H. F. Hornbostel, designing architect employed by Commissioner Lindenthal to prepare plans for the proposed Brooklyn Bridge Terminal and city offices on Manhattan Island, has a scheme which is grandiose to a degree, involving $50,000,000 ultimately, and $9,000,000 now. A 42-story building is contemplated, with trolley loops and other tracks in the lower stories or levels. This enormous terminal station will extend up as far as Duane Street, and provides for five stories of city offices. The building will be carried out on the same architectural design as the new Hall of Records, and the plan provides for the construction of the campanile up to that level. The campanile proper, with its thirty-seven additional stories, is to be used for office purposes, and to house city departments. The full height of the campanile, as projected, will be 650 ft., giving in all 400,000 sq. ft. of office room. The cost of $9,025,825 for this terminal station does not include the campanile above the roof of the base, or a height equal to that of the Hall of Records. The cost of completing the tower would be $1,468,800 more.

TECHNICS AND ECONOMICS.—At the recent congress of the Association of German Engineers, a paper read by Prof. Schmoller, of Berlin University, on "The Borderland Between Technical Progress and Practical Economics," was of general interest. He traced the history and development of technical skill as applied to the implements and machinery of civilized life up to the date, about a century ago, when the exact sciences began to furnish the general basis of technical progress. He called attention to the development of social and political life as synchronous with the modern progress of mechanics as applied for industrial purposes. The age of machinery was the age which had witnessed the recognition of the political and legal equality of all the citizens of the State. In the year 1750, when Germany had a population of 18,000,000, of whom 9,000,000 were laborers, the proportion of the physical power exerted by the human factor in economic activity was to the power exerted by machinery in the ratio of one to one. In the year 1895, when Germany had a population of 50,000,000, of whom 28,000,000 belonged to the laboring classes, the proportion of manual labor to labor done by machinery was one to six, or, according to other estimates, as one to ten. Nevertheless, it was recognized that the machine without the superintendence of the human factor was merely an automaton, and that its productivity could only be immeasurably increased in cases where industrial processes could be resolved into a variety of constantly recurring and identical movements.

LETTERS TO THE EDITORS.

The Metric System.

To the Editors of Electrical World and Engineer:

SIRS:—The criticisms of Mr. G. W. Colles, in your issue of July 18, on the metric system, are at least interesting reading, but a betrayal of less animus on the part of the writer would have given greater force to his remarks. As to the German writer quoted, his attitude is not unreasonable in a conservative German appealing to the prejudices of the older generation. It is, however, significant that the younger German generation had enough common sense to adopt the metric system, the newness of which proves it to be the product of an advanced civilization.

The most conservative of the civilized nations is without question Germany; and if at any time during the last thirty years there had risen any cause whatever to serve as an excuse for going back to the old "jumble of weights and measures," many attempts in the Reichstag would surely have been made to repeal the law compelling the use of the metric system. Everybody there admits the superiority of this system, and more than once was the writer there pitied because his fellow countrymen are so far out of touch with the modern spirit in this respect. It is, however, true that in smaller towns and villages I found some good old souls who still tenaciously clung to the discarded system, so far as the law would allow.

If Congress introduces the metric system in all the governmental departments, it would not be long before the public would not only be reconciled to the system, but clamor for it. The public ought to be credited with having at least that much common sense.

It is rather hard-hearted on the part of Mr. Colles to offer our government as "a dog to try nostrums on"; but it would be still more hard-hearted to withhold a remedy for our present commercial disability in the foreign trade arising from the use of a system of exchange even more absurd than that of the Chinese or Hottentots.

SANTA ROSA, CAL. J. G. VOGEL.

Absorption of Hertzian Waves.

To the Editors of Electrical World and Engineer:

SIRS:—I have just read with much interest in your issue of June 20 the article on "Recent Progress in Wireless Telegraphy," and particularly that section referring to Fig. 3, page 1053. In order to propagate electrical waves in a definite direction, Mr. De Forest surrounds the antennæ with a metallic screen connected to earth. I beg to refer to some experiments which I made in the same direction as early as 1899, partly in collaboration with Lieut. Poncelet. The method which I employed is analogous to that of Mr. De Forest, and my results corroborate the results which he obtained. An account of the experiments was published in *Comtes Rendus* of September, 1900, and I quote below an abstract of this paper which appeared in the *London Electrician*, October, 1900 (No. 5, p. 879):

"Signor Emile Guarini and Lieut. Poncelet have sent us a joint communication on experiments they have made with screens placed between a Wimshurst machine and a coherer. The Wimshurst machine, provided with its usual condensers, emitted Hertz waves which affected the coherer, and the experimenters satisfied themselves that only direct waves need be taken account of, as when a screen was placed between the coherer and the machine the former was protected. The distance between coherer and machine was a few metres. It was found that the human body, interposed between the machine and the coherer, effectively absorbed the rays whether the body was insulated or not. This might have been expected. On the other hand, a thin sheet of iron, which would not screen the coherer under normal conditions, screened it, when connected with the earth. The writers try to explain the different action of the insulated and earthed iron plate by the hypothesis that this metal screen 'constitutes a new radiator acting by induction from the transmitter.

"'The electric waves,' they continue, 'do not pass a metallic screen, but produce in it induced oscillating currents, which in their turn produce a radiation in space.' Earthing the screen prevents this inductive effect, they suggest. We think that the authors should have examined carefully their experimental conditions, and have endeavored also to reproduce the effect with a different arrangement of apparatus, before putting forward this theory. It is a pity that so much energy is wasted in methodless experiment in a field in which patient and methodical investigation is urgently needed."

The experiments above referred to were continued until several months ago, with some modifications introduced. The later results will form the subject of an article now under preparation.

Brussels, Belgium. Emile Guarini.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

The Vector Diagram of the Compensated Motor.—Heyland.—An article, illustrated by diagrams, in which the author discusses in detail the construction of the vector diagram for a compensated motor, similar to that drawn by him for an ordinary induction motor years ago, and noticed in the Digest at the time. The diagram gives an interesting insight into the mechanism of the compensating action. If the compensation is zero, the ordinary induction motor diagram is obtained. As the compensation becomes higher, the diameter of the diagram circle increases, thus indicating the greater efficiency of the motor. It is also shown by the diagram that the efficiency can be increased by shifting the brushes. The losses in the compensated motor are smaller than in the ordinary induction motor. The stator field is the same as in the latter, the rotor field is increased, according to the compensation, but the iron losses in the rotor can be neglected. The copper losses in the stator become smaller for a given output, as the current decreases with decreasing phase difference. The copper losses in the rotor from a given load upwards also become smaller in the rotor than they are in the ordinary rotor. The diagrams also show that for a certain output the slip is always less than in the ordinary induction motor, and in the same proportion, as the rotor field becomes greater on account of the compensation. A shifting of the brushes gives the result that the slip, when the motor is running without load, is not exactly equal to zero, but may even eventually become negative. The characteristic difference between the diagram for the ordinary induction and the compensated motor, is that the former has only one diagram, while a number of them are possible for the latter, according to the changes in the position of the brushes and the strength of the compensation.—*Elek. Zeit.*, July 23.

High-Tension Transformers.—Farley.—A paper read before the Canadian Electrical Association, dealing mainly with the transformers on the Shawinigan Falls line, as typical of the latest and best practice in the design of high-tension apparatus. The rising transformers are designed to step up from the generator pressure 2,200 volts two-phase, to 50,000 volts three-phase. The lowering transformers step down from 44,000 volts three-phase, allowance being made for a line drop of 12 per cent., to 2,400 volts three-phase, two transformers being connected in "T." Taps for 86.7 per cent. are provided in both the high-tension and in the low-tension winding; since two transformers connected in this way have a slightly higher efficiency and a better regulation than they would if connected either in V or in T, with the full windings of the transformers in use. The transformers were to be designed for operation at either 30 or 60 cycles. A design was made for a 30-cycle transformer of 1,110 kw for the raising and 1,000 kw for the lowering, the characteristics being such that high efficiency and good regulation would be obtained. Both high-tension and low-tension windings were made in two equal parts, with terminals connected either for series or multiple connections. For 30 cycles the windings were to be connected in series, and for 60 cycles in multiple; the capacity of the transformers is, therefore, doubled in the latter case. Operating at 60 cycles, the transformers will then deliver their rated output with an ohmic drop only one-half of that for full load at 30 cycles, but the inductive drop will be the same under either condition, and the regulation, therefore, at 60 cycles is better than at 30 cycles, the exact figure in the case of the raising transformer being for loads having a power factor of 100 per. cent., the extremely low value of 0.376 per cent. With the number of cycles increased by 100 per cent. and the number of effective turns decreased by the same amount, the flux density in the magnetic circuit will be the same, the loss per cycle being slightly more at the higher frequency than at the lower. The iron loss is, therefore, a little more than double at 60 cycles. The transformers are of the oil-insulated type, and the heat is removed from the oil by means of the conventional cooling coils through which water is circulated. These coils are of brass tubing and have no connections or joints of any kind inside the case, so that the danger from leaks is reduced to a minimum. The coils are wound in sections of only one turn per layer. The terminal board for the high-tension leads presented a more difficult problem; its solution was found, however, in the use of standard porcelain insulators mounted on pins and cross arms. Since the insulators are under oil, a compact arrangement was effected which has the merit of making this one of the strongest points of the transformer. A novel feature was introduced into the design of these transformers which lessens to a great extent the risk to surrounding property from the presence of the quantity of oil in which the transformers are immersed. The scheme involves the safe and rapid transfer of the oil to a place of safety in case of fire in the transformer building. At the bottom of the transformer tank there is placed a large valve, which connects directly with the water mains. In case of a fire this emergency valve may be opened and the oil forced out at the top of the transformer into a sink hole. The substantial construction of the transformer case, however, together with the water which will then fill it, will protect the transformer itself from harm, the only damage likely to occur being the wetting of the apparatus.—*Canadian Elec. News*, July.

REFERENCE.

Care and Management of Electric Generators.—Creed.—An illustrated article giving some points on the proper cleaning of commutators, fitting of brushes, etc. The article is intended for the dynamo tender.—*Power*, August.

Lights and Lighting.

Radiation from the Nernst Lamp Glower.—Hartman.—A long article, illustrated by numerous diagrams and tables, in which the author gives the results of spectrophotometric investigation of the luminous radiation from the Nernst lamp glower under varying current densities. The apparatus used was a Kirchhoff spectrometer, having a callimeter with two unilateral micrometer slits, which was adapted for the purpose of the investigation. The arrangement and standardization are described in detail. As a standard source of light an acetylene flame burning under constant pressure was used. The Nernst lamp used was a 104 volts alternating-current lamp. The diaphragmed acetylene flame used as a standard was determined in terms of the Hefner standard. Currents from

0.2 amp to 1.5 amp were used. The author arrives at the following conclusions: It appears that at the rated normal current strength the radiation from the glower of the Nernst lamp is relatively rich in the more luminous waves of the spectrum. It exhibits no marked selective radiation. Its light intensity apparently increases with age and is relatively less rich in the short, but richer in the long waves, than that from the acetylene flame, but its radiation rapidly becomes more like that from burning acetylene with increasing current strength. At current strengths below the rated normal value, the increase in intensity with increasing current strength is most marked in the long waves, and above this rated normal value of current strength the increase in intensity is most rapid in the short waves. At current strengths below the rated normal value the Nernst lamp is relatively less rich in short waves than the flame of the Hefner lamp, while above this current strength the opposite is true. At rated normal current strengths, or slightly above this, the color of the Nernst lamp radiation is very similar to that of the Hefner lamp. The luminous radiation from the Nernst lamp corresponds very closely to that from incandescent calcium.—*Phys. Rev.*, August.

Possibilities of Future Economies in Electrical Illumination.—Chamen.—A paper read before the recent meeting of the Municipal Electrical Association of England. The author thinks that the outlook in the direction of working the ordinary incandescent lamp at a materially higher efficiency than at present, is not very encouraging. He then passes over to the Nernst lamp and the cost of energy required by it. He states that a large number of these lamps have been in use in Buckingham Palace for the past 13 months and have reduced the consumption of current by about 50 per cent. He thinks that there is no apparent reason why some combination of a carbon filament with one or the other of the substances which give off a brilliant light, when heated to a moderate extent, as in the Welsbach mantle and the Nernst lamp, could not be evolved. These lamps would combine the advantage of instantaneous lighting with that of high efficiency. The author then considers the Hewitt lamp and states that it seems to have a great future before it. The absence of red rays in this lamp is an objection which he feels sure will be overcome. Arc lamps, having carbons made of a mixture of carbon with other materials, are next taken up. The difficulties which this arrangement encounters are enumerated. The author feels sure, however, that these difficulties will be overcome.—Lond. *Elec. Eng.*, July 17.

POWER.

Variable-Speed Motors and Their Relation to New Shop Methods.—Lozier.—A paper read before the recent meeting of the Canadian Electrical Association. The author first discusses the new shop methods of working every tool in the shop at its highest output, and making it possible thereby to increase the output of the average shop working under the old conditions by 300 to 400 per cent. He says that in most cases a standard shunt-wound, direct-current motor of about 600 revolutions at 250 volts is the thing for all classes of work. Its principal features should be: (*a*) its armature coils should be of a type designed to carry heavy overloads without deterioration of insulation; (*b*) its design should provide for low armature reaction to permit of high speeds with weak fields without sparking; (*c*) its structure should be of the protected type, but the enclosed motor should be avoided except for special cases; (*d*) it should be in a condensed and handy form, so as to be conveniently applied to any class of tool; (*e*) it should be interchangeable, so that it can be applied to any tool without being specially designed for that purpose. In this manner a stock of motors can be drawn upon for such necessities as may arise, and of such capacity as the particular tool in question may demand, one motor being readily exchanged for another should circumstances require. The speed range, in the author's opinion, is the backbone of the whole system, and should be selected with a view to meet the maximum requirements of any operation in the particular shop. Any of the mechanical methods of speed variation has the advantage that in reducing the speed of the tool, the size of the motor may remain the same, if the same amount of work is to be done by the cutting tool. This does not hold true if the motor speed is varied within itself electrically. The electrical method has the advantage that it can vary the speed of the motor as it runs, at will, and while the work is being done. This is an advantage that the mechanical method does not as yet possess to anything like the same degree. It therefore, in the opinion of the author, appears best to combine the two methods, wherever the requirements of the case demand a large range of speed. The practice now is to use a mechanical arrangement in connection with a variable-speed motor, the former consisting of a single or double reduction back gear, which enables the motor to reach the lower speeds of the range which are thrown out, and the motor will run directly on the spindle in the higher speed range. Of the two methods of varying the speed of motors, the author states that the multivoltage system covers the amount of current that must be handled at the lowest voltage, while the field weakening determines the high limit, when it reaches the sparking point of the motor, or perhaps the armature's peripheral speed. In common practice the speed ratio in the motor itself of 71½ to 1, is found to fit the majority of cases. In this arrangement the lowest voltage is 60 and the highest 250, the field of the motor being weakened so as to increase its speed by 150 per cent.—*Canadian Elec. News*, July.

Heavy-Service Lathe with Electric Drive.—A short, illustrated article. The machine is specially designed for electric motor drive, without reference to the forms developed for belt driven machines. The usual cone-pulleys in the headstock are replaced by a seat for the driving motor and its gearing and the electrical control switches. The machine is designed for the heaviest service which two tool posts can require. The two tool posts can be fed simultaneously outward or inward. The machine comprises also a two-speed gear change in the transmission from motor shaft to spindle, a hand traveling attachment for the tail stock and a lubricator pump belted from the motor shaft. The driving motor is a shunt-wound machine rated at 20 hp. The motor is supplied by a four-wire system, which makes six different voltages available. Since each voltage has a definite motor speed corresponding to it, there are six speeds possible without employing resistances; a field rheostat for weakening the field circuit serves to give the intermediate speeds. A two-speed pinion gearing again doubles this range of speeds. The changing of connections is all done automatically by a controller mounted at the front of the head-stock below the lead screw.—*Eng'g News*, July 30.

REFERENCE.

Electric Pillar Cranes for Handling Cupola Charges.—An illustrated note, describing a recent construction of electric cranes to be used in the foundry. The effective radius of the jib is 16 ft. and the hoisting capacity is 4 tons. The operator controls all the motions from a small cabin, which swings with the crane. There are three direct-current, 220-volt motors for swinging the crane, racking the trolley in and out, and hoisting the load. The speeds are 20 to 50 ft. per minute for hoisting, 100 to 150 ft. per minute for racking the trolley, and 3 to 5 r.p.m. for swinging.—*Eng'g News*, July 30.

TRACTION.

The First Third-Rail Road in Switzerland.—An article describing a line, recently put in operation between Fribourg and Morat, 22.4 km in length. Part of the line was previously operated by steam, and electricity was adopted on account of the grades, which are from 2 to 3 per cent. After careful consideration direct-current motors were adopted in preference to three-phase, because storage batteries could be used at the station to equalize the load and act as reserve. Direct-current motors reduce their speed slightly on grades, but three-phase motors, which run at constant speed, would have to be designed of sufficient capacity to maintain this speed on the steepest grades, and this would require much larger motors than if direct-current was used. A third-rail contact was considered more desirable for large currents; the three-phase system reduces complications in the overhead work. The overhead system is used at certain stations, elsewhere the third rail is employed, which weighs 25 kg per meter and is laid in 20-meter lengths; the insulators are spaced 4 meters apart. The top of the third rail is 135 mm above the top of the track rail and 660 mm from the gauge line, and as it is held in the insulators by gravity only, it is anchored at points by two insulated steel wires attached to the cross ties. The average train consists of one four-axle motor car, one three-axle trail car and three two-axle trail cars; it weighs 70 tons, has a speed of 23 km per hour on a 3 per cent. grade and 35 km per hour on a level. The motor car has two 150-hp motors, which operate at 750 volts. There are two sub-stations, each containing a storage battery consisting of

400 cells with a capacity of 207 amp.-hours, and also one synchronizing motor direct-connected to a direct-current generator of 100 kw. —*St. R'y Jour.*, July 25.

Track Construction with Special Reference to Rail Joints.—Davies.—The author states that the percentage of carbon in the rails in the best practice in traction is from 0.35 per cent. for a 50-pound rail to 0.55 per cent. for a 55-pound rail; rails of intermediate weight should have a corresponding percentage. The average percentage of phosphorus is about 0.06 per cent. and should not go above 0.1 per cent. Sulphur is very undesisable and should be kept as low as possible. Silicon should not exceed 0.2 per cent. The author then discusses the rail jointing and describes the process of making the Falk cast-welded joint. Bonding of the rails is then discussed in detail and the requisites for a good bond laid down.—Lond. *Elec. Eng.*, July 10; reprinted in *St. R'y Jour.*, August 1.

Traction Motor Suspension.—A note on some practical points. The suspension of a motor at three points, as is usually done on account of the reaction between the pinion and gear, tends to shift the motor out of horizontal alignment and so produce an uneven wear on the gear teeth. Instead of that the motor is mounted practically rigidly by a support at the pinion end of the motor.—*St. R'y Jour.*, July 25.

Ventilating Railway Motors.—A record of tests made on the Camden & Suburban Railway Company's lines, which indicate the practicability of ventilating and cleaning railway motors while in operation in regular commercial service. Natural draft is used, air being led by means of piping to the motor cases, and thence to an exhaust located on the car truck. Some data are presented showing the heat developed in motor cases in ordinary service and the reduction effected by the use of this apparatus.—*St. R'y Jour.*, July 25.

Car Acceleration Test.—An article giving an account of an acceleration test made on a car equipped with a multiple unit control. The car weighed 30 tons. An analysis of the diagram shows that the maximum consumption was 9 kw per ton and 8.55 kw-hours per car-mile, or 272 watt-hours per ton-mile.—*St. R'y Jour.*, July 25.

A Rational Train Resistance Formula.—Blood.—A reply of the writer to the criticism of his train resistance formula published in the June 27 issue. He first states that he is justified in grouping the head and stern air resistance in one expression, and also justifies his making this factor independent of the length of the train. He also gives the arguments in favor of the use of the fractional exponent. He then takes up the terms A and B, and states that he was justified in his use of these as given in his formula, because by his hypothesis A associates all forms of resistance which are independent of the speed, and of these the journal resistance is the largest portion. Also that B associates all terms which are a lineal function of the speed, and of these the track resistance is the most important. He thinks that empirical formulæ will lead to error, as they do not take into account new or extraordinary conditions, whereas the rational formula can be made to suit actual conditions if the coefficients are properly selected. In the same number there is an editorial on this matter, in answer to the above letter. The formula is still considered an impractical one, because sufficient information has not yet been obtained as to the factors of train resistance to calculate a rational formula. This is true of all the coefficients. His final term, which uses a fractional exponent, is also disapproved when used in combination with the first power of the same variable and not so desirable as either a formula with integral coefficients, or a formula of the $a - b_x{}^n$ type, as it has no recognized mathematical precedent. It is also more difficult to compute than an expression with integral exponents. In conclusion, Blood's investigation of the subject is commended, but the editor concludes that further information on train resistance is necessary before rational formulæ can be constructed.—*St. R'y Jour.*, July 18.

REFERENCES.

Electric Interurban Traction Line.—An article describing the Columbus, Buckeye, Lake & Newark Traction Company's line, which has just been extended to Zanesville. This system is expected to play an important part in the operation of through trains between Cincinnati, Cleveland, Pittsburg and Toledo. A description of a modern power plant and distribution system is included, as also descriptions of the equipment of the road, including passenger, freight and express cars and a number of combination coaches.—*St. R'y Jour.*, August 1.

Boosters.—Stephens.—An article illustrated by a number of diagrams, showing the connection of boosters when used in combination with accumulators, especially for traction purposes.—Lond. *Elec. Eng.*, July 3.

Street Railway Power House.—A long, well-illustrated article describing additions to the generating equipment and the new car house of the Hartford Street Railway Company. A new unit installed consists of a 1,500-hp cross-compound engine, coupled to a 1,000-kw generator.—*St. R'y Rev.*, July 20.

Power Station of the Olean (N. Y.) Street Railway.—An illustrated description, especially of the newly-built station at Ceres, where natural gas is used as fuel under the boilers.—*St. R'y Rev.*, July 20.

Electric Cars in Cripple Creek.—A description of a line operating under steam railroad conditions. Steam trains run over part of the route. There are two lines, the grades on one being 10 per cent. Each car is equipped with four 52½-hp motors. The cars are dispatched by telephone.—*St. R'y Jour.*, July 25.

Notes on Railway Shop Practice.—A communication from an engineer, giving the results of an inspection of several electric railway shops and power stations in New England. A wide diversity of conditions and practice is revealed.—*St. R'y Jour.*, July 25.

Milford Street Railway System.—A description of the electric railway lines centering in Milford, Mass. Some engineering features are discussed, particularly the utilization of storage batteries for keeping up the line voltage. Direct current is employed and two of the lines have battery auxiliaries. On another line 10,000-volt alternating-current transmission, fed by an inverted rotary, is employed. A comparison is made of the results obtained.—*St. R'y Jour.*, July 25.

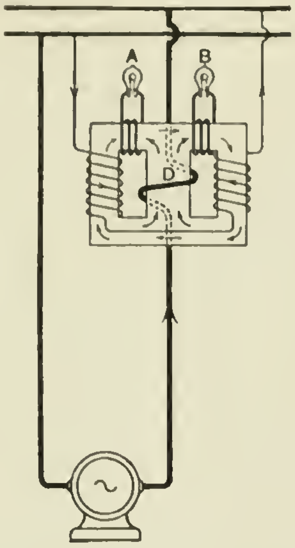
Emergency Car for Traction Roads.—A description of an emergency car in use at Orange.—*St. R'y Jour.*, July 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Single-Phase Motors as a Means of Increasing Station Earnings.—Layman.—A paper read before the recent meeting of the Canadian Electrical Association. The author states that economical operation of central stations is inevitably drifting towards the ideal basis of generation of one form of current, and the development by every means possible of a high load factor. Operating engineers are specifying the installation of consuming devices, which afford the lowest first cost, and the simplest possible system of distribution. The author contends that the single-phase, alternating-current motor lends itself readily to the development of this general scheme of economic production. The author is an advocate of the following arrangement of station service: (*a*) For large plants—Polyphase generators, with switchboard arranged for operating; first, polyphase feeders for all large power and rotary converter service; second, single-phase feeders for all general lighting service, and for all small power work, the switchboard facilities being such that any single-phase feeder may be switched to either phase of the generator busses; third, independent feeder regulators for all polyphase as well as all single-phase feeders. (*b*) For small stations—Either polyphase generators with single-phase feeders, which may be thrown by the proper switchboard devices to either phase of the generator, and each feeder provided with independent pressure regulator; or, single-phase generators with single-phase feeders, each feeder being operated with independent pressure regulator. This policy with respect to station and distribution equipment is based on the conviction that the single-phase motor has come to stay, and that it affords an alternating-current central station—polyphase or single-phase—the ideal means of distributing small power. The author believes that single-phase motors should receive the preference of the operating engineer of multiphase stations, up to units of at least 15-hp capacity, and in selected instances up to units of even 35-hp capacity. The justification for the use of single-phase motors by polyphase plants arises from the lower first cost of individual power installations, and also the higher efficiency of these installations in small units. In conclusion the author gives a description of a single-phase motor.—*Canadian Elec. News*, July.

Wires, Wiring and Conduits.

Arrangement and Control of Long-Distance Transmission Lines.—Cowan and Andrews.—The conclusion and discussion of their paper, previously noted in the Digest. The authors discuss methods of charging the cells and describe and illustrate in detail a method which one of them worked out some years ago. They conclude with the description of a modification of the discriminating transformer, which may be used with alternating current generators connected in parallel, for the purpose of indicating whether a generator is feeding the bus-bars or receiving current therefrom. Without some device of this character, the attendant has nothing to indicate, in the event of a failure, which generator to switch out, as the fault will cause the ammeters on both the defective and the other machines to indicate an excess current. The discriminating transformer is connected as shown in the adjoining figure. Red and green lamps, *A* and *B*, are connected respectively across the terminals of two secondary windings. A primary winding is connected directly across the bus-bars or across any secondary circuit excited from the main bus-bars. The effect of this primary winding is to induce a magnetic flux in the core of the transformer indicated by the thin arrows. A second primary winding, *D*, consists of one or two turns inserted in series with the generator connections. The effect of a generating current in this winding is to induce a flux in the direction shown by the thick arrows. The fluxes due to the two primaries oppose each other through the secondary connected to the red lamp, and assist each other to light the green lamp. Should the generator fail the direction of the series flux relatively to the shunt flux will be reversed, and as a consequence the green lamp will be extinguished and the red lamp lighted. The authors state that this current direction indicator has also proved of great assistance in disconnecting machines which were in parallel.—Lond. *Elec.*, July 17.



DISCRIMINATING TRANSFORMER.

ELECTRO-PHYSICS AND MAGNETISM.

Rôle of the Earth in Wireless Telegraphy.—KOEPSEL.—An article in which the author investigates mathematically the question whether the earth plays an essential rôle in wireless telegraphy. He thinks that it would be possible to get nearer to a solution of this problem if it could be proved that the influences which it is possible to exert on the earth with an ordinary sender are of such magnitude that they can influence materially the potential of the earth. He states that this appears at first sight paradoxical, as the electrostatic capacity of the earth is supposed to be infinitely great, but as a fact the earth has not such a great electrostatic capacity, it being only about 708 microfarads. He then investigates the question whether it is possible, with the relatively small means of modern wireless telegraphy, to disturb the potential of a globe of this capacity to a sensible degree or perhaps even to throw the globe into oscillations. He considers the case of an oscillating circuit with resonance wires on both sides. The resonance depends only on the product of the capacity and the self-induction of each resonance wire. Therefore, one of these values can be changed as desired. If, for example, a piece is cut off from one of the resonance wires, its self-induction and its capacity are, therefore, changed, and the resonance is disturbed. The piece cut off can, however, be replaced by a globe of a certain capacity, and this process can be repeated *ad libitum*. It is found in this way that the greater the wave length, the greater will be the radius of the globe which replaces an aliquot part of the wire. For instance, in order to replace with a wave length of 40 meters, 90 per cent. of the length of the resonance wire, there is required a globe of 0.57 meters radius. With a wave length of 4,000 meters it takes a globe of 407 meters radius to do the same thing. Furthermore, it is seen that with a wave length of 4,000 meters a resonance length of 10 cm from a wire 1 mm thick, would demand the connection of a globe of 979,000 meters radius. The capacity of such a globe is 9.79 × 10 to the seventh power, that of the earth being 6.37 × 10 to the eighth power; its capacity is, therefore, close to the capacity of the earth. When thick wires are used, the radii of the globes become still greater, and under these circumstances the capacity of the earth will be reached. The author then investigates at which wave length the earth will be in resonance with the oscillating system, if a certain minimum self induction, which can be reached within practical means, is admitted for that piece of conductor which serves as the connection with the earth. He finds that with an oscillating circuit of a wave length of 10,000 meters, at one side of which a resonance wire of 2,500 meters length is carried vertically upwards and the other side of which is earthed through a wire of 100 cm self-induction, the earth can be gotten into resonance. He calculates that the amount of electricity necessary for this is 0.0009 coulomb, an amount which can be reached in practice without any difficulty. The maximum current rush would not go above 15 amp., with minimum damping. The author thinks that though Marconi, with his installations for ocean telegraphy, probably has not gotten the earth into complete resonance yet, as the wave length which has been used by him is still too short for this purpose, he comes very close to the numbers mentioned above. If it is borne in mind that the resonance phenomena do not manifest themselves suddenly, but show frequently very flat maxima, it is not improbable that he might have put the earth if not into complete, yet into quite appreciable resonance, so that fluctuations of potential of the magnitude of one volt do not appear to be excluded, and in this manner the ocean telegraphy would really have been earth telegraphy. The author explains the fact that horizontal wires are not nearly so effective as vertical ones, for the reason that the horizontal wires localize the action because they are near to the earth. The differences of potential will be considerable in the neighborhood of the sender, but will not extend to appreciable distances. The vertical wire, however, because it is vertical, has no appreciable reaction on the earth, and it will be able to exert such a reaction less and less with its increasing distance from the earth, and therefore the fluctuations of potential have to distribute themselves over the earth. According to this theory, it should be possible to get signs at any desired distance, if only the sender is constructed in such a way, that by its help the earth can really be put into resonance. The author states that the only assumption made in these considerations is that the phenomena which are observed with systems of small wave length, can be transferred to those of large wave length. Whether the law no longer applies with increasing dimensions can be demonstrated only by experiments on a large scale. But as changes in the resonance length up to 90 per cent. with wave lengths of 40 meters, do not begin to show any appreciable deviation from the resonance law, the author thought himself authorized to draw the last consequences from this law, which may throw an entirely new light on the phenomena of wireless telegraphy.—*Dingler's Polyt. Jour.*, June 20.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Manufacture of Vanadium and its Compounds.—GIN.—A paper read before the recent International Congress of Chemistry at Berlin. The principle of the process is based on the great conductivity of vanadium trioxide and on the facility with which vanadium trifluoride is formed when fluorine attacks the trioxide in the presence of carbon. The vanadium trioxide, prepared by calcination of vanadic acid in the presence of carbon, is mixed with a suitable portion of retort carbon and pulverized resin, and worked up under heat to a plastic paste. This paste is pulverized and is then wire drawn hydraulically into prismatic or cylindrical bodies, which are exposed to a high temperature in a hermetically closed oven. The electrodes thus obtained are protected from the heat and dampness until they are used. The electrodes are said to be able to stand a current density equal to 0.7 of that of carbon electrodes of the same section. The anode of the furnace consists of a bundle of these electrodes; the cathode consists of a block of iron. Vanadium fluoride is electrolyzed with the formation of vanadium at the cathode and fluorine at the anode, which forms there a new quantity of vanadium fluoride, which is again electrolyzed. A good efficiency and sufficiently fluid bath is said to be obtained with a mean density of 2 amp. per sq. cm of the anode section and 6 amp. per sq. cm of the cathode, the voltage of the system being 11 to 12 volts. Some fluoride of iron is preferably added to the bath from time to time. Iron-vanadium alloys are thus obtained, and if iron is not introduced into the bath, almost pure vanadium may be obtained, but the tapping is said to be most sluggish and the contents of the bath ought in this case to be removed in the solid state, instead of by casting. It is stated that the process may probably be applied under identical conditions for the commercial manufacture of alloys of vanadium with copper, aluminum, manganese, etc., by replacing the cathodic bath of iron by a bath containing the metals whose alloy is desired.—Lond. *Elec.*, July 17.

REFERENCES.

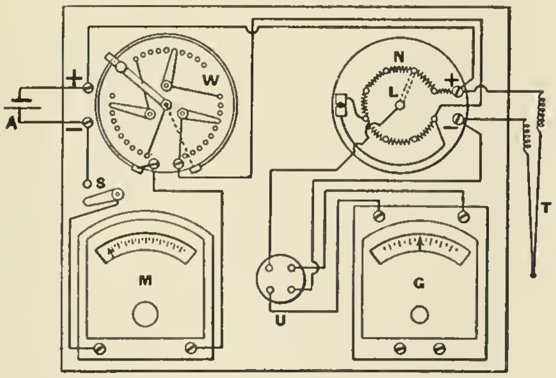
Accumulators in Dish Form.—Herzog.—An illustrated description of a new type of accumulator and the process of manufacturing. The accumulator plates are dish-shaped and are piled one on top of the other, the insulation of the various plates being accomplished by means of glass balls. The inner side of each plate acts as the positive electrode, and the outer side as the negative. The plates are provided on both sides with channels serving for the reception of the active mass. A table is given of the capacities in ampere-hours, etc., of the various types.—*Schweiz. Bl. f. Elek.*, June 22.

Electric Steel Furnace.—An illustrated description of the Kjellin electric steel furnace in operation at Gysinge, Sweden. The arrangement may be considered as an alternating-current transformer, the primary of which is supplied with 3,000 volts alternating current. The secondary is a single turn and consists of the material to be fused; there are, therefore, no electrodes.—*Electrochem. Ind.*, July.

Classification of Electrochemistry.—Townsend.—A continuation of his article in the first part of which he gave an outline of a systematic classification of the art of electrochemistry. He now discusses the characteristic features of each class separately.—*Electrochem. Ind.*, July.

Units, Measurements and Instruments.

A New Potentiometer.—A short illustrated description of an instrument designed by Prof. Lindeck and made by the German Physikalische Reichsanstalt at Berlin. A diagram of connections of the instrument is shown in the adjoining figure. *A* signifies the accumulator, *W* a variable resistance, *M* a milliammeter. The current also flows through a permanent resistance. Connected in shunt to the latter is the e.m.f. to be measured, in series with a galvanometer, *G*. To determine the e.m.f. in question, the variable resistance is adjusted until galvanometer is at zero; then obviously the desired e.m.f. is found by multiplying the current by the fixed resistance. Several fixed resistances are provided for measuring different e.m.f's. The e.m.f. to be measured is connected at *T*. The resistance box, *N*, contains three resistances, to be used for checking the milliamperemeter. If this is to be done, *T* is replaced by a standard cell and the compensation is carried out as usual. There are three resistances in *W*, consisting of three parts, containing 9 x 100, 9 x 10, and 9 x 1 ohms. With certain combinations of resistances the ammeter, if correct, will point to 150, 100 and 50 respectively on the scale. The resistance, *W*, has also a wire of about 1.5 ohm resistance arranged around the periphery of the plate forming the cover. It seems that the chief idea is to use an accurate milliammeter, together with a known resistance in order to measure voltages.—Lond. *Elec.*, July 10.



NEW POTENTIOMETER.

Telegraphy, Telephony and Signals.

Electrical Operation of Switches and Signals.—A long, well-illustrated article describing the Crewe system. The system depends on the use of long-pull electromagnets. A high resistance shunt is automatically switched into series with the signal magnet, as soon as the arm is lowered and the signal is held off in this way with quite a moderate expense of current. The long pull electromagnets have hollow conical pole pieces, and the end of the armature is also turned conical to fit into this. By adopting a very narrow angle, it will be seen that for a given travel of the armature the distance across the air-gap may be made as small as desired, and at the same time, since the lines of force start out from the whole inner circumference of the hollow, conical pole pieces, the area of the gap is much larger than it would be if the pole and its armature were cut off square in the usual way. Both these facts tend to diminish the magnetic resistance of the air-gap and thus the amount of current needed to move the armature. In the area of points (or switches, as they are called in this country), direct-pull magnets are not used, but a small reversing motor is employed instead. This motor is placed in a cast-iron box sunk below the rail level, near the points to be operated. The armature is arranged so that it can be replaced by a new one in a few minutes. The armature shaft drives by means of clutches a worm shaft, through which a wheel, having cam grooves on it, is rotated. These cam grooves act on the point rods and locking bars, the arrangement being such that to throw the points the signal man has merely to move over one lever in his cabin. The movement of the lever locks the signals, giving admission to the road for which the points are to be moved, throws over the locking bar, unbolts the points and finally releases the signals for the road for which the points are now set. The construction of the various devices is illustrated and explained in detail. The interior of one of the signal cabins is also shown.—Lond. *Eng'g*, July 17.

REFERENCE.

Rôle of the Earth in Wireless Telegraphy.—Koepsel.—See abstract under Electro-Physics.

New Books.

Experiments with Vacuum Tubes. By Sir David Salomons, Bart., M. A. London: Whittaker & Co. 49 pages, 54 illustrations. Price, 2 shillings.

This little book describes in a clear and entertaining manner a number of interesting facts pertaining to vacuum tubes. Many of the observations recorded in the book appear to be original and display considerable experimental skill. The writer has taken pains to express his observations and deductions in clear and simple language. The treatment of the subject is entirely practical. There are no mathematics, and if a theory is propounded the facts are brought forward upon which the theory is based. The book will be prized by all who are interested in the phenomena of the transmission of electric currents through gases.

Die Berechnung Elektrischer Leitungsnetze. By Joseph Herzog and Clarence Feldmann. Second Edition. Vol. I. Berlin: Julius Springer. 402 pages, 269 illustrations. Price, 12 marks.

This book deals with the graphics and arithmetic of conducting networks. The subject is very fully treated, both with relation to direct and to alternating currents. The treatment is clear and well illustrated by examples. It would be well if a translation could be secured for English-reading electrical engineers. The first chapter deals with the elements of the subject. The second chapter considers the simplest conducting systems. The third discusses the theory of conducting networks. The fourth sets forth the distribution of current and pressure in conducting networks. The fifth takes into consideration the distribution of current and pressure over long conductors. The book deserves the study of all electrical engineering students.

The Work of Wall Street. By Sereno S. Pratt. New York: D. Appleton & Co. 280 pages, illustrated. Price, $1.25.

Mr. Pratt, who is well and favorably known as a skillful journalist, has given special attention for many years past to financial questions, and has not allowed his other duties, such as New York correspondent for the *Philadelphia Ledger*, to interfere with his continuous study of the problems that center around the southern tip of Manhattan Island. In fact, this extremely handy and interesting book could not have been written by any one who was not only an expert but had got his facts at first hand as a financial reporter and economic writer. Mr. Pratt has, indeed, evidently accumulated so much material, it would be a worthy ambition in him to elaborate it some leisure day in a more pretentious book.

Dealing with dry statistics and serious aspects of finance, Mr. Pratt has made his treatment broadly philosophical and human, so that every page is illumined by some reference or fact or anecdote that catches the eye and retains the attention. Such a chapter, for instance, as that on panics, is at once thrilling as a record of the ups and downs of fortune, but full of information as to the manner in which economic science and practical finance endeavor to lessen the evils of reckless speculation and consequent loss and anxiety.

There are many notes and references of interest in the book in regard to the employment of electrical communication, and it is difficult to conceive of the Stock Exchange and modern banking without the telegraph, the cable, the telephone and the ticker. Incidentally, we observe that Mr. Pratt says that telephones were introduced in 1876. This must be a slight anachronism, as it was in that year the crude apparatus was shown by Prof. Bell at the Centennial. But it is certain that Wall Street was quick to adopt the new appliance, and some of our readers will recall Mr. E. A. Calahan's recent articles on the evolution of such methods "in the street."

Steam Power Plants. Their Construction and Design. By Henry C. Meyer, Jr., M. E. New York: McGraw Publishing Company. 160 pages, 65 illustrations, 16 plates. Price, $2.00

An admirable feature of this book is the essentially practical character of the information which it conveys. As a rule the writers of books on steam engineering appear to consider it necessary to preface the practical treatment of questions with a compilation of matter from text-books and theoretical treatises, there very often being little connection between such matter and the part original with the author. In the present book statement of theory, where it appears at all, is confined to but one or a few introductory paragraphs to a chapter, necessary for a logical development of the subject treated.

The first chapter is on the design of steam power plants, which is treated under the sub-heads of location of plant, drawings, type of power house, building foundations and engine foundations. The following two chapters are on steam boilers, complete specifications for tubular and water tube boilers being included. Chapter IV is on the selection of engines, and chapter V on specifications for the same. Steam and water piping are considered in chapter VI, condensers in chapter VII, and feed water heaters and economizers in chapter VIII. Chapter IX is on mechanical draft, chapter X on chimneys, and chapter XI on coal handling, water supply and purification. We know of no book on steam engineering that should prove more useful to the electrical engineer who from time to time has to deal with the design of the steam end of electrical plants, or who may be called upon to check steam equipment specifications.

The Polytechnic Engineer. Annual Organ of the Engineering Society of the Polytechnic Institute of Brooklyn, 1902-1903. 114 pages.

The preface of this volume opens with a criticism on similar books on the ground that the contributions are often by eminent experts and not representative of the efforts of society members; and it is added that the design is to limit the pages to papers prepared by members of the college engineering society. The papers are eleven in number, only one of which, however, treats of an electrical subject. The author of this is Mr. R. W. Hutchinson, Jr., the title being, "The Present Status of Industrial Electrochemistry." This gives an excellent résume of the more important commercial electrochemical processes, particularly those of recent date. In a paper entitled, "The Turbine, an Ideal Engine," Mr. Henry T. Leas sketches the theory of steam turbines, and describes in detail the Parsons and De Laval types. A paper by Mr. O. H. Clarke sums up the advantages and disadvantages of organic and mineral lubricating oils, the comparison being in favor of the latter.

Electrical Influence Machines. Their Historical Development and Modern Forms, with Instructions for Making Them. By John Gray, B. Sc. Second Edition. New York: D. Van Nostrand Company. 296 pages, 105 illustrations. Price, $2.00.

As the only work in the English language on static electrical generators, the new edition of this useful book is very welcome. Descriptions of the latest machines which have proved practically successful have been added, and some machines described in the first edition which have not given results of any practical value, have been omitted. A short account of the electronic theory is given and some additions is made to the early history of the static machine with oppositely rotating plates. As in the first edition, the greater part of the space is taken up with a description of the several types of Holtz and Wimshurst machines, about half of the contents being devoted to these. The author states that theoretically the static machine is equal in efficiency to the dynamo electric machine; owing, however, to leakage and faulty design, the practical efficiency of the former is only from 5 to 10 per cent. There is thus evidently much room for improvement, and the author points out in what direction this may well take place.

Electrical Practice in Collieries. A Manual for Colliery Managers, Under-Managers, Engineers and Mining Students. By Daniel Burns. London: Charles Griffin & Co. 221 pages, 142 illustrations. Price, $2.00.

The use of electricity in mining of late years has been so extensive, it has created virtually a new department of electrical industry; and this little volume is a striking evidence of the specialization that has already set its mark on the new field. A good part of the matter in the volume would also be pertinent in any other treatise dealing with questions of light and power in general, but as the mining engineer is kept specially in mind by the author, there is no harm in telling him some of the things he ought to know, if the instruction is clearly and usefully given, as it is here.

The more direct treatment of electricity in mining may be said to begin with Chapter V, where lighting is taken up. The next chapter deals with pumping, and then comes haulage, while coal cutting occupies the whole of Chapter VIII, and a final chapter is given to miscellaneous appliances, in which again lamps crop up, although they should apparently fit into Chapter V. Good practice is indicated and approved in each instance and a lot of practical figuring is given, so that the engineer can determine what results he ought to get from the capacity of his apparatus. The chapter on haulage is a little disappointing, for it is made to include with that subject the kindred but by no means identical one of transportation; so that mining locomotives hardly get the space and detail to which we think they are entitled. On the other hand, coal cutting is dealt with broadly and fully, and we are interested to note that in commenting on the performance of an American coal cutter, it is said that it could not probably be repeated in Great Britain, chiefly because "British coals are on the whole harder and more difficult to cut than the average American coals." It is, however, admitted that a great deal depends upon the willingness and aptitude of the workman, and we have more than once heard English employers say that they could not get out of American tools the records made almost as a daily commonplace in this country. Under the head of miscellaneous appliances come drills, and we are glad to note that the author has a favorable opinion of them, though admitting the rareness of the percussion type.

Correnti Electriche Alternate. Semplici, bifasi e trifasi. Manuali Hoepli. By Attilio Marro. Milan: Ulrico Hoepli. 615 pages, 217 illustrations. Price, 6.50 lires.

This is a practical treatise on alternating currents and alternating-current machinery, intended for the use of electrical engineers and students of electrical transmission and distribution plants. The book is in heavy pocketbook form and contains a great variety of practical information in readily accessible form. The illustrations are inferior from the standpoint of the American artist in illustration; but this is not a vital defect in a purely utilitarian volume. The work relates particularly to Italian construction and is specially interesting as clearly setting forth European methods of installation.

Electrical Plant in the Newark Free Public Library.

NEWARK, N. J., LIBRARY.

The buildings of the Free Public Library of Newark, N. J., occupy about 102 x 220 ft. The main building is four stories in height and 102 x 137 ft. in area, and is constructed mainly of brick, but faced on the front and part of the sides with Indiana limestone appropriately carved with figures and names prominent in art, literature and bookmaking. The interior is more strikingly beautiful. The entrance vestibule is executed in white Italian marble and mosaic and the central rectangular corridor into which it leads has a wainscotting of marble and a plaster frieze and ceiling decorated in color. Through the center the corridor is open to the skylighted roof, leaving hallways at each floor in the torm of arcades surrounding the court-like center space. From floor to floor these are reached by two bronze-railed marble stairways at each side except from the first to the second floor, where they are replaced by a single broad staircase entirely of marble, rising through the middle of the corridor, with its space directly in front of the main entrance, and its head at the entrance of the library delivery room on the second floor.

The buildings are lighted by direct-current arc and incandescent lamps and heated with exhaust steam by indirect radiation in connection with a plenum system of ventilation, and supplementary direct and direct-indirect radiation in the most isolated locations. A passenger elevator, five book-lifts, a plenum fan and three exhaust fans, all motor-driven, constitute the power load. The mechanical plant, including boiler and engine rooms, occupies a third separate building, located at the other rear corner of the main building, on a level with and adjoining the basement through which the pipe, duct and wire runs are carried. The boiler room is 34 ft. x 24 ft. under the rear court yard, so that coal may be brought in from the street and dumped through chutes to the storage bins, which are at one side of the room facing the boilers with a 6-ft. firing floor between. The steam generating equipment comprises two 100-hp return tubular boilers set side by side with space left for a third. They were furnished by the Erie City Iron Works, are 5½ ft. in diameter x 16 ft. long, and contain 5½ x 6-ft. grates. The boiler settings are arranged with fire brick flues above so as to cause the gases of combustion to pass back over the shell after passing through the tubes before being finally discharged through the brick smoke header. The latter contains a damper automatically controlled by a Kieley regulator to maintain the desired steam pressure, and connects to a rectangular brick chimney 74½ ft. high and 3½ ft. square on the inside. From a dry pipe in each boiler, connection is made by a 6-in. copper bend to a 10-in. steam header, which pitching slightly downward, passes through the dividing wall into the adjoining engine room, where it terminates in a down-curving elbow, the bottom being closed with a blank flange and dripped to a steam trap. A 7-in. pipe is taken from the upper side of the main near the end to a point overhead between the engines where through an inverted Y it divides into two 5-in. pipes to supply each of the two engines.

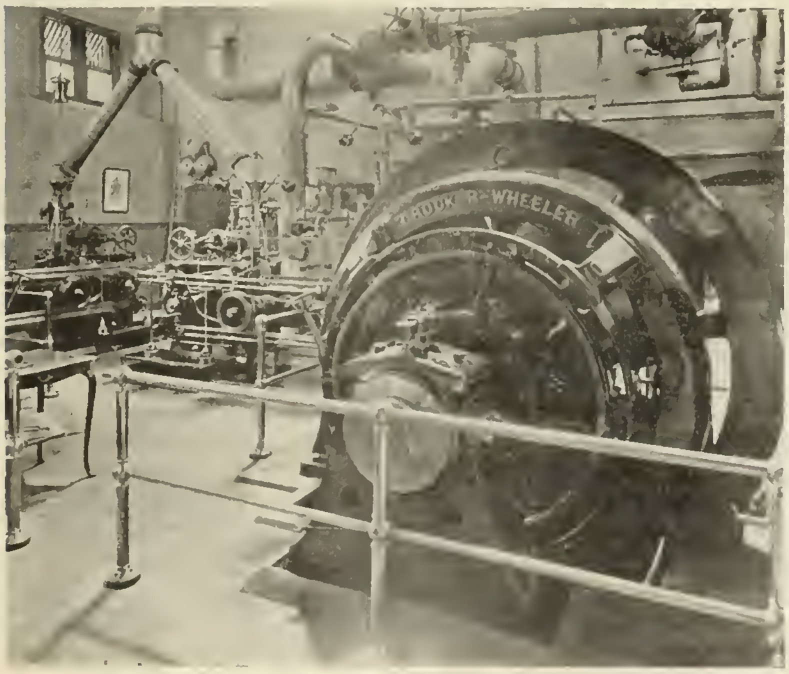


FIG. 2.—DYNAMO ROOM, NEWARK, N. J., PUBLIC LIBRARY.

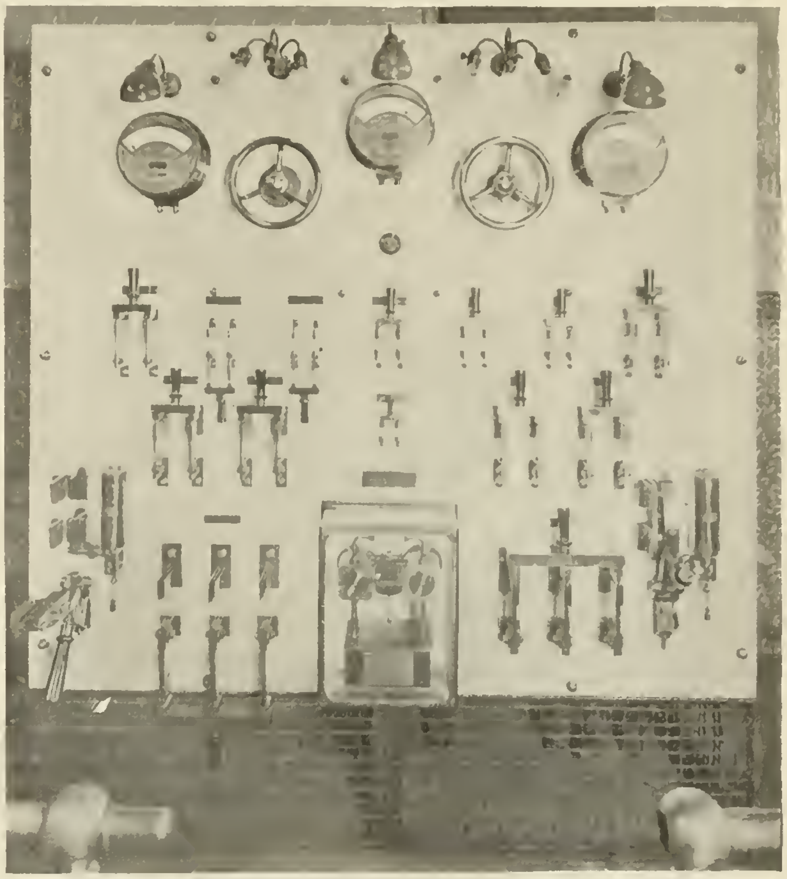


FIG. 3.—SWITCHBOARD, NEWARK PUBLIC LIBRARY.

The engines are Watts-Campbell Corliss type 16 x 30-in., horizontal side-crank, extra-heavy engines, and drive two Crocker-Wheeler 100-kw direct-current, 8-pole generators by direct connection at 120 r.p.m. When admitting steam at an initial pressure of 85 pounds, cutting off at one-quarter stroke, and exhausting with a back pressure of 5 pounds per square inch, the engines are capable of developing 136 ihp. Speed regulation is obtained in the usual manner by altering the point of cut-off through the agency of a fly-ball governor and mechanism, but to avoid accident a second governor is provided and so set that an increase in speed of 10 r.p.m. will cause the closing of a butterfly valve, cutting off the steam supply. The fly-wheels are 10 ft in diameter, weigh 20,000 pounds and are placed between the cranks and generators.

The generators were designed for a normal load of 800 amp. at 125 volts and a safe momentary overload of 40 per cent., but have proved capable of carrying even more, and for a considerable length of time. On one occasion, while only one set was running, the load was gradually increased until at 1,130 amp., or 41 per cent. overload, the engine reached its limit of power and refused to cut off. It is reported that throughout the test there was no noticeable sparking at the commutator and that at the close of it the field coils were only about 30°, and the brushes 7° warmer than the surrounding air. A total of some 2,500 16-cp lamps constitute the lighting load, and, as previously stated, the power load includes four motors in connection with the ventilation system, five motors for book-lifts and one motor for the passenger elevator.

The air circulation for ventilating is established by an 8-ft. Seymour disc fan driven by belt at 220 r.p.m. by a 15-hp motor, and discharging in that time between 63,000 and 65,000 cu. ft. of air. The removal of the vitiated air is made positive by the use of three exhaust fans of the Seymour disc type, located in the attic. One having a 4-ft. wheel is driven by a 5-hp motor, and two having 3-ft. wheels by 3-hp motors. Of the motor-driven book-lifts, three will raise 25 pounds at the rate of 150 ft. per minute, and the other two will carry 100 pounds 100 ft. a minute. All are provided with electric control whereby the cars may be brought to any floor by pushing the button corresponding thereto, if all of the doors into the shaft are closed. The opening of any one of them breaks the circuit and stops the car. The passenger elevator has a travel of about 52 ft. and will carry a maximum load of 2,000 pounds at 200 ft. per minute, or an average load of 1,200 pounds at 250 ft. per minute. In addition to the customary slack cable safety device and automatic top and bottom stops, the shaft was made tight at the bottom to afford an air cushion to catch the car in case of a failure of the other protections. After its installation the elevator was tested by loading the car with a weight of 2,000 pounds, and allowing it to drop from the top of the shaft, which it did without receiving any injury.

The switchboard is about 6½ ft. wide, 7½ ft. high and consists of two panels of white Italian marble. A single set of bus-bars on the back of the board serves for both light and power service, being connected to each generator through a single-throw, 3-pole switch, protected by a single-pole circuit-breaker. The instruments include two ammeters, one for each machine; a voltmeter, which by a multiple-point switch may be connected to either generator, and a recording station wattmeter. The feeder circuit switches are symmetrically grouped on both panels between the dynamo switches and the indicating meters. Three are for power and the remainder for light. The lighting feeders are supported on porcelain knobs 4 ft. apart and lead from the switchboard to and up the elevator shaft. These include two sets of conductors for the first floor and one set for each of the floors above. From a cut-off box near the shaft at each floor the distributing circuits are taken to the various marble panel boards, seventeen in all. In determining the sizes of the conductors, the maximum loss of potential allowed between the switchboard and the lamps was 5 volts: 3 in the mains, 1 in the sub-mains and 1 in the distributing circuits.

Mr. James M. Seymour, Jr., of Newark, N. J., was the consulting engineer in behalf of the library trustees. The contractors for the various parts of the equipment were as follows: The Philadelphia Steam Heating Company, for the heating system and steam pipe work; Gillis & Geohegan, of New York, for the fans and tempering coils; the Crocker-Wheeler Company, of Ampere, N. J., for the electric generators, and Blake & Williams, New York, for the electric wiring. Mr. George A. Warren is the operating engineer of the plant.

New Form of Resistance Box or Wheatstone Bridge.

The accompanying illustration shows a new form of resistance box or Wheatstone bridge, being placed upon the market by the Leeds & Northrup Company, 259 North Broad Street, Philadelphia, Pa. The instrument has been designed primarily for the rapid and accurate work required in submarine cable testing, but it is, however, adapted to any kind of resistance measurements required to be made in laboratories. As will be seen, the rheostat is the decade plan, consisting of four dials. Fig. 2 gives a sectional view taken of one section of the dial, and shows the brushes which make contact with the segment. There are eight of these brushes, of which four have an end bearing against the upper portion of the inside of the segment and four have an end pressure against the lower part of the inside of the segment. By this construction all strain is removed from the center bearing and the "feel" of the switch handle is the same throughout the entire sweep of the brushes over the segment. The edges of the brushes bearing against the segments do not lie in a line at right angles in the length of the brush, but are inclined at the small angle, thus obviating all danger of the brushes' edges cutting grooves in the segments. The contact resistance of the brushes with the segment to the resistance of the brushes themselves is on an average of about .0007 ohm, an entirely eligible quantity.

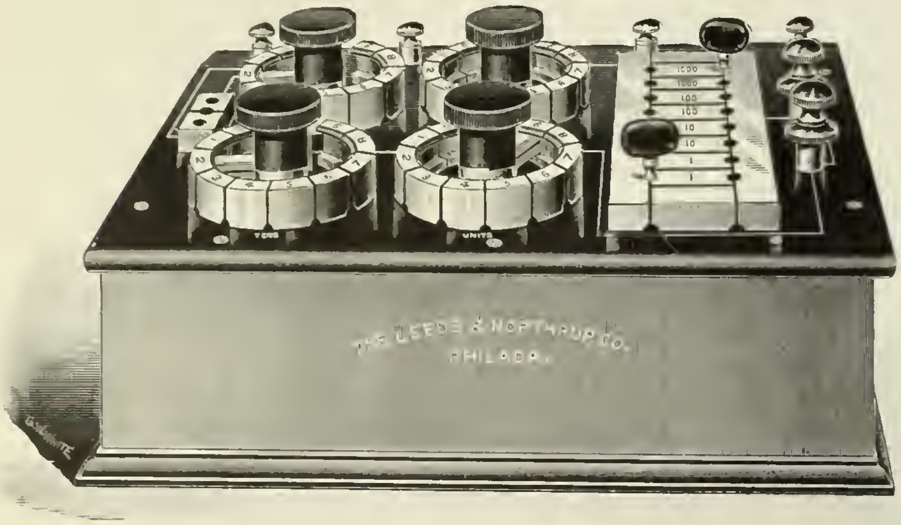


FIG. 1.—NEW TYPE OF WHEATSTONE BRIDGE.

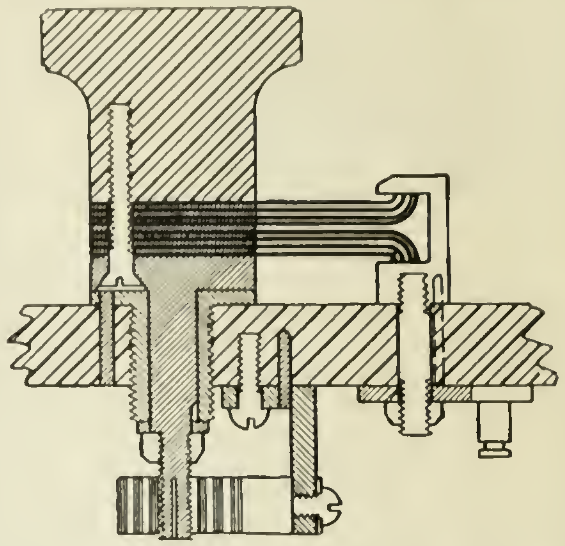


FIG. 2.—SECTIONAL VIEW, SHOWING CONTACT BRUSHES.

The arrangement of ratio coils has been adopted from a construction developed in Germany, but not heretofore used in this country. According to this arrangement, all of the ratio coils have one of their terminals connected with the common center, which corresponds to the bar marked *C*, in Fig. 3. The other terminal of the coil is connected to a separate plug, shown in the center row of Fig. 1. By this means even and uneven ratios may very simply be obtained, and the arrangement enables the user of a bridge to discover and check any errors in the adjustment of the coils, if such exist. Furthermore, by using more than two plugs and joining certain of the coils in parallel combinations, a large variety of ratios may be obtained. This system offers a convenient method of measuring the sensibility of a bridge and galvanometer combination. Another advantage is that errors due to plug contacts are practically eliminated, since only two plug contacts enter the circuit, while with even ratios is only the difference in the resistance of these contacts they can affect the result.

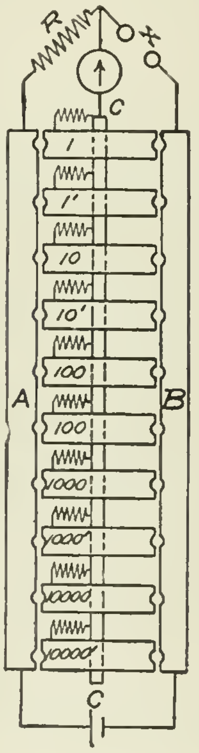


FIG. 3.—SCHEME OF CONNECTIONS.

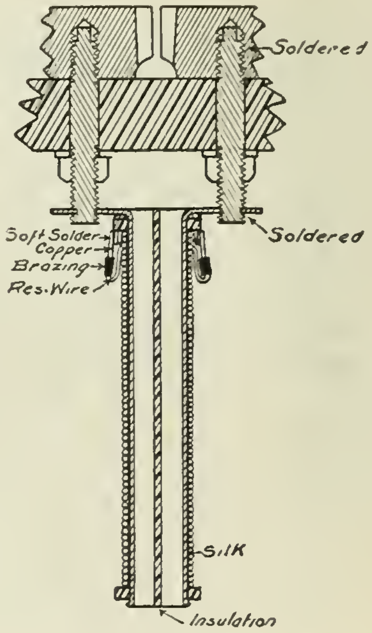


FIG. 4.—RESISTANCE SPOOL.

The spools upon which the resistance wire is wound are metal tubes (Fig. 4) in insulated metal halves, which also serve as terminals. The insulation between the two metal halves is made very perfect and the construction is such that the heat generated in the spool is rapidly dissipated, part passing off by radiation from the inside of the spool, part by radiation from the outside and another portion by conduction through the metal of the spool into the terminal soldered thereto. The makers guarantee an accuracy of adjustment for the ratio coils of 1/50 of 1 per cent., and for the rheostat coils of 1/25 of 1 per cent.

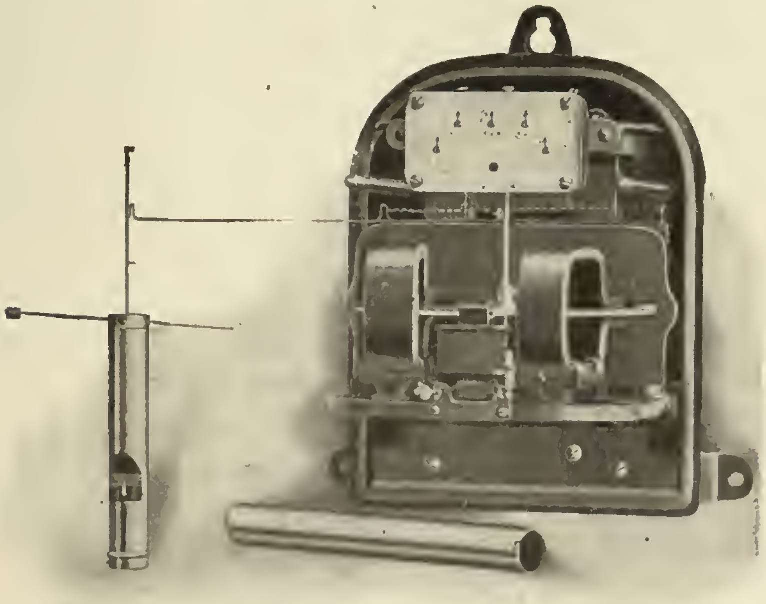
Cross Arm Manufacturers Organize.

The manufacturers of cross arms, pins and brackets used in electric line construction, held a meeting in Indianapolis, Ind., recently and organized an association to be known as the National Arm, Pin and Bracket Association. Forty members signed the roll, including some of the largest manufacturers in the country. The manufacturers disclaim any intention to control prices, but desire the bringing about of greater uniformity in the size and style of arms. It is said that the adoption of a standard was the main purpose of the organization. There are about 150 firms engaged in the manufacture of arms, pins and brackets, and it will be the purpose to bring them all into the association. The following officers were chosen: President, W. H. McElwee, Ronda, N. C.; vice-president, Daniel Ravenel, Franklin, N. C.; secretary, J. B. Majors, Madison, Ind.; treasurer, R. L. McQuat, Indianapolis, Ind.

Portable Torque Balance.

To enable station managers to measure torque when purchasing meters, the General Electric Company has designed a portable "Torque Balance" for measuring the torque of any motor meter. The stationary element consists of a light cylinder mounted on a supporting base which may be secured to a suitable support by means of a small center screw. The balance or weighing element is composed of two parts—a horizontal arm carrying the standard weight, and a vertical arm. The upper half of the vertical arm is provided with three small loops, while the lower half extends through the cylinder and terminates in a small index or pointer moving in the opening in the side of the cylinder. The entire moving system is suspended by means of highly polished pivots and bearings, insuring great sensitiveness.

The balance is connected, by means of a small link of finely-drawn wire, to a lever provided with three small loops similar to those of the vertical arm of the balance. This lever is attached to the meter shaft by a friction clamping sleeve. Two standard weights of one gram and one-quarter gram are supplied with the instrument and are secured in small receptacles conveniently located in the base holding the cylinder.



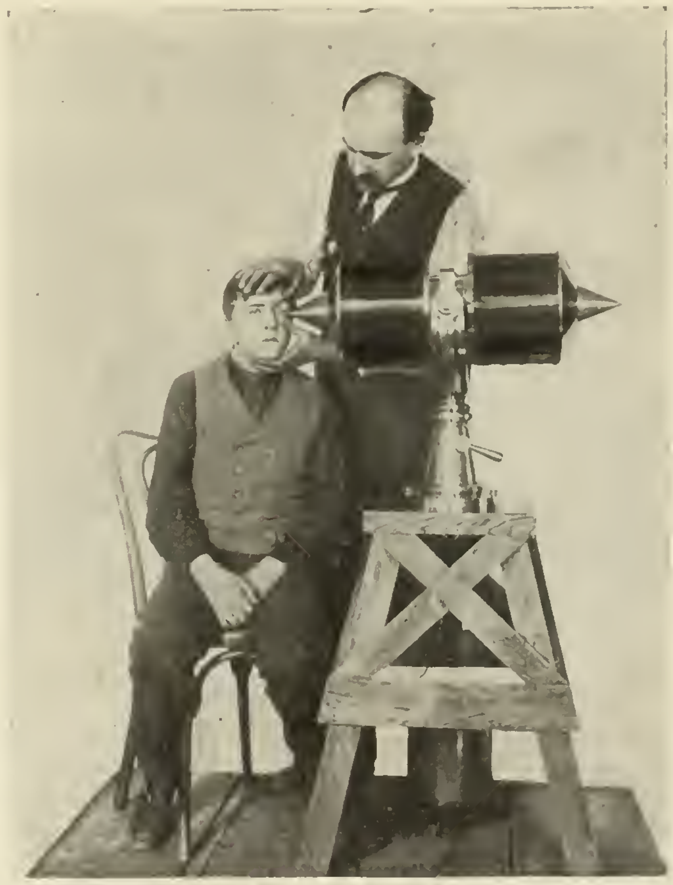
PORTABLE TORQUE BALANCE.

After placing the balance in position, the weight should be so chosen and the connecting link so placed in the loops, that when approximately full load current is passed through the meter, the pointer will rest on zero. One or two trials are sufficient to determine the proper weight and loops to be used in order to measure the torque of the meter under test. When the device is approximately balanced, final adjustment to a condition of exact balance may be made by increasing or decreasing the load. It will be found that the most satisfactory and most nearly accurate tests are secured when the meter is loaded to about its normal capacity.

The torque or turning movement is expressed by means of a simple formula, in "gramme millimetre" units, i. e., the torque produced by one gram acting at the end of an arm one millimetre in length. The entire mechanism folds compactly and is enclosed in a nickel-plated metallic case 7¼ in. x ¾ in.

Large Magnet for Oculists' Use.

In order to remove splinters of steel and other magnetic particles from his patients' eyes, Dr. E. C. Rivers, a prominent oculist of Denver, Colo., had constructed the special magnet illustrated herewith. Several very successful operations have been performed with this magnet. In one case Röntgen rays had been used and other methods tried in the endeavor to locate steel particles in a man's eye, but without success; with an application of this powerful magnet, however, it is stated that the portion of the eye containing the steel bulged out and with a careful incision they were easily removed. In case of a fresh wound where the filament has not had time to form over the opening, the splinter is readily drawn out through the hole it made in entering.



LARGE MAGNET FOR OCULISTS' USE.

The machine was built by the Carstarphen Electric Company, of Denver, after designs of W. P. Carstarphen, Jr., president of the company. It consists of a double magnet mounted on a handsomely finished brass pedestal, which in turn is supported on a polished oak stand. The case of the magnet is a solid forging of Norway iron, four inches in diameter and 29 inches long. It weighs 108 pounds and is supported on trunnions which rotate on a pivot, so that the pointed ends of the magnet may be raised or lowered or swung around in any position. The device is held fast in the desired position by locking levers.

The coils are 10 inches in diameter and are wound with No. 12 copper wire. The connections are such that with the coils in series the magnet may be operated from an ordinary 220-volt circuit, taking in this case 6 amp., or 1.32 kw of energy. By connecting the coils in parallel the magnet may be operated on a 110-volt circuit, taking 12 amp.

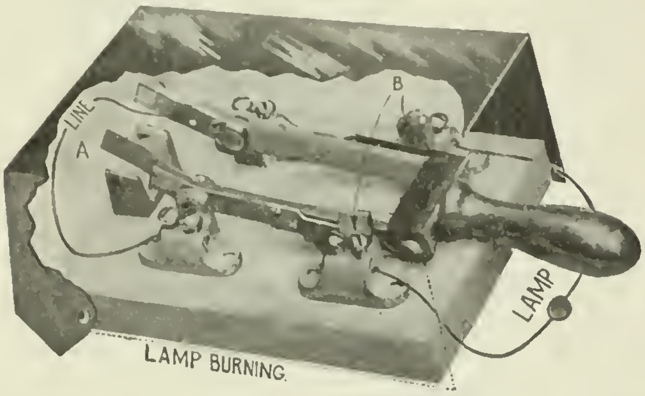
For regulating the current, a rheostat, made with slate leads and German silver resistance wire, is employed. This device stands on the floor and is regulated through eight variations by the operator's foot. When the foot is taken off a trigger arrangement automatically cuts off the current. Perfect control of the current is thus given the operator while leaving both hands free for his surgical work.

The magnet is calculated to exert an attraction of 150 pounds per square inch of contact. The pointed ends are removable, and when taken off and ends an inch square substituted, the magnet will support the weight of a 150-pound man. The weight of the apparatus entire is 350 pounds.

The accompanying illustration shows the method of applying the magnet, the operator in this case being Mr. Carstarphen, the designer of the machine. It may be added that the wireless telegraph system that is in successful operation between Santa Catalina Island and the California coast was built in his shop.

Cut-Out for Series Arc Lighting Circuits.

The Ozark cut out illustrated herewith is adapted for voltages up to 5,000 volts (at 10 amp.) and particularly intended for direct-current series arc lighting circuits. With this cut-out the circuit is never broken, for in the operation of cutting out a lamp, before the lamp circuit contacts are broken, a by-pass connection is made, so that a continuous path is always provided and consequently no arcing can occur. Ordinarily the cutting out of a grounded lamp when there are two grounds, will endanger a switch and all lamps between the two will remain out; with this cut-out, however, one of the grounded lamps can be cut out while the others on the circuit will continue burning, thus saving in fines for lamps out.



CUT SHOWING HOOD.

A series of tests of this switch made by the Illinois Engineering Company, of Chicago, showed it to be indestructible under any conditions which might arise in actual service, including the handling of a 5,000-volt current or the equivalent of a hundred-lamp circuit on one switch. The switch is small and compact, so that it may be placed inside a post, where cast-iron posts are used. The metal hood protects it from moisture and shields the live parts.

The Ozark cut-out is handled by Hart & Company, of Chicago, who soon expect to place on the market a modification with long blade for alternating-current circuits.

Enlargement of New York Subway Power House.

The New York rapid transit subway commissioners have purchased an additional lot, 108 x 200 ft., on which to build an addition to the power house now building on the space between Fifty-eighth and Fifty-ninth Streets and Eleventh Avenue to the Hudson River. The addition will make the plant the largest and most expensive in the world. It will cost altogether $7,000,000, and will be capable of generating 132,000 hp. In the boiler plant at first will be set up seventy-two boilers, each capable of producing 500 hp. The fuel for these boilers will amount to 1,000 tons of coal a day. The coal will be carried by belt conveyors to a storehouse 80 ft. above the ground, with a capacity of 25,000 tons. The ashes from these thousand tons a day will be carried by cars to scows lying in the river. The walls of the building will be of cut granite and terra cotta, and pressed brick. The windows will be fitted with steel frames and the roof will be of terra cotta and glass. There are five brick chimneys to rise above the plant. They are unusual in their construction, in that their bases will rest on steel platforms about 40 ft. above the floor of the power house. Building the stacks from the ground up would have occupied a great deal of valuable space in the middle of the building. The chimneys will reach a height of 265 ft.

The Kellogg Telephone Company's Strike.

Although we have from time to time reported the various developments in this celebrated strike, a brief resume of its course may here be given. In July, 1902, only 5 per cent. of the Kellogg workmen belonged to unions, while in April, 1903, only 10 per cent. were non-union men. Nevertheless, in the first week of May in this year a strike was called for the sole purpose of securing the complete unionization of the Kellogg plant, there being no quarrel about hours or wages, and the very fact that the percentage of union men had increased rapidly was convincing proof that no discrimination had been practised. In subsequent stages when the matter came before the courts, Judge Holdom declared that an agreement to employ only union men is of doubtful legality, against public policy and in conflict with the spirit of our government and of our institutions; and the Appellate Court in sustaining Judge Holdom, said that such an agreement would conflict with public policy, in that it would restrict the lawful right of the individual either to work for a livelihood or to employ whom he chooses. Two weeks after the strike was called, the company announced that the vacancies were to be filled, and that each employee was to be treated strictly on his merits. The period of violence now began. The men employed were intimidated and assaulted, and on May 25, about three weeks after the strike was called, Judge Holdom issued an injunction ordering the strikers to desist and refrain from threats and further violence, from picketing and from patrolling, and from in any way interfering with the company in carrying on its business in its usual and ordinary way. Acts of violence, however, continued to be committed, and Judge Holdom fined sixteen men for violating this injunction. Certain employees sued certain strikers for damages, while similar suits were instituted by the company itself, against certain unions as unions, and the Grand Jury indicted some strikers for assault. Another stage of the strike dates from June 24, when the teamsters of the company doing the Kellogg Company's hauling, went on a sympathetic strike. In this case, the transfer company had a contract with the truck drivers' local, but the Joint Council, disregarding this contract, ordered the strike. Following it, for two weeks, the plant of the Kellogg Company was blockaded, and Judge Holdom in vain sentenced violators of his injunction to fines and imprisonment. The Kellogg plant stood invested, guarded by policemen and detectives; employees were daily assaulted, plate glass windows were smashed and telephone wires cut. Finally, on July 8, the Kellogg Company sent a wagon to the freight station guarded by police, but on July 11, when wagons thus escorted arrived at the depot the freight men refused to handle Kellogg products. These men were immediately discharged, whereupon an officer of the freight handlers' union called on the teamsters to join with the freight handlers in a general sympathetic strike. The teamsters refusing their aid, the freight handlers went back to work. The Kellogg Company, however, still met much difficulty in transporting their products. Union teamsters blocked the streets whenever a Kellogg wagon appeared, which obstruction, together with assaults on the drivers, made police protection necessary. The teamsters also endeavored to enlist in their aid public officials. They appealed to Superintendent Cook, of the West Park system, to prevent the Kellogg Company from running its wagons on the boulevards, and an alderman presented a resolution in the council to the effect that in labor disturbances the police should remain "neutral." On July 20 Judge Holdom enjoined the teamsters from committing unlawful acts in injury of the Kellogg Company's business, and on July 23 the teamsters went back to work. The Kellogg Company is now running its plant almost at full capacity and is conducting its business as though no strike were in progress. The unions, however, have not given up the struggle, and the Chicago Federation of Labor has voted them $15,000 a month.

Wireless in the Navy.

During the recent naval manœuvres the value of the wireless telegraph has been demonstrated to the satisfaction of the naval officers. Under ordinary conditions it would have been several hours before the *Olympia* could have communicated her discovery of the invading enemy to any other ships of the squadron, even though she could have made a run for it, which the rules prohibited. But by the aid of wireless system not only was she able to inform the admiral of the approach of the enemy, but Admiral Barker's flagship, the *Kearsarge,* transmitted the message sent by the *Olympia* from ship to ship along the whole length of the coast from Mount Desert Rock to Cape Ann.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—It is not at all an unusual thing for securities in Wall Street to show an advance during the month of August, especially as soon as the conditions of the crops become favorably authenticated. It is still possible that some such turn may be given to the market, as August is still young, but it will take a good deal for the general list to recover from the staggering blows which have been administered to it during the first ten days. Just what is the matter with the market nobody seems to know, although Standard Oil influences are credited in many well-informed quarters with a strongly manifested desire during the last six months to put the market down and keep it down, in order to avoid more serious disturbances later, which would have resulted from a prolongation of the period of speculation and fancy prices. Be this as it may, there was hardly a stock which did not rule materially lower throughout the week, and it may be said that the depression has continued into the present week, although there have been some signs of stiffening associated with the presence in the street of a great many small investors, who have been picking up at wonderfully low prices a lot of the stocks that overburdened rich men and plungers have had to drop from sheer inability to carry the load. In view of the remarkable decline in prices, it is surprising that there have been so few Wall Street failures, but only one or two concerns have gone to the wall and none of these are of first-class importance. One of them was coupled last winter with the desperate and disgraceful drive against the New York Metropolitan Street Railway Company, so that its punishment is viewed in some electrical quarters with complacency. Money throughout the week has ruled fairly low, and the market was by no means excited, although naturally bankers were looking closely at loans and were more inclined than ever to throw out speculative stocks when offered as collaterals. 5 to 5½ per cent. was about the rate for long-term meney, and 1½ to 2½ per cent. for call money. The quotations given below are those for August 11, and in view of the rally will not mark, therefore, the extreme declines which were experienced during last week.

NEW YORK.

	Aug. 4.	Aug. 11		Aug. 4.	Aug. 11
American Tel. & Cable	77	77	General Electric	157	154
American Tel. & Tel	130	129¾	Hudson River Tel	..	..
American Dist. Tel	25	25	Metropolitan St. Ry	116¼	111
Brooklyn Rapid Transit	12½	41	N. E. Elec. Veh. Trns	..	5
Commercial Cable	149		N. Y. & N. J. Tel	..	..
Electric Boat	15	13	Marconi Tel	..	1¾
Electric Boat pfd	35	39	Western Union Tel	83½	81⅝
Electric Lead Reduction	1⅜	2	Westinghouse com	163	..
Electric Vehicle	5	7	Westinghouse pfd	165	..
Electric Vehicle pfd	8	10			

BOSTON.

	Aug 4.	Aug. 11		Aug. 4.	Aug. 11
American Tel. & Tel	130	129¾	Western Tel. & Tel. pfd	83	83
Cumberland Telephone	..	..	Mexican Telephone	1⅛	1½
Edison Elec. Illum	.	235	New England Telephone	120*	127
General Electric	..	154	Westinghouse	85	.
Western Tel. & Tel	13	13	Westinghouse pfd	85	.

PHILADELPHIA.

	Aug. 4.	Aug. 11		Aug. 4.	Aug. 11
American Railways	..	43	Phila. Traction	94½	91¼
Elec. Storage Battery	57	..	Phila. Electric	5½	5½
Elec. Storage Battery pfd.	58⅛*	60	Pa. Electric Vehicle	..	.
Elec. Co. of America	7¾	7⅞	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Aug. 4	Aug. 11		Aug. 4.	Aug. 11
Central Union Tel	..	..	National Carbon pfd	90	92
Chicago Edison	112	..	Metropolitan Elev. pfd	..	55
Chicago City Ry	165	165	Union Traction	3½	..
Chicago Tel. Co	120	..	Union Traction pfd	30	..
National Carbon	23*	..			

*Asked.

NEW YORK TRACTION FINANCES.—A great deal of public interest is manifested in the recent large trolley deals on Long Island. Discussing this situation, the *Wall Street Journal* says: "The liquidation in the local traction stocks has resulted in important changes in the ownership of these properties, and has special significance in view of the recent purchase of the trolley lines in Queens County. These trolley lines were bought by a syndicate which is said to include some Standard Oil people and some Philadelphia and Western people. This purchase is in line with deeply laid plans for the concentration of all the trolley and electric light interests of Greater New York into the hands of the people who at present control the Interborough Company. It seems that the whole impulse in the present movement turned upon the acquisition of Manhattan. The Metropolitan Securities Company was formed with the ultimate view of first securing possession of Manhattan, then of the Subway, and then of Brooklyn Rapid Transit. The deal was interfered with by the Interborough people securing control of Manhattan, taking it away from Metropolitan. Since then Metropolitan has been weakened considerably by the loss of Manhattan, and also by the litigation against its method of financing. This liquidation in Metropolitan has been taken advantage of by the Interborough people to secure a very strong holding of Metropolitan stock. The same people, taking advantage of the general condition of the market, have also decided that it might be an opportune time to get control of Brooklyn Rapid Transit. They have been helped in the latter case greatly by the disruption of the old Brooklyn Rapid Transit pool, which was forced to let go, and in letting go forced the price down to 38. On the decline, vast numbers of stop orders were also reached, so that it has been a comparatively easy matter to secure a very large holding of Brooklyn Rapid Transit stock, if not actual control. In the execution of stop orders, the sales are not reported on the tape, so that the transactions in the stock have been much larger than reported on the tape."

PROSPECTS OF DETROIT EDISON.—The president of the Detroit Edison Company, in a letter to a large holder of Detroit Edison bonds, states that the construction of the new generating station promises to be completed early next year, and that extensions and additions to the underground conduit and distributing systems are progressing rapidly. The growth of business has been restricted by the capacity of the present plants. The operating expenses during the five months of this year have been much greater than for the corresponding period of last year, because of the higher price for fuel, materials and labor, and because of the excessive cost of maintenance and repairs crowded into these months to enable the operating force to devote their time later in the year to the new construction, and also because the excessive loads, now carried by the several separate generating stations, have been unfavorable to economical operation. For the five months ending May 31, the gross earnings increased $26,808, while operating expenses increased $32,111. The actual net income for these five months was $89,832, and interest requirements were $38,301, leaving an actual surplus of $51,531. The above showing indicates that the interest on the Edison bonds is well secured. Some people hesitate to put money into local securities in Detroit because of fear that politicians may at any time assume an aggressive hostile attitude toward corporations in that city. On this point it may be stated that the city of Detroit has done its own public lighting for many years, but has not been responsible for the granting of other franchises. No franchise of any character for lighting is now held by other interests than the Detroit Edison Company and the Edison people believe that it is not likely that the territory which is so completely occupied will be invaded by others.

MEXICAN TELEPHONE ANNUAL.—The report of the Mexican Telephone Company for year ended February 28, 1903, is issued. The income account has already been published, showing in Mexican currency gross earnings of $246,368; net $111,997. It is said: "Our present concession for the City of Mexico will soon expire. The new application is being energetically prosecuted and a prompt renewal is assured us. The new concession will, however, be seriously burdensome to the company, as the Mexican government seems likely to demand the discontinuance of the aerial system and to require the adoption of an underground system, which will entail a heavy expenditure by the company." President Charles H. Rollins further says: "Business in general throughout the republic has continued prosperous, although the continual rise in exchange and abnormal fluctuations during the latter part of the year have, beyond a doubt, hampered this increase to a certain extent. The gain, per subscriber, in gross earnings for the year, as compared with the previous year, is .2075, and the increase in total expense is .6618, a decrease in net receipts, per subscriber, of .4543. This decrease is principally due to increase in expense in Mexico City and loss caused by opposition in Queretaro."

NEW YORK CONSOLIDATED GAS.—Stockholders of the Consolidated Gas Company were notified last week of the long-expected issue of new capital stock. The privilege of subscribing to the stock is given to stockholders of record on August 27. They may subscribe to the extent of 9 per cent. of their holdings, and the price which they will be asked to pay is $150 a share. The privilege to subscribe expires at the close of business on September 9 and subscriptions must be paid on or before September 15 at the National City Bank. No subscriptions will be received on holdings of fractional shares, but scrip will be issued for the same, which will be convertible into stock in multiples of $100 until December 31 next, after which date unconverted scrip may at the option of the company be redeemed in cash at the rate of $150 per share. In the official notice to the stockholders it is stated that the authorized capital stock is $80,000,000, of which there is now outstanding $72,917,759. Nine per cent. of the latter amount would be in round numbers $6,500,000. The object of the stock issue is said to be to meet the cost of important improvements in the gas system of the company, which is also the controlling power in the electric light field in New York City

PLANT FOR PRINCETON, N. J.—It is stated from Princeton, N. J., that plans are being made there for a large steam heating and electric lighting corporation, to be known as the University Power Company. A plant which will provide heat and light both to the University and the town, and probably the outlying districts will be installed. A few days ago the new power company presented an ordinance to the Common Council granting a franchise for the use of the streets for conduits, trenches and manholes, through which the electricity and steam might be properly distributed. The ordinance, after being amended, was passed by sections on the second reading, and will be finally passed on this week. The company will be incorporated with a capital of $500,000, to furnish steam as well as electricity to residents of Princeton. The ordinance will remain in effect for fifty years, and during this time the Borough Council will exercise the right to see that every condition named in the ordinance is properly carried out. The Princeton Lighting Company, which will be affected by the new company, have requested a postponement of the consideration of the new company's ordinance.

AMERICAN TELEPHONE HOLDINGS.—It is stated from Boston, in connection with the resignation of Vice-President Cummings, of the American Telephone & Telegraph Company, who, it is understood, represented New York interests, that New England people, having sold nearly all their other investments, such as Burlington, Atchison, Union Pacific and other Western railroads, held tenaciously to their telephone investments, and have been the large buyers of the new stock issue, while New York has been the seller of substantially all of the American Telephone & Telegraph shares that were placed there a year or two ago. It is understood that the City Bank, the Standard Oil interests and also the J. P. Morgan interests have parted with substantially all their telephone shares. At one time it was reported that the Morgan interests represented as much as $15,000,000 in American Telephone & Telegraph. New England having parted with her Western railroad interests, is now competent to carry the telephone interests of the United States as represented in American Telephone & Telegraph.

GENERAL ELECTRIC GOSSIP.—The evening edition of the *New York Sun* had the following item of gossip last Saturday: "One of the rumors that find a ready circulation in the street is to the effect that within the past few days a big block of General Electric stock changed privately. It is said that much of this stock was acquired by an individual prior to the taking of an option on the Stanley Company by a certain group of capitalists and that the balance of it was secured later when the Stanley Company passed to the control of the General Electric Company. It is not suggested that any speculative necessities forced the sale of the stock, nor can it be accepted authoritatively that there was such a sale. Still, such is the gossip and certain incidents of the week lend some color to it."

TEXAS TELEPHONES.—The independent telephone lines, known as the Commercial Telegraph & Telephone Company of Texas, have passed into the hands of H. T. Huntington, with Frank B. Smith, the originator of the independent system of the State, in charge. Mr. Huntington has acquired the system for approximately $400,000 and intends to invest $400,000 in improvements and in extension in Texas and later extend them over the Southwest.

THE YOST ELECTRIC MANUFACTURING COMPANY, of Toledo, Ohio, has increased its capital stock from $75,000 to $200,000 in order to take care of its rapidly-increasing business. Most of this increase will be taken up by its present stockholders. Although the company completed a new factory to increase its capacity only last May, it is found necessary to again increase the output on Yost sockets, and a number of new articles will be added to the line.

CONSOLIDATION AT ALTON, ILL.—On the 30th of July, 1903, the Alton Railway, Gas & Electric Company and Alton & East Alton Railway & Power Company were consolidated under the name of the Alton Light & Traction Company, with authorized capital $1,000,000; preferred stock issued, $500,000; common stock issued, $150,000.

PURCHASE OF ITHACA TROLLEYS.—George F. Archer, of Camden, N. J., has completed a big transaction for Philadelphia capitalists in the purchase of the entire street railway system of Ithaca, N. Y. The price has not been made public.

Commercial Intelligence.

THE WEEK IN TRADE.—As might be expected at this season of the year, general trade is quiet, but on the whole conditions have remained favorable and consumption has proceeded on a large scale It would be strange, indeed, if the downward fluctuations in Wall Street connected with the depression there did not have some effect upon commercial interests and dampen the ardor of general trade, but anything which makes for prudence and sobriety has its compensations, and in view of the enormous bulk of business that has been done for a few years past, a little slackening off might be quite other than evil. At the same time, some of the railroads report themselves busier than ever, and their general condition improved, as evidenced by the fact that the Canadian Pacific has increased its dividend rate, just when Wall Street is feeling bluest, while its figures of traffic show it to be justified in giving a larger return to the stockholders. Moreover, the crop reports issued by the government are on the whole of an agreeable tenor, wheat and corn promising heavily and being not far short of high-water mark in regard to both. In fact, so far as crop conditions have anything to do with trade and commerce, the outlook is very satisfactory. The copper market has remained simply inactive and weak, and lake and electrolytic have been about 13¼c., with casting ¼c. lower. In the iron and steel market, conditions are pretty steady and consumption has continued large, with the certainty that should it slacken off at all the large imports of the last year could hardly be repeated. The returns for the past seven months of bank clearings and of trade failures are encouraging, the clearings for July being next to January the largest for any month this year, and only 4 per cent. less than in July, 1902, due simply to smaller stock speculation. Business failures also for July were 7 per cent. less than in July, 1902, and 8 per cent. less for the period of seven months. The only inference from this can be that traders and bankers are alike careful and have not been spoiled by the long period of prosperity, which is happily still with us.

THE PETERBOROUGH HYDRAULIC POWER COMPANY, of which Senator George A. Cox is president, is building a new power plant on the Otonabee River in the town of Peterborough, Ont., Canada, which will be equipped with the following apparatus recently purchased from the Westinghouse Electric & Manufacturing Company. A 1,500-kw, 2,240-volt generator, 60 cycles, and running at 150 r.p.m., to be direct-connected to water wheels; also two 125-volt, direct-current, direct-coupled exciters of 75-kw capacity each, together with switchboard consisting of a large generator panel and two exciter panels. This power house, when completed, will be an unusually fine one and is to furnish power to the Peterborough Mill of the American Cereal Company, owned by the Quaker Oats Company. Power will be supplied to several other manufacturing plants in the town, and also to the Peterborough Light & Power Company, which does the electric lighting and small power business in Peterborough.

STROMBERG-CARLSON TELEPHONE PLANTS.—The Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., and Chicago, Ill., has recently sold switchboard and entire exchange equipment to the Lewiston Telephone Exchange Company, of Lewiston, Minn. They have also sold additional switchboard apparatus to the Minot Light & Telephone Company, of Minot, No. Dak. The Madelia Telephone Company, of Madelia, Minn., have recently bought their entire switchboard equipment from the Stromberg-Carlson Company. The Citizens' Telephone Company, of Mankato, Minn., have recently purchased a two-position toll line board, equipped with selective lock-out and toll line apparatus. The company have also recently sold twenty selective lock-out telephone equipments to the Independent Telephone Company, of Winthrop, Minn.; also a quantity of telephones to the Farmers' Mutual Telephone Company, of Volga, So. Dak.

CEMENT ENGINEERING.—E. P. Roberts & Co., of Cleveland, Ohio, consulting engineers, have opened a department of cement engineering and are now prepared to take entire charge of the designing and supervision of the construction and operation of cement plants. This firm has been in business for ten years and has large experience in electrical, mechanical and civil engineering, having had the consulting and supervising work for a great number of electric railways, electric lighting and power plants, manufacturing plants, etc. The cement department opens up a new field and the services of Mr. George S. Perkins, M. E., have been secured to look after the work. Mr. Perkins is a graduate of Stevens Institute of Technology, class of 1891, in the course of mechanical engineering and has had an extensive experience in the designing and constructing of cement plants.

AUTOMOBILE MANUFACTURING.—Mr. George H. Day, president of the Association of Licensed Automobile Manufacturers, states that the 26 members of the combination make not less than

90 per cent. of all the gasoline motors in the United States and that they are now prepared to prosecute for infringement of patents all the manufacturers, agents or users of gasoline motors not made by them. There are 120 auto manufacturers who are outside the fence. Up to date 26 important manufacturers and agents of gasoline automobiles have joined the auto combination, and have paid their dues of $4,500 each, but the 120 manufacturers, agents and importers who have thus far not associated themselves with the combination, do not accept as final the claim that the Selden patents bar them from manufacturing or using automobiles with gasoline as the motive power.

THE METAL "SELIUM."—German papers report the discovery by Edward Mollard, a Frenchman, of a new metal called "selium." According to the *English Mechanic,* the discoverer claims that selium costs but one-twelfth as much as aluminum and is lighter and stronger. It does not rust, and is, therefore, suitable for use in shipbuilding, for the manufacture of pipes, and for railroad construction. On account of its cheapness—and as it is capable of a fine polish, resembling nickel—it would be desirable for manufacturing cooking utensils. Its density is 2.6 and its hardness not quite that of iron, but greater than lead or zinc. Its power of resistance is said to be greater than that of iron, but less than that of steel. The melting point is at 1,600° C. In melting it contracts somewhat, ut molding in forms is not impossible. It will be well, however, to await more definite information concerning its properties.

THOMAS H. DALLETT COMPANY.—The well-known concern of Thomas H. Dallett & Co., of Philadelphia, have been reorganized and incorporated as the Thomas H. Dallett Company. The officers elected are: President, Thomas H. Dallett; vice-president and general manager, Ernest C. Bliss; secretary and treasurer, E. C. Clay. W. H. Van Sickel, lately New York representative of the Under Feed Stoker Company of America, and well known in the pneumatic tool industry, has been appointed superintendent. The company will increase the capacity of their plant, located at York Street and Sedgeley Avenue, and while continuing the manufacturing of their belt and electricity-driven portable drills, deck planers, etc., will devote special attention also to the manufacture of Dallett pneumatic tools.

KELLOGG TELEPHONE CONTRACT.—The Kellogg Switchboard & Supply Company, Chicago, has been awarded a contract by the Pittsburg & Allegheny Telephone Company for a 3,000-line, common-battery, multiple switchboard for McKeesport, Pa. The present equipment is to be 1,000 lines. The Kellogg Company has also received an order from the National Telephone Company, of London, England, for an 800-line, common-battery board for Lavender Hill, London. A contract has also been awarded to it for an exchange equipment at Pasadena, Cal., including a 7,200-line switchboard with 1,500 lines equipped. This contract includes the telephone instruments.

POWER HOUSE CONTRACTS.—The Indianapolis & Cincinnati Traction Company has awarded contracts for the construction of its power house at Rushville and work on the building will begin in a very short time. The contracts include the erection and the equipment of five sub-stations along the road. The Westinghouse Electrical & Manufacturing Company received the contract for the electrical apparatus and the Babcock & Wilcox Company was given the boiler work. The engines will be supplied and set up by the Fulton Foundry & Machine Company, of St. Louis.

STEEL MAKING BY ELECTRICITY.—Canadian capitalists are said to be interested in the electric furnace for making steel, invented by Marcus Ruthenburg, of Philadelphia, already noted and described in these pages. The inventor claims for his furnace that it will cheapen the process of steel making 20 per cent., and turn out a product equal to Bessemer. Electrolytic steel, he says, is an assured fact. Arrangements have been made by the Canadians for giving the process a commercial test near Niagara Falls, where electric power is cheap and plentiful.

PELTON WATER WHEELS.—We have the following from the Pelton Water Wheel Company, of San Francisco, Cal.: "We note in your Export issue of August 1st, on page 204, that mention is made in the Electric Light and Power notices, that the Rock Creek Power & Transmission Company, of Baker City, Ore., has contracted for De Remer water wheels for direct-connection to their 400-kw, three-phase alternators. This is an error, as we have the contract for supplying all water wheels and governors for this plant."

APPARATUS WANTED.—The Kenny Electrical Manufacturing Company, Nassau-Beekman Building, New York City, Paul T. Kenny, manager, etc., is in the market for a 600-hp vertical or horizontal compound condensing engine, as well as a direct-connected dynamo to hitch to same, either 220-volt, direct-current, or two-phase, 60-cycle. Details of second-hand outfit will be welcomed. The concern will also be shortly wanting a center-crank, direct-connected, 115-volt outfit, of 75 to 100 kw, 80 pounds steam pressure.

MOTORS, FANS, ETC., FOR INDIA.—The New York Export & Import Company, 133-137 Front Street, New York, which concern represents the interests of the Bullock Electric Manufacturing Company and the Dayton Fan & Motor Company, in British India and other Asiatic countries, has secured some substantial orders for motors, fans, etc. The same concern has also orders on hand for machine tools for installation in Indian railroad shops, etc.

CONVERSION OF AUSTRALIAN STEAM ROAD.—There is an extreme likelihood that part of the Sydney suburban traffic of the New South Wales government railways will be handled in the near future by electricity. Mr. Charles Oliver, the chief railroad commissioner, is agitating the matter of conversion. In the first instance it is proposed to change the motive power of the North Shore line. This section is 13 miles in length.

MORE ELECTRIC TRACTION FOR WEST AUSTRALIA.—An extensive electric traction system is to be constructed in West Australia. The lines will operate in and around Essendon, Flemington and Kensington. A. E. Morgans, the well-known West Australian mining man, is primarily interested in the project. A. E. Rodgers, general manager of the Perth & Kalgoorlie tramways, is drawing up the plans, etc.

UNITED STATES CARBON COMPANY.—The affairs of the United States Carbon Company, which failed about a year ago, were wound up at Cleveland, Ohio, on August 11 by the court's acceptance of the receiver's report and by the latter's discharge. The property was sold for $87,000, and the sum was used in paying off creditors, netting them a trifle more than 36 per cent. The total due creditors was $222,864.

BIDS WANTED FOR PLANTS.—The city of Monroe, La., will receive bids until August 17 for direct-connected engine and alternator, arc light transformers, etc. C. A. Downey is acting mayor. The Board of Public Service of Cleveland, Ohio, will receive bids until August 13 for two direct-connected generators and switchboard, to be installed in the engine house of the Kirkland Street pumping station.

POWER DAM CONTRACT.—The officials of the New Haven Railroad announce that a contract has been closed with the B. D. Pierce, Jr., Company, of Bridgeport, for a dam at Borden, Conn., which will make a lake of 30,000,000 gallons of water, to furnish motive power for the electric roads of that neighborhood owned by the New Haven road. The dam will be 25 ft. high and 175 ft. long.

ELECTRICITY FOR DURBAN HARBOR.—Electricity is to be used in place of hydraulic power for the purpose of operating cranes, elevators, conveyors, etc., at the important harbor of Durban, South Africa. It is not yet decided whether polyphase or continuous current will be employed. The initial equipment will have a capacity of about 300 hp. Mr. George Stobie is drawing up the plans, etc.

MEXICAN HYDRAULIC PLANT.—The hydraulic power plant of the Tezuitlan Copper Company, Mexico, is to be enlarged and contracts for equipment, etc,, will be let. The existing plant has a capacity of 666 hp. The current is transmitted to the company's mines four miles distant. The present equipment included Pelton water wheels. Another 333-hp outfit will be installed.

ELECTRIC DRILLS FOR THE ARGENTINE.—The export house of Kates & Bok, 79 Wall Street, has some orders for electric drilling equipments for shipment to the Argentine Republic. A good deal of new business now seems to be offering from that part of the world, and it is to be hoped that American concerns or their representatives will be smart enough to capture the orders.

THE EUREKA ELECTRIC COMPANY have just closed a contract with the Davenport & Tipton Independent Telephone Company, of Tipton, Iowa, for a 480-line express switchboard in four positions, embodying their flashlight transfer and flashlight clearing-out systems; also a chief operator's desk toll line switchboard of 50-line capacity.

EQUIPMENT FOR ARGENTINE REPUBLIC.—The Sindicato de Fabricantes Americanos (Syndicate of American Manufacturers), No. 3 Beaver Street, has secured several substantial orders for electrical equipment for installation in Buenos Ayres. Mr. George E. Willard, of the Syndicate, is now in that part of the world.

GENERATORS FOR PHILADELPHIA.—It is stated from Philadelphia that the Philadelphia Electric Company has ordered two additional 5,000-hp generators for their Gray's Ferry plant to cost together $240,000.

WESTERN ELECTRIC TELEPHONE SYSTEM FOR MEXICO.—The Western Electric Company has secured the contract for the telephone system to be constructed between Monterey and Torreon, Mexico.

General News.

THE TELEPHONE.

LITTLE ROCK, ARK.—The Lawrence County Telephone Company has been incorporated at Black Rock with a capital stock of $1,000. The officers of the company are I. W. Tucker, president, William De Armon, vice-president, E. J. Mason, secretary, C. H. Martin, treasurer.

WESTERN GROVE, ARK.—The Western Grove Telephone Company has filed articles of incorporation with a capital stock of $25,000, of which $3,000 has been subscribed. The officers are: President, H. R. Magness, vice-president, J. H. Floyd, secretary, C. L. Jones, treasurer, S. R. Crain.

COVINA, CALIF.—The Home Telephone Company operates a 160-drop board and gives service to 150 subscribers. There is expectation of 160 more subscribers from Glendora and other places.

CORA, IDA.—The Cora Independent Telephone Association has rural lines free to stockholders, the charge to others being 25c. There are 50 subscribers and 22 miles of toll line.

PLEASANT PLAINS, ILL.—The Boynton Telephone Company has increased its capital stock from $10,000 to $30,000.

WAVERLY, ILL.—The Waverly Telephone Company operates a 200-drop board, has 220 subscribers and 100 miles of toll line.

STERLING, ILL.—The Prophetstown Exchange of the Interstate Independent Telephone Company is to be rebuilt.

CHINA, ILL.—The Farmers' Telephone Company, incorporated with a capital stock of $2,500. Directors: H. W. Hillson and others.

HOUSTON, ILL.—The Peruvo Progressing Exchange supplies telephone service to 180 subscribers from a 75-drop board. It has 100 miles of toll line.

NUNDA, ILL.—The Union Light & Telephone Company has a 100-drop board and 65 subscribers with prospects of nearly as many more within a year.

RUSHVILLE, ILL.—The Rushville Telephone Company has not yet completed its system, but will probably start with near upon 200 subscribers. It does not own toll lines, but will connect with other companies.

LEE CO., ILL.—The Farmers' Telephone Company has been incorporated with a capital stock of $2,500. The object is to operate a telephone system. Incorporators: Albert N. Crawford, Henry W. Hillson and Christian M. Cross.

RUTLAND, ILL.—The Central Illinois Independent Telephone Company has metallic circuits and has exchanges at Rutland of 200 drops; Wenona, 250; Dana, 150; Long Point, 125 and 125 at another place. There are about 850 subscribers in all and 95 miles of toll line, with more to be built.

CHESTERTON, IND.—The North Western Telephone Company has 100-drop board capacity and 75 subscribers.

SIMS, IND.—The Sims Co-operative Telephone Company has been incorporated with a capital of $7,500. The officers are Chauncey B. Knowlton, president; H. C. Haines, secretary, and Isaac Rust, treasurer.

BOWERS, IND.—The People's Co-operative Telephone Company has 85 subscribers, a 100-drop board and 25 miles of toll line. The subscribers own their telephones and keep their lines in repair, paying 25c. per month for switchboard service and incidental expenses.

CENTRE POINT, IND.—The Centre Point Telephone Company operates a central switchboard, has 74 subscribers and has 50 miles of toll line. This system has connection with all the farmers' lines in the county and with other companies in Clay City and Brazil.

DES MOINES, IA.—The Butler County Telephone Company has been incorporated with a capital stock of $10,000.

ONOWA, IA.—The Manona Telephone Company has been organized with a capital stock of $100,000. Mr. J. W. Huff is one of the promoters.

DES MOINES, IA.—The Gold Field Telephone Company, witb a capital stock of $10,000, is of recent organization; among the directors being W. V. Palmer.

COVINGTON, KY.—The Kentucky Telephone Company has been granted a franchise to operate a telephone and telegraph system here.

FRANKFORT, KY.—The Northern Kentucky Telephone & Telegraph Company of Kenton County has been incorporated with a capital stock of $100,000. The incorporators are Frank L. Ludlow, Martin Durrett and Sol. F. Kineon.

LOUISVILLE, KY.—The Independence Telephone Company of Kenton County has been incorporated with a capital stock of $5,000. The incorporators are John M. Chambers, W. T. Loomis, Alvin Perry, C. M. Petty and John L. Vest.

EAST FAIRFIELD, MASS.—Tbe Central Maine Telephone Company has been organized with a capital stock of $10,000. Among the directors is M. D. Holt.

GREAT BARRINGTON, MASS.—The Southern Berkshire Telephone Company has been organized, and the following named officers elected: President, Roscoe C. Taft; treasurer, Clarence E. Culver; clerk, H. Mayhew Whiting. The new company expects to connect Great Barrington by telephone with Alford, Egremont, Sheffield and other places as soon as it receives the proper franchise, and later will extend to the middle West and all tbe New England States.

HARTLAND, ME.—The Hartland & St. Albans Telephone Company has been incorporated with a capital stock of $10,000. The promoters are Charles A. Moulton, Hartland; C. C. Hanson, St. Albans, and W. H. Farrah, Ripley.

MINAC PRIETAS, SONORA, MEX.—The Yaqui Copper Company has just completed the coostruction of a new telephone line between this place and Campo Santo Nino.

JACKSON, MICH.—The Citizen's Telephone Company has elected the following named officers: J. T. Richardson, president, Z. C. Edred, secretary and treasurer, and E. B. Fisher, general manager.

PLYMOUTH, MICH.—Connection has been made between the Co-operative Telephone Company and the Livingston Home Telephone Company, at this place, which will give connection with nearly 50,000 telephones in different parts of the state. The Co-operative Company, it is stated, has a switchboard capacity of 12,000 drops, although it has only 100 local subscribers.

ST. JAMES, MINN.—The St. James Telephone Company has been organized. W. M. Barrett is secretary.

NEGORD, MINN.—The Kerkhoven & Hoyes Telephone Company is operated only for local farm service. There are 25 miles of toll line and 50 subscribers.

WILLMAR, MINN.—The Kandiyohi County Telephone Company operates country party lines exclusively, has 225 miles of toll line and 225 subscribers at $1.50 per month.

WINDOM, MINN.—The Southwest Minnesota Telephone Company has a 240 drop board with 192 city subscribers, and 100 farmers. It has 350 miles of toll line and is about to construct more farm lines.

BEMIAJI, MINN.—The Iron Range Electric Telephone Company operates a 300-drop board, has 250 subscribers and 75 miles of toll line, with 40 more to be built. Orders for 50 more telephones have been placed.

PRINCETON, MINN.—The Minnesota Rural Telephone Company operates Stromberg-Carlson and Eureka apparatus; has a 200 drop board and 176 subscribers. It has 42 miles of metallic toll line, and 31 miles grounded.

ALBERT LEA, MINN.—The Albert Lea Telephone Company has a Kellogg switchboard with 150 drops and an Automatic of 1,000-drop capacity, 250 of which are installed. It connects with 13 toll lines entering the city. The demand for farmers' telephones is enormous. There are 400 subscribers.

MANKATO, MINN.—The Mankato Citizens' Telephone Company has a 3,200-drop switchboard, 800 of which are installed. There are 730 subscribers and 125 miles of toll and farmers' lines. Extensions of both the latter are contemplated. This is said to be one of the finest systems in the state and one of the few which has its lines underground.

SARCOPIE, MO.—The Sarcopie Telephone Company has a 50 drop board and 54 subscribers.

MACON, MO.—The Macon Telephone Company has a combination board of 500 drops and 700 subscribers, 200 of whom are farmers.

LUTESVILLE, MO.—The Valley Telephone Company has a 100-drop board, 50 subscribers and 27 miles of toll line with more projected.

LATHROP, MO.—The Clover Leaf Telephone Exchange has a switchboard capacity of 200 drops, 150 subscribers, and 65 miles of toll line.

BROWNING, MO.—The Browning Telephone Exchange is cooperative and subscribers are assessed $3 per quarter. There are nearly 300 subscribers.

RICHMOND, MO.—The Richmond Telephone Company has a 400-drop board, 650 subscribers and 25 miles of toll line. There are more telephones than drops, so farmers' lines have 10 to 15 telephones on one wire.

STURGEON, MO.—The New Century Telephone Company has three switchboards of 100 drops each, which supply service to 418 subscribers. There are 27 miles of toll line, the charge being 25c. to any place on the line.

AUX VASSE, MO.—The Buffum Telephone Company operates a 100 drop board, has 75 subscribers, and 500 miles of toll line. It has doubled its business in four months, and it will be again doubled in the next four months.

NORTH SALEM, MO.—The Browning North Salem & Winigan Telephone Company operates a party-line owned by 25 members, each of whom has one share of stock. The line is free to the shareholders, but a charge of 25c. is made to outsiders.

ARMSTRONG, MO.—The Howard County Telephone Company and Armstrong Exchange uses 70 drops of 100 board capacity, and supplies 160 subscribers. The company has nearly doubled its business in the six months it has been in operation.

JOPLIN, MO.—The Home Telephone Company uses a Sterling 4,000-drop board, 1,500 being installed. There are 1,400 subscribers here and 1,400 at Webb City, Carthage and Carterville. Connection is made with the Kansas City Long Distance telephone system.

MILAN, MO.—The Milan Telephone Company is owned and managed by Mr. J. C. Belshe. It has a 300-drop board, 250 of which are installed, and 250 subscribers. A toll line of 65 miles—the Sullivan County Telephone Company—is included. Improvements are to be made.

ROCKINGHAM, MO.—The Rockingham & Norborne Telephone Company has two central office switchboards and about 225 subscribers—all farmers. There are more than 150 miles of toll line, and the company has a mutual exchange of business, with all adjoining concerns, also with city exchanges.

CARLETON, MONT.—T. A. McClaim is organizing a company to construct a telephone system for the ranchers of the Bitter Root Valley.

OMAHA, NEB.—The Atkinson & Saratoga Telephone Company has been incorporated with a capital stock of $5,000.

TABLE ROCK, NEB.—The Table Rock Telepbone Company has a 100-drop board with a 70 drop attachment, 125 subscribers and a few miles of toll line.

FRANKLIN, NEB.—The Franklin Telephone Company operates a 100-drop board with 90 subscribers and 14 miles of toll line. The rate is $1 per month for subscribers and 15c. toll.

PONCA, NEB.—The Ponca Telephone Company has a 100-drop board, 80 city and 25 rural subscribers; 40 miles of toll line. The rates are 50c. per month. Each individual owns his telephone and has a share of stock in the company.

HAY SPRINGS, NEB.—The Hay Springs Telephone Line bas steadily increased, but is only run to pay operating expenses. There is a 25 drop board and 44 subscribers, 34 miles of main toll line, and 20 miles branch line. This is a ranch country.

COOK, NEB.—The Home Telephone Company operates a 100-drop board of Eureka make, with 110 subscribers and 24 miles of toll line. Several miles of party lines are projected. The company has a branch exchange at Gray, Neb., and a toll line into Tecumseh.

FLEMINGTON, N. J.—The A. B. Reading Local Telephone Exchange operates a party line 50-drop board, with 106 subscribers. There is a bright outlook in the farming district.

JERSEY CITY, N. J.—The Southern Telephone & Telegraph Company, of Jersey City, N. J., has been incorporated; capital, $25,000. Incorporators: Arthur Johns, E. P. Hervey and George W. I. Dwinell, of Jersey City, N. J.

JERSEY CITY, N. J.—The Atlantic & Pacific Telephone & Telegraph Company, of Jersey City, N. J., has been incorporated; capital, $25,000. Incorporators: Arthur Johns, E. P. Hervey and George W. I. Dwinell, of Jersey City, N. J.

PATERSON, N. J.—The Paterson, Passaic & Suburban Telephone Company has elected the following-named officers: President, Charles W. Kline; first vice-president, George A. Post; second vice-president, W. S. Hancock; treasurer, Barker Gummere; secretary, James W. Lindsay; assistant secretary, F. A. Demarest; counsel, Wayne Dument.

LAS VEGAS, N. M.—The Las Vegas Telephone Company proposes putting in a new switchboard and 6,000 feet of cable. It gives service to 390 subscribers and has a 400-drop board.

BLAND, N. M.—The Bland-Albemarle Telephone line expects to complete many improvements and to double its subscription list soon. It has a 25-drop board, 20 subscribers and 12 miles of toll line.

SARATOGA, N. Y.—At the annual meeting of the Saratoga Telephone & Telegraph Company the following named officers were elected: S. C. Medbery, president; Edward Davis, vice-president; W. Lewis Burk, secretary and treasurer.

ELLENDALE, N. D.—Leiby's Telephone Exchange operates a 100-drop Kellogg board and has 71 subscribers, with more expected in the near future.

BURLINGTON, IA.—The Modern Telephone Company has been incorporated with a capital stock of $300,000.

BUCKLAND, OHIO.—The Buckland Telephone Company is the name of a new company just formed here with H. D. Bowsher as president.

CINCINNATI, OHIO.—The Interstate Telephone Company has been incorporated with a capital stock of $10,000. Directors: F. K. Ludlow and others.

PAYNE, OHIO.—A telephone company has been incorporated here with a capital stock of $20,000. The incorporators are L. C. Polland, W. E. Rose, George Gamroth, H. H. Rose and H. G. Dyarman.

COLUMBUS, OHIO.—The Pultney Telephone Company, of Shady Side, has been incorporated with a capital stock of $1,000 by C. W. Rodefer, John A. Futhey, W. P. Harris, H. B. Wilkinson and C. W. Danford.

CLEVELAND, OHIO.—The United States Telephone Company has completed a long distance toll line into Dayton and Springfield. The exchanges in these towns are about ready to be opened. They will add greatly to the business of the long distance company.

PAINESVILLE, OHIO.—The Painesville Telephone Company has announced an increase in rates. The annual report of the company showed a very satisfactory condition of affairs, but the large increase in the number of subscribers seems to necessitate an increase in rates.

LIMA, OHIO.—A telephone war has broken out at West Cairo between the Bell and the independent interests. The Bell Company attempted to erect a pole line through the village, but the home company forcibly stopped the work. It is claimed the Bell Company has no franchise.

SALEM, OHIO.—The Business Men's Association has issued a letter advising the citizens not to pay the increased rates demanded by the Columbiana County Telephone Company. The association will make a stand against the company in its demand for higher rates for telephone service.

SPRINGFIELD, OHIO.—The Springfield-Xenia Telephone Company has increased its capital stock to $750,000. The company has over 600 subscribers in the towns and 150 among the farmers. The company has exchanges in Xenia, Jamestown, Yellow Springs and Springfield. The Springfield exchange is not yet in operation. L. M. Wolf, of Cleveland, is general manager.

CINCINNATI, OHIO.—The Cincinnati Telephone Company and the Fitzimmons Telephone Manufacturing Company have both applied for franchises in Cincinnati. In reply to an inquiry from the city, the latter company states that it owns 50 miles of wire; has an instrument in all the principal hotels in the city; has contracts with ten independent telephone companies and has four lines to the city corporation limits and connected with independent telephone companies, and that it has a pole line to Madisonville. The company's rates are $72 for business houses and $36 for residence telephones.

BIG SPRINGS, TEX.—The Western Telephone Company, of Big Springs, has been incorporated with a capital of $15,000. The names of the incorporators are C. L. Alderman, R. H. Kemp and Philip Pettit.

SEATTLE, WASH.—The Independent Telephone Company increased its capital from $600,000 to $1,000,000.

BURLINGTON, WIS.—The Burlington, Rochester & Kanesville Telephone Company will increase its capital stock from $2,500 to $5,000.

SCANDINAVIA, WIS.—The Scandinavia Telephone Company has been incorporated with a capital stock of $1,500. Among the directors is Mr. G. C. Wilson.

RACINE, WIS.—It is stated that over 15,000 farmers in this state now receive daily weather reports and weather prognostications by telephone. The reports are transmitted from the headquarters of the weather bureau from the department in this city to the managers of the various rural telephone lines in the state, either directly by telegraph or through long distance lines, and these managers report to their subscribers.

ELECTRIC LIGHT AND POWER.

PHOENIX, ARIZ.—The Fossil Creek Electric Company is constructing on Fossil Creek a plant to harness a 6,000-hp water fall, at a cost of about $1,000,000. The greatest length of power transmission will be 75 miles. The works at the Fossil Creek water falls will consist of two plants, the larger plant involving the construction of five miles of tunnels, ditches and flumes.

ELDORADO, ARK.—The Eldorado Light & Power Company has been chartered. The capital stock is $7,500, all of which has been subscribed for. James H. Stevenson, of Little Rock, is president and the other stockholders are Ector H. Smith, Roy D. Campbell and E. H. Lake.

CORONA, CAL.—The Corona gas and electric light franchises were sold on July 28 to George Brown and M. W. Findley, of the Corona Gas & Electric Company; gas franchise, $150; electric franchise, $250.

LOS ANGELES, CAL.—The Monterey County Gas & Electric Company, with a capital stock of $750,000, has filed articles of incorporation here. The directors are M. V. McQuigg, C. W. Allen, R. C. P. Smith, J. M. Gardiner and Cora E. Hubbell, all of Los Angeles.

LOS ANGELES, CAL.—The Los Angeles Electric Company will light the municipality the coming year—1,219 street lamps at $6.75 per month each.

ALTON, ILL.—The directors of the Alton Railway, Gas & Electric Company and those of the Alton and East Alton Railroad & Power Company have voted to merge the two companies into a new corporation to be known as the Alton Light & Traction Company. The capital stock of the new company will be $1,000,000. The directors elected were J. F. Porter, James Duncan, C. A. Caldwell, O. S. Stowell and George M. Ryrie. The new corporation will have control of the electric street railways in the Altons, as well as the heating, power and lighting plants. The new company will complete the constructions of the new road to East Alton, which was commenced several months ago.

STAUNTON, ILL.—The Staunton & Mount Olive Coal Company is going to put in electric haulage at its plant.

DIVERNON, ILL.—The Madison Coal Co. is putting in two 12-ton electric locomotives at one of its mines at this place.

COLLINSVILLE, ILL.—The Donk Bros. Coal & Coke Company is putting in two 10-ton electric locomotives at its mines.

EAST ST. LOUIS, ILL.—The Interstate Transit Company has announced its acceptance of the power and light franchise as passed by the Council. The company will furnish light and power to the city and to private consumers.

SPRINGFIELD, ILL.—Tho Springfield Light, Heat & Power Company has been incorporated, with a capital of $100,000. The object is the furnishing of light, heat and power. The incorporators are Emil G. Schmidt, Bluford Wilson and William H. Brown.

PANA, ILL.—The Pana Electric Light Company's plant, franchise, etc., were sold at Master's sale, July 25, to Robert Johns for $45,000. About three years ago Mr. Johns sold the electric plant and telephone exchange to Gregg Rollins and Froelich, of Chicago, for $75,000. Ever since that time the matter has been in the courts.

CHICAGO, ILL.—In the renewal of franchise granted to the Oak Park Yaryan Company by the village board of Oak Park, the company is given the right to increase its charge for heating. In return the company is to light and heat the village hall free, and pay the village $1,000 a year. Hereafter the rate will be by the square foot of radiation instead of cubic foot of space in the buildings heated. The change in rate is said to be an increase of 20 per cent.

WINONA, IND.—The Winona Electric Light & Power Company has been incorporated with a capital stock of $100,000. The directors are Thomas Kane, S. C. Dickey, H. F. Townley and others.

BLUFFTON, IND.—The Bluffton Electric Light Company has been incorporated with a capital stock of $30,000. The company will erect a new plant and supply the city with light and power.

WABASH, IND.—A contract for lighting the streets for ten years has been awarded to the Wabash Electric Light Company. The arc lights are to be increased from 28 to 70 and the number of incandescent lights decreased from 225 to 125. The old contract price was $76 for each arc light, and $18.50 for each incandescent light. The new contract prices are $70 and $17.50 respectively. The company will expend $20,000 in improvements.

ELKHART, IND.—The City Council has passed an ordinance requiring all electric light wires carrying current generated outside the city to be placed in underground conduits on the assumption that the voltage of currents from distances of five miles and more is too great for public safety, if overhead. The ordinance is thought to be aimed at the Elkhart & St. Joe Power Company, a syndicate of non-resident capitalists that is building the immense dam and power house ten miles below the city in the St. Joseph river.

EARLINGTON, KY.—The St. Barnard Coal Mining Company at this place is contemplating changing its power from compressed air to electricity, for the mining and hauling of coal. With this end in view it is building a large brick power house.

AUGUSTA, ME.—The Hoosac Mountain Power Company has been incorporated at Augusta for owning and operating a power plant, capital $500,000, of which nothing is paid in. President, F. L. Dutton; treasurer, E. F. Whittum. Directors: F. L. Dutton, E. F. Whittum, C. L. Andrews, Augusta; H W. Burgett, H. F. Bryant and R. H. Whiting, of Boston.

TURNER'S FALLS, MASS.—The Franklin Electric Light Company has elected the following officers: President, J. F. Bartlett; treasurer, W. C. D. Thomas; clerk, E. I. Cassidy; directors: J. F. Bartlett, C. W. Hazelton, W. D. Russell, Porter Farwell, E. I. Cassidy, C. W. Schuler.

WESTFIELD, MASS.—Work is rapidly progressing on the Buschmann power plant at Still Pond. The dam has been increased in height, much of the work on the dynamo house has been completed and the wires are all strung ready for connection with the indoor work. It is estimated that with the power available all of the north side of the river could easily be lighted.

TECATITLAN, JALISCO, MEX.—A new electric light plant is to be installed here. It has been exempted from taxation for a period of years.

EL FUERTE, SINALOA, MEX.—It is reported that the company which was granted a concession some time ago for establishing an electric light plant here to cost $50,000 has abandoned the project.

MAPIMI, DURANGO, MEX.—F. S. Glenn, general superintendent of the Penoles Mining Company, says that when the work of installing the engines is completed, that company will have sufficient electrical energy to light the entire premises as well as for doing all the hoisting from the mines and transferring the ore to the smelter.

CITY OF MEXICO, MEX.—It is reported here that the Siemens & Halske Company, which is the principal light and power concern in this city, has sold its property and concession to the Mexican Light & Power Company. The latter company is establishing a great electrical generating plant on the Necaxa River, about sixty miles from this city and has valuable rights under a concession granted it by the Mexican Government.

PUEBLA, MEXICO.—The Mexican Government has granted a concession to Mateo Gonzalez Maroon, or any company which he may organize for the purpose, to establish an electrical generating plant on the Cantarranas River, in the Atlixco district of this state. The concession also grants the right to construct and operate transmission lines. The proposed plant will utilize 200 gallons of water per second. The power is to be transmitted to the cotton mills of that district and to the city of Puebla, a distance of about 35 miles.

OMAHA, NEB.—The Omaha Electric Light & Power Company, recently organized, took over the property of the Thomson-Houston Electric Light Company and the two Council Bluffs lighting companies August 1.

NORFOLK, NEB.—The Norfolk Electric Light & Power Company has $18,000 stock, $10,000 bonds. It has 10 miles of circuit, 60 arc lamps and 3,000 16-cp incandescents. The company intends putting in a water power plant and will need a full outfit, with two 250-kw units.

MILFORD, N. H.—The Milford Electric Light Company has sold its plant to E. M. Prindle, of Providence, R. I., and Charles Bourland, of Boston. The plant is bonded for $50,000.

JACKSON, N. H.—The Wentworth Hall Electric Lighting Company is owned by Mr. M. C. Wentworth and operates 1,000 16-cp incandescent lights. It also does a business in electric cooking apparatus and laundry irons.

TRENTON, N. J.—A certificate of incorporation has been issued by the secretary of state to the Saginaw Bay City Railway & Light Company. The corporation is capitalized for $3,000,000, and is to engage in the manufacture of heat, power and light. The incorporators are Joseph F. Cotter, Wm. F. Eidell and J. C. Clow, all of Camden.

DUNDEE, N. Y.—The Dundee electric light plant operates 3 arc lights of 2,000-cp each, 64 25-cp series street and 2,000 16-cp commercial incandescent lights; also fan motors. This property is for sale.

ALBION, N. Y.—Work has been begun on the transmission line between Albion and Brockport by the Albion Power Company, the company having bought the Brockport electric works at that place some months ago. The Albion company has bought the Clark's mills property at the head of Stillwater, which will be used by the company in its increase of business at the electric plant at Waterport.

JAMESTOWN, N. D.—The Western Electric Company was formed one year ago with $25,000 capital stock. Mrs. J. H. Canham is president. It has now 20 city and 15 commercial arcs, with 4,000 incandescent lights.

ATHENS, OHIO.—The council has passed an ordinance providing for an issue of bonds for building an electric light plant.

COLUMBUS, OHIO.—The municipal plant will have 7 amp. arc lamps instead of 7.5. A further outlay of $2,500 will be put on the new switchboard and the plant will have 27 circuits with 2,400 lights.

INDIANOLA, OHIO.—An ordinance granting the Indianola Heating & Lighting Company a franchise for all the city territory south of the Pan Handle tracks fixes 10 cents net per 1000 watts for lighting and 8 cents per 1000 for power current. It is claimed that the previous ordinance of 1901 was less favorable to the company, providing for a sliding scale and liberal discounts.

SANDUSKY, OHIO.—Directors of the Sandusky Gas & Electric Lighting Company have approved a proposition to issue $100,000 of preferred stock. At the time of the organization of the Lake Shore Electric Railway, this was included in the railway system, but owing to the receivership of the railway company, the property was never paid for, and reverted back to the former stock holders. The company will make important improvements.

MIDDLETOWN, PA.—This town has a municipal plant superintended by Mr. F. P. Stauffer. There are 67 arcs of 2,000-cp and 3,000 incandescent lamps. The capacity of the plant has been increased lately.

WACO, TEX.—A dispatch from Waco says that competent engineers have passed upon the natural dam near Marlin, Falls County, and reported that the water power the dam affords, when converted into electricity, will supply lights and move factory wheels over a wide district with Marlin as a center. In some prehistoric convulsion a great vein of hard stone was set up on edge, the upper edge projecting several feet above the bed of the river and extending far into the valley on both shores. The upper edge forms a terraced dam at Marlin Falls, below which the water rushes in rapids and cascades, giving just the conditions needed for obtaining motor power.

CHARLESTOWN, W. VA.—The Charlestown Light & Power Company, B. D. Gibson, president, has 23 arc lights and 800 incandescents. There is a fine opening for a 1,000-hp water power plant in the vicinity.

THE ELECTRIC RAILWAY.

HOT SPRINGS, ARK.—The Interurban Railway & Power Company desires to interest capital in a scheme it has for developing water power and operating an electric railway and lighting system. The company has secured a 50-year charter in Arkansas, with rights of eminent domain for the lake and a right of way for a car line. The Suachita River is to be dammed four miles from the city limits. W. L. Stebbins gives an estimate of 20,000 horse power at ordinary flow, yet says it is safe to figure on a delivery in the power house of not less than 6,000 horse power at low water. All surveys, maps, etc., have been made.

NORWICH, CONN.—The Norwich Street Railway Company, which recently passed into the hands of new interests, has elected officers as follows: Stillman F. Kelley, of Boston, president; Horatio A. Bigelow, of Norwich, secretary and superintendent; Arthur St. J. Whiting, of Boston, treasurer. The Montville Street Railway Company, controlled by the same interests as the Norwich Company, has elected the same officers.

WILMINGTON, DEL.—The Delaware Suburban Railway Company is preparing plans for its new power house and will require complete equipment for the same. The line will extend from Wilmington to Elkton and surveys are now being made.

MT. VERNON, ILL.—The certificate of incorporation of the Southern Illinois Electric Railway Company has been filed. The company is capitalized at $50,000. The incorporators are John R. Piercy, George F. Ward, Samuel Casey, Louis G. Pavey, Samuel T. Maxey and Albert N. Johnson, of Mt. Vernon.

MUNCIE, IND.—The Union Traction Company is preparing to push its Lima connection, which will give almost a direct line from Indianapolis to Toledo. Surveyors are now at work on the proposed route between Portland and Celina, Ohio, it being the object of the Union Traction Company to tap the big Ohio system of traction lines.

INDEPENDENCE, KAN.—A franchise has been granted by the City Council of this place to A. A. Anderson, of Indianapolis, Ind., to construct and maintain an electric railway through the streets of Independence, and similar franchises have been granted at Cherryvale and Coffeysville. It is the intention to connect these three towns of Montgomery County, and the lines will also extend to Neodesha and Chanute and Iola. Ultimately the line will be extended to Kansas City.

SERGEANT, KY.—The Wise County Electric Light, Power & Transportation Company has been organized at Norton, Va. The corporation will build an electric railway connecting practically all of the Wise County mines.

HAGERSTOWN, MD.—The Hagerstown Street Railway Company will extend its system from Boonsboro to Myersville to connect with the Frederick road. It is stated that the link will cost $10,000 a mile, or in all, about $50,000.

AMITYVILLE, N. Y.—The Village Trustees have granted the South Shore Traction Company a franchise to build an electric railway through this village.

ITHACA, N. Y.—The Ithaca & Auburn Electric Railway Company, of Ithaca, has been incorporated to construct a forty-mile railroad from Auburn to Ithaca. Its capital is $1,000,000. The directors are Sherman Collins, Ithaca; Isaac P. Hazard, Dexter Wheeler, Poplar Ridge, Cayuga County.

TUXEDO, N. Y.—There is a project on foot for a trolley line from Tuxedo to West Point and Highland Falls. It is not expected that the line would be a money maker, as it would be practically a private line for residents of Tuxedo Park. The country through which it would pass is most picturesque and would be enjoyed by residents of the park.

CHARLOTTE, N. C.—A big concern, with $10,000,000 capital, is being organized in Virginia to be known as the Cumberland Transportation, Light and Power Company. The proposed railway line will be 25 miles in length. The power plant will be located at Morton. The company will also furnish light and power to a number of towns. Henry M. Smyth, of Wise County, is the chief promoter.

AKRON, OHIO.—Thomas L. Childs, the promoter of the Cleveland, Akron & Southern Fast Line, has secured a franchise in Summit County for the extension of the projected road from Akron to Massillon.

PAINESVILLE, OHIO.—The Cleveland, Painesville & Ashtabula Railroad Company, of Cleveland, have completed plans for a carhouse and repair shops for their electric road. The building will be erected at Painesville, Ohio, adjoining the power house, now under erection.

CINCINNATI, OHIO.—The Beulah Construction & Realty Company has been organized to build electric and steam roads in Colorado. M. Izer, of Cincinnati, is president; W. A. Beatty, of St. Louis, vice-president and general manager; J. E. Rize, of Pueblo, Col., secretary and treasurer.

COLUMBUS, OHIO.—Franklin County Commissioners have granted a franchise through the county to the Columbus, Marysville & Bellefontaine Railway Company, which is promoted by William Luchtenburg, L. K. Guthke and M. B. Earnhart. It will form a part of the through line from Columbus to Toledo.

COLUMBUS, OHIO.—The Scioto Valley Traction Company has awarded the contract for the construction of its power house. The building will be located at Reese's Corners, five miles south of Columbus. The contract for the electrical equipment for the house was placed some time ago with the Bullock Electric Company, of Cincinnati, Ohio. The company will soon close a contract for the erection of a car house, which will be located near the power house.

DELAWARE, OHIO.—Officials of the Mansfield, Mt. Gilead & Delaware Electric Railway claim that arrangements have been completed for financing the project. The right of way has been obtained and contracts for the construction of the portion between Mansfield and Mt. Gilead will be closed at once. W. W. Stark and C. E. Fritzinger, of Mansfield, are the chief promoters. The line will connect Delaware with the Columbus, Delaware &

Marion Railway, and will form part of the through route from Cleveland to Columbus.

HARRISBURG, PA.—It is stated that the Central Pennsylvania Traction Company will expend $1,000,000 on a new power house and enlargement of its system and equipment.

JOHNSTOWN, PA.—The Johnstown & Geistown Electric Railway Company has purchased a site at Jacob's Hollow for a power house. Right of way for the line between Johnstown and Geistown has been secured from Walnut Grove to Geistown.

HARRISBURG, PA.—Charters have been granted at the State Department to the East Butler Street Railway Company, capital $6,000, to build a one mile line; D. H. Sutton, president; J. F. Anderson, I. H. Teputman, J. S. Campbell, G. H. Murphy, W. D. Brandon, directors; Danville & Riverside Street Railway Company, capital $18,000, to build a three-mile line from Danville to Riverside via South Danville; W. F. Pascoe, of Allentown, is president.

HOUSTON, TEX.—The Houston Electric Street Railway Company has ordered additional boilers, generators and engines that will more than double the capacity of its plant on Commerce and Austin and La Branch streets. The building will also be enlarged. In addition to this betterment, the company expects to extend its system to Harrisburg.

NEWPORT NEWS, VA.—At a meeting of the Citizen's Railway & Electric Company the following named officers were elected for the next year: W. A. Post, president; W. J. Payne, vice-president; H. H. Dalton, secretary; W. J. Naw, treasurer; Charles M. Franklin, assistant treasurer.

MORGANTOWN, W. VA.—A new company has just been chartered here to operate an electric railway between Morgantown and Terra Alta. It is capitalized at $25,000, all of which is subscribed. The new company has bought out the plant which has supplied electric light to Terra Alta and will enlarge it. The incorporators are J. Ami Martin, manager of the M. & K. Railroad; W. E. Arnett, of the Second National Bank; W. J. Snee, W. H. Mahcroft and Frank Weaver.

SPOKANE, WASH.—Plans are about completed for what will be one of the longest electric railways in Eastern Washington. Calvin Lunceford, president of the Adams County Electric Transit Company, states that a company was organized a few weeks ago for the purpose of developing water power at Palouse Falls and constructing an electric railway from Washtuena north through Ritzville to some point on the Great Northern Railroad. The statement is given out that the road will go through Ritzville, Mohler, Harrington, Davenport, Medical Lake and into Spokane. The company will be ready to let contracts for building the dam at Palouse Falls in a few days. It is expected to develop 5,100-hp at low water. The electric railway will be about 140 miles long and is expected to cost about $8,000 per mile. It will tap 14,000 sections of the finest wheat land in the world, and it is expected the road will be ready to move the 1904 crop.

NEW INDUSTRIAL COMPANIES.

THE EXPANSION PLATE STORAGE BATTERY COMPANY has been incorporated at Camden, N. J., with a capital of $100,000.

THE MARTIN ELECTRIC COMPANY, of New York, has been incorporated with a capital of $15,000. Directors: Alexander Martin, G. L. Martin and F. D. Haines, New York.

THE ELECTRICAL & HOUSEHOLD MFG COMPANY has been incorporated at Newark, N. J.; capital, $100,000. Incorporators: Franklin Mortimer, Nellie Mortimer, Gardner W. Kimball.

THE RAPID TRANSIT AUTOMOBILE COMPANY, of Buffalo, has been incorporated with a captial stock of $10,000. The directors are Charles W. Roe, John M. Campbell and Arthur S. Hartsell.

THE HAVANA ELECTRICITY COMPANY, LIMITED, of London, has been formed to develop railways, lights, telephones, telegraphs and other electrical industries in Cuba. The capital stock is $1,500,000.

THE INDUSTRIAL STORAGE BATTERY COMPANY has been incorporated at Camden, N. J., with a capital stock of $500,000. The incorporators are Joseph L. Sticknev, Charles F. Guyon and G. H. Lang.

ORISKANY VALLEY ELECTRIC COMPANY, of Utica, has been incorporated with a capital of $100,000. Directors: G. I. Hovey, of Deansborough; J. F. McBride, of Clinton, and W. C. McAdam, of Utica.

THE NOLL ELECTRIC COMPANY has been organized in New York City to take over the business of Augustus Noll, electrical contractor. The officers are Augustus Noll, president; O. C. Braun, vice-president and treasurer, Chas. A. Noll, secretary.

THE ALLOWAY ELECTRIC COMPANY, of Chicago, has been incorporated, capital $2,500, for the purpose of manufacturing machinery, electrical apparatus and supplies. Incorporators: Wilmore Alloway, Harry Alloway and Edward McMahon.

THE GREENWOOD AND DAGGETT COMPANY has been organized at Portland, Me., for the purpose of manufacturing and dealing in electrical goods. The capital stock is $50,000. The officers are: President, William H. Green; treasurer, Percy L. Andrews.

HOLMES ELECTRIC COMPANY.—The Holmes Electric Company was incorporated at Baltimore, Md., last week by Gwyllyn R. Holmes, William H. Rose, Florence W. Holmes, Thomas Sudler and J. Cecil Knouss. The company will have a capital stock of $10,000 and will engage in manufacturing and dealing in electrical apparatus, etc.

THE TELEGRATYPE COMPANY has been registered at Augusta, Me., for the making and sale of electric apparatus. Capital, $300,000, of which nothing is paid in. President, I. L. Fairbanks; treasurer, J. Williamson. Directors: I. L. Fairbanks and J. Williamson, of Augusta; Paul Petukin and Joy Morton, of Chicago, Ill., and J. Berry, of Augusta.

LEGAL.

INJURY BY LIVE WIRE.—In affirming large damages recently in a case of injury from contact with a live wire, the supreme court of Illinois held that it was permissible in such a suit to present the clothing worn at the time by the plaintiff, as tending to illustrate the manner in which the injury was occasioned.

MUNICIPAL TELEPHONES.—A suit has been brought against Evansville, Ind., for an injunction to prevent it from taking stock in a municipal telephone system or from exercising any rights as a stockholder under the attempted subscription already made. The city can hold such stock under its charter, but it is contended that this is different from being chief organizer of an experimental company; besides which the city would be liable finally for all the indebtedness of the company should it fail, as it probably would do.

MOTOR STARTER LITIGATION.—H. Ward Leonard, who owns a large number of patents claimed to cover the features of what is generally known as the Navy type motor starter, has instituted suit against several manufacturers for the alleged infringement of eight of his patents in the Navy type starter as made and sold by them. Mr. Leonard claims that his patents cover all commercial forms of starters having any voltage release in combination with an independent magnetic overload circuit breaker. Also that his patents cover what is known as the enclosed type starter in which the resistance wire or ribbon is enclosed in an insulating and heat absorbing material, such as sand, contained in an iron box.

EDISON-LALANDE BATTERY SUIT.—An action against Thomas A. Edison for alleged infringements of patent rights on a galvanic battery has been brought in the United States Circuit Court at Trenton, N. J., by James W. Gladstone, of West Orange. This suit follows one filed by the Edison Manufacturing Company against Gladstone and others for a similar infringement. The two suits concern Edison's claimed improvements on the battery. Gladstone declares that the improvements were first patented by Felix De Lalande, of Paris, who sold his rights to William M. Offley, of Washington, who transferred his interests to Gladstone. The court is asked to compel the defendant to make an accounting of the profits made from the improvement, and turn them over to the plaintiff.

TELEPHONE RIGHT OF WAY.—In the appeal to the Supreme Court of Nebraska, of the suit of the Nebraska Telephone Co. vs. the Western Independent Long Distance Telephone Co., the syllabus of the decision by the court, Judge Albert presiding, was that: 1. The term "public roads," in section 14, c. 89a, Comp. St. 1901, giving telegraph and telephone companies a right of way along the public roads of the state, does not include the streets and alleys of a municipal corporation, and the unauthorized use of such thoroughfares for such purpose constitutes a public nuisance. 2. A court of equity will not lend its aid to protect a suitor in maintaining a public nuisance, nor in the doing of an act punishable under the laws of the state. The suit arose out of the effort of the Bell system to restrain the independent competitors in erecting pole lines with wires above and through the old wires in the village of Louisville, Neb. The decision affirmed the lower court's finding for the defendants.

TELEPHONE DIRECTORY.—An impatient subscriber who wanted a new directory issued the moment he had his telephone in, at Seattle, Wash., got a mandamus against the Sunset Telephone Company to compel it to issue its directory forthwith, on the ground that he was sustaining injury. The supreme court of Washington State made short work of the business and reversed the order. It was held: 1. Where a writ of mandamus was issued against a telephone company to compel it to issue a directory of its subscribers, and distribute the same "on or about April 15, 1902," from which defendant appealed and filed both supersedeas and appeal bonds, the fact that before the hearing of the cause on appeal an affidavit was filed showing that on the 15th day of April, 1902, defendant did distribute a telephone directory among its subscribers, which was published in the ordinary course of its business, without intending to comply with the order of the court, did not require a dismissal of the appeal on the ground that no controversy between the parties remained. 2. Where plaintiff applied for a writ of mandamus against a telephone company to compel it to issue a directory of its subscribers and the company, in its answer, asserted that it was about to issue a directory, which would be printed and distributed early in the month of April, 1902, it was error for the court, on such admission, to direct the issuance of a peremptory writ requiring the issuance of such directory on or before April 15, 1902, no writ being necessary, under such admission, to obtain the relief demanded.

WATER POWER AT SALT LAKE.—In a dispute with the city over the right of the Salt Lake Water & Electrical Power Company to use water and discharge it again from its plant into the city canal, the supreme court has strongly upheld the company. One passage of a decision on the subject is as follows: As said in the former opinion of the majority of this court, this is a case where the two uses can stand together without injury to the prior appropriator, and where there is no injury equity will refuse a recovery. That the decree herein is just, under the circumstances, and ought to stand, is emphasized by the fact that, of the very numerous parties, prior appropriators of water from the same stream, to this action, the city is the only one to complain, or to express any alarm because of the decision. That, for its own welfare—for its material advancement and that of the state—the city ought to encourage rather than discourage the location of industrial enterprises like the one in question it would seem there can be no doubt. The undertaking is in harmony with the progressive spirit of the times. Neither the establishment of the plant nor its operation violates any law. It utilizes electric energy which is destined to revolutionize the various methods of promoting power and propelling machinery. In its operation the water used is neither impaired in quality nor diminished in quantity, and the city, having, at the begnning of the operation of the plant permitted and sanctioned the use of the water, ought not now be heard to complain without showing resulting injury.

INSPECTION OF LIGHTING.—In affirming a decision for plaintiffs in a case of fatal injury due to shock, and in overruling exceptions, the Supreme

Judicial Court of Massachusetts says: "Whether the jury should have been instructed that there was no evidence of negligence on the part of the corporation itself turns upon the question whether the system of inspection was all that due care required of it under the circumstances. Under it no one had a duty of making a thorough examination, even by the eye, of the lamp and its connections, oftener than once in nine days, and all such examinations were made in connection with the manual work of cleaning globes and renewing carbons. The visits twice each night of the inspectors who drove past showed simply that the lamp was in working order at that time, and had no tendency toward ascertaining the presence of circumstances which might then be present and which at any moment might make the apparatus dangerous. Electric wires exposed in the open air to the action of the elements, and all the apparatus of the pole and lamp as they grow older, have an increasing tendency to become defective, while the destructive agency which they carry remains active. Under such a condition of things, the care which a corporation having a lighting plant extended throughout a city should exercise in the oversight of its apparatus, with a view promptly to discover defects giving rise to the greatest danger, is one which is peculiarly proper for the determination of a jury of the vicinage. In our opinion it was proper in this instance to submit it to the jury, and certainly, in our view, it would have been wrong to rule as matter of law that there was no evidence of negligence in this respect on the part of the defendant itself."

PERSONAL.

MR. A. S. COLLETTE, of J. G. White & Company, 29 Broadway, New York, has returned from a two months' trip to Europe. He visited England, Holland, Germany, France and Switzerland.

MR. H. E. RICHARDS. Among New York's summer visitors recently was H. E. Richards, advertising manager of the T. Bissell Company, of Toledo. Mr. and Mrs. Richards are making a little tour of the east before returning home.

MR. ALFRED WISEMAN, M. I. M. E., promoter of the Electric Tramway Equipment Company, of Birmingham, England, is on a short visit to the United States, for the benefit of his health. He has many friends in this country.

MR. H. H. VREELAND, president of the Metropolitan and Interurban Street Railway systems of New York City, who has been traveling in Europe and giving valuable testimony in England as to the handling of large passenger traffic returned home last week.

MR. HARRY T. EDGAR, vice-president and manager of the El Paso Electric Railway Company and the International Light & Power Company, has been making a trip north and taking a little vacation while attending to matters connected with the system under his charge.

DR. ROBERT DAHLANDER is on a visit to the United States on behalf of the Swedish State Railway Department, and will report on American electric railway practice. The Swedish government is seriously considering the change of its railroads from steam to electric power.

MR. C. P. STEINMETZ, chief engineer of the General Electric Company is named in the new faculty of Union College as head of the department of mechanical and electrical engineering. Few equal Mr. Steinmetz in his luminous exposition and swift insight into the real essentials of a problem or topic.

MR. W. DRUMMOND MARROW, electrical engineer, of Charlotte, N. C. has been selected by the Board of Commissioners of Laurinburg, N. C., as their consulting and supervising engineer to prepare plans and specifications for their electric light system and to install their electric light plant. This plant will cost $10,000.

MR. G. C. FRENCH.—The Iowa Falls Electric Light & Power Company has just elected a new superintendent in the person of Mr. G. C. French, of Chicago. Mr. French succeeds F. B. Curtis, who has been superintendent of the plant for the past seven years, who resigns to engage in business for himself at his old home in Chariton, Iowa.

MR. MORTIMER NORDEN, of the Norden-Bittner Electric Company, has just designed a new marine incandescent lamp with two filaments, each of which can be automatically cut in, in case the other burns out. The idea was suggested to him by Miss Colwell, who, it is said, will in the near future take out patents or several electrical devices.

DR. WILHELM OSTWALD, the distinguished German electrochemist, will arrive at New York next Tuesday on a visit to this country of some weeks, and will be present at the inauguration of a course in electrochemistry at the Leland Standford University. Dr. Ostwald will bring with him for introduction in this country a new photographic process which he has developed.

MR. H. F. TATE.—The many friends and business acquaintances of Mr. H. F. Tate, the Western manager of the National Conduit & Cable Company, will sympathize with him because of his recent bereavement in the loss of his daughter Beatrice, who was killed by a train at Williamsport, Pa., on July 29. Mr. Tate's daughter, who was only 12 years old, was in the East spending her vacation at his old home. The body was taken to Chicago for interment.

LIEUT. GODFREY L. CARDEN, R. C. S., who has been in Europe as the representative of the Department of Machinery of the St. Louis Exposition, met with much success there, particularly in Germany and Belgium, in securing operating exhibits. Many of the great European steam and gas engine builders will be represented at the Fair, and their exhibits of the latter machines of large power promise to form one of the striking features of the Exposition.

MR. J. L. HUDSON, of Detroit, one of the leading merchants of the country and famous for his advertising, having looked into the merits of the Thos. E. Clark Wireless Telegraph Company's apparatus, has adopted it for commercial use in his store, having installed two stations. This novel and scientific feature is a success. Orders and messages are being sent from station to station constantly. This not only affords a study to the electrical student, but also proves very entertaining to the many hundreds of customers who visit the Hudson establishment.

MR. LLEWELLYN PREECE and MR. FRANK Z. MAGUIRE, both of London and interested in electric railway matters, arrived on the *Lucania* Saturday to make a trip of observation. Mr. Preece is a son of Sir Wm. H. Preece, consulting engineer for the British Postal telegraph service. On arrival here, Mr. Preece found a cable announcing the dangerous illness of his father, who had been suddenly taken with pneumonia, and asking his immediate return. He therefore took the first returning steamer, the *Pretoria*, of the Hamburg-American line and was on his return trip two hours after arrival. He had never crossed to America before. Sir Wm. Preece occupies a very prominent position in the electrical profession, and his loss would be seriously felt.

MR. WILLIAM PASTELL has resigned his position as superintendent of motive power of the Worcester Consolidated Street Railway Company and will join the railway engineering staff of the J. G. White Company. Mr. Pastell is one of the best known electric railway engineers in New England, and possesses wide experience in this field of engineering. He was assistant engineer to the Lynn & Boston Railroad from 1893 until 1899, when he became its chief engineer. He held this position until May, 1901, when he resigned to take the one he is just leaving in Worcester. During his two years in Worcester, Mr. Pastell has effected marked improvement in the physical condition of this railway property. Mr. Pastell is also an authority on the subject of signals for electric railways.

MR. T. A. EDISON is quoted by the *Wall Street Journal*, as follows, in regard to the Marconi system: "There is absolutely no reason why Marconi may not develop a speed of 500 words a minute in the transmission of trans-Atlantic messages. On the other hand, there are technical scientific and mechanical obstacles which make it absolutely impossible to increase the speed of transmission by ocean cables. There is absolutely no doubt but that the Marconi system is successful. All this talk about lack of secrecy, interruption and the interception of messages, is nonsense. What secrecy is there in cable operation? At least ten men know the contents of every cable message, and none of them receives a very high salary. No business man ever entrusts an important business secret to the wires without employing a cypher code. There is no doubt but that code will be necessary in the wireless system just as it is in the cable system. Personally, I have no doubt but that the Marconi system is both a commercial and a scientific success. I have agreed to act as a member of the company's technical board and expect to consult with Mr. Marconi when he returns to this country."

MR. A. C. DINKEY.—As a result of the recent and important changes in the personnel of the United States Steel Corporation, it is understood that Mr. A. C. Dinkey will become president of the Carnegie Steel Company. He is only 37 years old. He was a telegrapher on the Baltimore & Ohio Railroad at Braddock at the age of 16, and later at the Edgar Thomson Steel Works. He then became a machinist at Pittsburg Locomotive Works for three years. He became associated with Thomas McTighe, Mr. McConnell and others in introducing electric lighting in Pittsburgh. He then went to the Homestead Steel Works and took charge of the electrical department. He was first to introduce electricity for driving feed tables and revolutionized rolling mill practice, displacing hooks and tongs operated by hand labor. Four men were only required at rolls instead of 25. He effected a great reduction in labor cost. The practice is followed all over the world. He was also one of the first to introduce electric cranes in rolling mills. He assisted in the development of the electric charging machine and has patented one type. He is also the inventor of the Dinkey controller in general use in steel works and rolling mills and a crane for soaking pits. In 1898 he was appointed assistant general superintendent of the Homestead Works, and succeeded William E. Corey as general superintendent in April, 1901. His career is one of the most striking in the steel industry.

EDUCATIONAL.

MASS. INSTITUTE OF TECHNOLOGY.—Prof. H. E. Clifford, of the electrical engineering department of the Mass. Institute of Technology, reports the following graduates this year in electrical engineering, with the positions taken: F. Z. Brown, Consulting Electrical Engineer, Richmond, Va.; J. H. Brown, Bar Harbor Electric Light & Power Co., Maine; H. C. Burdick, on a ranch in the West; G. H. Clark, Stone Telegraph & Telephone Co., Boston; R. W. Eaton, Westinghouse Electric & Mfg. Co., Pittsburg, Pa.; W. O. Eddy, General Electric Co., Schenectady, N. Y.; A. L. Fischer, Manager, The Standard Electric Time Co., Boston; S. H. Fletcher, General Electric Co., Schenectady, N. Y.; E. D. Forbes, Assistant in Physics Mass. Institute of Technology; J. M. Gammons, Assistant in Electrical Measurements, Mass. Institute of Technology; G. H. Garcelon, Westinghouse Electric & Mfg. Co., Pittsburg, Pa.; C. F. Gardner, Boston & Northern Street Railway, Boston; C. S. Glenn, General Electric Co., Schenectady, N. Y.; L. R. B. Gould, New England Telephone & Telegraph Co.; J. L. Jones, N. Y. & N. J. Telephone Co.; J. A. Mears, Consolidated Car Heating Co., Albany, N. Y.; W. E. Mitchell, General Electric Co., Schenectady, N. Y.; F. P. Montgomery, Indiana Traction Co.; H. M. Morley, Graduate student in electrical engineering, Mass. Inst. of Technology; H. G. Nutter, Crest Mfg. Co., Cambridge, Mass.; G. B. Obear, instructor in electrical engineering, Lowell Textile School, Lowell, Mass.; H. Osborn, assistant in electrical testing, Mass. Inst. of Technology; A. W. Pearson, N. Y. & N. J. Telephone Co.; C. H. Porter, with Stone & Webster, Boston, Mass.; A. A. Potter, General Electric Co., Schenectady, N. Y.; P. B. Rice, N. Y. Telephone Co., N. Y. City; F. T. Taylor, General Electric Co., Lynn, Mass.; J. W. Welsh, U. S. Steel Corporation; D. S. Wilson, Associated Mutual Fire Insurance Companies, Boston. In addition to these, the other graduates whose assignments are not known were J. A. H. Colgate, F. B. Crosby, J. J. Dooley, K. W. Endres, M. Ferry, D. H. Fisher, W. M. Gilker, R. J. MacGregor, F. C. Reed, D. A. Smith.

Trade Notes.

WALLACE BARNES COMPANY, Bristol, Conn., have in the hands of the printer a more elaborate catalogue than they have ever yet issued as to their specialties in small springs, wire and cold rolled steel.

SWEDISH-AMERICAN TELEPHONE COMPANY. Mr. E. B. Overshiner, president of the Swedish-American Telephone Company, who recently visited New York City, in an interview, stated that their business shows a marked increase during the summer months over last year and they find it necessary to run a night force in order to keep up with their orders.

THE WATERTOWN ENGINE COMPANY have recently opened a Chicago office at 27 North Canal St., in charge of the W. P. Lyons Company. Mr. Lyons is an engine man of long experience, perfectly familiar with the work of erecting and installing as well as of selling. He will be glad to respond promptly to any inquiries.

AUTOMOBILE INSURANCE.—Wilson R. Smith, 11 Produce Exchange Building, New York, is offering an automobile liability policy which insures an automobile against loss by fire wherever the machine may be, whether stored in any building, or while in transit by railroads or ferries anywhere in the United States. A form of insurance against accidents in automobiles is also offered.

SMALL RESISTANCE UNITS.—With this title the International Instrument Company, 23 Church St., Cambridge, Mass., has issued a pamphlet descriptive of flat and tube enameled resistance units for rheostats, controllers, dimmers and other uses where it is desired to have resistance in compact, indestructible form. As indicated by the designation, the resistances are in standard units which can be assembled in any number required for a given case.

TELEPHONINE.—The Telephonine Company of America, New York, has issued a small pamphlet setting forth the merits of an antiseptic telephone attachment. This mouthpiece attachment does not interfere whatever with the transmission of sound. About once in 15 to 30 days 20 drops of "telephonine" is put on the center of the pad in the mouthpiece, which gradually condenses from the pad on to the rim and inner surface of the mouthpiece and renders all germs innocuous.

CIRCULAR LOOM CONDUIT.—A twelve-page pamphlet recently issued by Thomas G. Greer, Chicago, is divided between advice to young men and enumeration of one hundred and one places where Circular Loom is used. Mr. Greer's advice to young men is equally applicable to men of any age who wish to succeed in life; and the indication of where an insulation such as that supplied by a Circular Loom is applicable will be of much instruction to those engaged in electrical installation.

SPARK COILS.—The Electric Contract Company, 53 Maiden Lane, New York, is making a coil known as the Williams Spark Coil, which is particularly adapted for gas and gasoline engine ignition. No paper or paraffine is used, the coils are wound in sections and the vibrator spring is on a rocker that is always clamped in position, there being no screw through the spring. Platino-iridium contact points are used. The same firm has issued a catalogue of the "Light of Asia" portable electric lamp.

THE LE VALLEY-VITA CARBON BRUSH COMPANY, in a circular, notifies its customers of the extraordinary operations of a former employee. It appears that this employee, under the name of the Excelsior Electric Company, solicited orders from many of the Le Valley-Vita customers, claiming to have been appointed sole agents for the sale of their carbon brush, which they offered at a reduced price. Orders received on such solicitation were filled, it is stated, with brushes stolen from the factory, which accounted for the price at which they were offered.

PEERLESS RUBBER MFG. COMPANY, 16 Warren Street, New York City, has just issued a very neat and handy pamphlet as to its Rainbow packing and other specialties, such as Dale's, Hercules, Honest John, Success, Arctic, etc.; as well as its other specialties in the line of sheet, square, round, etc., gauge glass rings, gaskets, rubber belting, valves, tubing, hose, mats and matting. This progressive concern sold no less than 1,526 tons of Rainbow packing last year, and some cogent reasons are given for this marvelous trade record. The pamphlet is its Engineers' Specialties Catalogue No. 58, and can be had by anyone on application.

THE "ELECTROTHERM."—The H. W. Johns-Manville Company, New York, has just issued a card containing on one side a large colored illustration of an "electrotherm," and on the other a view of an old-fashioned hot water bag. On each side is a cover divided in two down the center, the two halves opening like a double door. The advantages of the electrotherm are pointed out on the cover on the electrotherm side of the card, and the disadvantages of the hot water bag are enumerated on the cover of the other side. On each cover is a half-tone illustration of a thermometer intended to show the degrees of heat that can be maintained by each method of applying heat in the treatment of disease.

INTERNATIONAL INSTRUMENT COMPANY, 23 Church St., Cambridge, Mass., has been incorporated under the laws of Massachusetts, and will construct high-grade scientific laboratory and engineering apparatus. It will also offer the services of skilled mechanicians and the facilities of good equipment for the construction of new and improved forms of apparatus, and manufacture and sell the same, and will undertake the execution of fully designed physical, astronomical, psychological, electrochemical and meterological apparatus, as well as the development and perfection of partially designed apparatus. The company will also manufacture certain forms of its own development and procure for customers promptly and sell to them at makers' prices anything wanted in the line of laboratory supplies, either domestic or foreign.

"G. I." CHANGE OF ADDRESS.—In a circular to the trade, Mr. Martin J. Insull, second vice-president, says: On and after August 10, 1903, the address of the general sales offices of this company will be 529 West 34th Street, New York. This removal has been occasioned by the purchase of our present building by the Pennsylvania Railroad Company (for its metropolitan tunnel work), but the G. I. Company has taken advantage of the opportunity thus afforded to supply its own need of more facilities for all of its departments, due to the great and rapid increase of its business during the past few years. While thanking you for past favors, we are therefore also pleased to be able to advise you that with an enlarged manufacturing plant and generally increased and improved facilities in all departments, the G. I. Company will be able, when settled in its new quarters, to furnish a more varied line of goods, effect quicker deliveries, and in short to serve its customers better than ever.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 4, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

12,141 (Re-issue). APPARATUS FOR SELECTIVE ELECTRIC SIGNALING; J. S. Stone, Cambridge, Mass. App. filed July 11, 1903. A resonant circuit including a condenser having one fixed armature and one movable armature, together with means for indicating the movement of the latter.

735,052. ELECTRIC MOTOR; N. C. Bassett, Boston, Mass. App. filed Dec. 5, 1900. The counter shaft with its spur gear can be angularly shifted to any one of several positions around the frame of the motor to adapt the latter for use in various situations.

735,077. STARTING-SWITCH FOR ELECTRIC MOTORS; Augustine R. Everest, Lynn, Mass. App. filed May 22, 1902. The switch has "starting" and "running" positions, and at the proper time will automatically pass from the former to the latter.

735,083. SWITCH OPERATING DEVICE; G. E. Fry, Allegbeny, Pa. App. filed Aug. 28, 1902. A railway switch in which an electro magnet is used to set a lever in position to be actuated by the car wheel for throwing the switch.

735,103. CONSTANT CURRENT TRANSFORMER; D. O. Hull, St. Louis, Mo. App. filed Jan. 15, 1902. A two-part core for the primary and secondary coils, one of which is rotatable and adapted by its movement to shunt the magnet flux of the primary coil through the core around the secondary coil in harmony with the variations of current in the latter coil.

735,118. POLYPHASE ALTERNATING-CURRENT INDUCTION MOTOR; Walter Langdon-Davies and Alfred Soames, Surrey, England. App. filed June 9, 1902. The secondary core is so constructed as to offer a path of high resistance to Foucault currents, and the secondary winding is of high conductivity.

735,151. CENTRIFUGAL STARTING SWITCH FOR INDUCTION MOTORS; Henry G. Reist, Schenectady, N. Y. App. filed May 26, 1902. A plurality of independent switches are mounted on the secondary and independently actuated at different times by centrifugal force, thus gradually cutting out starting resistance.

735,160. ELECTRIC MOTOR; T. A. Seitz, Grand Rapids, Mich. App. filed March 23, 1903. The motor is mounted on a universal joint so that its shaft may be thrown into any position convenient for such operations as carving and engraving.

735,161. ELECTRIC ARC LAMP. C. Senez, Paris, France. App. filed Aug. 9, 1901. Details of a differential lamp.

735,168. ELECTRICAL MEASURING INSTRUMENT; J. F. Stevens, Philadelphia, Pa. App. filed Nov. 17, 1900. A mounting for the various parts whereby the moving system may be removed and replaced without changing a constant of the instrument.

735,170. ELECTRO MAGNETIC SWITCH FOR ELECTRIC RAILWAYS; S. B. Stewart, Jr., Schenectady, N. Y. App. filed May 1, 1901. An arrangement whereby the magnetization can be maintained and the switch held in the position to which it has been moved by the magnet with a less current than that required to effectively energize the magnet with a maximum air-gap.

735,171. SYSTEM OF ELECTRICAL DISTRIBUTION; S. B. Stewart, Jr., Schenectady, N. Y. App. filed May 31, 1902. The invention has for its main object to simplify the operation of connecting the actuating coil of the electro magnetic switch to the auxiliary source of power and the main source of power respectively, and of connecting the auxiliary source of power to the main source in order to recharge the former from the latter.

735,182. ELECTRIC HEATING APPARATUS; D. M. Watson, Portland, Ore. App. filed Aug. 19, 1902. A receptacle consisting of a wire framework having a flexible covering and with one end open through which to insert an electric lamp to be utilized as a heater.

735,188. LAMP SOCKET; H. C. Wirt, Schenectady, N. Y. App. filed April 30, 1900. Details.

735,189. CEILING BOARD HANGER FOR ARC LAMPS; H. C. Wirt, Schenectady, N. Y. App. filed June 19, 1901. The board is provided with a spring supported hook for the lamp and for a lamp controlling switch.

735,190. CONTROLLING INDUCTION MOTORS; Arnaldo P. Zani, Berlin, Germany. App. filed Aug. 11, 1899. The secondary has two alternator paths, one of high resistance and low inductance, and the other of low resistance and high inductance. At starting the secondary current owing to its high frequency will flow through the former, and at speed through the low resistance of the latter.

735,210. ENGINE STOP; J. H. Cary, Providence, R. I. App. filed May 18, 1903. An electro magnetic tripping mechanism actuating the throttle valve.

735,212. INSULATOR; V. G. Converse, Pittsburg, Pa. App. filed Nov. 10, 1902. Details of a petticoat insulator.

735,237. TROLLEY WHEEL; R. & R. W. Fox, Parkersburg, W. Va. App. filed May 20, 1903. The axle or pin of the wheel is carried by blocks having free movement in curved guides to permit the blocks to move independently when the wheel strikes an irregular portion of the wire.

735,249. ELECTRIC SWITCH; G. Hall, Providence, R. I. App. filed Oct. 31, 190[illegible]. Details.

735,2[illegible]0. ELECTRIC RAILWAY SYSTEM; G. I. Hanchett, Hackensack, N. J. App. filed July 18, 190[illegible]. A means for transforming energy comprising a dynamo, a fluid pressure mechanism for driving the dynamo, a device governed by the fluid pressure to cause the dynamo to act as a motor to furnish energy to restore the fluid pressure.

735,311. ATTACHMENT FOR PRINTING TELEGRAPHS OR OTHER SWIFT DELIVERING APPARATUS; C. M. Stinet, New York, N. Y. App. filed Feb. 11, 1901. A cabinet attached to a stock ticker and containing mechanism which receives the printed tape, and arranges it in regularly succeeding sections, a large number of which are exposed to view.

735,317. SNAP SWITCH OPERATING MECHANISM; W. C. Tregoning, Hartford, Conn. App. filed April 23, 1903. Details.

735,3[illegible]4. ELECTRIC PROTECTIVE SYSTEM; J. Weatherby, Jr., New Cumberland, Pa. App. filed March 24, 1903. Details.

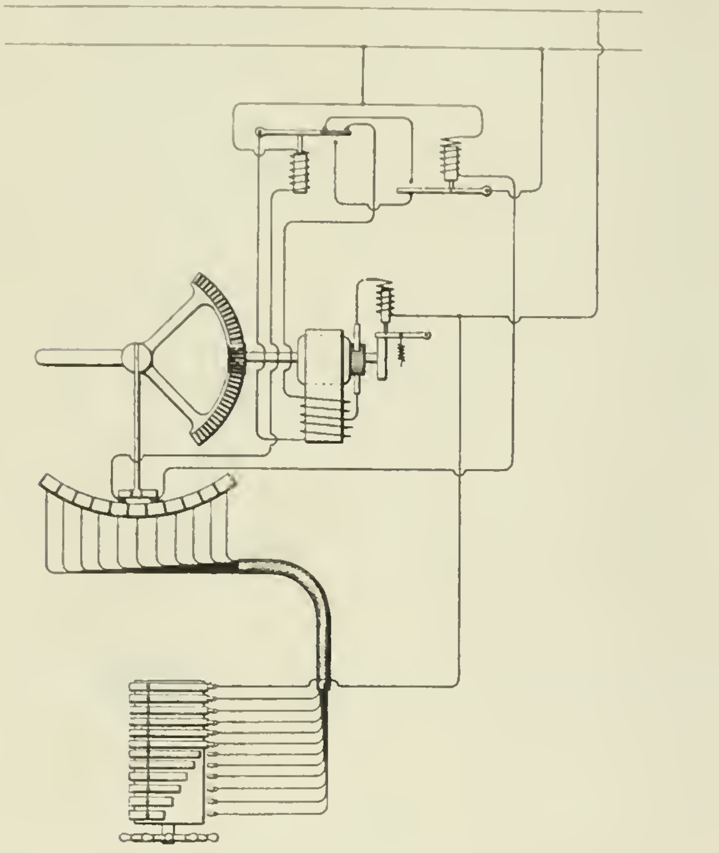
735,340. SURFACE CONTACT ELECTRIC RAILWAY SYSTEM; W. M. Brown, Johnstown, Pa. App. filed Dec. 18, 1902. In case the magnet on the car picks up iron objects from the roadway, they are removed by a constantly energized and stronger magnet, located in the roadway immediately ahead of a crossing, of branch track, so that short circuits cannot occur.

735,352. SYSTEM OF ELECTRICAL DISTRIBUTION; G. S. Dunn, East Orange, N. J. App. filed June 18, 1903. In connection with a multi-voltage four wire system, a switch is used by means of which a regular graduation of voltage can be impressed upon a motor.

735,363. ELECTRIC SWITCH; H. Gilmore, Boston, Mass. App. filed April 18, 1902. Details.

735,375. COMMUTATOR BRUSH HOLDER; C. H. Hines, Buffalo, N. Y. App. filed Jan. 30, 1903. The brush holder carries a scale by which the pressure exerted by the brush upon the commutator can be ascertained.

735,384. CHARGING SWITCH; M. R. Hutchison, Norwood, N. J. App. filed Nov. 26, 190[illegible]. An electro magnet and a permanent magnet co-operate in action upon a switch to determine the polarity of current flowing to the battery.



735,550.—Electric Steering Gear.

735,386. MEANS FOR CONTROLLING ELECTRIC MOTORS; J. D. Ihlder, Yonkers, N. Y. App. filed April 19, 1899. A push button control system for alternating current motors driving elevators.

735,406. SYSTEM OF ELECTRICAL DISTRIBUTION AND TRANSFORMING; C. M. Palmer, Fon du Lac, Wis. App. filed Dec. 13, 1899. Translating circuits including an inductive resistance are shunted across the terminals of storage batteries connected in a main circuit on which pulsating currents flow.

735,416. ELECTRIC SIGNALING APPARATUS; H. W. Souder, Tamaqua, Pa. App. filed March 25, 1902. Consists of a system capable of being operated by a number of cars following one another in the same direction, affording information to each motorman of the fact that one or more cars are ahead of him.

735,417. ELECTRIC SIGNALING APPARATUS; H. W. Souder, Tamaqua, Pa. App. filed Aug. 30, 1902. A railway block system in which the distant signal is first set and if the circuit is thus complete through it, the home signal follows, thus indicating that both signals are in working order.

735,419. TROLLEY CONTACT; H. W. Souder, Tamaqua, Pa. App. filed Sept. 25, 1902. A comb-like structure supported above the wire and adapted to be touched by the rim of the trolley wheel.

735,438. METHOD OF CONTROLLING ALTERNATING CURRENT MOTORS; Albert H. Armstrong, Schenectady, N. Y. App. filed March 2, 1899. In operating tandem induction motors, the primary windings of the first of the two motors is connected in delta.

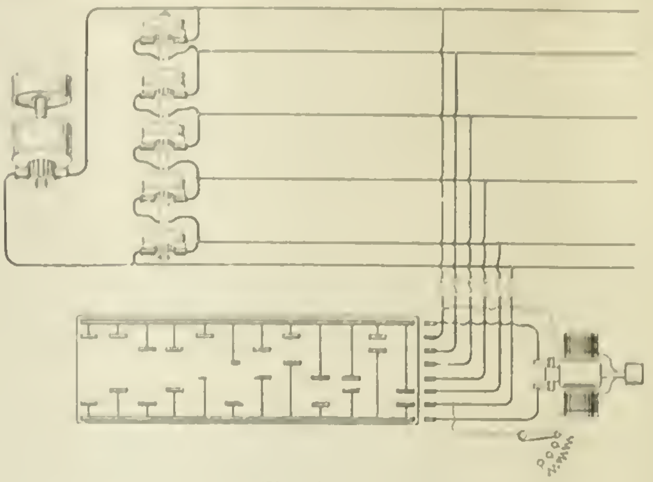
735,452. ELECTRIC SWITCH; W. L. Bliss, Brooklyn, N. Y. App. filed Feb. 26, 1902. A pneumatic switch comprising a cylinder, a piston-rod projecting through the head of the cylinder carrying a bridging contact, the latter being covered by a protecting cap.

735,464. ELECTROLYTIC DIAPHRAGM; Eugene A. Byrnes, Washington, D. C. App. filed May 12, 1903. (See page 257.)

735,508. MULTIPLEX TELEGRAPHY; P. E. Heina, Paris, France. App. filed Jan. 22, 1902. The application of a differential triple-wire transformer for transmitting duplex signals in the various systems of multiplex telegraphy, where pulsating currents are employed, and in connection with two induction coils, the primary wires of which are connected with the transmitting apparatus.

735,511. ANNUNCIATOR; E. M. Hewlett, Schenectady, N. Y. App. filed Aug. [illegible], 1900. The banner has an intermediate position to which it can be set to open an alarm circuit normally closed by the banner at the open position.

735,5[illegible]1. SWITCH FOR SYSTEMS OF REMOTE CONTROL; O. M. L[illegible]ey, Hanford, Cal. App. filed Oct. 16, 1902. Details.



735,352.—Electrical Distribution.

735,541. ELECTRIC AUTOMATIC GAS LIGHTER AND SHUTOFF; H. J. Lyons, Guyandotte, W. Va. App. filed Dec. 19, 1902. Comprises a bellows to be connected with a gas main and gas burner, with means controllable at will for inflating the bellows with gas and electrical apparatus connected with the bellows for automatically lighting the burners, when the bellows is inflated.

735,550. ELECTRIC STEERING GEAR; W. L. Merrill, Schenectady, N. Y. App. filed April 18, 1903. Brushes geared to the motor are adapted to move over a series of contacts and means are provided for charging a greater or less number of the contacts, and other means for varying the motor connections, which are dependent upon the position of the brushes.

735,577. HANDLE FOR ELECTRIC SWITCHES; C. G. Perkins, Hartford, Conn. App. filed June 10, 1903. Details of construction of a handle having a yielding connection with the rotary switch-spindle.

735,581. THERAPEUTICAL APPARATUS; A. Pollacsek and B. Beer, Vienna, Austria-Hungary. App. filed Oct. 20, 1902. A metal cap to be applied to the head, and to which is attached an electric coil through which alternating currents are directed for the purpose of exciting the scalp.

735,584. SURFACE CONTACT RAILWAY SYSTEM; W. B. Potter, Schenectady, N. Y. App. filed April 23, 1902. A positive and a negative feeder leading from the source of current and a ground connection at a single point located at the end of the negative feeder farthest from the source.

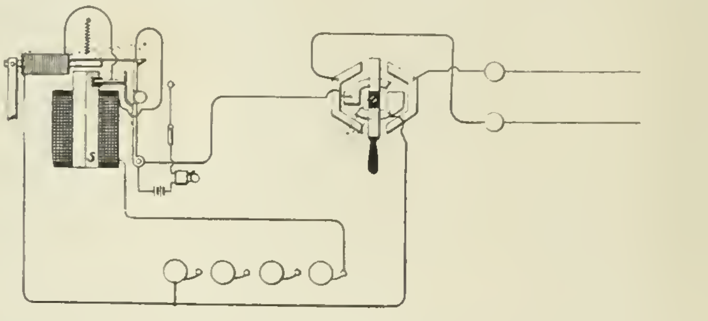
735,611. SPHEROIDAL STRAIN; L. Steinberger, New York, N. Y. App. filed Jan. 14, 1903. Two interlocking parts electrically insulated and surrounded by a sphere of insulation.

735,612. SINGLE LINK STRAIN; L. Steinberger, New York, N. Y. App. filed Jan. 29, 1903. One member consists of an eye, and the other of a tube passing through the eye with insulation inserted between the metallic surfaces.

735,613. SUSPENSION FIXTURE; L. Steinberger, New York, N. Y. App. filed Feb. 2, 1903. A fixture performing the function of a turn-buckle, of a strain and of a hanger for span wire clips.

735,621. ELECTROSTATIC MOTOR; Elihu Thomson, Swampscott, Mass. App. filed March 25, 1903. There are two elements analogous to the potential and current coils of a wattmeter. One is stationary and connected across the mains, and consists of two opposing metallic plates facing a hard-rubber drum; on the inside of the drum are strips connected with a commutator on which bear two brushes in series with the supply circuit. The drum will move if the brushes on the strips in an angularly displaced position with respect to the field plates.

735,631. INSULATED JOINT; G. A. Weber, New York, N. Y. App. filed March 4, 1903. A joint for railway rails in which there are two insulated breaks in the rail, instead of one, as usual.



735,384.—Charging Switch.

735,639. AXLE LOCKING DEVICE FOR TROLLEY HARPS; A. J. Wiggin, Kennebunk, Me. App. filed Feb. 7, 1902. A spring plate grasping the squared end of the trolley axle.

735,651. APPARATUS FOR CONTROLLING ALTERNATING CURRENT MOTORS; Albert H. Armstrong, Schenectady, N. Y. App. filed March 2, 1899. See note following patent No. 735,438.

735,686. METHOD OF OPERATING ALTERNATING CURRENT INDUCTION MOTORS; Arnaldo P. Zani, Berlin, Germany. App. filed Aug. 11, 1899. See note following patent No. 735,190.

735,672. TROLLEY RETRIEVER; A. W. Knutson, Canton, Ohio. App. filed Jan. 17, 1903. Details of a spring drum, and pawl and ratchet mechanism.

735,676. SYNCHRONIZER; D. J. Richards, New Baltimore, Mich. App. filed Feb. 24, 1903. Details of mechanism for automatically throwing machines together when they arrive at synchronism.

735,687. ELECTROTHERAPEUTIC APPARATUS; S. B. Zink, Portsmouth, Va. App. filed June 17, 1903. A bed-like structure having electrodes located at various points for easy application to the various parts of the body.

Electrical World and Engineer

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THE PARIS CATASTROPHE.

The terrible disaster at Les Couronnes Station of the Paris underground should serve as an awful warning to the management of similar systems. The Liverpool accident a year and a half ago was bad enough, but the present instance is far worse both in its results and in the causes which led to them. Each resulted from a train taking fire, but at Les Couronnes the burning trains were empty and the loss of life resulted from the smoke overwhelming the passengers of a following train, caught like rats in a trap and suffocated because they could not get out of the station, which served as a chimney for the burning trains. There is nothing new in a train, either steam or electric, catching fire through some accident in a tunnel or out of it, and until more care is exercised in encouraging fire-proof construction, trains will now and then be inflamed. But there is no need of loss of life even in such cases unless a collision has lent its fatal aid. We do not think that as a matter of experience, electric trains run more risk of fire than others, and in the present instance the train which furnished the victims was uninjured. The grim list of the dead cannot be charged up to electric driving nor to the intrinsic dangers of underground roads. From all the information which has reached us, it stands to the account of those who planned stations without sufficient means of exit. It has no more connection with the train service as such than a holocaust in a metropolitan theatre would have to the chance cause that might start the flame. There are very few theatres in which a fire once under way would not cause great loss of life simply from insufficient means of exit. The original source of the fire might or might not be due to negligence, but the arrangements which would block escape would certainly throw a great responsibility on the managers.

After the Liverpool disaster, Mr. Westinghouse raised a very pertinent discussion as to the dangers which might arise, but we thought then and think now that the danger lies not in electric driving nor any form of it, but in insufficient precautions against the results of a fire once started. Mr. Westinghouse's contention in favor of non-combustible cars is in itself sound, but it is fundamental and applies with equal force whatever may be the assumed cause of the fire. We do not yet know what, if any, were the precautions adopted in Paris, but in many, we think in most, instances American electricians have their electrical equipment so installed that the danger of fire from it is remote. But granting that an underground train may from some cause take fire, the all-important question is the ready escape of the passengers to a place of safety. Entirely non-combustible cars are by no means easy to construct, but accidents like that at Les Couronnes should teach the lesson that Manila Bay and Santiago taught the world's navies. Whatever steps may be taken in this direction, however, the means of escape from the dangerous confinement of a tunnel ought to receive the most careful attention. In particular, the tunnel should be as well lighted and ventilated as possible, and the exits to the street from stations should be ample to serve even in case of panic. Gates and turnstiles are everywhere, as they were at Les Couronnes, a source of danger. They are quite needless obstacles if there is proper attendance, and if present in any form, should be such as would immediately yield in case of necessity. In case of a panic ordinary turnstiles and sliding gates are very easily jammed and are quite certain to lead to loss of life. In a station filled with smoke, exit is none too easy even if the way is clear, and in the Paris catastrophe it looks very much as though the attendants lost their heads, as well as the passengers from the fatal train. Where the third rail is the source of power, an additional menace exists which the progress in guarded rail construction ought to render impossible in the near future. Looked at from any aspect you please, an unguarded third rail is a dangerous thing for any one compelled to court its acquaintance; and in case of a tunnel accident the chance for fatal results in the ensuing panic would be unpleasantly great.

But in spite of the terrible results of the Paris affair, we are convinced that similar potential conditions for disaster do not exist in our American practice. For one thing the underground lines, built and projected here, are planned with particular regard to good lighting and ventilation. They are, too, far more roomy than many of the foreign "tubes," and are fairly near the surface and provided with numerous stations. With the extra space comes less danger of dense smoke and far more room for escape in case of necessity. The provisions for ventilation are good, and it is hard to imagine any conditions under which a dangerous amount of smoke could accumulate. With attention to the matter of easy exits, it is difficult to see how even in the panic of a sudden fire the dreadful results of Les Couronnes could be paralleled. It must be remembered, however, that the chance of successfully fighting a fire once started on a train of ordinary construction is very small, and the only thing to be done is to get the passengers out as quickly as possible and to a place of safety. Precautions should be directed especially at prevention by making the material within reach of the electrical equipment as nearly fire-proof as possible. Whether it is advisable to attempt fire-proofing the car as a whole is open to some question; but it certainly should be possible to adopt a construction which would prevent the rapid burning that is the cause of a dangerous amount of smoke which is in such cases, as indeed in most fires, the principal peril to life. With proper protection of the electrical apparatus and circuits it should be practically impossible for a train to be set on fire unless as the result of a collision; and collisions with the block systems now in use or available should be quite out of the question. The real source of danger in the modern rapid transit systems is not the motive power adopted nor the manner of its application, so much as the severity of modern requirements as to speed and headway. Every year sees a more and more pressing demand for frequent trains, quickened acceleration and higher schedule speed. To meet these requirements precaution should grow with the service, and we are glad to say that on American systems such is generally the case.

LIGHTING AND TRACTION.

We have already given the details of the United States Census figures of electric lighting stations in this country, and have called attention to certain facts in regard to them. There are so many points of interest in these official and first authentic figures, it will take some time to digest and comprehend them. It may be noted primarily that in power plant capacity the lighting and trolley industries are very much on a par. The street railways have just about 1,300,000 horse-power in engine and water wheel capacity. The lighting plants have just about 1,750,000 horse-power. The output for the street railways was returned at 6,249,910 kilowatt-hours per day, or 2,261,484,397 for the year. The lighting plants report an output of almost the same figure, namely, 2,437,218,732 kilowatt-hours for the year, or 6,677,310 per day; so that while the output of the lighting plants is half a million kilowatts larger daily, the plants run fewer hours. This is quite in accordance with observation. The dynamo capacity of the railways is 1,204,238 horse-power, while the dynamo capacity of the lighting plants is 1,615,480 horse-power. Reducing this to kilowatts, it would appear that the capacity of the railways is in full use nearly eight hours daily, while the capacity of the lighting plants is in use about six hours daily.

After all, this is a rather surprising result, for a street railway system is understood to be in operation pretty well all around the clock, while lighting is necessarily limited to a few hours. On the other hand, the development of day circuits for power purposes has come in of late years to increase hugely the output of the lighting plants, while it is obvious that there must be many trolley systems that taken the year through would not average as many hours of operation as a busy lighting plant. In each case the controlling, economic idea must be to increase the number of hours of operation, for upon that item depends capitalization and return in dividends.

A QUESTION OF SCIENTIFIC PRIORITY.

Elsewhere we print an article by Brother Potamian, the distinguished authority on early electrical literature, in which he examines into the question of priority with respect to the experiment proving that the charge of an electrified body resides on the exterior surface. French writers as a rule assign credit for this experiment to Biot—at least by implication through designating the experimental apparatus by his name. Maxwell has claimed the honor for Cavendish, and others have assigned it to Coulomb. It is shown that the experiment was first performed in 1773 by Cavendish, and that the paper of Coulomb describing a similar experiment appeared in 1788. It also appears that while Biot never personally claimed credit for the demonstration, he refrained from stating in his writings that his knowledge on the specific subject was derived directly from the work of Coulomb. All of the benefit which the world has derived from the establishment of the great principle involved has, however, come from the publicity given to his work by Coulomb, the particulars and results of the Cavendish experiment not having been made public until 90 years after the publication by the former. Thus, so far as concerns scientific progress there is no debt of gratitude owing to Cavendish—that eccentric scion of a noble family who seemed to view mankind in general with no little of the contempt which he bestowed on woman in particular, and who pursued scientific investigations apparently solely for his own selfish gratification.

The settlement of this interesting question of priority directs attention to the great value for purposes of historical scientific research of the Wheeler Collection in the Library of the American Institute of Electrical Engineers. The preparation of a bibliography of this great collection is in the admirably competent charge of Brother Potamian, and when published the notes accompanying each title will be invaluable in facilitating research. Another great work in connection with the Institute Library remains, however, to be provided for, and that is the preparation of keys to the electrical and cognate papers in the great *Transactions* of scientific bodies which up to about a generation ago were almost the sole repositories of scientific knowledge in original form. During the past two years many complete sets of such *Transactions* have been placed on the shelves of the Library through the generosity of friends of the Institute. At present the Institute Library is probably richer than any other library in the United States in this extremely important branch of scientific literature, and the plans of the Library Committee contemplate making the collection practically inclusive of everything of value in this line. In the absence of keys to the contents, such a collection has, however, little value to those who cannot spare time for extended research, and the vast extent of the material is appalling even to the most enthusiastic delver in original sources of knowledge. Such a collection of keys as proposed would, moreover, be invaluable to every scientific and large public library of the world.

and its preparation and publication by the Institute would attach to that body a permanent and world-wide prestige. The proceeds of an endowment fund initially for this purpose could, after the completion of the keys—the preparation of which would be a labor of years—be utilized as a publication fund for other purposes, notably in the compilation and printing of a monthly index of current electrical and physical literature, in connection with a system whereby members by forwarding coupons could obtain in the shortest possible time periodicals containing articles noted which interested them. It is to be hoped that some day the Institute shall be made by the gift of some friend the custodian of a fund for the accomplishment to perpetuity of such worthy objects.

The Legalized Standard of Electromotive Force.

Prof. Carhart's paper on this subject, recently read before the American Institute of Electrical Engineers, points to the advisability of changing our devotion from the zinc-mercury cell of Clark, to the zinc-cadmium cell of Weston. Ever since the days of Volta, a voltaic cell has furnished the recognized concrete standard of electromotive force. The earlier forms of voltaic cell were subject to considerable variation in e.m.f., owing to polarization. The old Smee cells of zinc and copper in acidulated water, had an e.m.f. anywhere between 0.7 and 1.1 volts, depending upon the current-strength supplied, and upon the previous history. The Daniell cell, with its porous partition and copper-sulphate depolarizer, brought about a marked advance in the uniformity of voltaic standards. The e.m.f. of this cell ranged between 1.0 and 1.15 volts, according to polarization, concentrations and temperature. For years standard Daniell cells were employed in electrical laboratories. The solutions were prepared with care to definite concentrations, and the plates were freshly cleansed before use. The best results which could be obtained in this way varied within a range of one per cent. At length the standard zinc-mercury cell of Latimer Clark was produced. It was made from chemical substances that could be obtained and prepared with a relatively high degree of purity. It was remarkably constant and had a relatively small temperature-coefficient of e.m.f. This cell became a universal favorite as a concrete standard. A number of researches were conducted in electrical laboratories to determine the actual e.m.f. of the Clark cell. These standardizing measurements usually involved either an absolute determination of e.m.f. generated electromagnetically, and compared with the Clark cell; or, an absolute determination of a current strength, and a comparison of the drop of pressure effected by this current through a known resistance, with the Clark cell. The original standardization of the British Association Committee, when the ohm was first produced in concrete form, depended mainly on the first-mentioned method, and a small standard dynamo was constructed in such a manner that the e.m.f. of this dynamo at a measured speed could be computed. Nevertheless, the first set of measurements adopted produced ohms that were more than one per cent. too small, and the "B. A. ohms" first promulgated had to be corrected by years of observation and recomputation, first by about one per cent., to "legal ohms," and more recently by about one-tenth of one per cent., to "international ohms," the present universally accepted concrete standard.

The Chicago Electrical Congress of 1893, which adopted the international ohm, also adopted the Clark cell as the concrete standard of e.m.f., and assigned to it a conventional value of 1.434 international volts at 15° C. Prof. Carhart points out that it is practically certain that the true value of the Clark cell's e.m.f. at 15° C. is nearer 1.433 than 1.434. This represents a degree of uncertainty in our fundamental concrete standard of e.m.f. of about 0.07 per cent., or nearly one-fourteenth of one per cent.; whereas, two steady e.m.f's, in the neighborhood of one volt, can be compared numerically without much difficulty to a degree of accuracy of one-hundredth of one per cent., while a numerical comparison of correspondingly less reliability can be made down between them to say one-thousandth of one per cent. This degree of uncertainty residual in the Clark concrete standard of e.m.f. is by no means so trivial a matter as might at first sight appear. There is hardly any branch of electrical engineering in which as great a degree of accuracy is required for commercial measurements as in voltages near 100 volts. This is owing to the sensitiveness of incandescent lamps to the pressure at their terminals. A sixteen candle-power lamp of ordinary efficiency will vary in luminous intensity by about one candle with a change of one volt in say 116. Commercial measurements of candle-power and candle-power-time are sensitive to errors of one-tenth of a volt in 116. Consequently, the contract conditions under which incandescent lamps are made and sold, involve a degree of accuracy in voltage standards of nearly the same magnitude as the degree of residual uncertainty in the e.m.f. of the Clark cell.

It has been shown within recent years that the zinc-cadmium, zinc-sulphate, cadmium-sulphate cell is superior to the Clark cell as a standard of e.m.f., especially when made with supersaturated cadmium-sulphate solution. With under-saturated solutions, the cell is known as the Weston standard cell. The e.m.f. of this cell, in its most carefully prepared form, is only about 2 per cent. greater than the international volt, and its temperature-coefficient of e.m.f. in the neighborhood of 20° C., according to Prof. Carhart, is only about the 1/250th of one per cent. per degree Centigrade. These conditions render the cell specially well adapted for an international concrete standard. In view of the fact that the Clark cell has a much larger temperature-coefficient, and also that it has been hitherto impossible to arrive at uniformity of opinion as to the specifications under which the Clark cell should be prepared, it seems desirable that the cadmium cell should be generally adopted as the international concrete standard, assuming that there would be no difficulty in the patent situation. It is stated in the paper that the e.m.f. of the Clark cell at 15° C. is 1.40670 times greater than that of the cadmium cell at 20° C. This makes the e.m.f. of the cadmium cell 1.0187 volts, if the e.m.f. of the Clark cell be 1.433 volts at the specified temperatures.

The paper intimates that a redetermination is soon to be attempted of the e.m.f. of the cadmium cell by means of an absolute measurement of current strength, and with a revised form of electrodynamometer. A suitable steady current is passed through such an instrument, in series with a known resistance, the drop in which is balanced against a cadmium cell or battery. The electromagnetic force of the current is balanced by a measured amount of torsional force. The strength of the current may then be computed from the torsion and the geometrical constants of the apparatus. The main difficulty with such an instrument for very accurate measurements lies in the uncertainty of the principal dimensions of the coils, owing to shrinkage or deformity under the stresses originally applied in winding. In the new apparatus described, the external coil is wound on a hollow cylinder of plaster of Paris; while the internal coil is wound on a smaller cylinder of ground porcelain. The stability and homogeneity of these materials are relied upon to maintain the accuracy of geometrical form. With our concrete resistance standards reliable to 1/50th of one per cent., and concrete cadmium cells standards of e.m.f., reliable also to 1/50th of one per cent., the international ampere would be independently reproducible from the volt and ohm, to 1/35th of one per cent.

The Safety of Underground Electric Travel.

The terrible accident in the tunnel of the Paris Metropolitan Railway, noted in these pages last week, has naturally evoked endless comment and suggestion. It is reported from Paris that M. Vignes, the manager of the Metropolitan Railway, states that the catastrophe was due entirely to the neglect of Chauvin, the motorman of train No. 43, to observe the rule that when a motor becomes short circuited the motorman must isolate it from the remainder of the train and continue the run with another motor. Instead of doing this, Chauvin used hand grenades. Believing that he had extinguished the flames, Chauvin continued the trip with the damaged motor. The train, after leaving Barbes, crossed a viaduct, and the open air must have revived the fire. Chauvin refuses to be made a scapegoat. He says that it is impossible to isolate the motor from the rest of the train. Moreover, he had, earlier in the day, pointed out defects in the motor, which had been in the shops a half hour for temporary repairs.

At a special meeting of the Paris Municipal Council several of the members condemned the management of the Metropolitan Electric Railway, particularly in regard to a motion passed eight months ago inviting the company to improve the ventilation of its tunnel. The company will be asked to adopt a system for lighting its carriages and stations, which will not be connected with the electric rails. It will also be asked to provide oil lamps, to be kept constantly lighted, to increase the number of sidings, and to use fire-proofed hardwood in the construction of its carriages instead of pitch pine.

August Belmont, president of the Interborough Rapid Transit Company, of New York City, declared that there was no possibility of such an accident as that in Paris occurring in the New York Subway. "I want to emphasize the fact that the tunnel in Paris is not well ventilated," he said, "while in the New York Subway methods have been adopted to insure the free circulation of air. Both on account of the better circulation and the fact that part of the New York system is an elevated structure and trains run in from, and out to, the open air, there will be a syphoning of air in the tunnel by moving trains which will make the conditions here far better than in the Paris subway, which is all underground. Besides this, the entrances and exits of the New York Subway stations are open. Those of Paris are provided with self-closing doors. I also want to emphasize one of the most important features of the New York Subway. The system here has an independent lighting plant provided. One plant generates current for power and another plant current for lighting the Subway and stations. In Paris the lights in the tunnel went out, and this added greatly to the loss of life. In our system, whatever may occur in the tunnel, it is so arranged that it shall be perpetually lighted by a perfectly independent plant and current throughout the entire tunnel and all stations.

The *Daily Mail*, of London, prints an interview with Charles T. Yerkes, who is building underground tramways in London, on the subject of the Paris disaster. He says that four-fifths of the engineers, consulting or otherwise, connected with electric transit in London, are without practical knowledge. The case is the same in the United States, although the engineers there have more practical experience than those in London. Mr. Yerkes thinks that disaster is always possible, unless all inflammable material is removed entirely from electric railways. The managers of the local underground railways of London have issued statements with a view to assuring the public that such an accident as occurred on the Paris road would be impossible on their systems.

In an interview on the subject, Mr. E. P. Bryan, vice-president of the New York Interborough Rapid Transit Company, said: "Such an accident as that in Paris would, I firmly believe, be absolutely impossible in the Subway here. It is hard to understand how things could be quite so bad even in Paris, if the officials and people had not got so excited. I do not want to criticise, but the cars over there, at least when I was there, were light wooden affairs, and there was a good deal of woodwork, carved and otherwise. Besides, the people were crowded in in a manner far worse than you ever saw on the elevated. The ventilation was poor, and there was an awful smell of creosote, which both William Barclay Parsons and myself remarked. This creosote was used on the wooden ties to make them waterproof, and I believe that these ties helped to make the smoke and fire. Here we will use wooden ties, but they will be covered with broken rock and the ballast used on the same principle as the roadbed of the Pennsylvania Railroad.

"Then, too, our cars will weigh 68,000 pounds, will be of asbestos and transite on the flooring, while the sides, from the floors to the windows, will be of copper sheeting. The insulation will be carefully carried out by our own men, who will be kept well in hand. Defective wires make fires, and this fact we never have lost sight of. If our cars are not absolutely fire proof they are at least of slow combustion. Then, too, we have the provision for shutting off current in the event of accidents, and emergency shut-offs will be situated at every station. I think the chances of accident are reduced to a minimum when we have improved so much over the elevated system, and when it is remembered that not a single person has ever been killed while riding as a passenger on the Manhattan Elevated in spite of the fact that 4,000,000,000,000 people have been carried. The only deaths have been caused by people jumping against closed gates and in other ways through their own fault. In addition to all this, we have an absolute block system for express trains, so there never can be two trains on a block."

Engineer Thompson, who is in charge of the rolling stock, told of the car construction at the request of Mr. Bryan. "The first flooring is of maple, because that is the wood slowest to burn, and does not carry flame. This is the bottom on the sills, and on top is a layer of one-eighth inch roll of fine felt, an asbestos product. Then comes another floor of maple, and before any of the sheeting below the floor is laid all the timbers and the sides are covered a quarter of an inch thick with asbestos transite board. In addition we have four sheets of quarter-inch steel above the motor, and the motor wires and control wires of 550 volts capacity are all laid in electro-asbestos conduits and fastened to the lower sides of the floors with screws. On each cable are layers of asbestos insulation, and every point of contact is absolutely protected."

The fact is recalled by several New York newspapers that in January, 1902, Mr. George Westinghouse issued a letter in which he warned the public against the serious dangers of electric cars that are not fire-proof. The daily papers have also had an abundance of letters and interviews on the subject, which has assumed further importance from the fact that not only on the tunnel systems of New York City, but on the new tunnels between Manhattan Island and the New Jersey and Long Island shores, electric traction is to be employed; while the tunnels will be long without any intermediate exits.

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Edison Association Programme.

As previously announced, the twenty-fourth convention (nineteenth annual meeting) of the Association of Edison Illuminating Companies will be held at The Frontenac, Thousand Islands, St. Lawrence River, New York, commencing Tuesday, September 8, 1903, at 9.30 A. M. Indications promise a most successful convention from every point of view. We give below a list of the papers prepared to be read: "Commercial Experience with Nernst and Meridian Lamps," by Mr. W. B. Thompson, Detroit, Mich.; "Purchased Electric Power in Factories," by Mr. E. W. Lloyd, Chicago, Ill.; "Operating Features of High Tension Power Stations," by Mr. W. F. Wells, New York, N. Y.; "Position of Steam Turbines in Central Station Operation," by Mr. August Kreusi, Schenectady, N. Y.; "Overhead Pole Line Construction and Operation," by Messrs. A. H. Manwaring and J. T. Hutchings, Philadelphia, Penn.; "Comparison of European and American Engineering Practice," by Mr. Charles Schwartz, Chicago, Ill.; "Profitable Advertising," by Mr. W. H. Johnson, Philadelphia, Penn.; "The Central Station and the Isolated Plant," by Mr. Douglass Burnett, New York, N. Y.; "Depreciation in Electric Light Plants; How Estimated and Applied," by Mr. H. M. Edwards, New York, N. Y.; "Selection and Installation of High-Tension Switching Apparatus," by Mr. Leonard L. Elden, Boston, Mass.; "Illumination," by Mr. C. P. Steinmetz, Schenectady, N. Y.; "Results Obtained with Steam Turbines in Milan, Italy," by Mr. Guido Semenza, Milan, Italy; "The Development of Summer Lighting," by Mr. E. A. Leslie, Brooklyn, N. Y.; "Notes on Commercial Features of European Lighting Practice," by Mr. Arthur Williams, New York, N. Y.

Mr. Louis A. Ferguson, of Chicago, is president, and Mr. Wilson S. Howell, of New York, secretary.

The New Denver Telephone Exchange of the Colorado Telephone Company.

By C. W. Whitney.

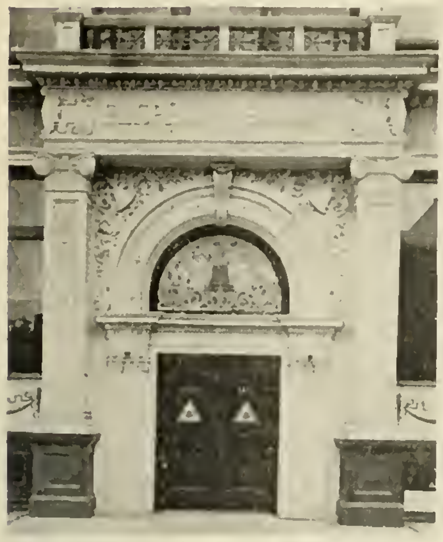

FIG. 1.—DOORWAY, DENVER TELEPHONE EXCHANGE.

THE Colorado Telephone Company has recently completed and is now occupying a handsome new four-story building at 1421 Champa Street, Denver. The company had entirely outgrown its former building on Lawrence Street, which itself was a comparatively modern building. In the new building are located the company's main exchange and the local and general business offices for the management of the entire telephone system of the State. Practically everything in the building, except some of the office furnishings, is new and of the most modern construction, this being especially true of the electrical equipment.

The structure, which is known as the Telephone Building, is a four-story and basement building and has ground dimensions of 75 x 125 ft., is entirely fire-proof throughout, having a steel frame consisting of 24-in. main girders and 12-in. laterals, with cast-steel columns. The floors are formed of tile laid in flat-arch construction, with the hardwood floor laid on lag strips. Omaha cream pressed brick and pressed terra-cotta tiling are used for the front, with stiff mud brick for the side and rear walls. All partition walls are of tiles, while the ventilating flues in the side walls are built of square sewer tile. The building is designed for six stories, and the fifth floor is already laid, being now used as the attic floor. The hall floors are laid with marble tiling and in the operating rooms a marble lithic tile floor is used. Portland cement is used for the basement floor. A very handsome design has been used for the entrance of the building, the emblematic bell being the chief feature of the terra-cotta repousse work and also of the stained-glass window over the doors. The architect for the building was the F. E. Edbrooke Architect Company, of Denver.

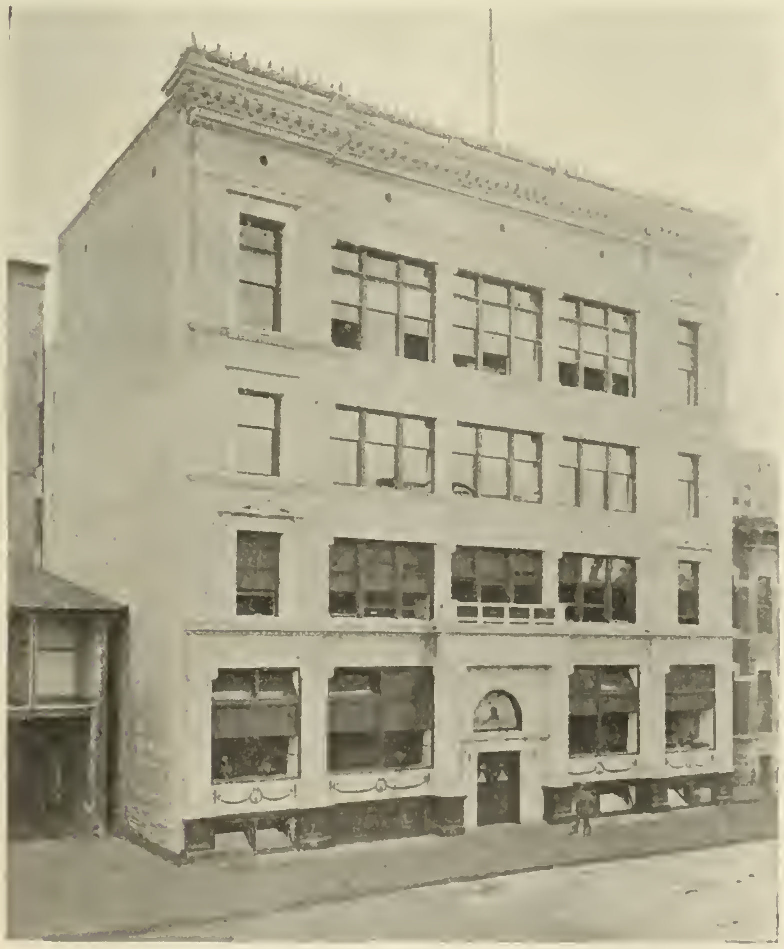

FIG. 2.—NEW TELEPHONE BUILDING, COLORADO TELEPHONE COMPANY, DENVER.

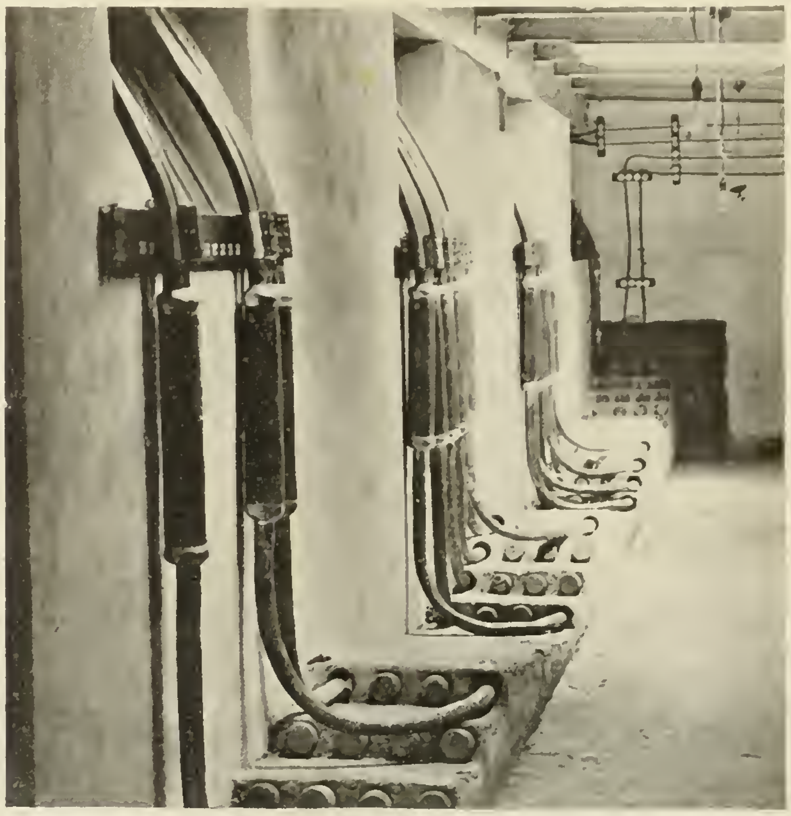

FIG. 3.—UNDERGROUND CABLES ENTERING BASEMENT AND CARRIED TO CABLE SLOTS.

CABLE RUN.

The 400-pair underground cables connecting with the underground distribution of the city enter the basement of the building from the alley. A new method of taking the cables out of the ducts is used, as may be seen in the accompanying cut, Fig. 3. The ends of the ducts are inclined and arranged in horizontal rows of four, with four rows in a set. There are four of these sets and each is directly under a vertical cable slot, through which the cables are carried to the cable terminal and distributing room on the third floor. Provision is thus made for the entrance of 64 400-pair cables. At present there are 17 400-pair No. 22 paper-insulated lead-covered cables and one 50-pair cables entering this cable room. The 400-pair cables divide into two branches, each consisting of a 200-pair wood and lead-covered cable, for the distribution to the main cable racks above.

The cable slots are 5 in. wide and 4 ft. 6 in. long, and are constructed of tile in a special wall supported on steel columns, which are entirely independent of the columns supporting the building proper. The slots are plastered smooth on the inside with Colorado portland cement. At each floor there are openings in the slots and clamping stations for supporting the cables. Each cable is clamped by means of a galvanized clamp bolted to an iron strip, which hooks over a steel I-beam embedded in the masonry. Each cable is easily accessible and can be taken out or repaired without interfering with the others.

CABLE DISTRIBUTION.

The 200-pair cables enter the west side of the distributing room and are carried under Linden steel-plate flooring to the vertical racks of the main distributing frame. Each vertical is designed to carry 250 pairs of lines, but at present is equipped with only 200 protectors. Of the 58 verticals on the frame, 35 are now equipped. When the capacity of the exchange will require the additional 50 protectors on top of each rack, a 200-pair cable will be split in four 50-pair cables, one going to the top of each vertical.

From the verticals the circuits are carried to the 10-rack horizontal side of the frame and there combined into 20-pair flat cables, in which form they are carried to the intermediate distributing frame. From this frame the three-wire circuits are carried in 20-circuit cables to the subscribers' multiple and trunking boards on the floor above. Back of the intermediate frame are the relay racks, while in the southwest corner of the room are coil racks and the fuse board. All of the telephone apparatus is built in conformity with the latest and most approved practice of the Western Electric Company, of Chicago. All cabling throughout the exchange is run in 10, 20 or 50-pair flat cable, which makes a very compact construction.

The fuseboard is about 10 ft. high and is formed of two black slate panels. There is a fuse on this board for each pair of operators' cords on the subscribers' board. There being 17 cords to each position, the fuses are arranged in sets of 17. There are also on this board for each operator's position three fuses for line signal lamps, two for supervisory lamps and one for the operator's transmitter battery circuit. Each subscriber's circuit is thus protected when making a call through the operator's cord, while additional protection is given by three supervisory-lamp fuses installed on the board for each position and by fuses for each set of three operator's cords. The fuses on the fuseboard are arranged so that when one blows a spring makes contact with a third bus-bar, thus completing a new circuit, lighting a signal lamp on the end of the row and ringing a bell to call the attention of the trouble man, Fig. 4.

POWER EQUIPMENT.

The power installation consists of a three-panel switchboard, two duplicate motor-generator charging sets, a 11-cell storage battery and ringing and testing machines, Fig. 8. Each charging set consists of a 20-hp, 500-volt, direct-current motor driving through a mechanical connection a 30-volt, 400-amp. generator. Power is regularly obtained from the 440-volt lighting circuit of the Denver Gas & Electric Company, but a reserve connection is provided with the 500-volt railway circuit of the Denver City Tramway Company.

The switchboard is built of black slate and is equipped with flush instruments. On the first or motor panel is a 500-amp., double-reading ammeter, rheostats, single-pole field switches and 500-amp., double-pole, single-throw, quick-break switches for the motors. At the bottom of the panel is a double-pole, double-throw main switch for throwing the system on the 440-volt lighting circuit or on the reserve 500-volt railway circuit. When the 500-volt current is used field resistance of the motors is cut out so as to keep the speed of the generators uniform.

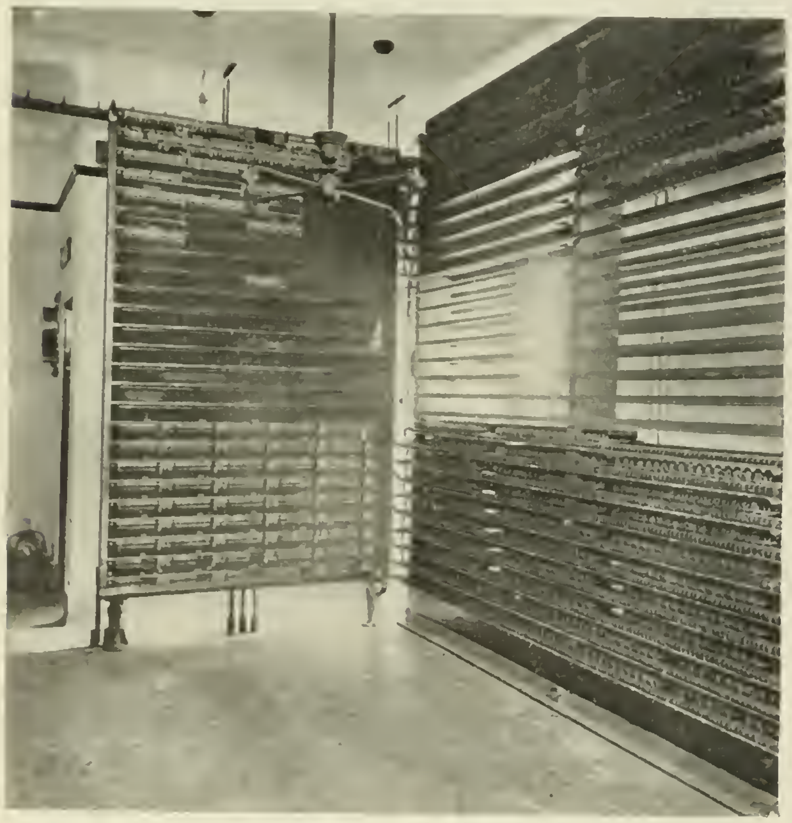

FIG. 4.—FUSE BOARD AND COIL RACK.

The second panel has a Weston 500-amp. ammeter, with switch for the 11 cells of battery and for two counter e.m.f cells. This panel also has the switches for the ringing and testing machines. The storage battery is controlled from the third panel, which is equipped with a 40 or 4-volt voltmeter and a commutator switch for reading the voltage of the individual cells. Two double-pole, single-throw switches control the generator circuits. The circuit-breakers are provided with reverse-current coils for throwing the breakers in case a generator should be cut in to charge the battery with a voltage lower than the battery voltage.

The storage battery is located in a small room adjoining the distributing and power room. It consists of 11 chloride lead cells made by the Electric Storage Battery Company, equipped with 21 plates, but with space for 10 additional plates. The normal rate of charge of the battery is 200 amp. The cells are set up on wooden boxes, which, when drawn out, allow the cells to be dropped away from the plates and removed. For supporting the plates a pipe is hung from the ceiling on which a block and tackle can be easily arranged. A Bristol recording amperemeter for the battery is mounted near the battery room door. Two counter e.m.f. cells are provided for holding down the voltage to 20 volts for the ringing machines, while the battery is being charged.

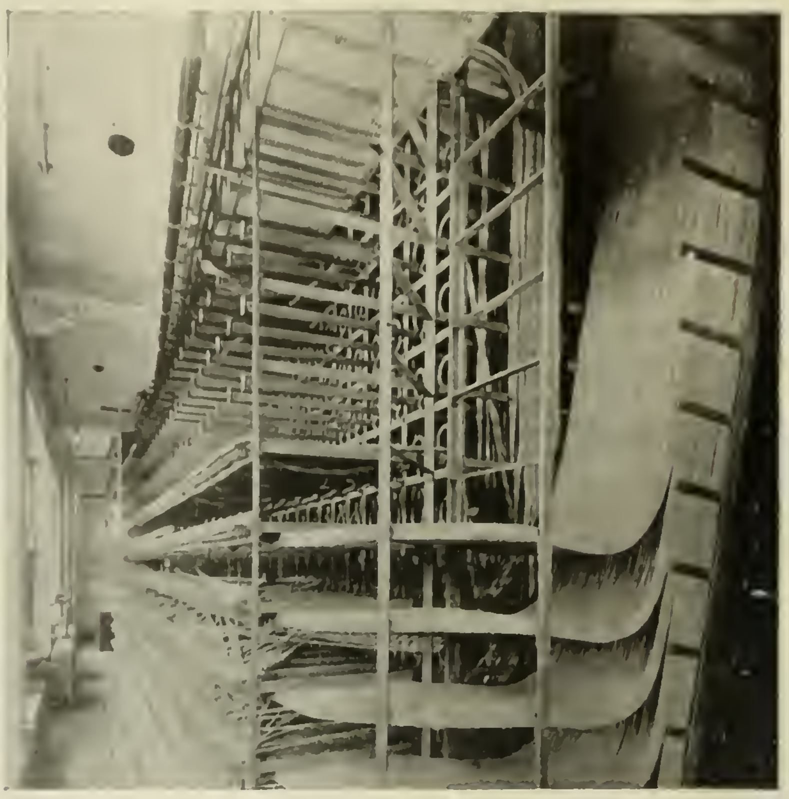

FIG. 5.—END OF INTERMEDIATE DISTRIBUTING FRAME, SHOWING 20-DUCT TRIPLE-LINE CABLES LEADING TO MULTIPLE BOARD.

The rest of the power equipment includes two combination ringing machines, a 440-volt primary motor-generator set, with 200-volt, 2-amp. secondary for supplying current for the telegraph circuits, a Crocker-Wheeler ¼-hp motor-generator for giving 500 to 700-volt current for use in making semi-annual cable tests, and a ringing machine for use on the toll lines during the day time.

OPERATING ROOM.

The main operating room of the exchange is 120 ft. long and 34 ft. wide for most of the length. At the south end the room widens out 10 ft. more to make space for the stairway to the operators' quarters on the floor below. The main subscribers' or A switchboard is located in straight sections on the west side of the room. It is 90 ft. 8 in. long and is 4 ft. 3¾ in. wide, and forms one of the longest straight stretches of switchboard in the country. It is a standard local relay, multiple, central-energy, lamp-signal board and consists of 16 eight-panel, three-position sections. The ultimate equipment of the board will have a total capacity of 9,600 lines, divided into 26 sections. Space is provided for adding two new sections to the present board, making the total length of the straight 18-section board 102 ft. The other eight sections will be placed on the opposite side of the room towards the south end. (See Figs. 5, 6, 7, 9, 10, 11, 12 and 13.)

The board is equipped with Montauk fire cable and is further protected with extinguishers and sand and blankets. There are also asbestos fire panels between the cord shelf and multiple cables. Rolling curtains are provided for the back of the board instead of movable panels. All the operators' telephone apparatus is located on a special shelf and is covered with hinged tin covers. This shelf

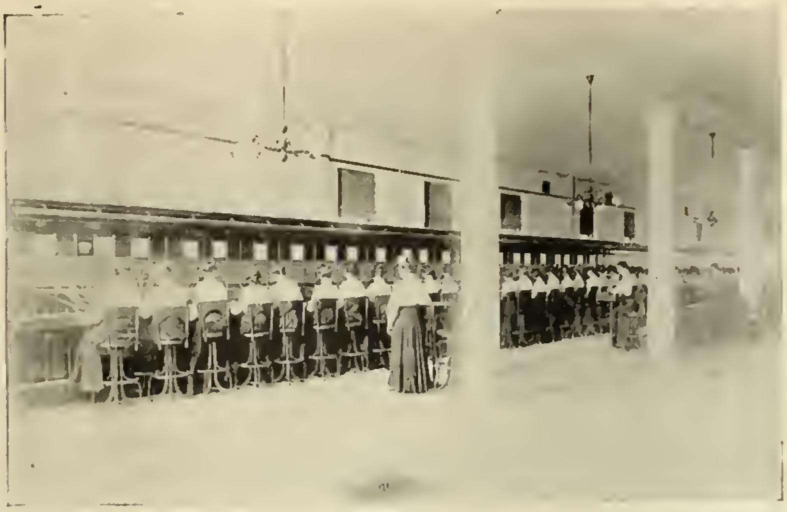

FIG. 6.—MAIN A SWITCHBOARD IN OPERATION.

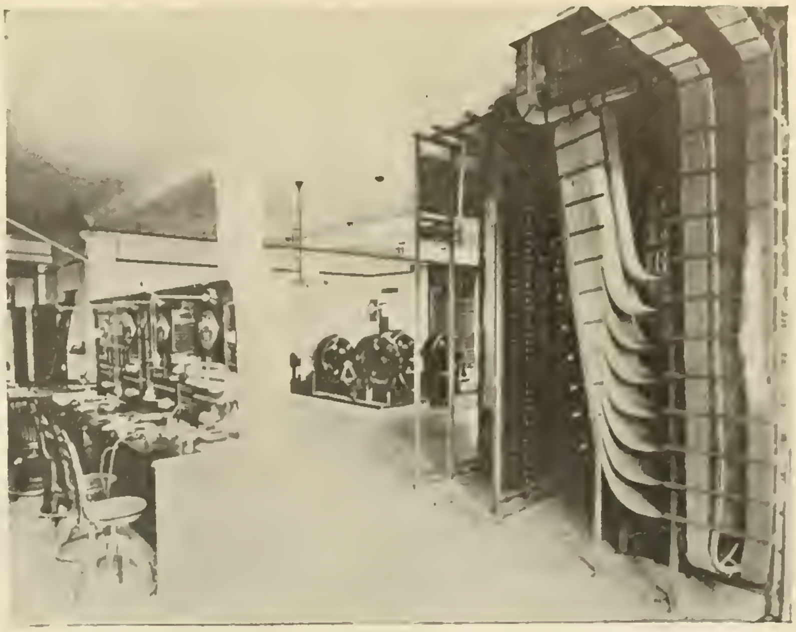

FIG. 8.—FOUR-POSITION WIRE CHIEF'S DESK, POWER PLANT, END OF RELAY RACK AND INTERMEDIATE DISTRIBUTING FRAME.

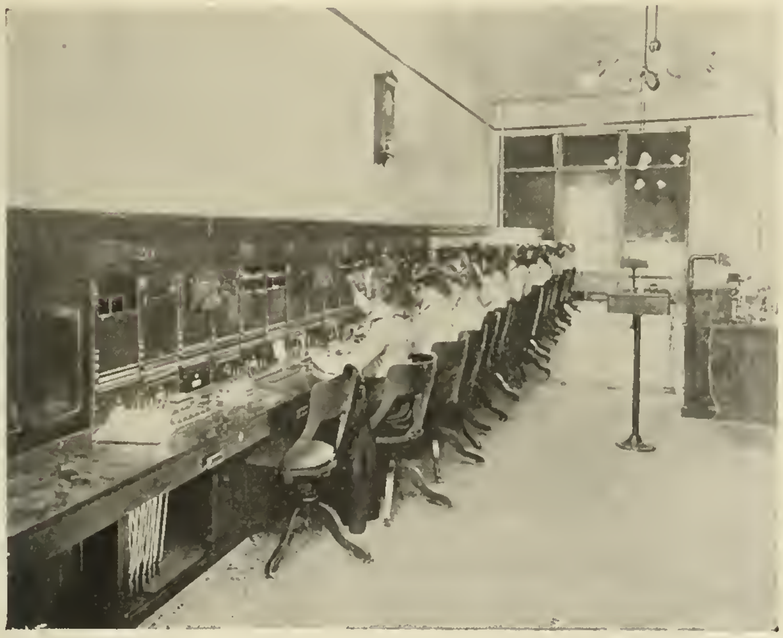

FIG. 7.—TOLL BOARD, SHOWING LINE OPERATORS' SECTIONS AND CHIEF OPERATOR'S DESK.

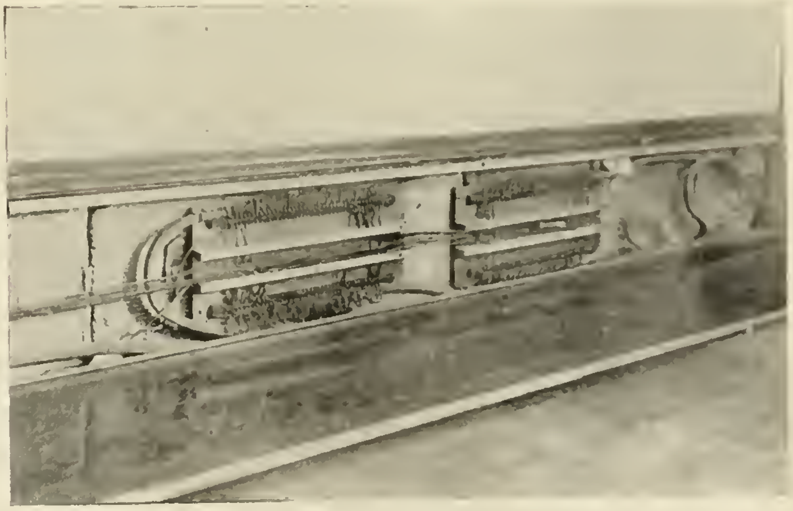

FIG. 9.—DETAIL OF REMOVABLE BASEBOARD, SHOWING WIRING TERMINALS FOR DESKS, ETC.

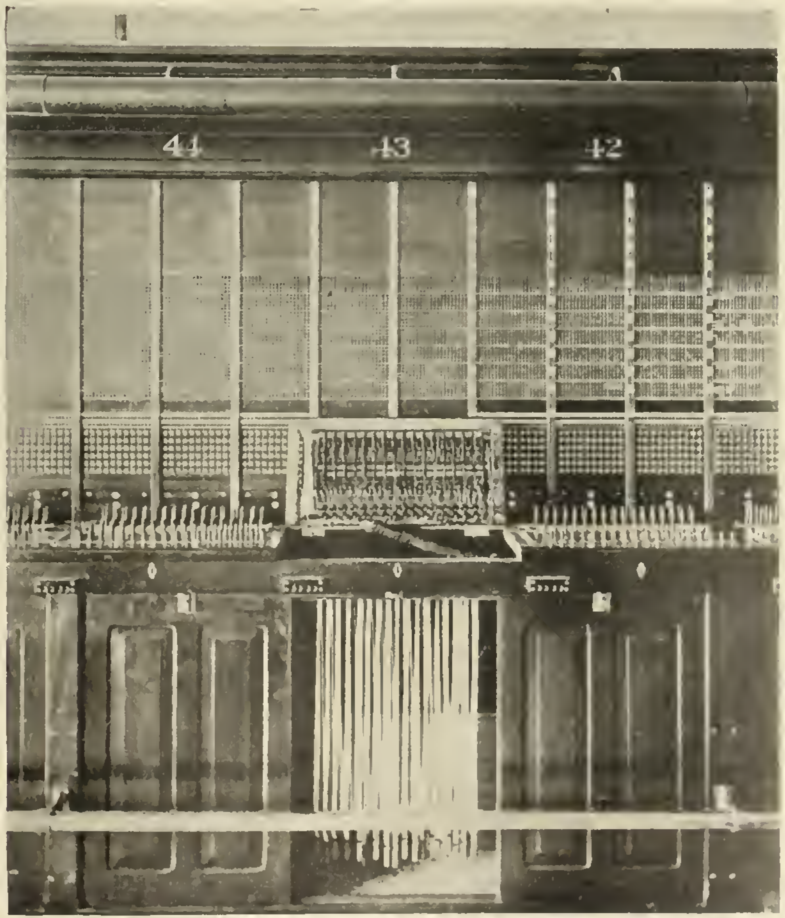

FIG. 10.—EIGHT-PANEL, THREE-POSITION SECTION OF MAIN A BOARD, WITH ONE OPERATOR'S CIRCUIT EXPOSED.

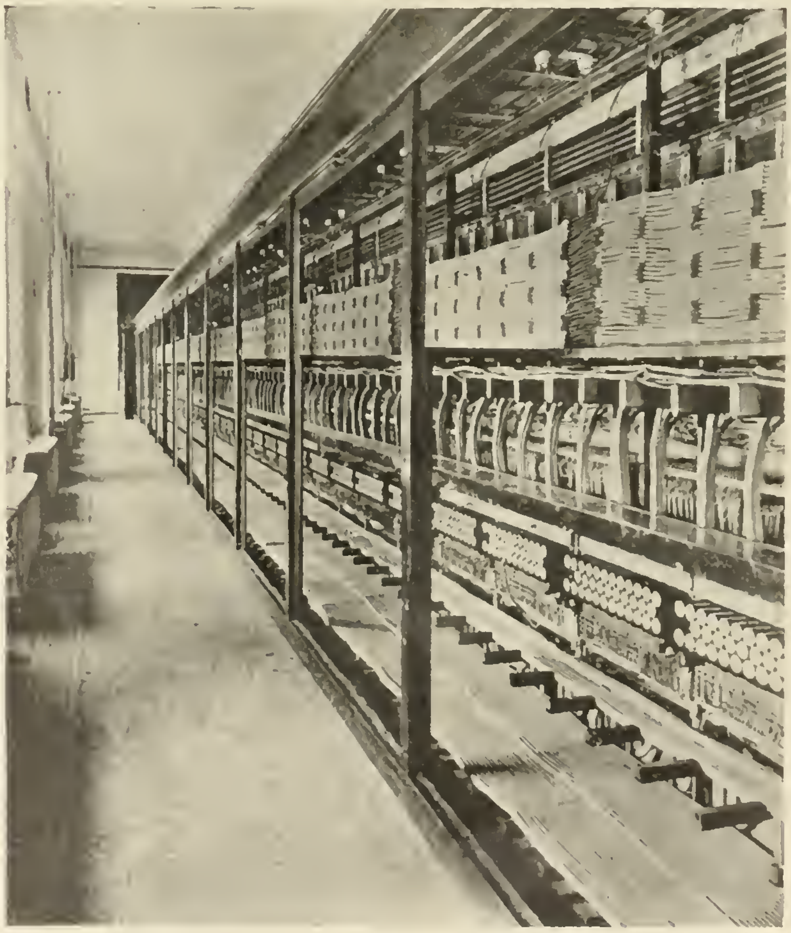

FIG. 11.—REAR OF MAIN A SWITCHBOARD FROM SOUTH END.

VIEWS OF THE DENVER EXCHANGE, COLORADO TELEPHONE COMPANY.

is just back of and below the cord shelf, instead of at the top of the frame as formerly.

The present capacity of the board is 5,000 lines and there are connected 4,027 multiple lines, carrying 6,815 stations, of which 5,090 are business stations and 1,725 residence stations. There are also 400 party line circuits on the board, but these are not on the multiples. The board has 47 operators' positions, panel No. 46 on the extreme left being equipped with voltmeter and other apparatus for testing. All preliminary testing is done by this operator, who reports to the operators at the four position wire chief's desk in the distributing room on the floor below. This position will eventually be connected with the wire chiefs by pneumatic tube service for sending reports of trouble.

Next to this testing position is one provided with 160 jacks for the company's private branch exchange.

The service distribution on the board is made up as follows: 1,258 flat rate lines carrying 2,040 stations, 1,781 message rate tally lines supplying 2,202 stations; 503 prepayment nickel lines carrying 1,085 stations, and 485 automatic pay station lines, carrying 527 stations. The 503 prepayment nickel lines are divided into 361 10-party lines and 142 two-party lines. As a rule not more than six stations are put on a 10 party circuit, and the designation strips are marked for the stations actually in service on the different lines. The operator's shelf is provided with throw-over levers, so that the calling party may be cut out and kept from the connection desired until the nickel is registered.

Different markings are used on the line signal lamps to designate the various classes of service and for some of the lines cut glass is used over the lamps. On the automatic pay station lines, which supply drug stores, restaurants, hotels and saloons, a separate color is used to distinguish the drug store stations from the others. In accordance with the city charter, the company is required to give free physician calls from drug stores, and the different colored lamps are used so that no physician may be called from a hotel, restaurant or saloon without the paying of the regular charge. On the multiple section of the board the different jacks belonging to the trunk lines of a firm having a private branch exchange are enclosed by white lines, so as to aid the operator in getting connection with that firm's private operator.

There are five supervisors for the subscribers' board and they are provided with stands in accordance with the latest practice of the Bell Company. There is also a manager's desk and at the north end of the room is installed a four-position information desk. The operators at this board are connected with the different positions on the A board and are, from the subscriber's standpoint, the "chief operators" of the exchange. So many trivial and unnecessary calls are made for the "chief operator" that the subscriber is connected with one of the information clerks, who invariably can give the same satisfaction to the complaining subscriber as could the manager of the operating room, who is thus relieved of a vast amount of trouble. The information clerks also are called upon to answer a vast number of questions as to the time of day, the baseball score, the time of trains, train reports, location of fires and anything else of interest. Their principal work, however, is supplying information concerning numbers of new subscribers and addresses of subscribers.

Back of the board is a clerk with two complete card indices. One index contains the names and addresses of subscribers, arranged numerically according to their telephone numbers. The other index is one not usually found in large telephone exchanges. It is indexed alphabetically by streets and numerically by street numbers under the different subscribers' stations. This index is used to supply information as to the name or telephone number of a party living at a certain address. The company has as many as 100 calls a day from people who have remembered the addresses of subscribers, but have not in mind the person's name or his telephone number. The company's ability to supply this information has been a great convenience to the subscribers.

Across from the subscribers' board at the north end of the room is the trunking or B board. This board now has five two-position sections and when completed will have three additional sections.

TOLL BOARD.

In a room 20 ft. long and 18 ft. wide, next to the local operating room, is the toll board. This board is divided into 10 two-position line operators' sections on the north side and three two-position recording operators' sections on the south side. Next to the recording sections is the toll-receiving and distributing clerk. The ultimate equipment of the toll board will consist of 24 two-position sections.

The toll board is provided with a pneumatic tube system for distributing the toll orders, similar to that in use in the New York and Philadelphia Bell exchanges. In the old exchange this service was performed by young girls. The recording operators receive the requests for toll connections from the subscribers through the local switchboard. They record the information concerning the desired toll connection on a slip, which is carried by a pneumatic tube to the receiving and distributing clerk. This clerk sends the order to the proper toll-line operator, who makes the desired connection. On the shelf of each recording section there is installed a dater of the American Clock Company's make, connected with a master clock, which changes the dates every minute. For each toll-line operator's section there is mounted in the shelf a calculagraph, which records on the toll slip the time and date and the elapsed time of the toll connection.

The blower for the pneumatic service is a No. 2 Green rotary blower and is installed in the attic. It is driven by a 2¼-hp, 500-volt, direct-connected motor.

In the toll board room are a supervisor's stand and a chief operator's desk, the title of chief operator being restricted to the toll department. There are at present 41 total lines leaving from the Denver exchange and connecting with all parts of the State. The toll wire chief's desk is in the cable terminal room and is provided with resistance and galvanometer for testing for trouble and grounds, the Varley test being used. Further mention of the company's toll business will be made later.

NEW BOARD CUT OVER IN THREE MINUTES.

The new switchboards were cut into service on July 12, the cut over from the old exchange occupying but three minutes. At the old cable room strings had been attached to the protectors on the verticals of the main distributing frame and at a given signal they were all pulled out, thus cutting off the old exchange. At the same time each of the operators on the new board plugged into the answering jacks, which operation opened the relay coils and let fall small mica or celluloid discs that had been placed in the coils to insulate them. Men in the cable room assisted in removing any discs that did not fall when the operators plugged in.

The company in the main exchange is handling about 50,000 line calls a day, about 15,000 incoming trunk calls and 8,000 outgoing trunk calls.

OPERATORS' QUARTERS AND OFFICES.

On the third floor, besides the cable terminal and power room already described, there are a locker room with expanded metal lockers, a well-appointed toilet room, a retiring or rest room, a lunch room and kitchen and an invalids' room for the operators. The offices of the traffic manager are also on this floor.

The second floor contains the handsome quarters of the president and general manager, E. B. Field, which are finished in Flemish oak. Other offices on this floor include those of the accounting and the engineering departments and the general superintendent. On the first floor are a well-arranged public office, with six long-distance telephone booths, the treasurer's department, collector's room, contract department, recording and filing clerk and stationery and store room. The basement contains the maintenance department, the equipment work room and the A. D. T. department. In the northwest corner of the basement are installed two 80-hp tubular boilers. These boilers are used for heating the building, but are built for power purposes so that if necessary a power plant may be installed.

LIGHTING AND WIRING FEATURES.

The building is very well lighted by windows and skylights and excellent artificial lighting is supplied by incandescent lamps. All wiring is run in steel bricated conduit and floor outlets are provided at various points in the different rooms for desk lights. The telephone switchboards are lighted by the trough system. In the center of the building is a wire and pipe shaft through which the steam and water pipes and light wires are carried to the different floors.

A very useful feature of the building is the system of baseboard wiring for the local telephone service. Starting from the company's private branch exchange position on the main board, trunk line cables are carried down the pipe shaft, connecting racks being placed at each floor. From these racks branch cables are carried to a central location in each department. These locations are generally behind the baseboard and from them cables are run to the different desks in the department. All the wooden baseboards in the building are removable and are lined with tile. One of these cable locations is shown in the accompanying illustration. Under the floors connecting with numerous outlets for the desks are galvanized iron ducts covered with 3/16-in. Linden steel floor plates. These plates protect the cables from any nails that might be driven through the floor. The molding in many of the rooms is wired and cables may also be run from the intermediate frame through the tile ventilating flues with outlets through the registers. In this way telephone wires may be run to any point in the building and any desired connection made without damaging the floor or walls. By cross-connecting the baseboard terminals circuits may be provided for bells, buzzers, private telephones, clock service, fire alarms or almost anything requiring electrical connections.

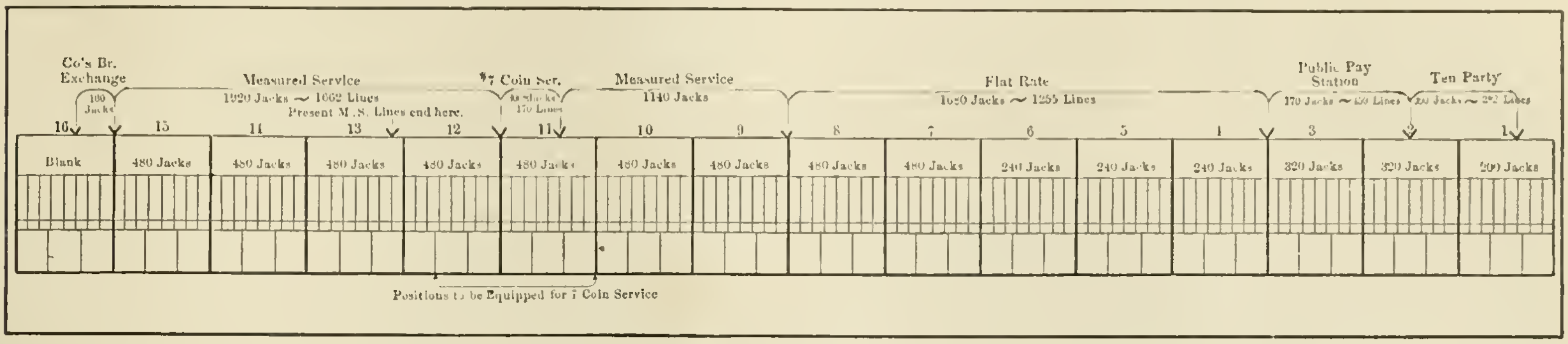

Fig. 12.—Diagram of Switchboard Plan.

The engineering department plans to install an independent power switchboard for miscellaneous purposes, in a space back of the main power board in the terminal room. This board will be equipped with a variety of apparatus for testing purposes, private storage battery service, telegraph circuits, clock daters, A. D. T. power and anything else that is distinguished from the general power supply.

OTHER DENVER EXCHANGES AND LOCAL DISTRIBUTION.

The Colorado Telephone Company has two branch exchanges in Denver, the South and York exchanges, and these also are equipped with relay multiple central-energy boards, so that the entire city system is now using the latest and most modern apparatus. In all three exchanges there are 5,474 lines connected supplying 10,061 stations. The distribution of the different services for the three exchanges is as follows: 1,467 flat rate lines, carrying 2,292 stations; 202 message rate meter lines, carrying 260 stations; 2,336 message rate tally lines, carrying 3,083 stations; 905 prepayment nickel lines, carrying 3,813 stations; 564 automatic pay lines, carrying 613 stations.

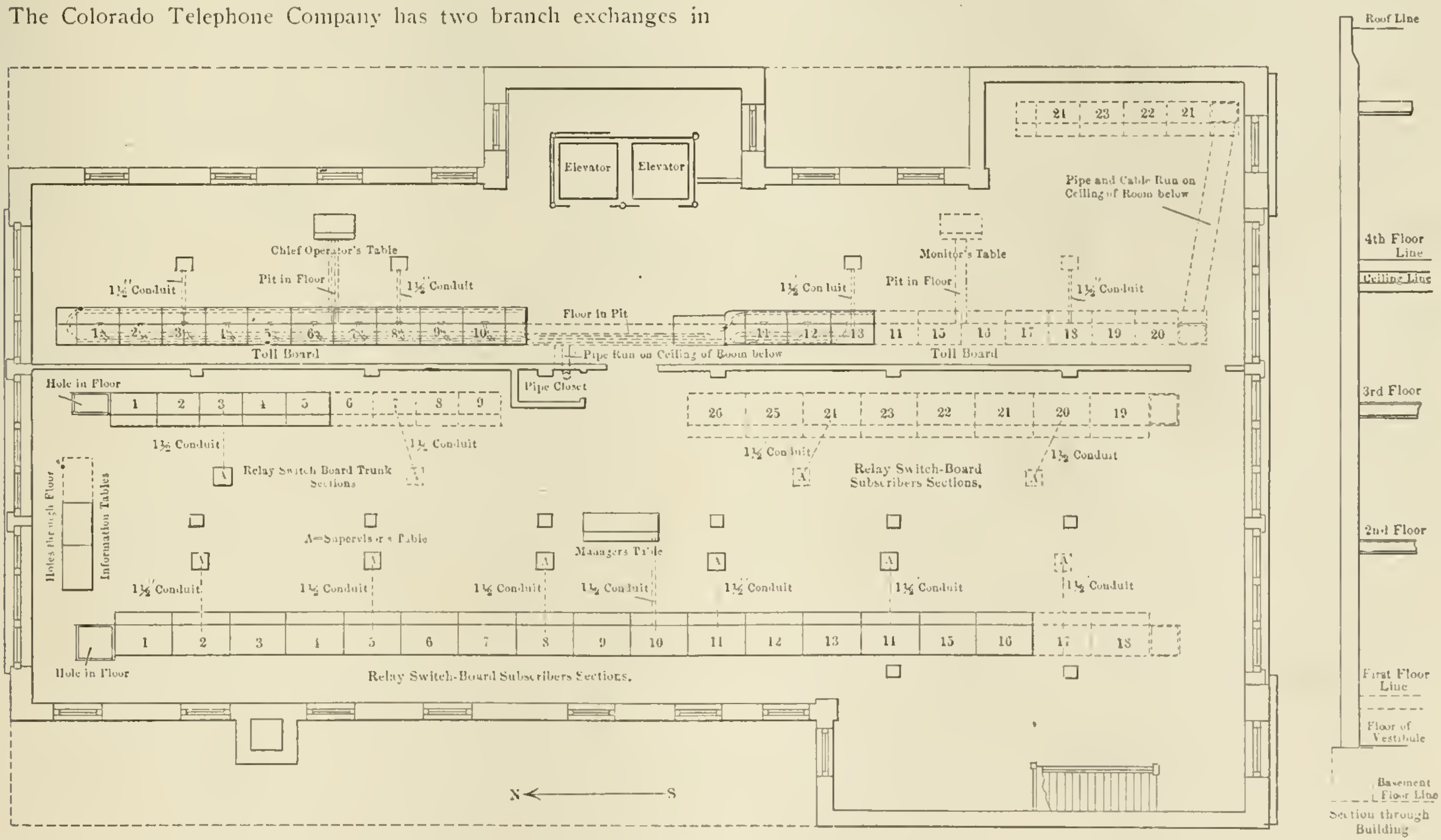

Fig. 13.—Plan of Exchange Floor.

The underground district of the city covers an area about three miles long by one-half mile wide and the district is being extended in the southern part of the city. There is a total length of conduit trench of 61,995 ft., this length being exclusive of the length of manholes, of which there are 230. The total capacity of the conduit in duct feet is 477,647 ft. About 22,000 ft. of bituminized fibre conduit, the American Conduit Company's make, has been laid during the last year, but most of the conduit is Camp vitrified clay, single duct.

Leaving the main exchange there are 17 400-pair lead-covered paper-insulated cables and one 50-pair lead cable. Multiple cables are used throughout in distributing. There is a total of 210,000 ft. of underground cable installed in the city, of which 6,200 ft. is 400-pair, 73,000 ft. 200-pair, 115,000 ft. 100-pair and 10,000 ft. 50-pair cable, the remainder being 70, 60, 55, 30, 25 and 20-pair cable.

The aerial distribution from all three exchanges comprise 430 miles of pole lines carrying 5,190 miles of wire, and includes 71,689 ft. of 100-pair cable, 184,035 ft. of 50-pair cable and 9,693 ft. of 25-pair cable.

The maintenance department of the telephone company is now busy taking out the old instrument magnets and installing the new common-battery telephones. About 150 changes are being made daily. In this department there are employed 120 men, including the wire chiefs, and their work embraces the maintenance of the entire State, as well as the local system. Upon cutting in the new telephone switchboard there were only 145 permanent signals of trouble on the board, while as many as 700 or 800 would not have been unusual. Twenty days after the new board was started there were only seven permanent trouble signals on the main exchange. This is also considered a remarkably low record, as on a board of this size from 75 to 80 permanent trouble signals might reasonably be expected.

DENVER RATES

The business and professional rates for telephone service in Denver are as follows: Unmeasured service, individual line, $120 a year; measured service, individual line, 400 calls, $50, with a sliding scale and four and three cents for excess calls; two party line, 400 calls, $42 and up, with five and four cents for excess calls; 10 party nickel line, seven cents a day; public pay station line, $5 guarantee a month and conversations five cents each. Residence rates for unmeasured service are $90 for individual lines and $60 for two party lines; measured service, individual line, is $42 for 400 calls and two-party line, $30 for 400 calls, both with sliding scales above 400 calls; two party lines guarantee 10 cents a day and 10 party lines guarantee five cents a day; individual lines, with coin receiving device, are $4 for 60 calls per month.

TOLL LINES AND STATE EXCHANGE.

Colorado is unique for a Western State, in that it has more toll lines per capita than any other State outside of New York. As shown on the map in Fig. 14, the toll lines of the company radiate from Denver, Colorado Springs and Pueblo and reach all the important cities and mining camps in the State, while connections with Wyoming, Montana and Utah are obtained through the Rocky Mountain Bell Telephone Company's system at Cheyenne, Wyoming. There are now in operation or ordered for immediate construction 2,300 miles of toll pole lines, carrying 12,000 miles of copper wire.

Of the 41 toll lines radiating from Denver, 15 circuits lead to Colorado Springs, 9 of them going on to Pueblo and southern points. From Colorado Springs to Cripple Creek there are 20 circuits, this forming the heaviest toll line in the State. This large number of circuits is occasioned by the large amount of mining business done in the Cripple Creek District. Many of the mine owners live in Colorado Springs and there are several private lines for their use.

Leading west from Denver to Central City there are nine circuits and three of these are continued west to the Leadville district and from there two lines are carried farther on to Glenwood Springs and Grand Junction in the western part of the State. Beyond Central City the lines cross the Continental Divide over Argentine Pass at an elevation of nearly 14,000 ft., the circuits being carried in three No. 9 and No. 12 two-pair submarine cables for a distance of 1½ miles. The circuits are carried over Mosquito Pass and Independence Pass in similar manner. The cables are buried a short distance in the ground so that they will not be damaged by snow or wind.

In Pueblo the company has recently completed an additional story on its exchange building and has installed a new common-battery equipment with an ultimate capacity of 4,200 lines. The present equipment of the exchange is 1,600 lines carrying 2,500 subscribers. In most of the town wires have been placed underground, the Camp single-duct conduit being used.

At Salida a new building has just been completed and a common-battery equipment installed with an ultimate capacity of 1,000 lines, equipped for 400 lines. This new board takes the place of an exchange outfit that was installed about five years ago by the Salida Telephone Company, which has since sold out its business to the Colorado Telephone Company.

During the last few months the company has completed a new copper toll line from Delta to Paonia, a distance of 35 miles. Small exchanges are located at Paonia and Hotchkiss, these towns with Delta being located in the recently developed fruit section in the Western part of the State.

The company has at present under way the construction of a 30-mile line from Durango to Mancos, with an exchange at the latter point; a line from Buena Vista to Salida, 28 miles; one from Cripple Creek to Salida, 65 miles; one from Salida to Alamosa, 102 miles, and one from Alamosa, westerward to Del Norte, a distance of 30 miles.

Among the improvements planned for execution during the present year are a line from Georgetown to Hot Sulphur Springs, 50 miles, on the route of the new Moffat Short Line, and the stringing of additional circuits on the lines between Denver and Trinidad, Denver and Cheyenne and Grand Junction and Durango. The lines to Cheyenne will connect with those of the Rocky Mountain Bell Telephone Company, now being built from Cheyenne into Montana.

At Trinidad the Colorado company has purchased ground and is preparing plans for the erection of a new exchange building. A common-battery system will be installed and the wires will be placed underground in the business part of the city. Trinidad has a population of 7,000 people, and has 1,080 telephone subscribers, a very large proportion for a Bell operating company, and one that might be envied by many Eastern Bell exchanges.

At Boulder ground has been purchased and plans are being prepared for an exchange building that will have a common-battery system, with ultimate capacity of 1,600 lines, equipped with 600 lines for 800 subscribers. The wires in the business district will be put underground. At Farmington, New Mexico, a new exchange is to be opened with 125 subscribers, and a branch exchange at Aztec. The Colorado company is also rebuilding its plants at Conejos, Del Norte, Monte Vista and Saguache. At Buena Vista the company has recently taken over the independent automatic system, remodeling the plant and installing its own apparatus.

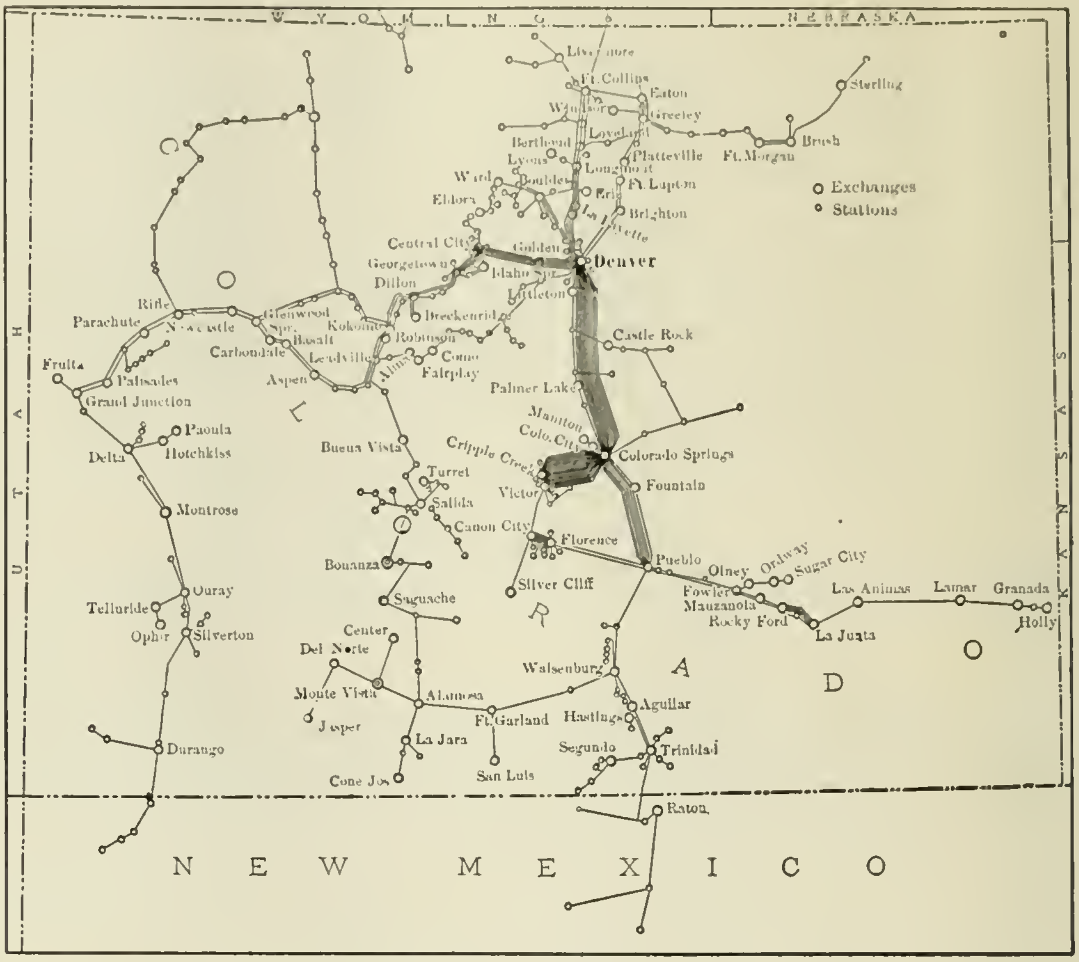

Fig. 14.—Principal Toll Lines and Connections, Colorado Telephone Company.

The company is now extending its southern limit from Raton, New Mexico, to Las Vegas, 120 miles distant. On the east the system extends to Holly, Colo., six miles from the Kansas State boundary. The western limit is Grand Junction, while on the north the system ends at Cheyenne, Wyo. Although the Colorado system crosses the southern boundary of the State at two points and almost touches the eastern and western boundaries, it has only one connecting point with other systems, that being at Cheyenne, as already mentioned.

Throughout its whole toll system the company uses a high-grade construction, with Nos. 12, 9 and 8 all copper metallic circuits. There are a very few grounded lines in the State, but they are being weeded out as rapidly as possible. An interesting piece of toll line work is used in the San Juan country, where on account of the heavy snow slides, cables cannot be used. The construction consists of long spans from 1,000 to 1,400 ft. in length stretched from one rocky point to another, the highest grade ¼-in. steel strands being used. The maintenance of lines in that section is very expensive.

The rates for toll service run from 20 cents up, according to the distance, with lower rates for night service. All rates are based on the three-minute service system. As a rule, all orders for toll connections between exchanges are sent by telegraph over the company's own telephone wires. No commercial telegraph business is done.

The company has adopted the policy of collecting for a toll connection as soon as possible after it is made. The collecting is done twice a day, and it is very seldom that a bill is presented more than 24 hours after the service is given. In this way the subscriber can have no excuse to forget that he used the toll line, and the company has no bad accounts. This system seems to work with greater satisfaction in Denver than elsewhere, as in this city there are many transients, who would be gone before the monthly or quarterly collector could get around. The company gets out toll script in 5, 10 and 25-cent values, which is sold to the subscribers without discount. For large customers the company sells $600 worth of coupons for $480, the coupons being good for one year.

MANAGEMENT.

The inability of independent operating companies to obtain a footing in Colorado may be explained by the liberal and broad-minded policy adopted by E. B. Field, the president and general manager of the Colorado Telephone Company, in giving good service throughout the State and in endeavoring to meet the needs and demands of the public in every reasonable way. There is but little of that antagonistic feeling against the company that has prompted so many citizens in Western cities to interest themselves in companies to fight the Bell exchanges. There are but two or three independent exchanges in the State and none of them are said to be in an overprosperous condition. An ordinance for an independent franchise in Colorado Springs was recently defeated, and several members of the Denver Charter Convention have put themselves on record as opposed to a competing telephone company in that city.

The management of the Colorado company has always been an enterprising one, and many features that are now standard Bell practices were originated or early introduced in Denver. Mr. Field is ably seconded in his liberal policy by E. M. Burgess, general superintendent of the company, while other efficient officials are H. A. Rhodes, engineer; F. A. Cannon, superintendent of construction; C. L. Titus, superintendent of maintenance, and W. F. Brown, manager of the traffic and operating departments.

The Colorado Electric Light, Power and Railway Association.

As the result of a very enthusiastic meeting of electric lighting, power and street railway men in Denver, Colo., on August 12, the Colorado Electric Light, Power & Railway Association was organized. The meeting had been called by Mr. George B. Tripp, of Colorado Springs, and representatives were present from 19 companies operating in Denver, Colorado Springs, Pueblo, Greeley and other points in the State. Through the courtesy of Mr. Henry L. Doherty, the meeting was held in the rooms of the Denver Gas & Electric Company. J. F. Vail was made temporary chairman and a constitution and by-laws were adopted, subject to future correction. The following permanent officers were chosen to serve until the first annual meeting: President, J. F. Vail, general manager Pueblo & Suburban Traction & Lighting Company, Pueblo; vice-president, William Mayher, manager Greeley Power & Light Company, Greeley; secretary and treasurer, George B. Tripp, general manager Colorado Springs Electric Company, Colorado Springs. The headquarters of the association will be in Colorado Springs and annual meetings will be held on the last Wednesday in October. This will bring the next annual meeting on October 28 and it will be a two-days' session. The convention will be held in Denver, and papers on topics of interest to the members will be presented, while the social feature will not be neglected.

The association begins its existence with very promising prospects and the officers are confident that nearly all of the 55 companies in the State will become members. Dues will vary from $10 to $25 a year, according to the population of the city in which the company operates. The object of the association is "to foster and promote the common interests of its members and to advance scientific and practical knowledge in all matters relating to electric light, power and railway companies; also to establish cordial and beneficial relations with kindred associations and between the manufacturers of electrical machinery and appliances and the members."

To Whom do We Owe the Experiment of the Ball and Hemispherical Conductors, Showing That the Charge Resides on the Outer Surface of an Electrified Body?

By Brother Potamian, D. Sc., Lond.,
Professor of Physics in Manhattan College, New York City.

PROFESSOR Silvanus P. Thompson, in his manual of electricity and magnetism, calls this ingenious method of demonstrating the fundamental principle of electrostatics, "Biot's experiment"; Everett enters no disclaimer in his translation of Deschanel's treatise, simply entitling it "the experiment of Biot"; Prof. Chrystal does the same in his article on electricity and magnetism in the last edition of the Encyclopædia Britannica, adding, however, in a foot note seven pages further on, that "the experiment was first made by Cavendish"; Prof. Reinold, in the 16th edition of Atkinson's "Ganot" goes a little further and divides the honor by saying that "the experiment was first made by Cavendish, but the apparatus is commonly known as Biot's"; lastly, French writers when they give the experiment a name, never fail to call it after the distinguished professor of the Collége de France. It was, therefore, with no inconsiderable surprise that I came across an exact description of this experimental demonstration in the electrical papers of Coulomb while reading them with a view to the bibliography of the Wheeler collection in the Library of the American Institute of Electrical Engineers, formerly the Latimer Clark Library at Westminster.

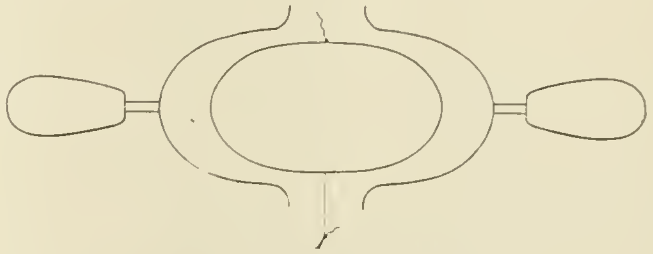

FIG. 1.—BIOT'S EXPERIMENT.

The passage occurs in the first volume of the *Collection de Mémoires relatifs à la Physique*, published in 1884 by the French Physical Society. It will be found on page 233, where it reads:

> "Il faut se ressouvenir dans tous les articles de ce mémoire relatifs à la théorie:
>
> 1° Que le fluide électrique agit en raison inverse du carré des distances de ses parties;
>
> 2°Qu'il se distribue sur la surface des corps, mais qu'il ne pénètre pas au moins d'une manière sensible dans l'intérieur des corps. Nous avons prouvé la première proposition dans notre premier mémoire, volume de 1785; la deuxième, dans le quatrieme mémoire, imprimé en 1786. On peut la confirmer par une nouvelle expérience qui paraît decisive; voici en quoi elle consiste. On isole un corps conducteur que l'on électrise; on lui forme ensuite une enveloppe coupée en deux parties, qui laisse en se reunissant, un peu de jeu entre elle et le corps. Que cette enveloppe ait ou non la même figure que le corps, peu importe au succes de l'expérience. Si l'on électrise le corps placé sur un isoloir et qu'on le renferme entre ces deux parties de l'enveloppe, soutenues par deux bâtons idio-électriques, en retirant les deux enveloppes, on trouvera au moyen de nos petits électromètres à suspension de soie, que toute l'électricité du corps a passé aux enveloppes et que le corps, ou n'en conserve point, ou n'en conserve qu'une partie insensible."

The passage may be rendered as follows:

"One must keep in mind while reading the articles of this paper that have any bearing on electrical theory (1) that the electric fluid acts according to the law of the inverse square of the distance of its parts, and (2) that the electric charge resides on the surface of conductors penetrating them to no appreciable depth. The first proposition was proved in a paper of ours which the Académie inserted in its *Transactions* for 1785, and the second in the volume for 1786. The latter proposition may be confirmed by a new experiment which appears to be decisive. An insulated body is electrified and then surrounded by a conductor cut in two so that when the parts are brought together but little space is left between them and the enclosed body. It matters not to the success of the experiment whether the enveloping shell has or has not the same form as the body itself. The latter, after being electrified, is clasped by the divided shell, held by insulating handles; then, when the shell is removed, it will be found on testing with one of our little electrometers[1] that the charge has passed from the inner body out to the surrounding shell, leaving the body itself either neutral or with a charge so feeble that it cannot be detected."

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[1] Described on page 178 of the memoir.

This clear description of an experiment which the author calls "new" and "decisive," and which has since become classical, was published in the proceedings of the *Académie des Sciences* for 1788, when Coulomb[2] was fifty-two years of age, and Biot[3] only fourteen. It is, therefore, plain that if we are to ascribe the experiment to a French physicist at all, it must go to Coulomb and not to Biot. No doubt, the latter did much by his books and especially his brilliant lectures to make the experiment widely known, and to popularize it; and, as he nowhere attributes it to himself, we are forced to conclude that some of his admiring pupils, perchance some maker of physical apparatus, took the liberty of affixing his name to it. Be this as it may, it was as thus christened that the experiment became familiarly known in the lecture room.

The apparatus used by Biot is outlined in his *Traité de Physique expérimentale et Mathématique* (Paris, 1816), where it appears as an ellipsoid suspended by a silk thread and surrounded by a pair of closely fitting conductors of the same form, provided with insulating handles, Fig. 1. No name is associated with it in the text; a fact that is rather surprising when we remember that Biot was thoroughly conversant not only with all the published papers of Coulomb from which he gives copious extracts, but even with his manuscripts to which he occasionally refers. Moreover, as Biot was an unstinted admirer of the great engineer and electrician, it is not easy to account for this omission of Coulomb's name in connection with an experiment which was then, as well as now, considered to be one of primary importance.

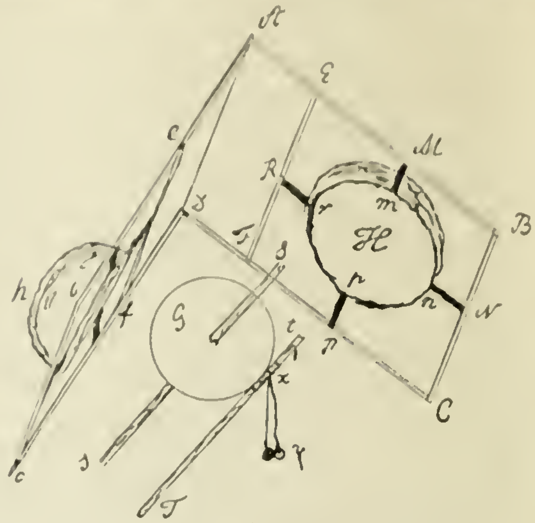
In taking leave of the *Mémoires* of Coulomb, I cannot but recall the words of Prof. Chrystal in his admirable article of one hundred papers on "Electricity and Magnetism," already referred to. On page 21 he writes: "Nothing is better calculated to rouse the failing enthusiasm of the tyro in experimental electricity than a perusal of the works of Coulomb, unless it be to read the *Experimental Researches* of Faraday."

We shall now consider the claims of that quiet, methodical and persistent delver into the secrets of nature, the Honorable Henry Cavendish.[4]

Clerk Maxwell describes the experiment of the ball and hemispheres on page 81 of the first volume of his *Treatise on Electricity and Magnetism*, and speaks of it as belonging to Cavendish. Prof. J. J. Thomson does the same on page 33 of his *Elements of Electricity and Magnetism*, while Principal Lodge, in his *Modern Views of Electricity*, page 11, writes of it as "the famous Cavendish experiment, sometimes referred to in French books by the name of Biot."

Let us see what Cavendish undertook and what he really did. Turning to Art. 218, page 105, of his *Electrical Researches*, as edited by Clerk Maxwell, and published in 1879, we read: "The intention of the following experiment was to find out whether when a hollow globe is electrified, a smaller globe enclosed within it and communicating with the outer one by some conducting substance is rendered at all over or undercharged, and thereby to discover the law of electric attraction and repulsion."

The apparatus which he devised and which is illustrated in the text, consisted of a fixed globe on an insulating support and a pair of hinged wooden frames with two pasteboard hemispheres attached to them by means of glass rods, Fig. 2. When the hemispheres were brought together, they formed an insulated spherical shell concentric with the globe. A wire held by a silk thread and easily removable served to establish communication between the two systems formed by the globe and surrounding shell. The method of operating is given in the paper as well as the results obtained, after which Cavendish states his general conclusion, on page 110, in the following words: "It thus appears that if a globe 12.1 in. in diameter is enclosed within a hollow globe 13.3 in. in diameter, communicating with it by some conducting substance and the whole is positively electrified, there is no reason to think from any circumstances of the experiment that the inner globe is at all overcharged. Hence, it follows that the electric attraction and repulsion must be inversely as the square of the distance."



(Fac-simile reproduction.)

FIG. 2.—BALL AND HEMISPHERES OF CAVENDISH.

Maxwell concludes his remarks on this experimental illustration of a great physical law by saying that the account of it given by Cavendish is "one of the most perfect examples of scientific exposition."

A difference in the manner of operating must be here noticed. Cavendish electrifies the hemispheres and then connects them to the inner globe. Severing this communication, he withdraws the hemispheres and tests the globe, which he finds to be neutral. Coulomb, on the other hand, communicates the charge directly to the insulated body, after which he applies the conductors, and shows that they carry off all the electricity. The difference of procedure, however, is one of detail; it involves no principle whatever.

Fig. 3 shows the apparatus as usually constructed for lecture-room purposes.

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[2] Coulomb, Charles Augustin de, born in Paris, 1736, where he died in 1806. In early youth he showed a great aptitude for mathematical studies. After entering the corps of military engineers, he was sent to the island of Martinique where he remained nine years. On his return to France, he shared with Van Swinden the prize offered by the *Académie des Sciences* in 1779 for the best method of constructing ship's compasses, and two years later won the prize offered by the same body for the theory of simple machines. It was in this paper that he described his celebrated experiments on friction. From 1784 to 1789, he was mainly occupied with his electric and magnetic work, presenting during that period seven lengthy papers to the Académie. Coulomb devised his torsion balance of which he made extensive use after satisfying himself that the angle of torsion is accurately proportional to the moment of the twisting couple. The reader will not fail to recall the $4\pi\rho$ proposition, now known as *Coulomb's Theorem* which states that the force just outside an electrified conductor is 4π times the density. It was indeed meet that the electrical unit of quantity should be named after him.

[3] Biot Jean Baptiste, 1774-1862. After a brilliant career at the lycée Louis le Grand and the Ecole Polytechnique, Biot was appointed in 1800 to the chair of physics in the Collège de France. Honors soon came to the young savant, being admitted in 1803 to the *Académie des Sciences* and appointed member of the *Bureau des longitudes* in 1804. He worked for some time in conjunction with Arago on the triangulation for the measurement of an arc of the meridian, begun in Spain by Méchain. The literary character of many of Biot's works, notably his "Researches on Ancient Astronomy," opened to him the door of the *Académie Française* in 1856. He was elected Fellow of the Royal Society (London) in 1815 and was awarded the Rumford medal in 1840 for his remarkable researches on the circular polarization of light.

[4] Cavendish, Henry, 1731-1810. Mathematician, chemist, physicist. His life was one of seclusion wholly devoted to the pursuit of science, a "set of stables" attached to his father's house being transformed into a laboratory for the purpose. With a torsion balance, originally suggested by Rev. John Michell, he determined the mean density of the earth, the average value of 29 measurements being 5.448. Professor Vernon Boys, working in 1895, obtained 5.527. Cavendish was elected to the Royal Society in 1760 and in 1772 we find him associated with Benjamin Franklin on a committee to consider the best means for protecting the powder magazine at Purfleet against lightning. One member, a certain Mr. Wilson, insisted on blunt lightning-rods, but the other four recommended pointed conductors. In his paper on the torpedo, Cavendish maintained that the shock was a real electrical phenomenon, constructing a wooden model by way of illustration with which he imitated in water the discharges of this singular electrical fish. He distinguished between quantity and degree of electrification just as we do between charge and potential. Accuracy was everything with him, appearance nothing. Some of his results are but little short of marvelous; thus he found the capacity of a circular disc to be 1/1.57 that of a sphere of equal radius; our formula is $C = \frac{2r}{\pi} = \frac{r}{1.5708}$. Cavendish may justly be considered as the co-founder with Coulomb of quantitative electricity. Dr. Wilson, his biographer, wrote: "His theory of the universe seems to have been that it consisted solely of a multitude of objects that could be weighed, numbered and measured; and the vocation to which he considered himself called, was to weigh, number and measure as many of these objects as his allotted three score years and ten would permit."

The question of priority yet remains. As we have seen, Coulomb's paper was published in 1788; the manuscript of Cavendish shows that the experiment was made by him on December 19, 1773[5]; that is fifteen years earlier. This chronological fact does not, however, detract one tittle from the merit of Coulomb, for the simple reason that Cavendish did not communicate his results to the scientific world, preferring to keep them by him in manuscript. Only two of his papers were printed during his lifetime, both in the *Phil. Trans.*, the first in 1771, entitled "An attempt to explain some of the principal phenomena of electricity by means of an elastic fluid," and the second in 1776—a very remarkable paper—on the torpedo. It is, therefore, highly probable that Coulomb was not acquainted, even by hearsay, with the electrical achievements of his illustrious but singularly reticent contemporary. Both studied experimentally the law of variation of electric force, both devised the same simple and ingenious experiment to determine it, and both concluded from their observations that no law but that of the inverse square of the distance would adequately account for the unelectrified condition of the inner globe. Science affords numerous instances of similar independent researches and discoveries: witness that of the calculus by Newton and Leibnitz, the Leyden jar by Von Kleist and Cunæus, and the mathematical discovery of the planet Neptune by Adams and Leverrier.

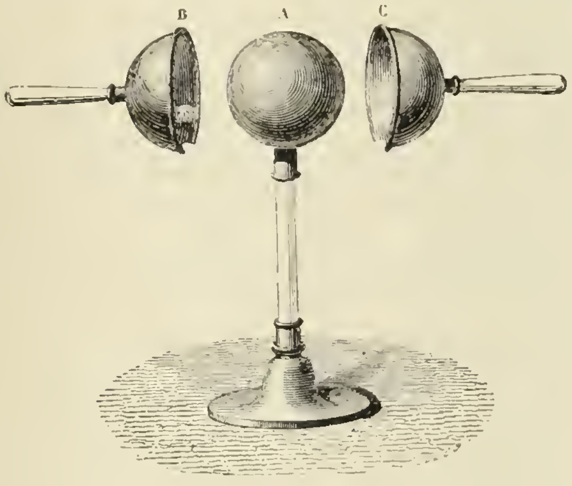

FIG. 3.—LECTURE ROOM APPARATUS.

From the above brief exposition it will be seen (*a*) that Cavendish was the first to make the famous experiment suggesting the law of the inverse square, and (*b*) that Coulomb was the first by ninety years to publish it. If the present usage of deciding questions of priority by date of publication be held to apply to the experiment under consideration, then it must henceforth be credited to Coulomb. In any case, the name of Biot must be dropped.

Starting Induction Motors.

The well-known standard method of starting induction motors consists in inserting non-inductive resistance in the secondary of the motor, this resistance being gradually cut out as the motor runs up to full speed. If a rheostat with sliding contacts is used, there may be sparks, and such sparks are absolutely prohibitive if the motors are used for certain special purposes, for instance in flouring milles, oil refineries, etc. For such purposes a different method of starting has been devised by Mr. A. P. Zani, of Berlin, Germany, for which two patents were granted him on August 4. While this method is in principle the same as the method mentioned above, it is of an automatic nature, no rheostat being employed. The currents in the secondary are caused to flow through a circuit provided with alternative paths, one of high ohmic resistance and little if any self-induction, the other of low resistance, but of comparatively high self-induction. At starting when the slip is large and the frequency of the currents in the secondary is high, the reactance in the path of high inductance is so large as practically to prevent any considerable current from flowing in this path, thus causing nearly all of the current generated in the secondary to pass through the high-resistance path. As the speed of the machine rises, the frequency of the induced currents, which is proportional to the slip, decreases, thus correspondingly diminishing the reactance due to self-induction, and so causing a greater portion of the induced currents to pass through the path of high resistance. When the speed of the motor has risen sufficiently, the frequency of the secondary currents is so low that the counter e.m.f. of self-induction in the inductive path is greatly reduced. Then nearly all of the current will flow through this path of low resistance. In order to further increase the variation of the reactance, additional means may be employed, for instance, the reluctance of the magnetic circuit may be varied (Fig. 1).

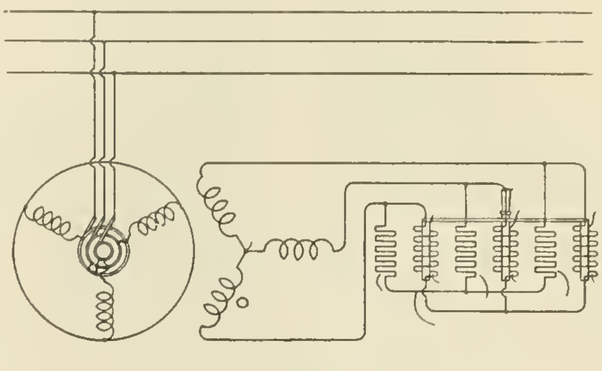

FIG. 1.—ZANI METHOD.

A patent was granted on August 4 to Mr. Henry G. Reist, of the General Electric Company, for an improvement of the method by which the resistance is inserted at starting in the secondary of an induction motor is cut out automatically by centrifugal force. The inventor uses a plurality of independent switches mounted on the secondary and arranged to be actuated independently and at different times by centrifugal force, for the purpose of cutting out the starting resistance step by step as the speed increases. The construction of the switch is also a novel feature of the invention.

A patent was recently granted to Mr. T. J. M. Girault, of Paris, France, for a method of starting in which the terminals of the phase windings of the secondary are connected to the primary of a transformer, the secondary windings of which are closed through variable resistances, which are gradually changed (Fig. 2). The advantages for this arrangement are that the use of large currents is avoided, and that it is unnecessary to use lengthy cables of large cross-section if the controller is at some distance from the motor. A patent for another method of starting was recently granted to the same inventor (Fig. 3). In this the arrangement consists essentially of two motors, the "principal" motor and an "auxiliary" motor. The secondaries of both motors are in series, while the primaries are so arranged as to exercise on the common secondary circuits a concordant action when the motor is working at normal speed. The rotors of both motors are connected mechanically so as to insure the same slip relatively to the stators. When the motor is started, only the primary of the principal motor is excited, while the primary of the auxiliary is open. The auxiliary motor then acts as a strong self-induction coil, and the current in the secondary is, therefore, small.

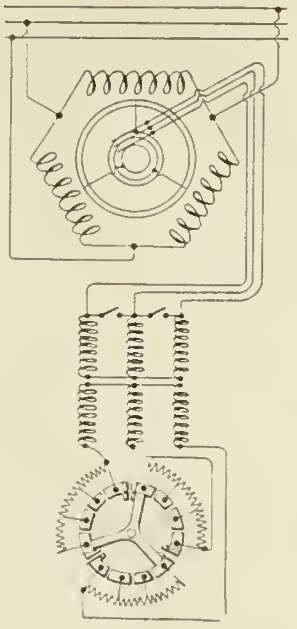

FIG. 2.—GIRAULT METHOD.

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[5] Maxwell remarks that this should be 1772.

The primary of the auxiliary motor is then gradually more and more excited.

A novel solution of the starting problem is offered in a patent granted August 4 to Messrs. Walter Langdon-Davies and Alfred Soames, of Surrey, England. The motor is started and brought up to about full speed without the use of the winding on the secondary. The core of the secondary is made of solid brass or wrought iron or steel, of sufficient thickness to afford a path of high resistance for Foucault currents set up within it. On the other hand, the windings on the secondary have a high conductivity, so that when the motor has run up to full speed and the circuit of the windings is closed, there is small slip and but a small current flowing in the solid body. Very little heat is said to be generated in the solid body of the secondary when running at full speed.

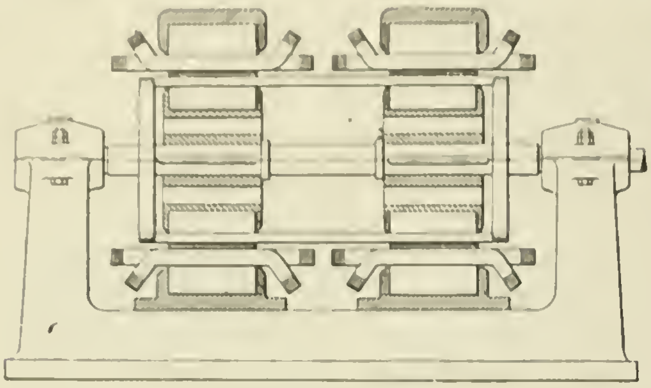
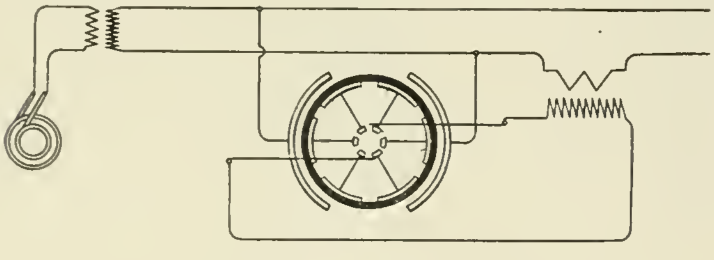


FIG. 3.—GIRAULT METHOD.

As single-phase induction motors do not start from rest, it is usual to provide, in addition to the main single-phase winding, a starting winding in which the phase of the current is different. This starting winding is intended to be used only in starting, and if the attendant forgets to disconnect it after full speed has been reached, the motor will operate inefficiently, and the starting winding may burn out. To prevent such mistakes of the operator, Mr. A. R. Everest, of Lynn, Mass., has devised a starting switch for which a patent has been granted to him on August 4. This switch has "starting" and "running" positions, and when it has been moved into its starting position and is then released, it will be automatically moved into the running position.

Electrostatic Motor.

A patent has recently been granted to Prof. Elihu Thomson, of Swampscott, Mass., for an electrostatic motor for very light work, such as the driving of the recording mechanism of wattmeters. It may be operated under very high voltages and may be very cheap of construction, as it does not involve the winding and core system of the ordinary electromagnetic motors. It has two elements quite analagous to the potential and current coils of the operating motor of an ordinary Thomson wattmeter. The one element of the electrostatic motor is connected across the mains and may be assumed to be stationary; it consists in the case of a single-phase system of two metallic plates, placed opposite to one another and facing the outside of a cylindrical hard-rubber drum, which is between them. Two metallic plates are thus charged electrostatically to the potentials of the two opposite mains.



THOMSON ELECTROSTATIC MOTOR.

On the inside of the hard-rubber drum a series of equidistantly-spaced metallic plates is mounted which are insulated from each other and form the second element or the armature of the motor. These plates are connected to a commutator on which bear two brushes in series with the supply circuit, thus corresponding to the series coils of an ordinary wattmeter. The drum is movable about its axis. When the circuit is closed on the two elements, the drum will rotate, provided the brushes bear upon the commutator segments in an angularly displaced position with relation to the field plates. The charge received from one side of the circuit acts repulsively upon one of the armature plates and attractively upon the other; after a definite range of movement sufficient to bring under the brushes a new pair of commutator segments, this attractive and repulsive effort is transferred to an adjacent pair of armature plates, and thus the rotation of the movable element is maintained so long as the circuit remains closed. Transformers may, of course, be interposed in the connections of the supply circuit with the two elements of the motor.

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Some Tests of Recording Wattmeters.

By Ingwald A. Rosok.

In some tests of several makes of recording wattmeters, the connections and methods employed were in all cases as follows: The ammeter or series coil of the portable wattmeter was placed in series with the meter under test, care being taken in case of the portable wattmeter to insert it on the service side of the meter. The voltmeter or shunt coil of the portable wattmeter, or both in case both a voltmeter and a portable wattmeter were used, were connected in multiple with the shunt coil of the meter. Runs were then taken beginning with the smallest loads at which the meter would move and increasing them with each successive run until 50 per cent. overloads were reached. The results were plotted on co-ordinate paper laying off the load as found by the portable wattmeter or ammeter and voltmeter as abscissæ and the percentage of load registered by the formula,

$$Watts = \frac{3{,}600 \times constant\ of\ meter \times rev.\ of\ disc}{Seconds\ of\ run}$$

as ordinates. The resulting curves then showed the accuracy of the meter under all loads and conditions.

When leading or lagging currents were used an ammeter, a voltmeter and a portable wattmeter were connected in the circuit, since it in all cases was desirable to know the power factor. This was obtained by dividing the reading of the portable wattmeter by the product of the voltmeter and ammeter readings, which gives the power factor in decimals.

The running efficiencies of the meters were determined by finding the I^2R losses in the field and armature, the sum of which gives the total watts lost. The total number of watts passing through a meter minus the watts lost in the meter divided by the total watts gives the running efficiency, or

$$Running\ Efficiency = \frac{Total\ Watts - Watts\ Lost\ in\ Meter}{Total\ Watts}$$

It will thus be readily seen that in order to have high efficiency a meter must have a large impedance in its shunt coils and a small resistance in its series coils. In most of the meters tested the running efficiencies at loads of .05 of their rated capacities were found to be about 95 per cent., at .1 about 97 per cent., at .2 nearly 99 per cent., and at full load about 99.5 per cent. On overloads the running efficiencies were generally smaller than at full load.

The all-day efficiencies were obtained by finding the number of watt-hours lost in 24 hours when the meter was carrying a full load for different periods per day. The watt-hours lost in the meter subtracted from the total watt-hours passed through the meter divided by the same gives the all-day efficiency, or

$$All\text{-}day\ Efficiency = \frac{Total\ Watt\text{-}hours - Watt\text{-}hours\ Lost}{Total\ Watt\text{-}hours}$$

Curves were then plotted with watt-hours as abscissæ and percentages of loads registered as ordinates. These curves rise more slowly than the running efficiency curves, and considering five hours an average period of full load, the efficiencies were found to vary from 98 to 99 per cent., an average being about 98.5 per cent. This is about 1 per cent. less than the average full load efficiencies, the difference being due to the large number of watt-hours lost in the shunt coils of the meters at no load.

The running performances of the meters under different non-inductive loads varying from zero to 50 per cent. overload were found as previously explained. Most of the meters tested were new from the factories and these performances were, therefore, in all cases found to be very good.

Variations in voltages were found to have considerable effect on the direct-current meters with compensating coils. It was thus found that one 15-amp. meter tested ran 10 per cent. too fast on 1-amp. loads when the voltage was 10 volts above normal, and 10 per cent. too slow when the voltage was 10 volts below normal pressure. On meters without compensating coils changes in voltages of 10 per cent. or less had no noticeable effect. Of the induction meters tested only one was much affected, the performance of the others being but very little changed. The meters affected ran in all cases too fast on high and too slow on low voltages.

Different frequencies affected all of the induction meters noticeably. It was thus found that several of the meters tested which ran correctly on 60 cycles, ran from 5 to 10 per cent. slower when tested on 40 cycles and from 2 to 6 per cent. too fast when 80 cycles were used. The ampere-hour meters were very little affected and the meters with commutators were not affected at all by changes in frequencies.

Inductive loads were found to affect meters with commutators considerably, lagging currents making them run too fast and leading currents too slow. The errors for power factors of 80 were found to vary from 1 to 4 per cent. from the non-inductive load readings. On smaller power factors the errors were greater. Thus, for a power factor of 60 the error in one meter tested on full load was found to be as much as 12 per cent., while in others it varied from 5 to 15 per cent., and in one meter it was found to be over 20 per cent. The errors when leading currents were used were found to be a little greater with the same power factor and load than with lagging currents. The induction meters were not affected noticeably under power factors of 60 or more. With smaller power factors, however, they all ran more or less too fast, except one which was oppositely affected, it being made to run too slow.

All meters would run too slow if they were not kept clean and had their pivots and jewels in the best of condition. It was thus found that an old meter tested which ran much too slow was improved 5 per cent. by changing its jewel and pivot, and it was improved 3 per cent. more by polishing its commutator and cleaning its integrating train, making it run nearly correctly on full load and start on a much smaller load than before.

The effect of not having the meters installed level was quite marked on small loads. It was thus found that all meters tested would run from 3 to 8 per cent. too slow on loads of one-fifth of their rated capacity when inclined 10°.

Compensating the meters for friction makes them start and run on much smaller loads than when not compensated. The latter, however, were found to be very little affected by vibrations, while the former were considerably affected, some of them also being made to creep on no load.

Subjecting a meter to short-circuits has the tendency to weaken the retarding magnets and make it run too fast. Thus one meter tested ran 3 per cent. faster, having blown two 10-amp. fuses in a fuse block having a distance of one inch between binding posts. All the direct-current meters tested were more or less affected by short-circuits. Those meters having their leading-in wires at the top were, however, much less affected than the meters which had their leading-in wires at the bottom. Induction meters having iron shields were not affected by short-circuits. Large masses of iron placed near the meters made most of those without iron fields run too slow, but did not affect those having iron fields. Different temperatures, atmospheric pressures, humidity, etc., affected one type of ampere-hour meters considerably, but had no noticeable effect on any of the other meters tested.

Aging has considerable effect on most meters. Thus two meters were installed new from the factory in a place where there was some vibration. After three months' service they were found to run nearly 3 per cent. slower than when installed. Several other meters tested for aging showed similar results. Thus a new 25-amp., 220-volt, 3-wire meter ran before installation 7 per cent. too fast on 1-amp., .9 per cent. too fast on 20-amp., and 1.1 per cent. too fast on 30-amp. loads. After having been in service three months in a place free from vibrations it ran 15 per cent. too slow on 1-amp., 1 per cent. too slow on 20-amp., and 3 per cent. too slow on 30-amp. loads.

A 10-amp., 100-volt, 2-wire compensated wattmeter tested before installation, ran correctly on 3-amp., 1.4 per cent. too fast on 3-amp. and 8 per cent. too fast on 8-amp. loads. After three months' service it would not run at all on 5-amp. loads; on 3-amp. it ran 2 per cent. too slow and on 8 amp. it ran 1 per cent. too slow.

Nearly all induction meters will start on smaller loads than meters with commutators. It was thus found that some of the induction meters tested would run fairly correctly on less than 12-watt loads.

Several tests were made in order to compare the performance of meters with commutators on alternating and direct currents, and it was found that most of the meters tested would run with exactly the same accuracy on alternating as on direct currents.

Leblanc Rectifying Transformer.

Two interesting patents were granted on June 2 to Mr. Maurice Leblanc, the well-known electrical engineer and inventor of Paris, France. The original application, filed on January 4, 1901, was later divided and two patents granted, one for a "transformer," the claims referring to the apparatus; the other for a "method of shaping rotary fluxes and operating transformers," the claims referring to the method. The latter patent is assigned to Mr. George Westinghouse.

The fundamental principle of the invention is that by means of "compensating windings" Leblanc is enabled to shape a rotary complex magnetic flux at will, so that certain predetermined components are entirely suppressed; it is thus possible to suppress all but a single component and to obtain an exactly sinusoidal rotating flux of two branches. As this is of fundamental importance, it may be explained somewhat more in detail.

If an iron ring about which circuits are wound is supplied with polyphase currents, a rotating magnetic flux is produced which is in general of a compound character. If we consider the flux at a given moment, as though it were fixed, and examine it from point to point of the ring, then it is a function of the position of the point on the ring. If we assume, as in Fig. 1, a fixed radius, *O A*, any point *B* of the ring is determined by the angle, w, which the radius, *O B*, forms with the fixed radius, *O A*, and the flux, Φ, at any point is a function of w; moreover, it is a periodic function because it attains the same value each time the angle, w, is increased by 2π. According to Fourier's theorem, it may, therefore, be represented in form of the following series:

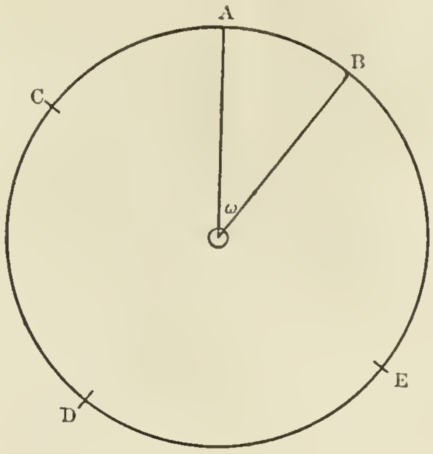


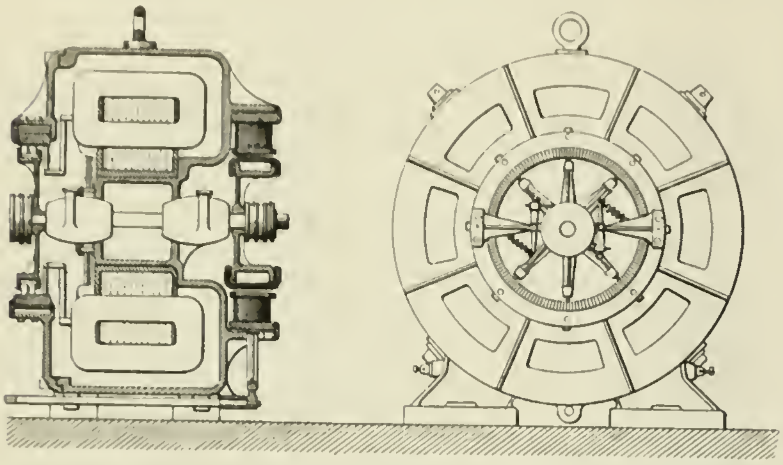
FIG. 1.

$$\Phi = \Phi_1 \sin(w - a_1) + \Phi_2 \sin(2w - a_2) + \ldots$$
$$+ \Phi n \sin(n w - a_n) + \ldots$$

This shows the "compound" character which the magnetic flux at a given moment has in general. What Leblanc accomplishes by means of his "compensating windings," is to suppress all terms of the series with the only exception of the first one. The flux thus obtained, $\Phi = \Phi_1 \sin(w - a_1)$, is a "pure sinusoidal flux of two branches." If we assume the angle, *A O B*, to be a_1 in Fig. 1, the flux has the value zero at the points *B* and *D*, it is a maximum at point *C* and a minimum at point *E*. Or we may start from point *B* and pass along the two branches, *B C D* and *B E D*; then, beginning from point *B*, the flux gradually increases in both branches, according to a sine law, passes through a maximum at C and D, and then decreases again.

Now, such a pure sinusoidal flux of two branches is required for the production of a strictly constant and uniformly rotating magnetic field. What Leblanc essentially accomplishes by means of his compensating windings is, therefore, to screen out all the disturbing elements of the given flux of his apparatus and shape it so that a constant uniformly rotating magnetic field is obtained.

While this result may be applied for various purposes, its most important application is to rectifying transformers, in which polyphase or single-phase currents are transformed into direct current by connecting the secondary windings to the segments of a commutator. These secondary windings are usually embedded in iron and the e.m.f.'s of self induction of commutation are so great as to make commutation practically impossible. By the use of Leblanc's compensating windings, however, regardless of the sudden change of current during commutation by the short-circuiting of the coils, the e.m.f.'s induced in the successive coils correspond to a symmetrical polyphase system. It is thus possible to commutate a closed magnetic circuit transformer without meeting any excessive e.m.f. of self-induction.


FIGS. 2 AND 3.

A cross-section of the rectifying transformer of Leblanc is shown in Fig. 2. The central part of the apparatus is a stationary transformer ring, which is separately shown in Fig. 4. At the left hand of the transformer ring, in Fig. 2, there is an annular stationary commutator; within it a spider rotates, carrying brushes whose outer faces make contact with the inside surface of the commutator segments. At the right hand of the transformer ring there is a two-phase alternating-current motor which is mounted on the same shaft as the spider for the brushes at the left end, and serves for rotating them. The field magnets of this motor are mounted on a yoke which is rotatably mounted within an annular bearing, so that the field magnets are adjustable circularly. By shifting the magnets, the same result is obtained which in the ordinary case of a rotary converter is obtained by shifting the brushes.

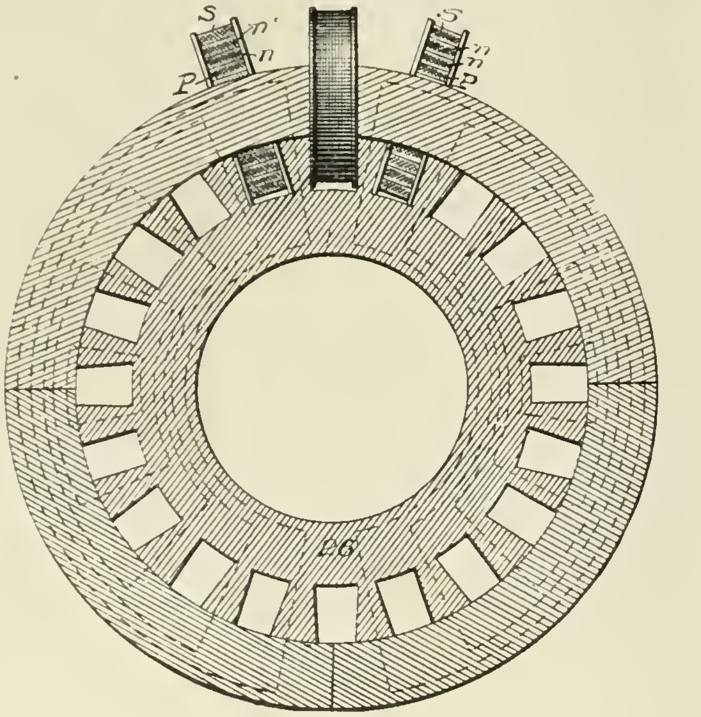


FIG. 4.

The front elevation of the apparatus is shown in Fig. 3, the annular commutator is seen and inside the spider with eight arms, carrying the brushes. The first, third, fifth and seventh arms are connected to one slip ring; the second, fourth, sixth and eighth to another slip ring. These two slip rings are shown in Fig. 2. Fig. 3 shows how these two slip rings are connected by two brushes to the binding posts, + and −. These are the terminals of the direct current circuit of the rectifying transformer. The alternating current terminals are displaced around the circumference of the apparatus in a symmetrical manner.

The number of pairs of poles of the two-phase motor is equal to the number of groups of commutator segments. To the field system of the two-phase motor a magnetic shield is secured, of the well-known Hutin and Leblanc type; its function will later become apparent in the discussion of the conversion of single-phase currents.

The mechanical construction of the ring core of the transformer is shown in Fig. 4, while the electrical connections are diagrammatically indicated in Fig. 5. It will be seen that the lines of magnetic force lie almost wholly within iron. In the present case the ring core is provided with 20 bobbins, each composed of four separate coils; the inner coils, *P*, are the primary windings of the transformer, the outer coils, *S*, are the secondaries, the intermediate coils, *n* and n^1, being the compensating coils.

The commutator has four groups of 20 segments each, numbered consecutively 1, 2—20; in general, like segments of the four groups are electrically connected as indicated by the wires on the outside of the commutator in Fig. 5. The 20 secondary coils, *S*, are connected in series and each of them is electrically connected at one end with the commutator segments bearing the corresponding number. The 20 primary coils, *P*, are also connected in series. The terminals of the two-phase current leads are at the four points, 14, 15, 16, 17, which are 90° removed from each other.

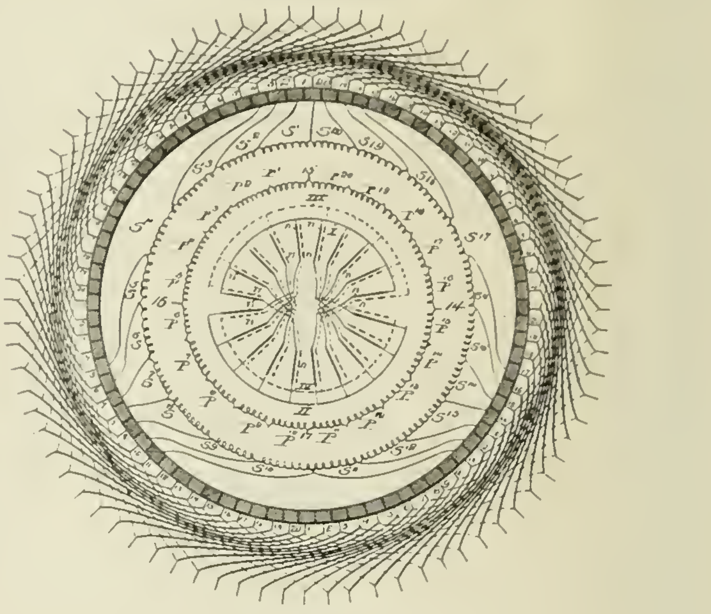


FIG. 5.

The arrangement of the two sets of compensating coils, *n* and n^1 (diagrammatically indicated inside the circle formed by the primary coils in Fig. 5), and their operation are the principal novel feature of the transformer. The one set, *n*, is the "sine compound compensating circuit" (indicated by full lines), the other set, n^1, the "cosine compound compensating circuit" (indicated by broken lines). As shown in Fig. 4, each slot of the ring contains one coil of each set, the number of turns at the point *x* of the ring being determined according to the two equations,

$$n_x = c \sin \frac{2\pi}{2K} x,$$

$$n^1_x = c \cos \frac{2\pi}{2K} x,$$

where *c* is a constant and *2K* the number of slots, which is 20 in the present case. The number of turns at each point is, of course, determined by the distance from an arbitrary zero point, $x = 0$, for instance point A in Fig. 1; at this point the sine compensating coil has no turns at all.

The method of interconnection of these coils is shown in Fig. 5. The sine compensating circuit is composed of a network of K parallel branches, each branch containing two coils (n) in series, the two coils being displaced by 90°; the two sets of ends of these K parallel branches are connected to the rings, *I* and *II*, respectively. The interconnection of the cosine compensating coils is analogous; the ends of the K parallel branches are here connected to the rings, *III* and *IV*, respectively.

Now we may assume that we have a pure sinusoidal flux of two branches which, at a certain moment, is zero at the points B and D in Fig. 1, as discussed in the introduction of this article. We may also assume that the point A is the zero point from which the number of turns of the sine compound compensating coils is determined, according to the equation just given. Then it can be shown by mathematical analysis that the rotating sinusoidal flux at the moment when it is zero at B and D, induces in each one of the K parallel branches of the compensating sine circuit the same e.m.f., and this e.m.f. is proportional to the angle w between OA and OB. Hence the rotation of the sinusoidal flux produces at one certain instant zero e.m.f. in every branch; at any other moment there will exist an equal e.m.f. in each of these parallel branches and in the same direction in all, and this e.m.f. is measured by the sine of the uniformly increasing angle, w, which represents the velocity of rotation of the sine flux. The analogous result may be proven for the cosine compensating circuits, but in this case the e.m.f. in any branch is proportional to the cosine of the angle w.

If the coils *I* and *II* are not connected to each other, nor the coils *III* and *IV* to each other, then the rotation of the pure sine flux in the iron core will generate no currents of any kind, either in the compensating sine circuit or in the compensating cosine circuit. There will simply be generated a series of equal and equally directed e.m.f's in the parallel branches of the compensating sine circuit, which means that no current will flow from any one of these branches to any other of these branches (for the same reason that no current flows when two galvanic cells of equal e.m.f. are connected one against the other). A similar remark applies to the compensating cosine circuit.

If, however, the rings *I* and *II* are connected to two terminals of the two-phase motor, shown at the right hand of Fig. 2, and the rings *III* and *IV* to the other two terminals of this motor, two quarter-phase currents will be supplied to the motor so that the energy for driving the motor is derived from the compensating coils. But there will still be no flow of current from any one of the K compensating sine branches to any of the other K compensating sine branches, and the balance or equilibrium of the system will not be disturbed.

Assuming now that there is no external connection between the terminals *I* and *II* and between the terminals *III* and *IV*, it is manifest that the uniform rotation of a simple sine flux in the iron ring will have no effect on the compensating circuits, and the compensating circuits will have no effect on the uniformly rotating sine flux; each will exist precisely as if the other were not present. On the other hand, it can be shown that any other type of flux than the uniformly rotating simple sine flux will cause the generation of e.m.f's in the compensating branches which will no longer be equally directed, hence currents will flow from one branch to another. For a simple sinusoidal flux of two branches the compensating branches behave like open circuits, while for a flux of more than two branches the compensating branches short-circuit each other. The compensating circuits will, therefore, act as magnetic screens for all types of fluxes in the iron ring, except the simple sine flux, and will squeeze out and destroy these fluxes; but the simple sine flux will be allowed to move in the ring just as if the compensating circuits were not present.

This represents the solution of the general problem. It is of interest to give the application which Mr. Leblanc suggests for the special case of the transformation of single-phase currents to direct current. In discussing this problem Mr. Leblanc makes use of the resolution of a single-phase field into two revolving fields, which is often used in the mathematical discussion of single-phase current phenomena in European text-books. As can be easily seen, a single-phase flux is mathematically equivalent to two equal rotary fluxes, revolving with equal velocities in opposite directions. The effect of Leblanc's compensating windings in this case is to obliterate all but the pure sine or two-branched components of these two fluxes, revolving in opposite directions.

Now it becomes necessary to obliterate one of these two rotating fluxes. The scheme by which Leblanc claims to accomplish this is to connect the compensating circuits of the transformer to the armature circuits of his synchronous two-phase motor, the field circuits of which are supplied with direct currents, and to the field poles of which a magnetic shield of the Hutin-Leblanc type is applied. The armature circuits of the motor will then be the seat of e.m.f's corresponding to two oppositely rotating magnetic fields. One of these fields will move in a direction opposite to that of the rotation of the armature with a velocity equal to that of the armature, and will, therefore, be stationary in space. It will not be affected by the magnetic screen in the motor. The other rotating field will move with reference to the armature and in the same direction as the armature with a velocity equal to that of the armature. It will, therefore, move in space—i. e., with reference to the magnetic shield—at a velocity equal to twice that of the armature. The magnetic shield will, therefore, consume and thus obliterate this rotating field and the other one is alone left in the armature circuits of the motor. The compensating circuits will then also be the seat of currents corresponding to a single rotating field moving in a given direction.

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Transformer House Dynamited at Idaho Springs, Colo.

The accompanying illustration shows the result of a dastardly attempt to destroy life and property made at the Sun and Moon mine, near Idaho Springs, Colo., on the night of July 28, as previously noted in these pages. The evident plan had been to blow up the shaft house, transformer plant and compressor house of the mine with two kegs of powder, but the discovery of the dynamiters by the watchman, who saw them light the fuse, caused the men to leave all the powder at the transformer house, which was completely wrecked, as the picture indicates. At the right in the illustration is seen the compressor building and in the distance with the two stacks is the shaft house. At the time of the explosion there were 14 men at work underground in the mine and four men above, and had the shaft house been destroyed, there undoubtedly would have been considerable loss of life. As it was no one was injured except one of the dynamiters, who was killed by the explosion. This man had been known as a strong sympathizer with the union which was on a strike at the mine.

DYNAMITED PLANT, IDAHO SPRINGS.

The transformer house was a frame building sheeted with steel and contained three General Electric 75-kw. oil-cooled transformers. Current was received from the plant of the Union Light & Power Company at Georgetown, 13 miles distant, at 10,000 volts, three-phase, 60 cycle and was stepped down by these transformers to 440 volts. The power was used to operate two 100-hp General Electric induction motors that drove air compressors for the mine.

The transformers shown lying on their sides were ruined. The force of the explosion knocked them over and the oil caught fire, completely destroying the insulation. The casing of one transformer was cracked and the other one had a hole blown in it. The transformers left standing were found uninjured, a fact that is somewhat remarkable when the force of the explosion and the heat of the burning oil are considered. The oil switch of the transformers was ruined, as was the wiring in the station. Immediately in front of the standing transformer is seen the bank of lightning arresters that had been mounted above the transformers.

A similar attempt was afterward made to destroy the water power plant of the Union Light & Power Company at Georgetown, but it resulted unsuccessfully.

New Telephone Patents.

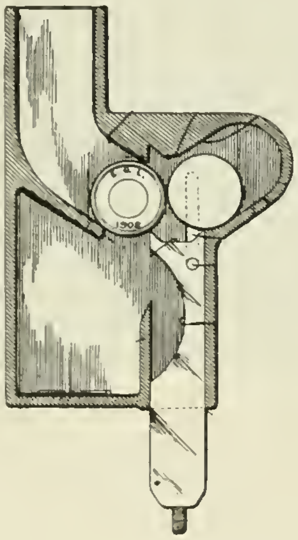
SUBSCRIBER'S MESSAGE REGISTER.

Where measured service is the standard for telephone contracts, the burden of keeping record of calls is no small task, and where the ticket system is used, i. e., where the central office operator writes a check for each call, the average load per operator is reduced about one-third. As a means of obviating this drag, many different sorts of message registering devices have been brought forward, one of the simplest being that wherein a counter is mounted at the subscriber's premises.

Mr. G. A. Long has recently patented a very compact device of this kind, his patent being assigned to the Gray Telephone Pay Station Company. The shape of this register is not far different from the push socket switch, the operating plunger projecting through it increasing the resemblance. Within the case are a rachet counter and a gong so connected with the plunger that the depression of this latter both operates the counter to score 1 and sounds the gong to notify the operator that the count has been made. A hammer latch and a damper associated respectively with the gong hammer and the gong prevent any possibility of a false or premature signal.

TELEPHONE LOCK.

Another method of keeping count of calls is to require prepayment for the individual calls, the telephone lock being a device which prevents the operation of the hook switch until the proper coin has been deposited. Such locks are extremely simple mechanically, the latest design having but two moving parts. This is the invention of W. H. Scott, of St. Louis, whose patent has been assigned to the Controller Company of America. The accompanying figure shows a section of the lock just after a coin has been deposited. Normally the locking disc (to the right) rests on the shelf shown below, thus restraining the bolt against any upward thrust from the hook switch lever, shown in section at the bottom of the cut. Under the conditions shown the bolt is free to rise, pushing the coin and disc into their respective slots. The cut-away portion of the bolt then rises so that it forms for the coin a runway leading into the coin box. The disc is then retained in its slot until the bolt again descends.



TELEPHONE LOCK.

TWO-LINE SWITCH.

Under the title "Rotary Extension Bell Switch," Mr. G. E. Coils has patented a rotary switch which can effectively control two lines without the necessity of other switching apparatus. The particular combination of circuits in the inventor's mind is that of two lines terminating at a common point and desiring connection with that point at times independently and at times simultaneously. The rotating switch has contact rings and points to connect the main telephone set to either or both lines at will, always connecting an extension bell to the idle line

BURGLAR ALARM ATTACHMENT.

Mr. Solomon Schwarzschild, of Rochester, has produced another burglar alarm attachment for telephone lines. The novel features embrace time switches limiting both the setting and turning off of the alarm attachment at such times as the protected premises are to be legitimately entered. The present patent covers the combination of the alarm devices with the telephone circuit.

Radium, Heat and Cold.

According to a special cable dispatch of August 15, another discovery as to the properties of radium has been communicated this week to the French Physical Society by Professor Curie. It was only in March last that eminent men of science refused to accept the statement so irreconcilable to scientific experience that radium possesses the property of maintaining a temperature at a point three degrees higher than that of its surroundings. But the fact that, in addition to the marvellous radio-active properties already described, radium has this unique and unprecedented power of the emission of heat has been established beyond the possibility of question. Strenuous efforts have been made to obtain accurate measurements of this heat production and determine the effects of external conditions in promoting and retarding it.

Professor Curie found that heat emission remains unchanged through a very wide range of temperature, there being no perceptible variation at the temperature of a summer day, or that of liquid air, but if a downward stride is taken from the temperature of liquid air to that of liquid hydrogen, radium shows that it is not always unaffected by the external temperature.

And here comes the amazing new fact that the change in the rate of heat emission of radium within the comparatively short distance of absolute zero is in exactly the opposite direction to what might be expected in view of the effect of low temperatures on ordinary chemical action, for at the temperature of liquid hydrogen the heat emission of radium, instead of being reduced, is augmented. In simple language, the substance which does not change its heat at all temperatures, from that of an ordinary room to that of liquid air, gives out a greater heat when subjected to the greatest cold that scientists have yet reached.

These experiments with liquid hydrogen have led to the curious discovery that freshly prepared salt or solution of radium has a comparatively feeble power of giving off heat at all temperatures, but the power steadily increases for about a month, when it reaches its minimum activity, which it then maintains apparently indefinitely. These remarkable results have failed to throw any light upon the process whereby radium maintains a constant emision of heat radio-activity.

Municipal Steam Turbine Plant, at Anderson, Ind.

An interesting municipal electric lighting plant enterprise is under way at Anderson, Ind., and marks the second introduction of the steam turbine in American municipal power plant service. The city of Anderson has for some years operated an electric light plant in connection with the city water works, located near White River. The electric installation is housed in a separate building approximately 50 ft. x 100 ft. adjacent to the water works plant, whose boilers furnish the steam power necessary for the operation of the electric light plant. The present lighting equipment comprises two belted generating units, but the increasing demand for light and power renders the available capacity inadequate to carry even the present load at times, resulting in a severe overloading of the entire equipment. In order to secure immediate relief from these conditions and avoid the necessity of erecting additions to the power house, Westinghouse steam turbine generating units have been selected for power extensions. At the present time two 400-kw units will be installed, together with one 20-kw exciter, direct-connected to a Westinghouse standard engine and a complete switchboard equipment.

As the result of the employment of turbines in this plant it has been found possible to install a complete boiler plant in the electric light building, thus rendering the operation of the lighting system entirely independent of the water works system. The new boiler plant consists of three 310-hp Sterling water tube boilers equipped with Roney mechanical stokers. The boilers will not be arranged for superheat, but will supply saturated steam to the turbines at 150 pounds pressure, all condensation being returned to the boilers by a steam loop and Holly gravity return system. The turbo-generators will furnish three-phase currents to the lighting power and distributing system at a frequency of 60 cycles and at 2,200 volts pressure, no step-down transformers being used. The turbine equipment will operate condensing as the plant is located near the river bank, where condensing water is available. Surface condensers will be used and the condensation from the turbines will be returned directly to the boilers, as the exhaust is entirely free from oil.

An interesting feature of the turbine installation is brought out by the fact that by replacing the belted units with turbine-driven units, sufficient space is made available for the installation of the complete boiler plant, together with an additional turbine unit and the necessary boilers at such times as the future demands upon the plant require this extension. Mr. E. R. Vincent, M. E., of Indianapolis, Ind., has been retained by the city of Anderson as consulting engineer, and the installation is under his general supervision.

Recent Electrochemical Developments.

REDUCTION OF NITRO AND AZO COMPOUND.

The employment of a surprisingly large number of trained chemists and electrochemists for pure research work is the principal means by which all the larger chemical works in Germany endeavor to retain their leading position in the world in the field of organic chemistry. Electrolytic methods for oxidation and reduction of organic compounds form one of the favorite subjects of this systematic research work, and the following three patents on the reduction of nitro and azo compounds are representative of the work being done. These were issued August 11 to Mr. Max Buchner, assignor to C. F. Boehringer & Soehne, of Mannheim, Germany. The anodic and cathodic compartments are, of course, separated from each other to obtain a high current efficiency. The nitro or azo compound is held in solution or suspension in the cathode department.

The reduction formerly was assumed to require an acid solution and has been shown to go on well in the presence of tin ions. The use of metallic tin is, however, of commercial vaue only if a comparatively small quantity of tin can be used over and over again in the reduction of comparatively large quantities of the starting materials. One of Mr. Buchner's patents refers to a method of carrying on the reduction in such a way that the recovery of the tin is simple. It is based on the fact that tin may be electrolytically precipitated even from strong acid solutions of tin in hydrochloric acid (which remain at the end of the reduction of the nitro compound), if the reducing process is so conducted that the tin used is converted only into stannous chloride and exists in the solution as such, together with the resultant amines. A second patent refers to the use of chromium, lead, mercury, or iron instead of tin. The third patent refers to the reduction in an alkaline solution in the presence of copper, the reduction to amine being almost quantitative.

The facts ascertained by the inventor are somewhat surprising and unexpected in view of former investigations, especially of Elbs; they emphasize the fact that we still know really very little concerning some fundamental points of the mechanism of electrolytic action. In recent years it has become customary to "explain" by the term "catalytic action" all processes in which apparently inert materials have some effect on the final result, but in reality this term only serves to conceal our ignorance of what really happens.

ELECTROLYSIS OF FUSED SALTS.

In the electrolysis of fused substances which are externally heated, a great difficulty is generally found in the rapid destruction of the containing vessel, especially of its bottom plate, which rests on the fire box. A patent was granted on August 11 to Mr. C. W. Roepper, of Philadelphia, for details of a mechanical construction of the fusion vessel, which enables one to easily and cheaply replace the heating bottom plate whenever it is destroyed. The fusion vessel is a rectangular metal box without bottom; the lower edges of these sides rest and fit on top of the side walls of the fire box. The top of the walls of the fire box are recessed for this purpose. The bottom of the fusion vessel is formed of a comparatively thin arched metal heating plate, D, which lies directly over the fire box, presenting its concavity thereto. It is supported upon its edges, which project between the lower edges of the sides of the fusion vessel and the recessed portion of the top of the fire box.

NICKEL PLATING.

In the early experiments with nickel plating great difficulties were experienced on account of the tendency of layers of electrodeposited nickel to peel off. This difficulty has now been more or less successfully overcome and various secret "dopes" are used by practical platers to get a firm deposit. A patent has been granted on July 28 to Mr. Thomas A. Edison for the following method by which a thin electrolytic deposit of nickel on iron or steel can be rendered firmly adherent. After completed electrolysis the nickel-plated pieces of iron or steel are brought into a non-oxidizing atmosphere, for instance of hydrogen, and heated to a temperature sufficient to weld the film of nickel to the iron or steel backing. A bright yellow heat is required for that purpose. The contact thus produced between the nickel and iron or steel is so perfect that sheets plated in this way can be formed into various articles by the drawing or stamping process without cracking or flaking the film.

PURIFICATION OF WATER.

The list of electrolytic methods of purification of water and defecation of sewage has been increased by another one for which a patent was granted on August 11 to Mr. Samuel S. Pridham, of Newark, N. J. The novel features are details of the mechanical construction of the cell and the use of electrodes of an alloy of magnesium and aluminum.

ELECTROLYTIC DYNAMO.

A peculiar application of the principle of unipolar dynamos for electrolysis has been patented by Mr. F. E. Elmore, of London, England. The dynamo and the electrolytic cells are in one apparatus and metallic conductors or rubbing contacts are avoided. For this purpose an electrical conductor with the electrodes at each end thereof, is moved in a magnetic field situated between the electrodes, the simplest arrangement being a circular conductor with electrodes concentrically arranged on it rotating in a circular field.

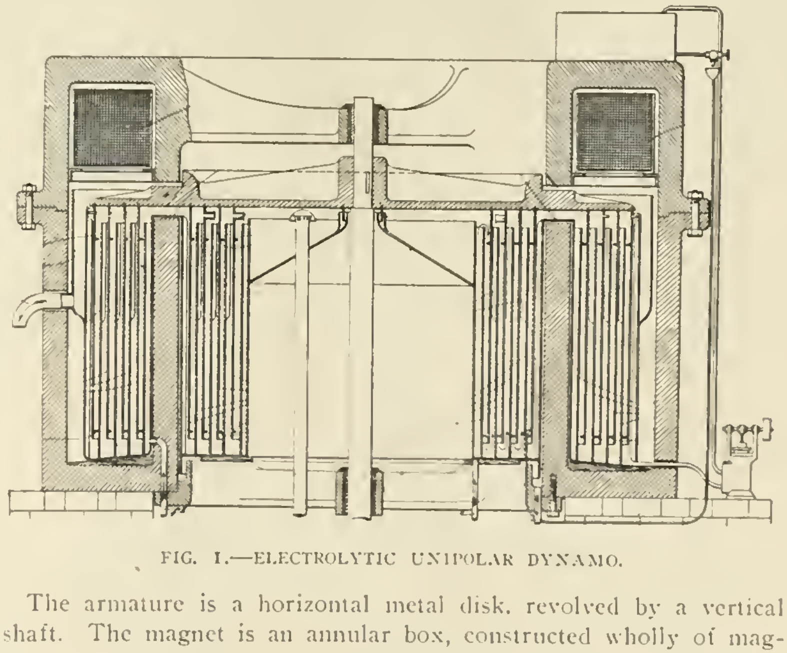


FIG. 1.—ELECTROLYTIC UNIPOLAR DYNAMO.

The armature is a horizontal metal disk, revolved by a vertical shaft. The magnet is an annular box, constructed wholly of magnetic material and completely closed except that its inner wall is divided horizontally to form an air-gap through which the armature extends. The exciting coils are wound round the upper parts of the magnet. The lower part of the magnet contains an annular vessel and a similar vessel, of small diameter, is contained in the space enclosed by the magnet. Each of these vessels constitute an electrolytic cell, the two being in electrical connection through a continuous conductor passing through the air-gap, but insulated from the magnet citing. The one set of electrodes are cylinders set on the bottom of each cell so as to partition it into a number of chambers. Into each such chamber there extends a like concentric cylinder, depending from the armature; the set represents the other electrodes. When the armature is revolved, current is generated and flows through the cells. The application of the apparatus for the electrolysis of brine for the manufacture of caustic soda and chlorine is described.

BATTERY INVENTION.

Mr. C. J. Reed has patented a new method of formation for storage battery plates. He first subjects a metallic lead plate to the action of hydrochloric acid gas in a closed receptacle, preferably in conjunction with an oxidizing agent, such as chlorine or one of the higher oxides of nitrogen; a layer of lead chloride is thus produced. The lead chloride is afterwards reduced to metallic lead, either electrochemically or by the reducing action of metallic zinc or some other suitable reducing agent; or it is converted directly by electrochemical action into lead peroxide.

Mr. A. F. Clark, of Philadelphia, has patented a method of manufacturing storage battery plates of that type in which the grid is formed under pressure; the object is to so form the gratings of the grid that they may be readily removed from the mold and be used with a special form of supporting separator. The details of the invention are of a mechanical nature. The separator forms what may be called an envelope which encloses the entire positive plate.

Messrs. W. Teto and J. W. T. Cadett, of Ashlead, England, have a new composition for use as a plastic or semisolid electrolyte in accumulators. It consists of powdered or precipitated lead sulphate moistened with dilute sulphuric acid of about the average strength used in storage batteries.

Mr. A. V. Meserole, of New York City, has patented details of mechanical construction of a battery in which the active material is contained in wafers of kidney form which are mounted on a pair of tubes. The objects to be thus attained are stated to be the utilization of a greater amount of active material and compensation for the expansion of this material.

BOOSTER FIELD EXCITATION.

Mr. Lamar Lyndon, of New York City, has patented some improvements of the field excitation of a booster when used together with a storage battery to absorb the fluctuations in the load. He provides the booster with balanced field coils influencing the booster to generate e.m.f. in opposite directions. Under normal conditions these coils are so arranged as to neutralize each other in their effect, so that the booster generates no e.m.f. The one booster field coil is connected across the line and wound to cause the booster to feed current out to the line. The other booster field coil is a shunt coil between the battery and the line and wound to oppose the battery discharge. The booster field is thus a differential field directly responsive to the voltage fluctuation at the battery terminals, and is thus in a measure responsive to load fluctuations in the line. Quite a number of modifications of this arrangement are described. Thus, in the adjoining diagram, an additional field winding for the booster is provided which is in the main circuit and influences the booster to feed additional current to the line. Further adjustment is possible by means of variable resistances, one being shown in the diagram in connection with the last named coil.

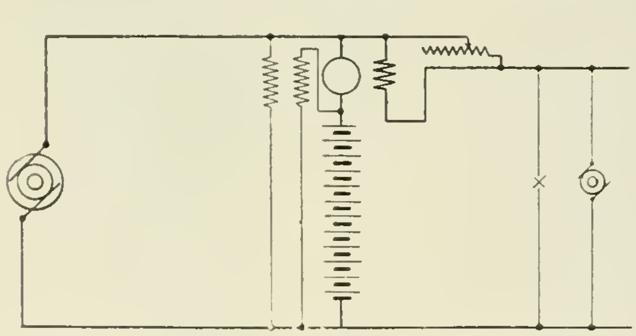


FIG. 2.—LYNDON STORAGE BATTERY BOOSTER SYSTEM.

Two further patents have been granted to Mr. H. Halsey, of New York City, pertaining to the type of cell, the general character of which was noticed in our last issue. One patent refers to means for maintaining the movement of the electrolyte, the other to a receptacle for containing and gradually feeding a dipolarizing fluid to the electrolyte.

CURRENT NEWS AND NOTES.

SUBMARINE CABLE DAMAGE.—The West Indies were visited by a fierce and destructive hurricane last week. The hurricane demolished the cable hut, landlines, and office at Holland Bay, Jamaica, the landing place of the Porto Rico cables. Communication was restored by rejoining the cables on the beach, an operation of great difficulty.

TROUBLES IN KOREA.—Mail advices from Tokio say: "The trouble between the Korean authorities and the Japanese Railway Company, which is attributed to secret Russian action at Seoul, is approaching a climax. At the same time the Seoul electric railway, a United States concern, is having trouble. The line has been objected to by Koreans, and consequently scarcely any passengers are traveling. The United States Minister has claimed damages at the rate of $100 a day from the Korean Government in consequence of the lack of traffic.

WORLD'S DEMAND FOR TOOL-MAKING MACHINES.—The *Deutsche Industrie Zeitung*, in its issue of July 17, 1903, calls attention to a congress or convention of Germany's tool-machinery makers. Reports of those present went to show an increase of business in the Empire; but the orders were not large enough nor the prices satisfactory. The orders from the Government were not nearly as large as desired. Complaint was made against the custom of the large iron mills of contracting for machinery only on condition that part payment be made in the iron or steel products of the mills. Another evil complained of is the custom of the iron or steel mills of making their own conditions when contracting, instead of following, as formerly, well-established customs. In the matter of contracts in which it is provided that the tool makers take steel or iron from the mill, great abuses have crept in. The contract provides sometimes that fully 50 per cent. of the bill be paid in material. Inasmuch as the greater part of a tool-making machine's value lies in the labor expended on it and the most of the material is cast iron, the demand of the mill to be allowed to pay for it in its products seems unfair and unjust. It is thought that little can be done in individual or isolated cases, but that a combination of the machine builders might effect a reform. Reports made to the convention regarding foreign trade show a decline. In France everything was quiet, Italy offers little encouragement, Spain promises great things by and by, particularly for the marine. The United States, it was said, must be given up as hopeless because of its own development of machine making.

NIAGARA POWER FOR TORONTO.—The special committee appointed by the Toronto City Council to consider the question of electric energy has received a supplementary report from the City Engineer. Mr. Rust thinks the cost of plants to develop energy at Niagara for the use of Toronto and other municipalities would be between $4,000,000 and $6,000,000. In the neighborhood of 18,500 horse-power would be necessary to supply the city. After consulting with Mr. Alexander Dow of Detroit, the electrical expert, Mr. Rust, came to the following conclusion regarding the cost of energy per horse-power: "Assuming that it will be $10 per horse-power at Niagara, the cost delivered at the city limits would be $18.96, providing for 13,500 horse-power. To increase this 50 per cent., making it about 20,000 would bring the cost down to $16.48 delivered at the city limits. If the Toronto Railway Company will agree to take their power from the city over the same line, it would be reduced to $15.23 per horse-power. Taking the highest figure the cost per horse-power at the city limits would be $18.96. Adding distribution losses and the expense of distribution, this brings the total amount to $38.16. These figures show that the city should receive an average figure for power distributed sufficiently in excess of $38.16 per annum to prevent any possibility of loss. If they could find a market for 25,000 horse-power this estimate can be reduced to $33. Assuming that the power will cost an average of $38.16 per horse-power and comparing this price with the present rate charged in this city for electric light and power, a very large saving would be effected." Mr. Rust's opinion was that steam power in Toronto, as estimated from the cost at the city water works, cost about $60 per horse-power, and on that account a great number of customers could be had for the city power.

WIRELESS TELEPHONY.—It is reported that the Erie Railroad Company will equip one of its North River ferryboats and the Jersey City ferry terminal with the Collins wireless telephone system, of which details have been given, with illustrations, in these columns.

POLICE PATROL SYSTEM.—Police Commissioner Greene, of New York City, has made arrangements with the New York Telephone Company for a complete police signal system on the Island of Manhattan. The subject has been agitated for 15 years. To start with, there will be 661 telephones in iron boxes on poles, etc., at an annual cost of $20,855, inclusive of everything. Only policemen will carry keys. The boxes will be painted gray, and about 15 x 18 in. The service is to begin by October. Brooklyn has an older system in use.

ANOTHER WIRELESS NEWSPAPER.—The *Block Island Wireless* is the name of a little paper published daily on Block Island by the *Providence Journal.* The paper is issued every morning and contains a summary of each day's news, sent it through the De Forest system. In the past the people of New Shoreham and their hundreds of summer visitors have had to wait for news until the arrival of the afternoon boat on the day following the occurrence of any important event. Now they have a newspaper of their own. This is the first newspaper in the East entirely dependent on wireless telegraphy for its news, and the experiment is said to be satisfactory.

MONEY BY WIRELESS.—The Cunarder *Campania* has established a wireless money-order department. The office is open at all hours and there are no fees. Henry Robertson, a passenger on the trip that ended last week, found he had not enough money to pay the customs duties on his purchases abroad. Recalling that his mother was a passenger on the *Lucania,* traveling in the opposite direction, he sent her through the air a message asking her to pay the purser on the *Lucania* fifty dollars and send him wireless word to that effect. The money-order transfer between the two pursers was then easily effected.

EFFECT OF FREE TRANSFERS.—It is stated that the operating expenses of the Chicago Union Traction Company owe their largest increase to the universal transfer system imposed on them by the city of Chicago a year ago next October. Before this period the company used about 1,000,000 transfers monthly, whereas at the present moment 2,000,000 transfers or thereabouts are necessary to meet the large traffic over the company's lines. This statement bears out the report that Metropolitan Elevated traffic has been cut into 3,000 or 4,000 per day on account of this transfer system. Officials of the traction company state that most of the injury to elevated road traffic comes in the summer months.

SEPARATING MAGNETIC PARTICLES FROM WOOD PULP.—A patent issued August 11 to Mr. C. J. Reed describes an arrangement for the separation of magnetic particles from wood pulp. Two cylindrical soft-iron cores suspended in a tank have helical grooves in which are placed the magnetizing coils. Each of these is surrounded by a closely fitting brass cylinder, which revolves about its axis. At rest the iron particles would gather in helical lines corresponding to the grooves on the core; as the cylinders revolve, however, the particles in endeavoring to follow the line of greatest attraction are given a downward helical motion and finally drop off the end of the cylinder. In the tank are guides which cause all the pulp entering to come into contact with the cylinders before passing out on the opposite side.

THE SUPPLY OF EDISONS.—A special cable dispatch from Paris, as subjoined, advises that the supply of Edisons is not running out: "A young Brazilian to come before scientific circles in Paris is Señor Oswaldo de Faria, a youth of sixteen, who is solving problems which foiled electrical specialists. He has invented a regulator permitting the transformation of currents to regulate light with incredible ease and simplicity. This week the Brazilian Minister, a number of leading electrical and scientific authorities and engineers assembled in his mother's drawing-room and enthusiastically applauded his achievements. An apparatus utilizing current from the Champs Elysées central station produced a fixed light, propelled a four-horse-power motor and actuated a coil giving a 22-in. spark, besides charging accumulators rapidly." How wonderful!

TANDEM-MULTIPLE CONTROL OF INDUCTION MOTORS.—When the primary windings of an induction motor are connected in delta, the e.m.f. impressed on each coil bears the ratio of the square root of 3 to the e.m.f. impressed on the individual coils when connected in star. Since the torque on an induction motor is proportional to the square of the impressed e.m.f., it follows that the change of the primary windings of the motor from star to tandem connection results in increasing the torque of the motor three times. For a method of control of induction motors based upon this principle, a patent has recently been granted to Albert H. Armstrong. The application of this principle is especially useful in connection with the control of induction motors by the tandem-multiple system When induction motors are operated in tandem, their torque is materially lower than that which they would have were they connected in multiple. By connecting in delta the primary windings of the first of the two tandem-connected motors, it is possible to more than counterbalance the inherent lessening of the torque due to the tandem connection.

IMPROVEMENTS IN TELEGRAPH INSTRUMENTS.—Three patents were recently granted to Mr. John C. Barclay, of New York City, for improvements in the construction of telegraph sounders, relays and repeaters. In the use of relays with magnets movable toward and away from their armatures, much trouble has been experienced from breakage of the armature or its pivots while the instrument is being adjusted. To prevent such breakage the inventor employs a novel location and arrangement of the armature with respect to the poles of the magnet, and provides a stop to limit the motion of the magnet towards the armature; for this stop the trunnion bracket is used, which has sufficient strength and solidity for the purpose.—In using ordinary main-line relays as sounders, their magnet is usually enclosed in a resonance box. Mr. Barclay has devised a new construction of the resonance box of such "box relays," in order to improve the sound and facilitate the adjustment of the instrument. He makes the resonance box relatively shallow, so that it encloses a portion only of the magnet; the box rests upon the wooden base of the instrument at certain points only; moreover, suitable sound-holes are provided and the resonance box is made of metal except the end carrying the anvil, which is of wood.—In the polar duplex repeater commonly used at present, a main-line polar relay is provided, the magnet of which is connected to the incoming line. This relay controls, by means of a local circuit and battery, a pole-changer arranged to connect a generator to the outgoing line and to reverse the direction of current therein with each operation of the main-line relay. It is quite evident that the whole operation will be condensed and simplified and the speed of the repeater increased if the main-line relay itself connects the generator to the outgoing line, and controls the polarity of the current in this line. Such a system, however, has distinct difficulties in construction, mainly on account of sparking. Mr. Barclay has devised a polar relay of this type in which there is little or no sparking, and which may be used as a main-line repeating relay without interference with its operation by sparking and with a considerable gain in speed of the system. By eliminating the local pole-changers at the repeater station, the variation of signals heretofore observed, due to imperfect adjustment of the pole-changers, has been entirely removed, and the quality of the signals greatly improved. The device in operation reduces the number of repeaters in a circuit one-half.

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LETTER TO THE EDITORS.

Rotary Disks.

To the Editors of Electrical World and Engineer:

SIRS:—In an article printed in your issue of February 15, 1902, I described an arrangement of "Rotary Disks," and what follows is a description of a new experiment with the same, and conclusions concerning these. I used two arrangements of disks. One is a single shellaced mica disk on a short axle; the sparks from the secondary of an induction coil were made from slightly raised points under this disk to one side near the circumference. The other consists of two shellaced mica disks on the same axle about ⅜ in. apart. The axle in this case was a thin piece of steel about 1¾ in. long. The sparks were made near the circumference between the two disks. The disks are 2¼ in. diameter, and rotate in a horizontal plane in jewelled bearings. The spark length is generally ¾ in., reduced to ⅝ in. or less. Sometimes I have used 1½ in. reduced to 1¼ in.

The object in writing this is to answer the question whether a charge on a piece of mica in rotation as described moves with the rotation or remains at rest and slips on the mica. I will first give a simple experiment which appears to settle the above question.

I placed a small particle of sealing wax on the upper side of a disk not far from the circumference and noted what occurred when the disk was set in rotation by the sparks under it. I found that the particle of sealing wax remained nearly if not entirely at rest, when furthest away from the spark gap, but when it approached near the spark gap as the disk rotated, it began to dance, and when over the spark gap, it sprang high up in the box containing the arrangement, and generally landed off of the disk.

It must be remembered that I was dealing with rapidly dissipating charges, but I can still distinctly recognize the fact that the charges on the disk were slightly shifted in the direction of rotation, and that there was constant slipping of the charges on the disk. An analogy is that of water poured on a revolving wheel, such as a grindstone, at the top of the wheel or on the side that has the upward motion. I have often noticed the slight shifting of the water forward on the wheel in such cases.

While I have no experiments to show whether the phenomenon would occur when the charges are of low potential, I have every reason to believe it would. The slipping and slight shifting of the charges on the rotating disks perfectly account for the rotations obtained from — to + when the disk is started from — to +, as formerly described. It must be remembered that there was nothing under the disks or near them, to which the charges could extend their lines of force and hold thereto.

BALTIMORE, MD. ALFRED G. DELL.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Motor-Starting Switches.—BATE.—A paper read before the Birmingham Section of the English I. E. E., with the discussion. The author points out the great divergencies that exist in the construction of switches, and proposes, in order to avoid misunderstandings and to encourage standardization, to follow the example set by the German Institution of Electrical Engineers, and to classify starters and starting resistances as follows: Class 1. Occasional use, where a sufficient interval is allowed between the times of use to permit the resistances to cool down to air temperature. This represents the majority of cases, and the author is of the opinion that the resistance should be able to carry the full load current safely for at least half a minute, and carry an overload of 20 per cent. of current—i. e., 50 per cent. of watts—for say 10 seconds. Class 2. Frequent use, where the interval is not sufficient to allow of complete cooling, or where the time taken in attaining full speed is unusually prolonged for any reason. Class 3. Continuous use would include speed regulators. The author considers the "absorption" type of wire resistance in which the wires are surrounded by cement, sand or other suitable material, not only the best but also the cheapest. This type is somewhat more difficult to repair than the radiation type is, especially if cement is used instead of sand, but this slight drawback is more than compensated by the protection of the wires from mechanical injury and from damp. If properly made, the absorption type stands overloads for a short time, just as well as the radiation type. As far as liquid resistances are concerned, the author thought that they offered many advantages for exposed situations and large powers. A slight drawback is the need of replenishing the liquid from time to time. To give satisfaction to the general user, the liquid starter must be provided with an overload and "no-volt" release. If a "no-volt" release cannot be used conveniently, the main double-pole switch must be interlocked with the resistance, so that the current cannot be switched on while the resistance is cut out. The author then discussed the methods of connecting the resistances with the motor. He points out the weaknesses of the method of connecting the armature to the starting lever, and to join both the main and the shunt magnet wires to the last or "full-on" contact of the resistance. The field is then excited when the main switch is closed, and the motor is started and stopped without demagnetizing the magnets. When the lever touches the first contact, the full torque is applied instantly to the armature, and this causes undue strain on the moving parts. A more serious weakness of this method of connection is that when the motor is at rest, with the starting switch in the "off" position, the magnet windings are not connected across the brushes, and if the main switch is opened, the kick of the magnets will be very likely to rupture the insulation of the field spools. In regard to switch work, the author advocated the same classification as that proposed for resistances.—Lond. *Elec.*, July 24.

Harmonics in Alternating-Current Machines.—GUERY.—A mathematical study on the principal causes of the production of harmonics and the means of preventing their production. The author deduces different conditions which must be fulfilled in order to get a voltage curve without appreciable harmonics. In the first place, a sinusoidal distribution of the inducing field along the air-gap is necessary, which may be obtained by giving the air-gap a variable length at the different points of the polar surface. In order to suppress the harmonic due to the slots of the armature, he suggests inclining them toward the radial line, so that the outer end of one slot is radially in line with the inner end of the next slot. To suppress the harmonics due to the armature current, it would be necessary to so construct the winding that the conductors of the same circuit are distributed according to the sinusoidal law over the periphery of the armature.—*L'Eclairage Elec.*, July 11.

REFERENCES.

Rules for the Testing of Electric Machines and Transformers.—DRUCBERT.—A very long article giving a summary of the rules adopted by the German Electrical Society, and a comparison with the American rules.—*L'Eclairage Elec.*, July 18, 25.

Speed-Reducing Gears.—ERECKY.—An illustrated description of a gear based on the principle of rolling friction, especially adapted for electric motors.—*Zeitsch. Oest. Ing. und Arch. Ver.*, July 24.

LIGHTS AND LIGHTING.

Heat Radiation of Incandescent Lamps.—FISCHER.—A long article, in which the author gives the results of a scientific investigation, in order to ascertain how much of the energy of the current appears in the form of heat and of light energy in the ordinary incandescent lights. For these experiments he used an incandescent lamp of 110 volts, having resistance, when cold, of 300 ohms. The heat energy was measured by a thermopile, and the light energy by a prism-photometer. Several tables of results are given, showing that by far the major part of the electrical energy is converted into heat. With a current of .317 amp. the author finds 99.82 per cent. appearing as heat energy and only .74 per cent. as light, the latter gradually rising to 26.5 per cent. when the current had increased to .718 amp.; the lamp was then giving about 32 cp. Under the normal conditions of the 16-cp lamp, the author found about 85 per cent. as heat and 15 per cent. as light, with a current intensity of .621 amp.—*Zeit. f. Beleucht.*, July 13, 20.

New System of Incandescent Arc Lighting.—An article giving a table of tests of a new type of arc lamp and a description of the method stated to have been elaborated by Blondel, of arranging and treating the carbons. The carbons are constructed in several zones or layers, and the mineral admixtures, which are fusible salts chosen for their luminous capacity, are incorporated in considerable proportions with the carbon in the inner zones. The outer zone is formed of pure carbon, and it is stated that it protects the carbons against lateral combustion and also gives them the necessary conductivity. The arrangement of the electrodes is such that a very highly mineralized carbon is placed below another less mineralized, thus producing the result that the arc between the two is constantly situated below, and in the axis of a disk of refractory material. The latter disk serves as reflector and also to prevent the arc from climbing up on the upper electrode. The table shows that a lamp of 3.3 amp. gives 1.5 times more light than a 10-amp. lamp of the old style and 6.5 times more than a 3.3-amp. old-style lamp.—*Rev. gen. des Sciences,* July 30.

REFERENCE.

Electric Light Plant for Dutch Torpedo Boats.—A short article, illustrated by drawings. The plant is designed to give 65 amp. at 80 volts when running at 500 r.p.m.—*Eng'ing,* July 31.

POWER.

Electrical Hoisting Plant for Coal Mine.—Guarini.—An illustrated article, describing a plant recently installed at a German colliery. The hoisting engine has a daily capacity of 2,700 tons, with one platform, and 3,200 tons with two platforms. It is driven by two 1,400-max.-hp motors, one on each side of the driving pulley. Direct current at 500 volts is used in connection with a buffer storage battery. By the gradual switching in of the storage battery and alteration of the exciting current of the motor magnets, various speeds can be attained without undue energy losses. The starting gear consists of two perfectly separated starting resistances. The arrangement is described in detail.—*Western Elec.,* August 8.

REFERENCES.

Electric Harbor Cranes.—Rothmueller.—A long, well-illustrated article, giving a description of various electric harbor cranes. The details of construction of the different types are given.—*Zeitsch. Oest. Ing. und Arch. Ver.,* July 17.

Electric Motors in Iron Works.—An illustrated article containing a description of the equipment of a plant for the manufacture of structural and ornamental steel and iron. The tools, cranes and lifting appliances in the works are driven by electric motors.—*Eng. Record,* August 1.

TRACTION.

Lowestoft Corporation Electric Tramways.—An article describing a traction line recently opened in England. The line is an overhead trolley installation, the main line being divided by the harbor, crossed by a swing bridge, situated almost exactly in the center of the town. The work calling for special note in connection with this system is the surmounting of the difficulties caused by this swing bridge. A shallow section of rail has been used, fixed to the ironwork of the bridge and electrically bonded to it. The maintenance of the circuit is secured in the following manner: Six light steel standards are mounted upon the bridge and carry an aluminum conductor of T section, which is further supported by stay wires. With this form of construction no undue strain is put on the bridge. A device is employed on the overhead line at either end of the bridge to connect the trolley wire with the mains when the bridge is closed. The overhead line on the bridge and the approaches are fed by a separate underground cable, connected through a switch placed on the bridge and operating with the movement of the bridge. When the bridge is tilted before swinging, current is completely cut off on this section and vice versa. The rail circuit is maintained under the harbor by means of a cable. The cables are drawn into a steel pipe, fitted internally with a wooden partition of star section, each cable laying in its own compartment, thus giving every facility for withdrawal and renewal. The cables are connected to a switch and testing board on either side of the harbor. The capacity of the whole installation is 1,575 kw, or about 1,900 kw on emergency load. The generating sets are so arranged that any one of them can be used for lighting or traction. High-speed engines, directly coupled to compound-wound generators are employed, the series winding of which is cut out if they are used for lighting. There are two 550-kw, one 250-kw, one 150-kw and one 75-kw generator. There is also a set of balancers and boosters of 18-kw capacity, and a set of 40 kw. The latter can be used for traction in case of emergency, as between the two balancers, on the same shaft, is a compound-wound, 80-kw motor-generator, which can be connected to the overhead line. A description of the permanent way and rolling stock is also given.—Lond. *Elec.,* July 24.

REFERENCES.

Interurban Electric Road for Hauling Coal.—An article describing the Denver & Northwestern Interurban road.—The road connects some coal mines 15 miles from Denver with the city. Special electric motor dump cars are used. The gauge is 3 ft. 6 in. The dump cars have four hoppers and can dump all of the load on either side and are all equipped with air brakes. The company also operates a passenger service.—*St. R'y Jour.,* Aug. 1.

Sleeping Cars on Electric Lines.—An editorial in which it is claimed that there is a field for sleeping cars, which is not now furnished by the steam railway companies. This is particularly the case between cities 150 to 200 miles apart. The sleeping car service of the steam railroads between such towns is usually inadequate because the distance is covered too rapidly and because the sleeping car and train schedules are made up for the convenience of through travelers, and not for local traffic of this kind.—*St. R'y Jour.,* August 1.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Automatic High-Tension Switches.—Vogelsang.—An illustrated article containing a description of the author's constructions of high-tension circuit-breakers for alternating currents. He does not use alternating current in combination with series transformers, as is customary in American types, but a small maximum high-pressure relay operated with alternating current, and closing a local circuit of a continuous current from the exciter, and this operates the mechanism. He considers that this arrangement has the advantage of avoiding the heating of the relatively large coils which are constantly in the circuit in the other construction; it also constitutes a simplification of the mechanism in the case of polyphase circuit-breakers, in so far as only one magnet is necessary in place of two. The apparatus is so constructed that in connection with a time relay the contact is closed when a certain maximum current has been reached and is opened again, when the current should fall again to the normal before the time relay has acted. For a reverse-current relay the employment of series transformers is necessary, but as they only have to act on the relay, which is of very small size, they do not have to be large. When a time relay is used, the closing of the contact of the maximum or reverse-current relay actuates first the time relay, which then closes a second contact of a local direct-current circuit after a few seconds, which opens the switch.—*Elek. Zeit.,* July 30.

Mexican Water Power Electric Plant.—An illustrated description of a water power plant with electric distributing system at San Simonito, near the City of Mexico. A working head of about 700 ft. on the water wheels is obtained, with a normal output of about 1,200 hp. The generating machinery consists of three units of 300 kw each. Each unit consists of a 66-in., single-nozzle Pelton wheel, running at 360 r.p.m., coupled to the shaft of a three-phase, 6,600-volt and 60-cycle generator. The governing of the water wheel is accomplished by an electric relay governor, operating a deflecting hood over the nozzle. The guaranteed minimum efficiency of the alternators on non-inductive load, 100 per cent. power factor, is 92 per cent. at full load, 89 per cent. at half load and 82 per cent. at quarter load. There are two exciter units, each consisting of a 30-in. Pelton wheel at 850 r.p.m., direct connected to a 20-kw dynamo of 60 volts. There are three 250-kw transformers, oil-insulated and water-cooled, which raise the potential to 25,000 volts for transmission. The sub-station equipment comprises transformers in units of 150 kw, which lower the potential to 2,200 volts and convert the three-phase into two-phase current for distribution.—*Eng'ing News,* August 13.

WIRES, WIRING AND CONDUITS.

New Cable Conduits.—A note on a new method of making conduits. They are formed by arranging long tubular cores in the excavations, which cores are covered on the outside with a thin layer of graphite and paraffine. They are then surrounded by cement, and after the latter has set, steam or hot water is introduced into the hollow cores, with the result that the easily-fusible layer melts and the cores can then be taken out. The fatty mass remaining on the inside of the tubes thus formed facilitates the drawing in of the cables.—*Elek. Zeit.,* July 23.

ELECTRO-PHYSICS AND MAGNETISM.

Induction Coils Operated with Alternating Currents.—Wien.—An article describing a method employed by Prof. Wien to get the necessary high potentials at the secondary of an induction coil. He had an alternating-current machine constructed for 1,200 alternations (600 cycles) per second. The machine has 36 poles and runs at 2,200 r.p.m. The current was led directly into the primary of a large induction coil and a strong stream of sparks was immediately obtained between the terminals of a spark-gap 38 cm apart. He thus demonstrated that the potentials which are obtained by the use of interrupters can also be gotten in the manner described and thinks that a method is thus made available for an exact measurement of these high potentials.—*Phys. Zeit.*, August 1.

REFERENCES.

The Utilization of the Electric Waves.—Turpain.—A paper to be read as an introduction to the discussion of the subject of the utilization of electric waves, before the Physical Section of the French Association for the Advancement of Science, at the coming meeting. The author outlines the present state of our knowledge on the subject for telegraphic, meteorological, mechanical and lighting applications.—*l'Eclairage Elec.*, July 25.

Magnetic Observatories of the United States.—Bauer and Fleming.—An illustrated article, dealing mainly with the construction and the equipment of the Cheltenham Magnetic Observatory, at Cheltenham, Md. The construction and insulation of the walls of the observatory are described in detail.—*Scien. Am. Supp.*, August 8.

ELECTRO-CHEMISTRY AND BATTERIES.

Active and Inactive Condition of two Identical Carbon Electrodes in Molten Electrolytes.—Harden.—The author made the observation that two carbon rods dipped into molten calcium chloride showed a difference of potential against each other, though they were not in connection before with any other source of current. It was thought that this might be due to thermo-electric currents as a result of the difference of the electrodes used; but the magnitude of the difference of potential observed was against this explanation. A carbon rod was carefully treated to free it from all impurities and then cut in two parts and both ends subjected to the highest white heat by means of a blast lamp. The millivoltmeter which was connected with the rods showed only 5.5 milivolts, when the two hot ends were in contact. They were then dipped into melting calcium chloride. As soon as the salt began to melt, the galvanometer showed a deflection, one time towards the right, and again towards the left. This movement took place every time when fresh electrodes were used, also when the bath was molten when they were introduced. After a short time, however, a steady activity of one electrode appeared, the deflection being steadily towards one side. The difference of potential increased with increasing temperature, going down again after this temperature had been overstepped. This point was with chloride of calcium at about 650° C., and the difference of potential amounted to 0.15 volts. This phenomenon was also observed with calcium nitrate, but to a smaller degree. The elevation of the melting temperature of the salt was also not the determinative factor, for if the electrolyte was molten chloride of lead, a difference of potential of 0.35 volts was observed, though the temperature was only 360° C. The distribution of the temperature seems to play an important rôle, for the amount of the difference of potential varied considerably if the crucible was heated only at one side, but the singular fact was ascertained that the activity was greatest at that electrode which had the lowest temperature. If one or the other electrode was heated alternately, the direction of the current was often reversed, but not always.—*Phys. Zeit.*, July 15.

Electrical Equipment of Carbide Works.—Perkins.—An illustrated description of the electrical equipment of the carbide works at Flums, Switzerland. The generating station has a capacity of 2,400 hp and is located 1.8 km from the works. Three large turbines of the horizontal type are each directly coupled to an 800-hp revolving-field, 5,000-volt, alternator of the three-phase type. Their dimensions and connections are such that they may be also used as single-phase machines supplying a current at the same potential. The power transmission line consists of six copper conductors insulated by porcelain and mounted on iron "tops" or caps upon wooden poles. The furnace room contains eighteen carbide furnaces, and the material is placed in them by an electric elevator. The transformer house contains three 850-kw, single-phase, oil-cooled transformers, with a ratio of 5,000 to 65 volts. The primary windings of the transformers are arranged with triangular connection with the high-tension conductors, the greatest fall of potential being 2 per cent. and the efficiency is 98 per cent. The secondary conductors are arranged for single-phase current from the transformers, the copper conductors having a cross-section of 4,800 sq. mm. and a total weight of 4.5 tons for each group of six furnaces. The current employed in each furnace is from 2,200 to 2,500 amp. The carbon electrodes are regulated by hand with chain gearing. The production of the carbide requires from two and a half to three hours, and it remains from 1 to 1½ hours in the furnace for cooling off. The eighteen furnaces are in continuous operation, and are arranged in groups of six or four, twelve being usually in operation at the same time. The weight of carbon electrodes required per ton of carbide produced are said to be about 30 kgms.—*Electrochemist and Metallurgist*, July.

Electrode Voltage.—Johnson.—An article on the electrode voltage or electrode potential and on the practical importance of measuring this quantity. A certain e.m.f. is in general necessary to pass as appreciable current through an electrochemical system. For electrolytic conduction Ohm's law states that amperes multiplied by ohms equal the difference between the impressed voltage and the critical voltage at which an appreciable current begins to flow. He compares this with the action of a safety valve which will not act before the critical pressure is reached. The critical voltage or decomposition voltage may be considered as the sum of the anode voltage and the cathode voltage. Each electrode voltage is determined separately by measuring the e.m.f. between the electrode and an artificial "standard electrode." Measurements of each electrode voltage separately are, for instance, used in practice to determine which of the two plates of a storage battery is exhausted first. When the total decomposition voltage is zero, the anode voltage is equal and opposite to the cathode voltage; this is, for instance, the case in copper refining. It is different in nickel refining, because the energy evolved in the solution of nickel from the nickel alloys in the cast nickel anode is not equal to the energy required to deposit nickel hydride on the cathode. The cathode voltage can easily be charged by adding a depolarizer to the catholyte. The article is illustrated by numerous diagrams.—*Electrochem. Ind.*, July.

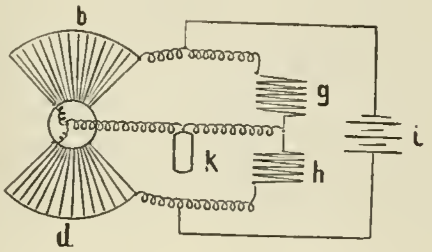
The Present Position of the Theory of Electrolysis.—Whetham.—A paper read before the recent meeting of the Faraday Society, England. After a theoretical discussion of the dissociation theory, the author sums up his inquiry by saying that the phenomena of electrolysis and the osmotic properties of electrolytes clearly indicate that the conduction of a current through an aqueous solution consists in the convection of charged ions through the liquid, the ions being dissociated from each other while they are electrolytically alive. In a fused salt, however, it is possible that conduction may be due to a mere possibility of interchange between the electrified parts of the molecules, without any permanent and definite dissociation. Some process in the nature of Grotthus's chain may, in this case, secure the migratory freedom necessary for electrolytic conduction.—Lond. *Elec. Eng.*, July 9; abstracted in *Electrochem. Ind.*, August.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Accuracy of Standard Resistances.—Jaeger.—A summary of the results obtained at the Reichsanstalt in the work on standard resistances of mercury and manganine respectively. The opinion of Siemens, that the mercury standard could always be reproduced with accuracy, has been verified to an extent hardly expected by him, since the error does not exceed one or two parts in 100,000. The Reichsanstalt guarantees an accuracy of 1 in 10,000 in the resistances examined by it. It possesses five mercury standards made between 1890 and 1897. The mean value of the three new tubes differs from the mean of the two older tubes by only four parts in a million, the greatest departure of a single tube from the mean value being 2 in 100,000. As regards their reproduction, the main difficulty lies in the weighing of the mercury, which must adhere to the glass to within a fraction of a light wave. But the manganine resistances offer a convenient link between the mercury standards and the public. Within a period of 10 years a variation of the standard manganine resistances cannot be established with any certainty, although the electrical measurements can be carried out to within one part in a million. They do not vary by more than four parts in 100,000 in any case.—*Sitsungs. der Akad. Wiss.*, Berlin, May 7; abstracted in Lond. *Elec.*, July 24.

Electrical Revolution Counters.—An illustrated description of two instruments for measuring the speed of rotating machines and for transmitting the indications to any desired distant place. The apparatus consists of a small magneto generator, which is connected with a voltmeter by means of thin wires. For a number of revolutions above 600 the generator is directly coupled with the shaft, the velocity of which is to be measured. For speeds below 600 gearing has to be employed. For machines which are reversible the instrument is so constructed that its zero point is in the middle, so that the direction of the revolution of the machine can be seen from the direction of the movement of the needle. This instrument can be used in any position and is completely enclosed to protect the commutator from dirt. Another apparatus consists of a small magneto alternating-current dynamo and an alternating-current voltmeter. It has the advantage of not requiring a commutator. The measuring instrument of this apparatus can only be used in vertical position.—*Der Electro-Techniker,* July 15.

Electric Transmission of Compass Readings.—A short illustrated description of the Siemens and Halske system for indicating compass positions at various places about a ship. The method depends upon bolometer action, the primary compass dial having a triangular piece cut out of it, above which is arranged an incandescent lamp. The transferring mechanism is indicated in the adjoining figure. Four quadrants of a circle, two of which, *b* and *d*, are shown, are arranged of wire grating and their center is directly under the center of the primary compass dial. Each two opposite quadrants constitute two branches of a Wheatstone bridge, the other branches of which are formed by manganine resistances *g* and *h*; *i* is the battery and *k* a coil of wire wound around a drum. If, now, the compass dial is so turned that *b* is exposed to the radiation from the incandescent lamp, then the resistance of *b* is increased and a current flows through the bridge and the coil *k*. The latter, wound on a drum and movably supported in a strong, nearly homogeneous, field between electromagnets, takes a position at right angles to the lines of force. The drum, therefore, exactly corresponds to the movements of the compass dial. The compass is said to have great stability, for the indications of the drum are independent of changes in the intensity of the heat radiations and the changes of intensity of the main current in the Wheatstone bridge, if only the same current travels through both connections.—*Elek. Rundschau,* July 1.



COMPASS INDICATOR.

Influence of the Shape of the Current Curve on Induction Meters.—Stern.—A study of the influence of the shape of the alternating-current curve on the indications of induction meters, built according to the Ferraris principle. Such influence, if it existed, might cause errors in the readings if meters, which had been adjusted for a certain shape of curves, should be used on circuits with a different curve. Moreover, meters might indicate differently on account of the change of curve brought about by changes in the load during the day and night. Experiments were conducted with Ferraris meters of different construction, built by various makers in Germany. The curves obtained thereby are reproduced and analyzed. From the table of constants the author draws the conclusion that the induction meters manufactured in Germany indicate with sufficient accuracy even with great differences in the shape of the curve. The author then deduces a formula to separate the whole number of watts into watts of first, third, fifth, etc., frequency, and gives curves to show the percentage errors of the meters as a function of the present of the higher periodic watts. The errors are about of the same numerical order as the percentage of watts of higher frequency. As these are rarely more than 3 per cent. of the watts of higher periodicity, this number signifies at the same time the practical limit of error of induction meters, as far as the shape of the curve is concerned. The error is always such that the meter has the smallest constant with a pure sine wave: i. e., it then runs fastest; the more impure the wave, the slower the meter runs. The author thinks that the experiments show that none of the higher amplitudes are essentially different as far as bad influence on the meter is concerned. The third amplitude is usually regarded as especially harmful, but this is the case only when it appears stronger than usual; if the percentage of the fifth amplitude is as high as that of the third, it is just as harmful.—*Elek. Zeit.,* July 23.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—A note announcing the consolidation of the Braun-Siemens and the Slaby-Arco systems of wireless telegraphy in Germany. It is stated that it is proposed to evolve a new system combining the advantages of these two, which is to be called the German Spark Telegraphy System.—*Elek. Anz.,* July 23.

Telegraphophone.—An illustrated description of improved commercial forms of Poulsen's telegraphophone. Current from the secondary of an ordinary microphone and induction coil system passes through a coil surrounding a small magnet. A continuous steel surface is drawn past the latter, and the steel surface (wire, disk or ribbon, as the case may be) is magnetized in a manner corresponding with the variations of current produced by the voice. When the coil is connected to an ordinary telephone receiver and the magnetized steel surface again drawn under the magnet at the same speed, the words spoken into the microphone are reproduced. The chief novelties are as follows: In the smaller patterns of the instrument a steel disk is used, which is rotated by clockwork, while in the larger pattern steel wire is employed, which is wound off from one wheel to another by an electric motor contained in the base of the instrument. Sufficient wire is on the instrument to give a record ¾ hour long. Provision is made for erasing an old record before a new one is put on. The application of the principle of the instrument to the evolution of a telephonic relay is expected.—Lond. *Elec.,* July 31.

REFERENCES.

Telephone Progress and Prospects in England.—Hanmer Quail.—An article discussing the tendencies of telephone service, especially the movement for a cheapened and improved telephone service.—*Telephone Mag.,* July.

Eastern Telephone Development.—Demarest.—A popular article, giving a historical review of the beginning and development of the independent telephone movements in the East.—*Tel. Mag.,* July.

Fessenden System of Wireless Telegraphy.—Lindow.—A long, illustrated article, giving a description of the system, based upon the patent specifications.—*Elek. Zeit.,* July 23.

MISCELLANEOUS.

The Future of the Steam Engine.—A long editorial, dealing with the future of the steam engine, now that the original Parsons turbine patent has expired. The opinion is expressed that engine builders will have to enter this field, unless they content themselves with building the smaller class of prime-movers for which the turbine seems to be less adapted than for larger units. The makers of large reciprocating engines will have another course open to them, by building internal combustion engines, which promise to be the principal competitor of the steam turbine in the economical production of power on a large scale. It is stated that Brown, Boveri & Co., in the case of a 10,000-hp turbine, have guaranteed a steam consumption of 15.4 pounds per kw-hour, which is claimed to be equivalent to 8.8 pounds per indicated hp-hour. Comparison is made between the Parsons type and the Curtis type, as built by the General Electric Company of America. It is stated that the efficiency of the latter is not yet as high as that of the former, but that it is yet in its infancy, and there is no reason why with more experience better results should not be obtained. Even as matters stand the steam consumption of the Curtis turbine closely approaches the best figures given by engines of the ordinary type, being equivalent to a little over 11 pounds per indicated hp-hour. Attention is drawn, however, to the Potter system, comprising the use of steam at 300 pounds pressure, superheated by 200° F. or more, with a speed of 600 r.p.m. for a piston speed of 2,000 ft. per minute. It is stated that a steam consumption of under 9 pounds per indicated hp-hour is guaranteed by this system.—*Eng'ing,* July 31.

New Books.

ELECTRICAL ENGINEERING. An Elementary Text Book. By E. Rosenberg. New York: John Wiley & Sons. 8vo. 267 pages, 263 illustrations. Price, $1.50.

The aim of this work is to meet the requirements of beginners, i. e., not the common reader desirous of getting a little "popular" literature on the subject, but the student or machinist who wishes to get sound fundamental ideas, so that the practical basis thus laid may be employed as a solid foundation for later superstructures. Mr. Rosenberg has been and still is chief electrical engineer at some of the leading works in Europe, and the translation from German into English has been done by Mr. Carl Kinzbrunner, one of his former associates, and by Prof. W. W. Haldane, both of whom are on the staff of the Municipal School of Technology, Manchester. Hence, one need hardly be surprised to find a distinct Teutonic and British flavor to the whole book, but this is due rather to the use of European apparatus than to anything else. Many of the appliances illustrated look odd or unfamiliar to American eyes, but they serve all the same to exemplify a principle or a method, and that is the main thing.

Basing his development of the subject upon lectures delivered before factory hands and other employees, Mr. Rosenberg has proceeded as usual from simple and elemental principles in electricity and magnetism, and while he covers a good deal of ground before he finally gets through his task, at no point does he outrun the ability of comprehension of any person of ordinary intelligence and education. The lectures are, as already intimated, not "popular" in the sense of those of Forbes or Fleming, as examples, but the goal in every case seems to be to work the idea out toward a concrete piece of apparatus rather than toward a perfect expression or a complete formula. In other words, while giving a fair grasp of the underlying physical concepts, its trend is wholly engineering and not philosophical; and considering its purpose perhaps no better praise could be offered. Moreover, for well advanced engineers also, it is a pretty thorough treatise on current European practice, although of course no attempt has been made to include all the standard machines and appliances there on the market.

Aside from the "trade" cuts, some of which have seen better days, there is a profusion of excellent new diagrams, clearly and strongly drawn, and these will be much appreciated by any mechanic or student. The book is also well arranged, well indexed and admirably printed, not with elegance, but in such a manner as to make the most of the 267 pages. A good feature are a number of "examples" in smaller type, although this is not carried out on any set plan.

INDIA RUBBER AND GUTTA PERCHA. A Complete Practical Treatise on India Rubber and Gutta Percha in their Historical, Botanical, Arboricultural, Mechanical, Chemical and Electrical Aspects. By John Geddes McIntosh. New York: D. Van Nostrand Company. 396 pages, 86 illustrations. Price, $7.50 net.

This handsome volume is a translation from the French of Seeligmann, Torrilhon and Falconnet, and Prof. McIntosh was formerly lecturer on the chemical technology of gums, resins, etc., at the Polytechnic, in London. It is divided into two parts, the first dealing with rubber and the second with gutta percha, and the method of treatment is the same in each case, beginning with the history, location, climatology, etc., and advancing through the methods of collecting the raw material to a consideration of its various properties. We then have the manufacturing treatment, the nature of the finished product and its many uses. A liberal amount of space is devoted to testing, with the inclusion of data on submarine cables under various aspects. Not the least valuable part of the book are the chapters given up to an enumeration and discussion of "substitutes," from which one gets an interesting glimpse into the vast possibilities of the sophistication of both raw materials, although it is by no means to be inferred that these pages tell everything in that direction. With the increasing use of the two gums, it is indeed inevitable that science and industry should seek to supplement the supply, just as wood pulp does that of rag. The electrical arts certainly owe much to these substances, even in their poorest grades; and it is not to be wondered at that Mr. Edison has said he would rather have discovered a perfect insulation than have made any of his other inventions.

Our electrical readers interested in the subject will find useful data in the chapters on vulcanizing and on ebonite. The book is in fact full of data, although some of it might have had a little more of the digester. There is an excellent index, and a quite interesting bibliography. The cuts are numerous.

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Picnic of a Drafting Staff.

The annual outing or picnic of the staffs of Western electrical manufacturing companies is an established institution and one that might well be copied in other localities. During the present season one of the most successful of these enjoyable occasions was the picnic given August 1 by the members of the Drafting Department of the Western Electric Company. Special cars conveyed the party to Cedar Lake, Indiana, where dinner was preceded by numerous athletic contests, including a 100-yard dash, with 45 entries; three-legged race, running long jump, swimming and diving competition, tug of war, boxing, etc.—the winner in the several contests receiving prizes in the form of a set of drawing instruments, slide rule, engineers' hand book, etc. The items of the mimeographed menu were disguised by electrical designations, with an occasional allusion to one of the diners.

A DRAFTING STAFF PICNIC.

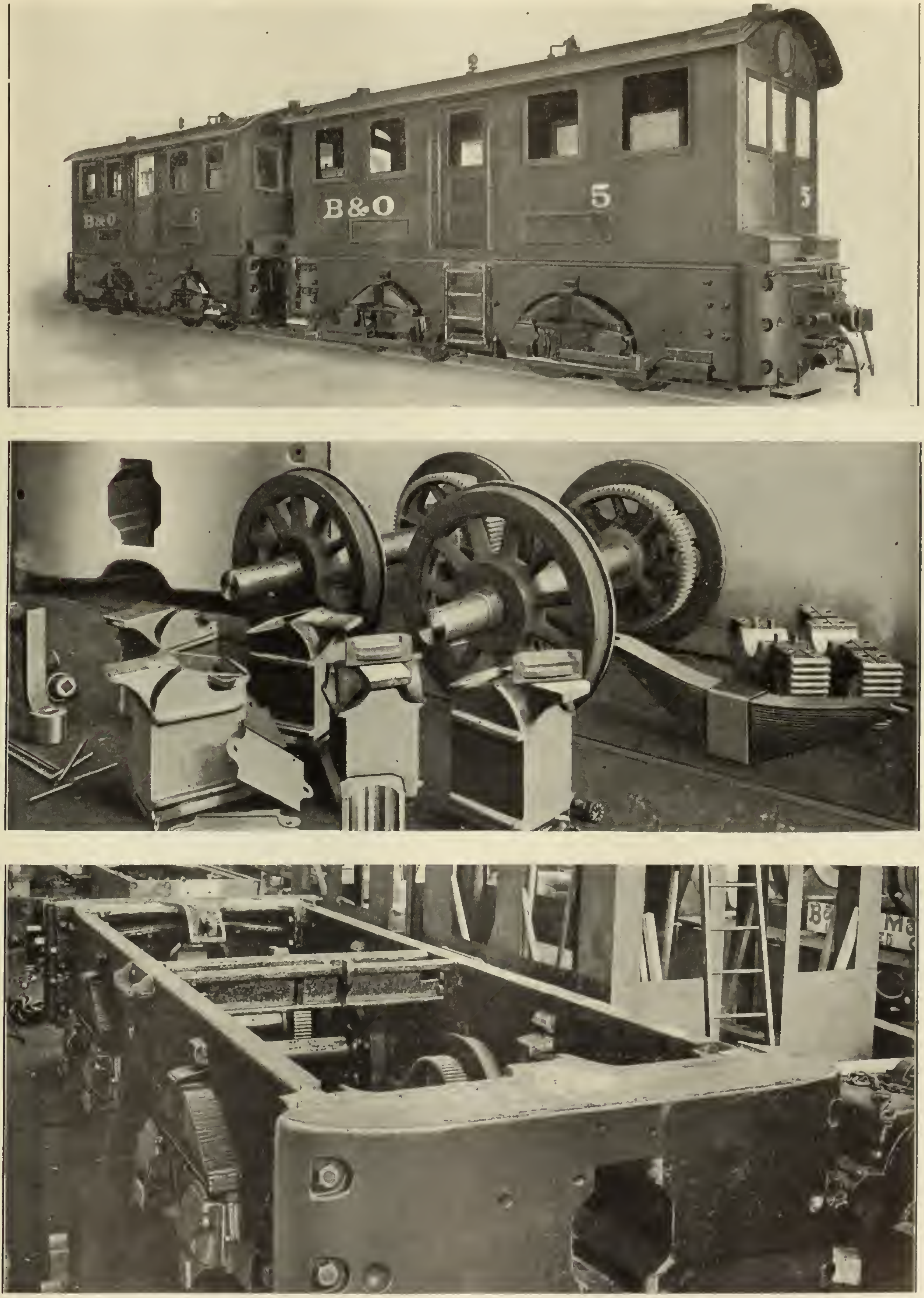
New B. & O. Locomotive.

The most powerful locomotive in the world has just been built by the General Electric Company, at Schenectady, for the Baltimore & Ohio Railroad, for use in its tunnel underneath the city of Baltimore. This locomotive will handle all the freight traffic of the B. & O. which passes through Baltimore, and will operate over the same section as the present electrical locomotives built by the General Electric Company, and which have been in successful operation for the past eight years.

In designing this locomotive the specifications called for an electric locomotive capable of handling a 1,500-ton train including the steam locomotive, on a maximum grade of 1½ per cent. at ten miles per hour with corresponding higher speed on lighter grades. This required a locomotive weighing approximately 160 tons on the drivers for purposes of adhesion, and the engineers of the General Electric Company decided that the most practicable scheme was to build an articulated locomotive consisting of two complete 80-ton units operated together as one locomotive by means of the Sprague-General Electric multiple unit control.

The section of the road to be operated runs from Camden Street Station through the tunnel to the summit of the grade outside the tunnel, a distance of 3½ miles. Under practical operating conditions the motors have sufficient capacity to maintain this service hourly, running loaded up the grade and returning light.

On account of the simplicity and accessibility and minimum number of wearing parts, it is believed that the maintenance account of this locomotive will be very low. All wearing surfaces have been made large for the purpose of insuring long life. At the same time, special provision has been made for their easy replacement whenever



Figs. 1, 2 and 3.—New Electric Locomotive for Baltimore & Ohio Railroad.

it becomes necessary. There is a large space under the cab floor in which a man can stand and inspect the motors or truck gear.

The whole locomotive consists of eight G. E. 65 motors, four on each half. These motors have each a capacity of 225 horse power, making a total capacity of 1,800 horse-power. The main body of the truck frame consists of a rectangular framework of cast steel built up of four pieces, two side frames and two end frames, made strong and heavy. The parts are machined at the ends and securely fitted and bolted together, thus forming a very strong and rigid structure capable of withstanding the most severe shocks without injury. The end pieces form the buffer beams, and to these a suitable standard draft gear of approved design is attached. The side frames have machined jaws protected by wearing shoes between which the journal boxes slide.

The truck frames are supported at four points on equalizers. Each equalizer rests on a pair of half elliptic springs, the ends of which are supported on top of the journal boxes through suitable wearing plates. This construction forms a simple and effective arrangement of parts.

The journal boxes are made quite similar to standard car journal boxes, the parts, however, are made larger and stronger. The brasses can be easily removed, and by dropping down the wearing shoes it is possible to remove a journal box complete without removing the wheels and axles or other parts of the truck. In order that the locomotive may round curves easily, the axles are given considerable lateral movement in the journal boxes, it being practical to do this with this design of electric locomotive and thus reduce the effective rigid wheel base. Wheels, axles or motors can be easily removed from the trucks by dropping into a suitably constructed pit or by raising the truck frame.

Each section of the locomotive has eight steel-tired spoked wheels. The tires are 2⅞" thick with M. C. B. standard tread and flange and are securely held in place by approved fastenings. The axles are made of forged steel turned throughout, 6" x 12" in the truck journal bearings, 8" in the wheel fit and 7½" in the motor bearings.

The cab is large and roomy. The floor rests on the truck frame. The lining floor is made of 1¾" hard pipe tongued and grooved, the upper floor is of hard pine ⅞" thick, tongued and grooved and laid in the opposite direction from the lining floor. The sides and roof of the cab are made of sheet steel. On each side there is an entrance door, and at each end there is an additional door which permits of ready communication between sections when coupled together. Large windows afford a practically unobstructed view in all directions.

The controlling apparatus, consisting of master controller, engineer's valves, etc., is in duplicate, a complete set being located in diagonally opposite corners of each cab, so that the engineer, when it suits his convenience can stand in the front end of the locomotive when running in either direction.

Each section of the locomotive is equipped with one bell, one whistle, two locomotive headlights, approved air-brake mechanism, including two engineer's valves and air gauges, necessary brake cylinders, foundation brake, air reservoirs, couplers and draw heads; also Leach pneumatic track sanders. Each section of the locomotive is equipped with a multiple unit control so arranged as to be able to operate each section independently, or two or more sections coupled together.

Automobiles in England.

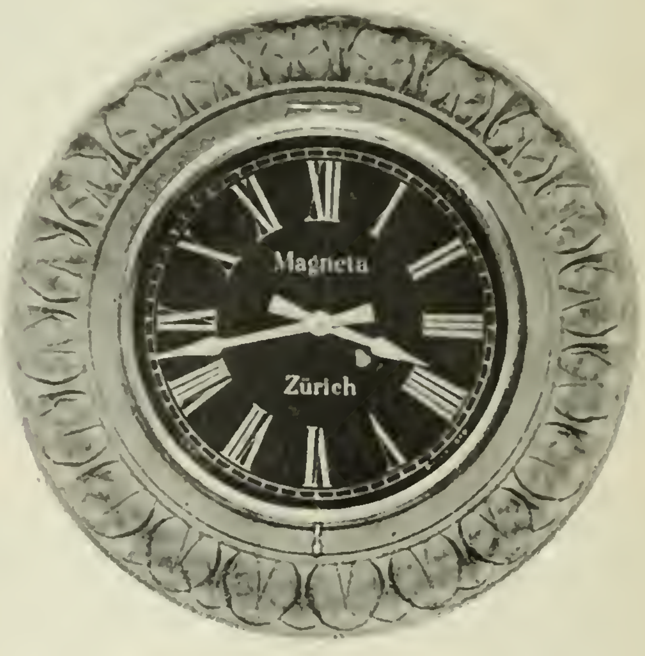
A cable from London of August 8 says: "After a long debate the bill regulating the use of motor cars on public roads was passed through the Committee of the Whole at 2.30 o'clock this morning. The House was keenly, even bitterly, divided on the subject, and the bill was considerably amended after it was received from the House of Lords, where it originated. As now amended, it provides for a maximum speed of 20 miles an hour on open roads and 10 miles in towns. Drivers must be licensed and cars must be registered. Fine and imprisonment are provided for driving to the public danger, and a fine is provided for not stopping in case of accident. Mr. Long, who had charge of the bill in the House of Commons, proposed to establish a test to determine the efficiency of drivers, leaving the decision to the House, which rejected the proposal. The bill will now have to be returned to the House of Lords for consideration of the amendments. A feature of the discussion was the impatient contempt on the part of those supporting the motorists toward what they regarded as the old womanish conservatism of those insisting upon the protection of the non motoring public. There was much heat on both sides, and the angry exaggerations of the disputants make amusing reading. Motorists liken the attitude of their opponents to that of the Chinese toward the first railway in China, which they bought up and destroyed because it terrified people. The other side, alluding to the selfishness of motorists, described them as "road hogs," driving infernal machines.

Magnetic Synchronous Clocks.

The usual systems of electric clock service are operated by currents produced either by primary or storage batteries. Among the disadvantages of these systems are the comparative unreliability of batteries and the wearing of the electric contacts, which render the service at times unreliable and always expensive, since their maintenance requires constant and skilled electrical supervision.

To obviate these objections is the purpose of a new system of clock service, known as the "Magneta," for which Hugo Reisinger, 11 Broadway, has acquired the American rights. In this system the master clock generates momentary currents which operate synchronously the system of secondary clock. The "Magneta" system, which is of Swiss origin, is rapidly gaining ground in Europe, where it has recently been adopted by the city of Cologne for a street clock service, and been installed in Palace of Justice, Hamburg, and in the railroad stations and offices at Frankfort, the service in the latter city also extending to many of the prominent buildings and to the new Palast Hotel.

Briefly, the master clock each minute causes a bobbin to make a rapid quarter revolution in the field of an electromagnet. The current thus generated operates all of the secondary clocks connected, by actuating the armature of an electromagnet, which armature controls a clock escapement. The details have been very carefully worked out, provision being made in the master clock for the continuance of its synchronism, while the driving mechanism is being wound up. The driving is attached to the striking movement, which latter in turn actuates each minute the clock movement and, consequently, the magneto generator.



MAGNETIC CLOCK.

A very interesting and complete working exhibit of these clocks can be seen at 11 Broadway, New York, in the extensive offices occupied there by Mr. Reisinger, including various types of dial, etc., so as to illustrate fully the method of operation and the results.

Marconi System In Alaska.

Engineer Richard Pfund reports from Alaska that all of the Marconi stations in that region will be completed and in operation by the signal corps in the course of a few days. He also reports that the wire and cable lines were destroyed during the last winter, making communication impossible.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—In referring to the depressed condition of the stock market last week, we expressed the opinion that while the blows given to the market were of a most punishing character, it was nevertheless true that August usually saw a rise in prices. It would now appear that this August is to prove no exception to the rule, for although the quotations remain far below what they were last year, there has been a very sharp and sustained rise all along the line. So far as can be judged, the semi panic which prevailed, and which caused the throwing overboard of good securities at great sacrifice, was restricted to Wall Street, giving an excellent opportunity to people with money all over the country to come in and pick up securities which yield an excellent return on the investment. The shake-up in the street has naturally caused a great deal of heart-searching and investigation, and newspapers and all kinds of authorities have been probing the situation to see whether anything is really and seriously the trouble after all. The net result of the investigation is most encouraging, for all the reports are of a hopeful tenor, and nothing has appeared to prove that trade is suffering from over-production or that commercial credits have been unduly strained. It is just as well that there should be conservatism and prudence, but so long as these qualities are exercised there is nothing in sight to prevent the country from pursuing the path of prosperity which it has now been treading for some years. In fact the financial troubles of the past week or two have witnessed such a wholesale reduction in prices of all shares that this period might well mark the beginning of "better times"; for one would have to go back almost to 1893 to find the parallel for such tremendous slumps as have marked some quotations. We are glad to note the renewed strength of electrical stocks, as indicated by many of the quotations given below for August 18th:

NEW YORK.

	Aug. 11	Aug. 18		Aug. 11	Aug. 18
American Tel. & Cable	77	77	General Electric	154	168
American Tel. & Tel.	129⅝	136	Hudson River Tel.	..	..
American Dist. Tel.	25	25	Metropolitan St. Ry.	111	116
Brooklyn Rapid Transit	41	47¾	N. E. Elec. Veh. Trns.	5	6¼
Commercial Cable.	.	149	N. Y. & N. J. Tel.	..	..
Electric Boat.	13	16	Marconi Tel.	1¾	1⅝
Electric Boat pfd.	39	40	Western Union Tel.	81⅝	83¾
Electric Lead Reduction	2	1¾	Westinghouse com.	..	170
Electric Vehicle	7	8	Westinghouse pfd.	..	175
Electric Vehicle pfd.	10	11			

BOSTON.

	Aug. 11	Aug. 18		Aug. 11	Aug. 18
American Tel. & Tel	129⅝	136	Western Tel. & Tel. pfd.	83	83
Cumberland Telephone	..	..	Mexican Telephone	1⅛	.
Edison Elec. Illum.	235	238	New England Telephone	127	126⅛
General Electric	154	168	Mass. Elec. Ry.	..	23¼
Western Tel. & Tel	13	13	Mass. Elec Ry. pfd.	..	80½

PHILADELPHIA.

	Aug. 11	Aug. 18		Aug. 11	Aug. 18
American Railways	43	45	Phila. Traction	94¼	95½
Elec. Storage Battery	..	..	Phila. Electric	5⅛	5¾
Elec. Storage Battery pfd.	60	57⅛	Phila. Rapid Trans.	..	13
Elec. Co. of America	7⅞	8⅛			

CHICAGO.

	Aug. 11	Aug. 18		Aug. 11	Aug. 18
Central Union Tel	..	..	National Carbon pfd.	92	91
Chicago Edison	..	..	Metropolitan Elev. com.	..	23
Chicago City Ry.	165	170	Union Traction	..	..
Chicago Tel. Co	..	..	Union Traction pfd.	..	..
National Carbon	..	23½			

ELECTRICITY ON MANHATTAN ELEVATED.—The quarterly report of the Interborough Rapid Transit Company, embracing the figures for the operation of the Manhattan Elevated Railway lines since April 1, when the subway company took them over under lease, shows an increase in earnings and decreases in operating expenses as well as increase in the number of passengers carried. The gross earnings of the company, all from the operations of the elevated lines, were $3,271,787, an increase of $414,537 over the gross earnings of the corresponding period of 1902, under the old management. The expenses were $1,302,089, a decrease of $99,217. The three months' net earnings amounted to $1,969,698, an increase of $513,554. The item of "other income" is $90,187, a decrease of $21,100, the figures for the total income being $2,059,885, an increase of $492,454. Interest and taxes were $684,563, an increase of $28,714, making the three months' surplus $1,375,322, an increase of $463,740. The passengers carried numbered 66,105,436, against 57,699,248 in the corresponding period of 1902, an increase of 8,406,188. The report for the year, including the Manhattan and the Interborough figures, shows $12,208,337 gross receipts, an increase of $1,542,426 and 246,587,022 passengers carried, against 215,259,345 carried in the previous year, an increase of 31,327,677 passengers. The operating expenses were 44.73 per cent., against 51.74 per cent. the year before, a decrease of 7.01 per cent.

SUSQUEHANNA POWER.—The statement is made that the Susquehanna Power Company, which was recently incorporated for the purpose of harnessing the water power of the Susquehanna River and conveying it for use in Baltimore, has secured subscriptions to nearly $10,000,000 of its capital, and is about to sign a contract with the General Electric Company for electrical machinery involving, before the apparatus shall all have been installed, the expenditure of from $2,500,000 to $3,000,000. Mr. S. Davies Warfield, president of the Continental Trust Company, who is the only one in a position to make an authorized statement, when shown this dispatch, said: "There is no statement to be made public at this time regarding the Susquehanna project." It is known that the engineers and others identified with this project have been exceptionally busy for the past six months. A number of well-known electrical and hydraulic engineers have made exhaustive investigations of the project for leading Northern and New England capitalists. The enterprise is looked upon with great favor in those quarters, especially among interests which have had experience with similar projects. It will be a big thing for Baltimore, as it will supply an abundance of cheap power. Three developments of 50,000 hp each are planned, and every detail of the construction has been completed. The power company will furnish current to the United Railways and to the United Electric Light & Power Company, of Baltimore.

AN OPPORTUNITY IN GAS.—The following story is told by the *Wall Street Journal* as to the stock of the Consolidated Gas Company, which controls electric lighting in New York City: "A year ago a capitalist who owned 2,000 shares of Consolidated Gas, then selling at 223, sold at that figure, and has loaned the money which he received for the stock—namely, $446,000, at the generally high rates of interest which have since prevailed. In other words, he found that money could be used more profitably by loaning it out than by keeping it invested in this high-priced stock, which was then yielding him less than 3.65 per cent. a year. On Tuesday this same capitalist purchased 2,000 shares of Consolidated Gas at about 166, paying therefor $332,000. To-day he finds himself the possessor not only of the same stock which he owned a year ago and then sold, but also a profit of $114,000 in cash. The stock has not depreciated in value since then, so far as the payment of dividends is concerned, and now he holds it at a purchase price which makes the income per year a reasonable profit for the use of his money. The $114,000 profit which he has secured through the sale and then repurchase of the stock, is, in addition to the profit which he has made by the loaning of the $446,000 during the past year. He has by this operation increased both his capital and his yearly income."

BUYING GENERAL ELECTRIC.—An article on the recent active buying of stock in small lots says: "All of the transfer offices in the financial district have been rushed for weeks to make out certificates in the names of small investors. Although the stock market tape has shown recently an unusually large aggregate of odd-lot transactions, a large proportion of such buying is done in round lots by the brokers, the certificates being split up afterward. For example, a broker having ten odd-lot orders in the same stock for ten shares each would buy a 100-share lot and send it to the transfer office to be "split up." There are brokers who make a specialty of this old-lot business and among them they piece round lots out of odd lots. It saves work and besides better execution is possible on round lots. The buying of 2,000 shares of General Electric on Monday to be split up into small lots is an instance. The floor specialist in General Electric did that. Reports from Amsterdam, N. Y., say that the population within range of the company's plant has been loading up with odd lots of this stock."

QUEENS COUNTY (L. I.) TROLLEY.—One of the Wall Street news bureaus has printed the following: "We have excellent authority for the statement that the control of the Queens County traction companies has been bought by the Long Island Railroad Company, and that neither the Belmont nor Rockefeller interests had anything to do with the recent change of ownership of those companies, notwithstanding the many reports to the contrary. The same authority states that the Pennsylvania Railroad, which has acquired the Queens County companies through its ownership of the Long Island Railroad, has also secured a very large interest in the Brooklyn Rapid Transit Company. William C. Giles, of 41

Wall Street, is said to have been the active intermediary in the negotiation which was consummated by the purchase of the control of the Queens County companies, but he positively declines to confirm or deny the statement."

CAR WHEEL DEAL.—It is stated that a consolidation of eight of the car wheel manufacturing plants of the country is under way. Appraisals are being made. The plants to be consolidated have a daily output of about 2,700 wheels, consuming approximately 1,000 tons of iron and scrap. The new company will produce about one-fourth of the wheels produced in this country annually. The American Car and Foundry Company and the Griffin Car Wheel Company are the two largest producers, their plants having an output of about 1,000 wheels each. The following concerns have given options on their plants: Rochester Car Wheel Company, Rochester, N. Y.; Maher Car Wheel Company, Cleveland, Ohio; New York Car Wheel Works, Buffalo; Cayuga Wheel Company, Syrepa; Lobdell Car Wheel Company, Wilmington, Del., Maryland Car Wheel Company, Baltimore; Ramapo Car Wheel Company, Ramapo, N. Y.; Keystone Car Wheel Company.

GOOD GENERAL ELECTRIC BUSINESS.—The recent decline in General Electric, according to Wall Street authorities, was accentuated by the forced selling by parties who received the stock in exchange for Stanley Electric Company stock. New business with the General Electric Company has received a passing check, as new promotions in the electric railway line have been halted by reason of the difficulty in floating new securities. The company has orders which will keep its plants in full operation into 1904, and, as a matter of fact, its May and June business was the largest in the company's history. It is stated that for the six months ended July 31 the business has increased 10 per cent. over the same months in 1902, and contracts in hand indicate a gross business this year of fully $40,000,000, an increase over last year of $4,000,000.

THE CUYAHOGA TELEPHONE COMPANY, of Cleveland, reports the following figures for its independent system for six months ended June 30, 1903, as compared with the previous 12 months:

	1903. 6 months.	1902. Year.
Gross	$201,566	$385,852
Expenses and taxes	104,968	229,710
Net	$96,598	$156,142
Interest	58,115	*155,600
Surplus	$38,483	$542

* Includes $40,858 for depreciation.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—The $9,135,200 of assenting stock of the Westinghouse Electric & Manufacturing Company, to list which application has been made to the Stock Exchange, is stock that has been issued to stockholders in order to raise money for making extensions to plants to meet the growing business of the company and for working capital. A portion of this stock was issued in 1901, and the amount includes the $4,500,000 issued in May, which was taken by stockholders at $80 per $50 shares. This makes the amount of assenting stock outstanding $18,516,551, leaving nearly $2,500,000 of this stock still in the treasury.

ELECTRIC CANAL PROPULSION.—At Cincinnati on August 15, Receivers Schoepf and Richardson, of the Miami and Erie Canal Transportation Company reported to the Superior Court on the condition of the concern, which is equipping the canal for the electrical propulsion of boats. The total expenditures have been $1,285,549, while the assets are $118,722, principally in power houses, locomotives and building material. More than $125,000 has already been spent for equipment. It is estimated that it will require $217,200 to complete the line from Cincinnati to Dayton.

CHICAGO METROPOLITAN ELEVATED.—Directors of the Metropolitan Elevated road have voted to pass the semi-annual dividend on the preferred stock. This was due, according to the official statement, to the fact that the earnings for only four months were actually known to the directors, and the increased cost of operation, materials and supplies and the extraordinary settlements for damage and injury suits formerly pending.

BELL TELEPHONE.—By officials of the American Telephone & Telegraph Company it is stated that judging from subscriptions received to date practically all of the $21,943,200 new stock will be taken by stockholders.

DIVIDEND.—The directors of the American Railways Company have declared the regular quarterly dividend of 1½ per cent., payable September 15.

THE V. R. LANSINGH CO., of Chicago, has decreased its capital stock from $30,000 to $17,000.

Commercial Intelligence.

THE WEEK IN TRADE.—The various reports from different parts of the country as to fall trade indicate that the general conditions are excellent, and that the excellent promise of the crops has stimulated the renewed hopefulness and activity. While it is naturally a dull season it would appear that preparations for fall trade are unusually large, and that even at this moment many manufacturers are working overtime. The railroads also are reporting congestion of traffic, particularly around Kansas City, in the coal regions of Pennsylvania, and in the lumber district of the Northwest, while out in the wheat fields it is reported that great quantities of grain are being dumped on the bare ground owing to sheer lack of storage capacity. The railroad earnings for August show an average gain of 7.7 per cent. over last year, and 16.3 per cent. over 1901. Bank exchanges for the week in New York, owing to the stock exchange depression, were 5.6 per cent. less than a year ago; but were 21.7 larger than in 1901. Other large cities, however, show a gain for the week of 7.2. With regard to the copper market, that also must be reported strong, as we ventured to think it would be, and prices have advanced from ¼c. to ⅜c. a pound, and active inquiry is reported for lake at 13½c. bid. Advices from London also report copper stronger there, and it is said that foreign consumers who have allowed their stock to run down are buying. It would appear that something of the kind must be the case, as the exports of copper lately have been quite below the average.

AKRON DYNAMO AND MOTOR ORDERS.—The Akron (Ohio) Electric Manufacturing Company reports the following recent orders: Green-Wheeler Shoe Company, Ft. Dodge, Iowa, one 15-kw generator; Goldsboro Lumber Company, Dover, N. C., one 30-kw belted generator; Trow Directory Publishing & Book-Binding Company, New York, one 100-kw generator, one 50-kw generator; Florence Iron Works, Florence, N. J., one 150-kw belted generator, four 20-hp motors; U. S. Pump & Supply Company, Toledo, Ohio, one 35-hp steel motor; F. R. Penn Tobacco Company, Reidsville, N. C., one 20-hp motor; Astoria Steel Company, Astoria, N. Y., one 7½-hp motor; S. B. Stine & Son, Osceola Mills, Pa., seven 20-hp motors; Salt Lake Hardware Company, Salt Lake City, Utah, one 30-kw engine type generator; Silver Lake Park Company, Silver Lake, Ohio, one 120-kw belted generator; W. S. Tyler Company, Cleveland, Ohio, one 25-hp steel motor; Troy Laundry Company, Cleveland, Ohio, one 60-kw engine type generator, one 1½-hp belted motor; Ward-Corby Company, Chicago, Ill., two 12-hp belted motors, one 15-hp direct-connected generator, one 50-hp direct-connected generator, one 75-kw direct-connected generator; Ward-Corby Company, Pittsburg, Pa., two 15-hp belted motors, one 15-hp direct-connected engine type generator, one 50-hp direct-connected engine type generator, one 75-kw direct-connected engine type generator; Conron Bros., New York City, one 100-kw engine type generator, one 75-kw engine type generator; Jefferson Ice Manufacturing Company, Janney, Pa., one 22½-kw generator, one 5-hp steel motor, one 10-hp Crane motor, one 2-hp steel motor; C. C. Heisen, 350 Dearborn Street, Chicago, Ill., one 200-kw generator; Iron City Engineering Company, Pittsburg, Pa., one 25-hp motor, one 50-kw engine type generator; Imperial Engine Company, Painted Post, N. Y., one 15-hp steel motor; H. Loeb, Caledonia, Pa., one 35-kw generator; Donovan Iron & Wire Works, Toledo, Ohio, one 90-hp motor, one 1½-hp steel motor and the same style as follows: two 3-hp, one 20-hp, three 7½-hp, one 10-hp, one 5-hp, one 2-hp; Deming Ice & Electric Company, Deming, Luna County, New Mexico, one 50-kw generator; W. H. Smith & Co., Indianapolis, Ind., one 20-kw generator; The Wehrle Company, Newark, Ohio, one 10-hp motor; Central Electric & Manufacturing Company, Youngstown, Ohio, one 35-kw engine type generator; Aurora, Elgin & Chicago Railroad Company, Batavia, N. Y., one 10-hp steel motor; Aultman Company, Canton, Ohio, one 7½-hp crane motor; Cream of Oats Company, Warren, Ohio, one 10-kw belted generator; Dravo, Doyle & Co., Pittsburg, Pa., one 10-hp steel motor; James Reely Repair & Supply Co., 229 West Street, New York City, one 30-hp steel motor, one 2-hp elevator motor; Murray Iron Works Company, Burlington, Iowa, one 10-hp, one 12-hp, one 6-hp crane motors; Murphy Varnish Company, Newark, N. J., one 1-hp, one 15-hp, one 3-hp motors; Warren Sheet Metal Company, Warren, Ohio, one 45-kw generator, two 15-hp motors; Allegheny Plate Glass Company, Hite, Pa., one 20-hp motor.

BALL ENGINE RECENT SALES.—The Ball Engine Company, Erie, Pa., report the following shipment of engines for electric service during July, all direct-connected, where not otherwise stated: Longmont Beet Sugar Company, Longmont, Colo., one 150-hp direct-connected engine; two 250-hp direct-connected engine. Lookout Mountain Iron Company, Battelle, Ala., one 125-hp engine; Hamilton Hotel, Louisville, Ky., one 100-hp; one 80-hp. Vermont Hospital for Insane, Waterbury, Vt., one 125-hp. Polyclinic Hospital, Philadelphia, Pa., two 80-hp. Tawas Sugar Company, East Tawas, Mich., one 50-hp; one 80-hp. Alvey & Ferguson Company, Louisville, Ky., one 150-hp. Owosso Sugar Company, Owosso, Mich., one 50-hp; one 80-hp. Imperial Tobacco Company, Rocky Mount, N. C., one 80-hp. Imperial Tobacco Company, Wilson, N. C., one 70-hp. Pittsburg Coal Company, Allison Mine, one 400-hp. Federal Chemical Company, Nashville, Tenn., one 40-hp. Washington Electric Light & Power Company, Washington, Pa., two 350-hp. Jefferson Coal Company, Piney Fork, Ohio., one 350-hp. California Fig Syrup Company, Louisville, Ky., two 50-hp. Cooper, Wells & Co., St. Joseph, Mo., one 150-hp. Manhattan Railway Company, New York City, two 150-hp. Menominee River Sugar Company, Menominee, Mich., one 60-hp; one 80-hp. Windsor Sugar Company, Windsor, Colo., one 60-hp; one 80-hp. Fort Collins Sugar Company, Ft. Collins, Colo., one 150-hp; two 250-hp. Stewart & Co., store, Baltimore, Md., one 200-hp vertical double direct-connected. First National Bank Building, Chicago, two 300-hp, vertical cross-compound, direct-connected.

IMPORTANT MEXICAN PROJECT.—Americans are primarily interested in another important Mexican electrical project which will embrace the supplying of the city of Guadalajara with light and power and the construction of an extensive system of electric railroads through the State of Jalisco, within a radius of some 100 miles of Guadalajara. Captain W. A. Rogers and Arturo Latour de Vasquez are the principal parties concerned. The syndicate, according to advices from Mexico, has acquired from Facundo Perez a concession to develop water power along the Santiago River, in the State of Jalisco for a distance of about 17 miles. This concession extends to the boundary of the grant that is held by the French company now generating current for Guadalajara. San Cristobal, a town about four miles from Guadalajara and two miles below which the concession of the new syndicate applies, will be made the principal power station. It is expected that within two years 60,000 hp will be at the disposal of the new concern. In about a year the first 10,000 hp will be available. In order to secure the fall necessary to generate the power, long ditches will have to be constructed through rock. The longest ditch will be about ten miles. The fall thus gained will be more than 500 meters.

PURCHASE BY GREGORY ELECTRIC COMPANY.—Mr. A. O. Kuehmsted, vice-president of the Gregory Electric Company, of Chicago, writes us as follows: "We have bought out the stock of dynamos, motors, electrical supplies and the repair department, together with the good will of this part of the business, of our leading competitors here in Chicago, Schureman & Hayden, and are going to continue that business at the old location. Our Mr. R. H. Watson will have charge of this warehouse. Our general offices will continue as heretofore at 54 to 62 South Clinton Street. This new place gives us now three warehouses here in Chicago, all of these well located and especially equipped for handling electrical machinery, warehouse No. 1 and the main offices being at 54 to 62 South Clinton Street; warehouse No. 2 on the Chicago, Burlington & Quincy Railroad tracks, at Sixteenth and Lincoln Streets, especially arranged for handling railway generators and large apparatus, and warehouse No. 3, the Schureman & Hayden stock and repair works, at 133 to 139 South Clinton Street."

BELL TELEPHONE OUTPUT.—The instrument statement of American Telephone & Telegraph for the month ended July 20 and since December compares as follows:

Month ended July 20:	1903.	1902.	Changes.	
Gross output	69,194	59,935	Inc.	9,259
Returned	44,116	34,054	Inc.	10,062
Net output	25,078	25,881	Dec.	803
Since Dec. 20:				
Gross output	669,258	648,044	Inc.	21,214
Returned	279,257	260,321	Inc.	18,936
Net output	390,001	387,723	Inc.	2,278

During July the Chicago Telephone Company achieved a net gain of 1,485 telephones for city and country, bringing telephones in use up to 92,214; the increase over July, 1902, being 294. The company expects to reach the 100,000 mark about January 1st.

PUYALLUP POWER HOUSE.—The contract for building the great power house of the Puget Sound Power Company out on the Puyallup River has just been let to Rydstrom & Bihler, of Tacoma, Wash. The contract calls for the completion of the plant December 1 of this year. The contract includes the erection of the fifty-ton crane, which is required in the works for the movement of the huge parts of the machines to be installed. It is also provided that the contractors shall be prepared for the installation of the interior machinery before the completion of the building, as much of the machinery could not otherwise be got into the power house at all. Mr. Bihler is well known as having long been at the head of the engineering department of the Northern Pacific Railroad, besides which he has been in his time engaged in heavy contracting. Mr. Rydstrom is perhaps best known from his former position of commissioner of public works.

CURTIS TURBINE FOR NEW OMAHA LIGHTING PLANT.—The Thomson-Houston Electric Light Company, of Omaha, has let contracts through the United Electric Securities Company, of Boston, Mass., for considerable equipment, to be installed in its new plant. The General Electric Company has taken a contract for two Curtis turbines of 1,500-kw capacity each. The condenser will be built by the Wheeler Condenser & Engineering Company. The contract for the boilers calling for 2,000 hp in four units and for superheaters and chain grate stokers has gone to Thayer & Co. They will be Aultman & Taylor make. The stokers will be built by the same firm. The superheaters will be manufactured by the Power Specialty Company, New York.

ELECTRICAL MANGANESE PLANT.—Arrangements have been completed for the establishment of electrical manganese works at Shawinigan Falls by the Electrical Manganese Company, of which B. E. Kingman, of New York, is president. The company has secured twelve acres of land on the Great Northern Railway at Shawinigan and contracted with the Shawinigan Water & Power Company for the delivery of 5,000 hp. According to their contract, 1,200 hp is to be delivered the company for its manganese plant by August 15. It is the intention of the company to enter upon the manufacture of different kinds of steel, and it is on this account that such a large contract for horse-power was made.

EQUIPMENT FOR LITTLE ROCK PLANT.—The Little Rock (Ark.) Electric Light & Traction Company, controlled by Newman & Sons, of New Orleans, La., has just awarded contracts through Ford, Bacon & Davis, 24 Broad Street, New York, for various equipment to be installed in its new plant. The General Electric Company has taken the contract for the generators—two of 1,500-kw capacity each, direct-connected to cross-compound condensing engines of 2,000-hp capacity each. The engines will be Allis-Chalmers. The boiler contract for 2,000 hp in four units was allotted to Thayer & Co., Incorporated, for the Aultman & Taylor Machinery Company, Mansfield, Ohio.

IMPORTANT SOUTH AMERICAN TRACTION PROJECT.—An extensive trolley system is to be constructed in the City of Rosario by the Anglo-Argentine Company, an English syndicate represented by William Gay. Several horse lines will be electrically converted. The scheme, according to South American advices, is a very comprehensive one, involving every quarter of the city. Agar, Cross & Company, a well-known South American commission house which represents the Westinghouse interests in the Argentine Republic and Uruguay, and whose New York offices are in the Bowling Green Building, are after the contract for the power house equipment, etc.

STEAM RAILROAD CONTRACT.—The Buffalo, Rochester & Pittsburg Railroad has just let contracts for the complete electric equipment of their present shops and roundhouse at Buffalo Creek and the proposed shops and roundhouse at the junction of the Buffalo & Rochester divisions near Salamanca. Both plants will be operated by electric power and lighting, which means the expenditure of many thousands of dollars in the original equipment. The contracts have been awarded to the General Electric Company through the efforts of A. C. Smith, one of the General Electric Company's representatives in Buffalo. Work will be soon started.

SIGNALPHONE CONTRACT.—The Signalphone Company, of Milwaukee, is completing the contract for equipping the grounds of the Louisiana Purchase Exposition at St. Louis with a police telephone system. The company has already shipped $7,000 worth of equipment to the grounds and the work of installing the system will be commenced shortly. The system will be complete and telephones will be placed so as to be easily accessible from any part of the grounds. It is expected that the system will afford the St. Louis fair more ample police protection than given any of the large expositions during the past few years.

EQUIPMENT FOR FALL RIVER LIGHTING PLANT.—The Fall River (Mass.) Electric Light Company is at present awarding contracts through French & Hubbard, of Boston, Mass., for equipment for its new power station. Thayer & Co., Incorporated, Boston office, has secured the boiler contract. There will be four units, making in all 3,000 hp.

BULLOCK ORDERS.—The Bullock Electric Company has secured a contract amounting to $50,000 from the Chicago Elevated roads for electric equipments. The company's business for July was the largest in its history.

MEXICAN LIGHTING PROJECT.—An electric light plant is to be built in the town of Tamazula de Gordiana, State of Jalisco, Mexico. Steam power will be used. Vincente Viera is interested in the undertaking.

General News.

THE TELEPHONE.

SANTA ANA, CAL.—The Home Telephone Company has let a contract for a $13,000 pressed brick building here.

DELTA, CAL.—The contract for building a telephone line from Delta, on the railroad to Shasta County, by way of Trinity Center to Carrysville, Trinity County, has been awarded. The line will follow the Northern Trinity toll road, and will be 30 miles in length. Later the mine owners of the Coffee Creek district will extend the line to their properties.

DENVER, COL.—Orders have been issued by E. B. Field, of the Colorado Telephone Company, for the extension of the company's lines into Grand Lake, Hot Sulphur Springs and Kremmling. It is expected that the lines to these points will be in operation within the next ninety days.

NEW BRITAIN, CONN.—The capital stock of the Farmington Valley Telephone Company, of New Britain, has been increased from $10,500 to $27,000.

CHICAGO, ILL.—The Farmers' Telephone Company, of Lee County, has been formed to operate a telephone system. Capital, $2,500. Incorporators: Albert N. Crawford, Henry W. Hillison, Christian Gross.

BRYANT, IND.—The Bryant Telephone Company has been formed with $10,000 capital.

INDIANAPOLIS, IND.—The State Board has fixed the assessment on telephone property in the state at $6,810,552, as against an assessment last year of $5,043,579, an increase during the year of $1,765,973.

BURLINGTON, IA.—The Modern Telephone Company, of Burlington, has been incorporated; capital $300,000.

DES MOINES, IA. The Summit Rural Telephone Company has been formed in O'Brien County. Capital $1,000.

WATERLOO, IA.—The city council has granted the right to the Iowa Telephone Company to place their wires underground. The company will expend $100,000 in this city, part of it being in a fine new building with offices and general supply quarters.

SUMNER, IA.—A majority of the stock of the Sumner Telephone Company, capital $30,000, and owning about 150 miles of line and large exchanges at New Hampton and West Union, Iowa, has passed in the hands of Victor Stevenson, who controls the Standard and Interstate lines.

DES MOINES, IA.—The Mutual Telephone Company has decided to buy a Stromberg & Carlson multiple switchboard and connections. This board has a capacity of 12,500 and will be fitted up for 3,600 telephones. It will cost $95,000. This does not include the conduits to carry the wires underground into the exchange building.

LANACONING, MD.—The Western Maryland Telephone Company contemplates putting in a line from Eckhart to Clarysville.

ONAWAY, MICH.—The Onaway Telephone Company gives service to Onaway and Rogers City from two switchboards of 135 and 100 drops respectively. It has 160 and 100 subscribers, 130 miles of toll line, with 50 more projected and 70 waiting subscribers.

DETROIT, MICH.—The Co-operative Telephone Company has issued a list of "Independent" exchanges with which it connects throughout Michigan, containing the names of 575 places not on other companies lists. The Co-operative is putting stations in a number of down-town places.

DETROIT, MICH.—The Michelson & Hanson Lumber Company, of Lewiston, has purchased of T. H. Deyarmond the Mio telephone line as far as Pennsylvania Crossing and will use it in connection with its camps in that vicinity. Frank Klooz will operate the remainder of the line.

DUNDEE, MICH.—The Dundee telephone exchange now has over 200 subscribers, including 60 farmers in the vicinity of Dundee. The exchange was established by F. W. Gradolph and began business April 1, 1902, with about 50 subscribers. The exchange enjoys a good patronage upon its toll line service, connecting with the U. S. line, and having access to the large independent exchanges of Toledo, Adrian, Jackson and other towns having independent service.

DETROIT, MICH.—The lines of the Detroit Co-operative Telephone Company and the Livingston County Home Telephone Company have been connected near Plymouth, and the Detroit concern now has connections with different independent circuits throughout the state by reason of this connection. The Co-operative Telephone Company has but slightly over 100 telephones in operation at present, the canvass for subscribers having been deferred until state telephone service could be offered. A switchboard sufficient to operate 12,000 telephones has been installed at 32 Michigan Avenue. The company consists of the following persons: President, C. M. Burton; vice-president, Max J. L. Towler; secretary, J. C. Danziger; treasurer, J. Ward Howland. A. A. Cowles has been elected manager. The shareholders of the company are all Detroiters, of whom the list shows 700 in all.

GRAND RAPIDS, MICH.—At the annual meeting of the stockholders of the Citizens' Telephone Company, of Grand Rapids, the officers elected were the same as those who have conducted the affairs of the company for the last year: C. F. Rood, president; Edward Fitzgerald, vice-president; W. J. Stuart, treasurer; E. B. Fisher, secretary; C. E. Tarte, general manager; Albert Stacey, superintendent of construction, and Edmund Land, electrician. The gross income during the year closed was $274,343.79, an increase of $76,232.81; the gross expenses of the past year for operation, management, general expenses, taxes, etc., were $76,066.60; for reconstruction, repairs, maintenance and depreciation, $100,499.46; after paying dividend requirements of two per cent. each quarter, aggregating $82,777.73 in the year, the sum of $15,000 was carried over in surplus, making the surplus account $55,231.48.

HASTINGS, MINN.—The Hastings Telephone Company has been incorporated by H. J. Sumption, Irving Todd, Jr., L. A. Whitford, John Heinen, W. E. Boerst and N. B. Gergen, with an authorized capital of $50,000.

PIPESTONE, MINN.—The Dell Rapids Telephone Company will construct 50 miles of rural lines in the vicinity of that place.

HANNIBAL, MO.—The Bluff City Telephone Company has had a cable laid across the Mississippi River at Hannibal to connect with telephone lines in Illinois.

JERSEY CITY, N. J.—The Atlantic & Pacific Telephone & Telegraph Company has been formed, capital stock $25,000. Corporators, Arthur Johns, L. P. Hervey, George F. J. Dwinell, all of Jersey City. The company is to operate telephone and telegraph lines.

MOUNT HOLLY, N. J.—The Farmers' Telephone & Telegraph Company, of Moorestown, has been incorporated in the County Clerk's office with Clayton Conrow, Horace Roberts, Ellis H. Rudderow, Edmund S. Holmes, Charles B. Jessup, Frederick Lippincott and George L. Holmes, all prominent farmers in the vicinity of Moorestown, as the incorporators. The authorized capital is $25,000.

LYNDONVILLE, N. Y.—The Lake Side Telephone Company has been formed; capital, $100,000. Directors: W. A. Tuttle and Grant Spaulding, Lyndonville; S. A. Coe, Yates.

NORTH TONAWANDA, N. Y.—The Niagara County Telephone Company operates a 600-drop board capacity and has 525 subscribers. The toll lines are all controlled by the Independent Union Telephone Company.

GRANVILLE, N. Y.—The Granville Telephone Company operates one 200-drop board, two of 100 each and three of 10 each. There are 700 subscribers and 100 miles of toll line. Several extensions are projected.

AUBURN, N. Y.—The Auburn Telephone Company has an automatic board of 450 drops, and a magneto board of 240 drops, with about 675 subscribers and 25 miles of toll line. The company will probably put in a new automatic system of the Automatic Electric Company, of Chicago, with capacity increased to 3,000.

CINCINNATI, OHIO.—The Board of Public Safety is taking steps towards placing the entire telephone system of the department underground.

COLUMBUS, OHIO.—The Putney Telephone Company, Shadyside, has been formed by C. W. Rodefer, John A. Futhey, W. P. Harris, H. B. Wilkinson, C. W. Danford. Capital stock, $1,000.

TOLEDO, OHIO.—The Toledo Telephone, Telegraph & Messenger Company has filed with the city solicitor and other city officials a formal application for permits to make the proper connections in its messenger and call box system, as required to do under the franchise ordinance granted it.

CINCINNATI, OHIO.—The Interstate Telephone Company has been incorporated at Columbus by a number of prominent Cincinnatians. The company was formed, the organizers say, to apply for a franchise to operate a telephone system in Cincinnati, and the City Council in the near future will be asked for a franchise. The incorporators of the company are Sol. P. Kineon, Oliver L. Perin, E. Zimmerman, R. H. Elliston and Frank K. Ludlow. The application for a charter states that the purpose of the company is to operate telephone and telegraph lines in Cincinnati and Dayton, Ohio, and the interlying counties. Wires are now being stretched in Kentucky and connections with wires to Louisville have been made. These over-river lines will form an adjunct to the Cincinnati company and it is thought that from $3,000,000 to $5,000,000 will be spent.

CHESTER, PA.—The United Telephone & Telegraph Company, of this city, which started business in opposition to the Bell system several years ago, has decided to put its wires underground.

BEAVER, PA.—The Beaver County Telephone Company, an independent concern, has been organized here, and application for a charter will be made. The company will install a system touching all important communities in the county, giving particular attention to the rural service. The capital will be $100,000.

WILKESBARRE, PA.—The Telephone Company of Wyoming County has begun the construction of a line from Centremoreland, Wyoming County, to Wyoming. From Centremoreland connection will be made with the Newton line, running to Mill City, Lake Winola and other points. The Newton line connects with the Bradford County line, which is a part of the New York State Company.

VERMILLION, S. D.—A stock company is proposed in Spirit Mound and Pleasant Valley townships to build a telephone line to Vermillion.

WORTHING, S. DAK.—The Worthing Electric Company is the latest telephone organization here. It begins with a 50-drop board and 35 subscribers. The company is capitalized at $5,000. President, M. Johnson; secretary, J. M. Montgomery; treasurer, A. W. Hawn; general manager, F. J. Hawn.

SAN ANTONIO, TEX.—The independent long distance telephone lines of Texas, known as the Commercial Telegraph & Telephone Company of Texas, has, as already stated, passed into the hands of H. E. Huntington, with Frank B. Smith, the originator of the independent system of this state, in charge. Mr. Huntington has acquired the system for approximately $4,000,000, and intends to invest $400,000 more in improvements and extensions. The system comprises 1,000 miles of toll lines in the heart of the cotton belt of the state, from San Antonio to Shreveport, La., and from Port Arthur to Waco.

OGDEN, UTAH.—The Rocky Mountain Bell Telephone Company is planning another extension to its system in Weber County which will give the city a first-class connection with all precincts in the Ogden valley. Huntsville and Eden are already connected, and the Eden line will be extended to Liberty.

BURLINGTON, WIS.—The directors of the Burlington, Rochester & Kansville Telephone Company will increase their capital stock from $2,500 to $5,000.

ELECTRIC LIGHT AND POWER.

STOCKTON, CAL.—Bids will be received by the city clerk until September 14 for constructing a steam electric light plant.

LOS ANGELES, CAL.—A 30-year franchise to erect poles and string wires for the transmission of electrical energy has been granted to the Edison Electric Company. The company will operate at Claremont and Lordsburg.

SACRAMENTO, CAL.—J. A. Robinson has applied for a franchise to erect, construct and maintain along the public roads and streets of the city wires for transmitting electric current for lighting the city, and bids for said franchise will be received until Sept. 11.

NIMSHEW, CAL.—The power plant here will soon furnish electricity. The power house is situated on Butte creek, and after the water is used by the Nimshew plant will run as now, some five or six miles further to the Centerville plant, where 8,000-hp is now being generated. This new power house will be of steel so as to reduce to a minimum all danger of fire.

DENVER, COLO.—A syndicate of local capitalists, including Thos. J. Milner, have secured an option of 7,000 acres of land in Estes Park, to be used as a site for a power plant and reservoirs. The company also plans a number of electric railway lines in this vicinity. A project for the building of a large power plant and reservoirs at Estes Park has recently been made public. The syndicate, consisting of Denver capitalists, has secured an option on 7,000 acres of land in the park. On this site they propose to construct three of the largest reservoirs in the West, acquiring the water from the big Thompson River, and to establish a power plant of sufficient capacity to supply Denver and the surrounding towns.

COLORADO SPRINGS, COLO.—Geo. B. Tripp, general manager of the Colorado Springs Electric Company, states that his company has recently installed in its sub-station in the center of the city a 300-kw, 2300-volt, 60-cycle, three-phase generator, which is now being used as a synchronous motor to drive by means of line shafting 500-volt direct-current generators. During the winter months the machine will be used as a generator and will be steam driven. The Colorado Springs Electric Company is anticipating some trouble in securing coal for its power station, as the miners in the coal fields adjacent to the power plant have made demands on the operators for higher wages and shorter hours and if the demands are not acceded to a shut-down is probable. The Colorado Springs Electric Company supplies power to the three large ore-reduction mills just west of the city and they are about to shut down on account of the big Cripple Creek strike.

GRIFFIN, GA.—Mr. Wm. C. Whitner, of Rockhill, S. C., reports that the Towaliga Falls Power Company is to construct a power plant, dam and canal at Griffin, at a cost of $200,000.

BUFORD, GA.—An application for a charter has been filed with the Clerk of County Court, for the Winding Shoals Electric Power Company, which proposes to construct a dam on Chattahoochee River, five miles away, to build a circuit to this city and furnish power as well as light. H. I. Jacquish, of Gainesville; D. B. Stancliff, of Atlanta, and W. W. Gorham, of Chicago, Ill., are said to be interested.

GRIFFIN, GA.—Mr. W. G. Adams has been appointed to superintend a large contract for the Towaliga Falls Power Company, of Griffin, Ga. The contract, which is in charge of Mr. Whitner, is for a dam, race and power house to be built 15 miles from Griffin to light the city and run four or five large cotton mills in that place. These establishments now use steam. The work will cost about $200,000, and when completed will furnish 3,000-hp.

HOPEDALE, ILL.—Frank A. Albertson, of Pekin, has been granted a franchise for an electric light plant.

DIXON, ILL.—Henry C. Higgins, of Sterling, has secured a franchise for a gas and electric light plant at Dixon to cost about $150,000.

SPRINGFIELD, ILL.—The Springfield Light, Heat & Power Company has been formed to supply power; capital $10,000. Incorporators: E. G. Schmidt, Blufford Wilson, W. H. Brown.

SPRINGFIELD, ILL.—The Culver Construction Company, of Springfield, has secured the contract for the construction of the new power plant on E. Monroe Street, to cost about $60,000.

AURORA, ILL.—Electric machinery will probably supplant other motive power in the Fox River valley. Since the traction company's new power house at Batavia began business, there has been an abundance of power for the road and for any number of customers along the line. It is now proposed to furnish light and power to farm houses along the valley at a reasonable cost. Feed cutting, threshing and pumping by electrical power is also the intention of the company officials.

DURANT, IND. TER.—The citizens have voted to issue $85,000 bonds for water works, a sewage system and an electric light plant.

RICHMOND, IND.—Mr. S. O. Yates has secured the contract for an addition to the plant of the Richmond Heat & Light Company for $5,000. New machinery will also be added. Barton & Storrs are the owners.

SUMMITVILLE, IND.—The Madison Circuit Court judge has continued the order restraining the town board from purchasing the local electric light plant. The citizens object because of the necessary increased tax rate to complete the purchase.

WARSAW, IND.—The City Council has granted the Winona Electric Light & Water Company a 50-year franchise to construct and operate a complete electric light and power system, a hot-water heating plant and a water works with spring water for drinking.

INDIANAPOLIS, IND.—The Citizens' Heat & Light Company, of this city, obtained a franchise some time ago and agreed to have its plant in operation by Sept 1, 1903, but as yet it has not broken ground nor filed the $10,000 bond to assure the city of the carrying out of the contract.

RICHMOND, IND.—Attorney John T. Beasley, of Richmond, representing Bertron & Storrs, New York bankers, has completed the purchase of the Richmond (Ind.) Light, Heat and Power Company, formerly owned by Richmond and Dayton men. The eastern firm will make a number of improvements in the Richmond property. Richmond also has a municipal electric lighting plant.

CLARION, IA.—The citizens have voted to enlarge the electric light plant.

ELDORA, IA.—The Eldora Electric Light & Heating Company's fine plant has been sold by its owner, William S. Porter, to Ferris Bros., of Monmouth, Ill. It is said that the consideration was $40,000.

FT. RILEY, KAN.—The War Department has awarded the Junction City Electric Railway, Light & Ice Company the contract for lighting the streets and buildings. The company will enlarge its plant at Junction City and furnish current as far as the military reservation. The government will furnish all material at the post and will do the wiring. The cost of the work at the post and on the plant will be about $80,000.

JACKSON, KY.—The Jackson Electric Light & Power Company, recently incorporated in Delaware will immediately begin the erection of a power house.

SAG HARBOR, L. I.—The present electric light contract expires in September, and the village will then either purchase the present plant or build a municipal plant.

GLEN COVE, L. I.—The Glen Cove Light & Power Company, of Oyster Bay, has been incorporated, capital $15,000, by P. H. Grimm, J. W. Campbell and E. Luyster, of Glen Cove.

AUBURN, ME.—The Lyman Falls Power Company has been organized at Auburn, Me., to develop power on the Connecticut River; capital, $10,000. George B. Bearce, president, Lewiston, Me.; Fred W. McDonald, treasurer, Groverton, N. H.

PORTLAND, ME.—The Cuyamel Company has been organized at Portland, Me., for the purpose of doing a real estate and gas and electric light and heating business, with $500,000 capital stock, of which nothing is paid in. The officers are: President, William H. Green, of Portland, Me.; treasurer, Percy L. Andrews, of Portland, Me.

BALTIMORE, MD.—Bids are wanted Aug. 22 for replacing and repairing the storage batteries in the court house electric plant. Address Edward D. Preston.

UPTON, MASS.—The Upton Electric Company has been authorized to issue $7,500 new capital stock to construct a plant there.

DOUGLASS, MASS.—The State Gas & Electric Light Commission have allowed the Douglas Electric Company to issue new capital stock to the amount of $7,500 for the construction of its plant there.

GREENFIELD, MASS.—McCaghey & Linehan, of Little Falls, N. Y., have secured the contract for building the dam and power house at Gardners Falls for the Electric Light & Power Company. The General Electric Company will furnish the machinery, which will include two generators and two pairs of 27-inch horizontal water wheels. The plant will generate 1,100-hp.

PLYMOUTH, MICH.—The Michigan Electrical Company, of Detroit, has secured the contract for constructing an electric light plant for Plymouth.

ALPENA, MICH.—The Alpena Light, Heat & Power Company has been incorporated at Augusta for the business of electricians, capital $500,000, of which nothing is paid in. President, F. L. Dutton; treasurer, E. F. Whittum. Directors: F. L. Dutton, E. F. Whittum, C. L. Andrews, L. H. Tracy, of Augusta; Geo. P. Smith and J. P. Lindsay, of N. Tonawanda, N. Y.

ELY, MINN.—It was voted August 4 to issue $40,000 bonds for extending the water works and electric light plant.

TWO HARBORS, MINN.—Bids will be received Aug. 23 by the village trustees for changes and additions to the electric light and water plant consisting of a 150-kw direct-connected single phase alternator, a 250-hp high-speed compound condensing engine, condenser, heater and boiler feed pump, a 200-hp boiler and system of steam water and exhaust piping. Oscar Claussen is the consulting engineer, St. Paul.

ST. JOSEPH, MO.—The City Council is considering the question of constructing a municipal electric light plant to cost about $100,000.

LINCOLN, NEB.—A construction company has asked permission to construct a wing dam in the Niobrara river at a point near its mouth, for the purpose of carrying a part or all of the water through a channel around Niobrara island. The company intends to use the power thus gained to operate a system of water motors to generate electricity for power and lighting. It will require two years to complete the work, which will cost $150,000.

NIAGARA FALLS, N. Y.—Bids will be received Aug. 17 by the Common Council for furnishing to the city for a term of five years from Nov. 1, 1903, about 400 electric arc lights of 2,000-cp each. Jas. J. Mahoney is the chairman of the Committee on Public Lights.

CONCORD, N. C.—The Concord Light & Ice Company has been chartered with $75,000 capital.

SHELBY, N. C.—The Lily Mill & Power Company, of Shelby, has been chartered to manufacture cotton and operate an electric plant by water. The concern proposes to furnish electric power to a number of cotton mills at a figure cheaper than the mills are now expending for steam or water power.

ATHENS, OHIO.—Bids are wanted Aug. 24 for $15,000 electric light bonds. Address W. B. Golden.

WILLIAMSBURG, OHIO.—Bids are wanted Aug. 31 for $4,500 electric light bonds. Address Chas. Hoffman.

DAYTON, OHIO.—The Citizens' Heat, Light & Power Company, of Dayton, capital $10,000, has been incorporated.

ASTORIA, ORE.—A modern electric light plant is to be installed in the new Hume Mill and wires will be run for nearly 300 lights. The contract for installing the plant has been let to Trullinger & Hardesty, and work on it is to be begun at once.

AURORA, ORE.—The county court has granted a franchise to the Aurora Electric Company to construct and maintain an electric light line along the highways from Aurora to Gervais, for the purpose of transmitting electric power. The work on the new line must be completed within one year.

CANYON CITY, ORE.—H. H. Anderson, of Fredericksburg, Va., will soon start work on the construction of a large electric power plant at Sparta. The machinery has been shipped from Pittsburg. The plant will be constructed at a cost of $200,000. It will furnish power to Baker City, La Grande, Union, Sumpter and probably some other towns.

EUGENE, ORE.—The Lane County Electric Company is the name of a new corporation which will merge the Eugene Light Company into a larger and more progressive company. This new company will change the location of the Eugene electric light plant to Springfield within the next three months. The station will be maintained as a sub-supply station and probably to run the incandescent service in Eugene by night. The new plant will run all day as well as all night and furnish not only light for Eugene and Springfield, but power for the use of manufactories at both places. The company already has a franchise from the county for the right of way for the poles to Eugene. The poles are so set along the road that a trolley line attachment would need but the fastening on of supports for the wire.

MONONGAHELA, PA.—The Electric Light Company will reconstruct its plant, install new dynamos and a new gas engine. Mr. Wm. Ewing is superintendent.

WILMERDING, PA.—The Wilmerding Electric Light Company has been organized by Henry [illegible] and David Goldstein to supply light, heat and power in Wilmerding and East McKeesport.

MIDDLETON, PA. Ethelbert R. Heisey, cashier of the Dallastown National Bank, and George R. Heisey, of Marietta, representing a New York syndicate, have purchased the Red Lion Electric Light Company's plant for $10,000.

PHILADELPHIA, PA.—The James D. Lalor Engineering Company, of Philadelphia, consulting engineers, are equipping the Lippincott Building with a light and power plant, the contract for which was awarded to the Kingsbury, Samuel Electric Company, Baltimore, Md.

HARRISBURG, PA. The new Paxtang Electric Company are making rapid progress with the work at their plant in South Harrisburg. A number of contracts for lighting business places and private residences have already been secured by the company and new ones are being received daily.

MYERSDALE, PA.—The borough council has granted a fifty-year franchise to "The People's Light, Heat & Power Company," for this borough. The company must be ready to furnish lights by Nov. 1, 1903, or forfeit its rights under this franchise. They must also furnish power both day and night, and a failure to do so 30 days in succession would forfeit their charter.

MONTREAL, QUE.—The City Council has decided to engage Mr. Chas. E. Phelps, of Baltimore, Md., to prepare plans, specifications and estimates of cost of building an underground system for all electric light, telegraph and telephone wires.

ANDERSON, S. C.—A syndicate has purchased a 6,600-hp water fall near Anderson, and will develop same for electrical purposes. Some of the stockholders of the Anderson Water, Light & Power Company are reported interested.

MEMPHIS, TENN.—The North River Electric Company has been formed to purchase, lease, maintain and operate water power for development of electricity, to operate mills, power and lighting plants. The incorporators are G. Richard Berlin, E. L. Berlin, J. J. Sharer, J. A. Riddell and Edward C. Martz. The capital stock is from $10,000 to $25,000.

MARLIN, TEX.—Engineer Fullenwider, of Austin, has made a survey of the falls of Brazos River near here, to determine the cost of an electric plant to be established there by a company of local capitalists.

READSBORO, VT.—Mr. W. S. Kelly, of Providence, R. I., is interested in the development of the water power of Howe's Pond and damming Deerfield River at Readsboro for electrical purposes. Some of the power will be transmitted to North Adams, Mass.

WYTHEVILLE, VA.—The Town Council has granted a franchise to the Stone Electric Light & Power Company for an electric light plant. Bids for construction will be received at once. A. F. Stone is the engineer in charge.

SEATTLE, WASH.—Bonds to the amount of $590.000 have been sold to be used for constructing the proposed municipal power and lighting system.

MARYSVILLE, WASH.—The council has granted the Everett Railway & Electric Company a franchise to light the city with electricity for a period of fifty years.

SEATTLE, WASH.—The time for receiving bids for the municipal electric light plant has been extended from Aug. 11 to Aug. 25. C. B. Bagley is the secretary of the Board of Public Works.

TACOMA, WASH.—Franchises have been granted to the Puget Sound Power Company, the Tacoma Industrial Company and the Snoqualmie Falls Power Company for the use of certain county roads in erecting electric lines for the transmission of power.

PALOUSE, WASH.—The Palouse Light & Power Company will have all the necessary machinery for their plant on the ground in the next few days, and it is announced by the management that the city will be lighted with electricity by the 15th of September.

HILLSBORO, WIS.—Mr. Myron Goodsell has secured a franchise for an electric light plant.

ASHLAND, WIS.—Prendergast & Clarkson, of Chicago, Ill., have secured the contract for a $30,000 electric plant for the Atlantic Dynamite Company.

THE ELECTRIC RAILWAY.

EUREKA, CAL.—Articles of incorporation of the Humboldt Transit Company have been filed to build 20 miles of electric railway in Eureka and an additional 54 miles to other towns in Humboldt County. The capital stock is $300,000, of which $75,000 has been subscribed. The directors are J. C. Bull, Jr., of Eureka, George Henderson, of Oakland; R. W. Bull and John C. Bull, of Arcata, and Charles P. Cutten, of Eureka.

LOS ANGELES, CAL. Plans are being worked out for an electric road between Stockton and the Yosemite Valley, by Charles Gage, of Denver, representing a syndicate of Chicago, New York and Cleveland capitalists. Interested with Mr. Gage is Edwin De Haven, a Tonopah mining man. The present plan is to build a standard gage road from Stockton to the valley by way of Chinese Camp, to Big Oak Flat, to Merced, to Hamilton, to Crocker.

HARTFORD, CONN. The Crystal Lake Railway Company has organized and $50,000 of capital stock has been subscribed for. Charles L. Perkins is president of the company and Arthur Perkins, secretary and treasurer. It is the intention to build an electric railway from Crystal Lake to run north to the Massachusetts line, a distance of nine or ten miles.

ATLANTA, GA.—The Georgia Railway & Electric Company has purchased $250,000 of machinery for the equipment of two sub-stations. One will be erected near Decatur and the other will be built on the Marietta line. By means of these sub-stations the Georgia Railway & Electric Company will be in a position to furnish current for a distance of fifty miles from Atlanta. Work on the trolley line to Marietta has already begun and an extension of the Decatur line is contemplated.

DIXON, ILL. The Dixon, Rock Falls & Southwestern Electric Railway, which is engaged in the preliminaries for an electric railway from Dixon to Rock Falls and nearby points, has elected officers as follows: G. H. T. Shaw, of Dixon, president; A. C. Hanley, vice-president; R. L. Leitch, secretary; O. E. Maxson, treasurer; H. L. Sheldon, attorney. The company has recently been granted a franchise in De Kalb.

INDIANAPOLIS, IND.—The Indianapolis, Danville & Rockville Traction Company has filed a petition with the County Commissioners for a franchise over and along the Rockville gravel road.

WINCHESTER, IND.—Surveys have been made by the Eastern Indiana Traction Company for its line, which extends from Hamilton, Ohio, to Marion, Ind. Construction will be begun about Sept. 1.

CHESTERTON, IND.—The City Council has granted a franchise to the Chicago, Indiana & Michigan Railway Company, which proposes to build an electric railway from Michigan City through Chesterton and other towns in Northwestern Indiana.

BELLEVILLE, IND.—The ordinance committee of the City Council has favorably reported an ordinance to grant the Morrison Express Company, of East St. Louis, a franchise to run freight and express cars over the tracks of the Belleville Railway system.

BLOOMINGTON, IND.—W. H. Schott, president of the electric light and heating plant in Bloomington, and also interested in the Indianapolis plant, will ask for a franchise from the Bedford City Council for an electric railway line through the quarry districts of Monroe and Lawrence counties.

INDIANAPOLIS, IND.—The Tipton, Frankfort & Attica Traction Company, which is to furnish connections with the Indianapolis, Northern & Northwestern trunk lines, has been incorporated; capital stock, $50,000. The directors are J. H. Fear, J. G. Clark, J. C. Shanklin, W. R. Dunham, G. M. Shortle, L. M. Green and Samuel Clark.

RICHMOND, IND.—The Indiana Eastern Traction Company will be the first electric line in this State to use the third-rail system. The overhead trolley will be used only in passing through cities. In the country the line will have its own enclosed right of way. Construction on this line, which will extend from Hamilton, Ohio, to Marion, Ind., via Richmond, will begin soon. It is the purpose of the company to build from Marion to Chicago.

INDIANAPOLIS IND. An electric railway to connect this city with Toledo is being promoted by J. Morgan and J. L. Weadlock, of Toledo, Mr. Morgan is president of the Dayton, Ohio, Traction Company, and has been instrumental in building the network of lines about Dayton. The line will parallel the Wabash for some distance, connecting Toledo, Defiance, Napoleon and Van Wert, Ohio; Decatur, Hartford City, Alexandria and Noblesville, Ind.

ELWOOD, IND.—As to the incorporation of the Union Traction Coal Company, President McCulloch, of the Indiana Union Traction Company, says that the company was simply organized to hold coal leases and properties acquired in Sullivan County. It is understood that the plans of the Indiana Union Traction Company and its allied Indianapolis Traction & Terminal Company, both of which are interested in the new Plainfield line that is to be pushed through to Brazil, propose to penetrate not only the Sullivan County coal fields, but also those of City and Park counties.

DAVENPORT, IA.—The Davenport & Suburban Railway Company has filed amended articles of incorporation with the Scott County Recorder, increasing its capital stock from $500,000 to $1,400,000. The company intends to build an interurban line of railroads from Davenport to Muscatine.

COUNCIL BLUFFS, IA. The Council Bluffs, Tabor & Southwestern Electric Railway Company has filed articles of incorporation. The headquarters are in Tabor, Fremont County; capital, $200.000; William J. Dobbs, president; Arthur S. West, secretary. The company is authorized to construct an interurban railway in Iowa, Missouri and Nebraska, and it is designated that the main line shall run through Pottawattamie, Mills and Fremont counties in Iowa, and Atchison, Nodaway, Holt, Andrews and Buchanan in Missouri.

KENTUCKY.—The Southern Kentucky Interurban Traction & Power Company has been formed with a capital of $125.000. Incorporators: C. W.

Courts, J. M. McCutcheon, J. C. Browder, J. R. Crewdson, R. P. Manly, R. R. Clark, J. W. Clark, H. S. McCutcheon and W. P. Bainbridge.

AMITYVILLE, L. I.—Wilkins K. Putnam has been granted a franchise to erect poles, string wires and lay tracks for the building of a cross-island trolley between the incorporate village limits in Amityville and the northerly limits of the town. The franchise is in line with others granted and calls for the laying of the rails, the building of the road under the direction of the commission, and within one year from the acceptance of the franchise. After ten years the town is to have two per cent. of the gross earnings of the company.

CARIBOU, ME. At a special meeting Caribou voted to appropriate $25,000 toward the construction of an electric railway from Caribou to Washburn and Perham.

ELKTON, MD.—The Kent & Cecil Light, Power & Railway Company has awarded the Tennis Construction Company, of Philadelphia, the contract for building its new line from Chesapeake City to Elkton, Newark and Stanton.

SPRINGFIELD, MASS.—The Hoosac Valley Street Railway Company has received a decree granting a location for the railway on the west side of the State road south of the city.

WILLIAMSTOWN, MASS.—The selectmen of Williamstown, Mass., have received an application from Dr. S. L. Lloyd, of that town, for a franchise for an electric railway from Williamstown station to the Vermont State line, a distance of nearly three miles. It is the link for the connection of the proposed roads from Troy to the State line, and Bennington, Vt., to the State line, with the Hoosac Valley Company for North Adams and points in the southern part of the county.

FITCHBURG, MASS. The Leominster, Shirley & Ayer Street Railway Company has been organized, with George W. Clifford, of Fitchburg, president; Wesley W. Sargent, superintendent; Charles F. Baker, of Fitchburg, clerk. The directors voted to make a 10 per cent assessment on the stock subscriptions and to begin at once the construction of the road. The company holds franchises for a line forming a connection between the Fitchburg & Leominster Street Railway and the proposed line from Ayer to Lowell. The franchises expire June 1, 1904.

MERIDA, MEX.—A street railway is to be constructed between the San Antonio hacienda and the town of Huhui by Dr. Domingo Evia, of this city.

HOUGHTON, MICH. The Houghton County Street Railway Company expects to extend its lines from Lake Linden to Tamarack-Osceola mills, and possibly to Hancock.

IONIA, MICH.—Local capitalists are planning an electric railway from Ionia to Crystal Lake. The distance is 35 miles, and it is estimated that the railway can be built for $125 per foot, or $230,000. Ionia's Common Council has guaranteed a bonus of $5,000

VICKSBURG, MISS.—The Vicksburg Street Railway Company proposes extending its system to Wattersville, two miles.

ST. LOUIS, MO.—The certificate of incorporation of the Southern Illinois Electric Railway Company has been filed. The company is capitalized at $50,000, and its principal offices will be at Mount Vernon. The line will run from East St. Louis to a point at or near Maumee, on the Wabash River. The incorporators are John R. Piercy, George F. Ward, Samuel Casey, Louis G. Pavey, Samuel T. Maxey and Albert N. Johnson, all of Mount Vernon.

BUTTE, MONT.—The Butte & Salmon River Electric Railway Company has been incorporated and capitalized at $2,000,000, of which $200,000 has been subscribed. The incorporators are T. B. Moss, H. W. Rowley, M. A. Arnold, T. D. O'Donnell and O. F. Goddard, all of Billings. The new road will traverse Silver Bow and Beaverhead counties, starting from Butte. It will run to Horse Prairie and thence through the Lemhi Pass into Idaho.

PATERSON, N. J. The Paterson State Line Traction Company proposes to build a line from Paterson to the State line near Suffern. The company intends to run through Hawthorne, North Paterson, Midland Park, Ridgewood, Allendale and other villages.

ALEXANDRIA BAY, N. Y. The St. Lawrence Electric Railway & Land Improvement Company, which owns and operates the trolley road between Alexandria Bay and Redwood is seriously contemplating building a 20-mile extension of the road to Watertown, taking in the route along Indian River and Butterfield Lake.

TOLEDO, OHIO.—Contractors have been invited to bid on the construction of the Ohio & Michigan Traction Company's line, 48 miles in length. Contracts will be awarded Sept. 1. The line will extend from Toledo to Ann Arbor, by way of Dundee, Milan and Petersburg.

CLEVELAND, OHIO. W. S. Louge, representing Cleveland interests, has purchased the franchises and property of the Frankfort & Suburban Railway. The line comprises seven miles of road, which has not been in operation for about a year. Several miles of new track will be built.

CLEVELAND, OHIO. A. E. Green, representing John B. Hoefgen, has made application for four new 3-cent fare routes as follows: On Denison Avenue, from Rhodes Avenue to the city limits; on Summit Street, from Erie to Seneca Streets; on Edgewater Boulevard, from Taylor Street to Lake Avenue; on Doan Street, from Wade Park Avenue to Ansel Avenue. The Cleveland Electric Railway has also asked for a franchise on Woodland Hills Avenue, Fairmont Street, Cedar Avenue, Dona Street, to the city limits, or by way of Quincy Street instead of by way of Cedar Avenue.

PETERBOROUGH, ONT. A franchise for an electric railway has been granted to the Peterborough & Ashburnham Radial Electric Railway Company. The plans include Ashburnham, Lakefield, Young's Point and Chemong.

CHARLEROI, PA.—The Pittsburg & Charleroi, Street Railway Company has bought the property between Eleventh and Twelfth Streets for the purpose of constructing on it large car houses.

READING, PA.—Extension papers for the construction of the Pottstown & Suburban Railway Company in Berks County have been filed. This line will be 12 miles long. When completed this new line will form the connecting link uniting Reading and Philadelphia by trolley.

BUTLER, PA.—The Butler Passenger Railway will extend its lines to the edge of the new town of East Butler, three miles up the Bonnie Brook Valley. The officers and directors of the new company are D. H. Sutton, president; J. F. Anderson, J. H. Troutman, J. S. Campbell, F. H. Murphy and W. D. Brandon, directors.

PROVIDENCE, R. I. E. K. Watson, of Warren, has been awarded the contract for building the sub-station for the Warren & Bristol branch of the Rhode Island Company at Barrington. The new station is to cost about $13,000.

NASHVILLE, TENN.—A charter has been granted the McMinnville, Woodbury & Nashville Railroad Company, with $10,000 capital stock. The incorporators are John M. Gant, Thomas S. Weaver, W. E. Gamble, M. D. Smallman and Walter S. Anderson. The line of the proposed road is from McMinnville through Woodbury, Jefferson, Smith's Springs to Nashville, with a branch from Smith's Springs to Donelson.

HOUSTON, TEX.—Work has begun on the addition to the power house of the Houston Electric Company. The addition, with the new machinery will entail an expenditure of $100,000. The plant is being enlarged primarily to provide power for the line to Harrisburg, which the company plans to construct next year.

NORTON, VA. The Wise County Electric Light, Power & Transportation Company has been organized to build a road connecting practically all of the Wise County mining regions.

SPOKANE, WASH.—The Adams County Electric Transit Company expects to build a railway between Spokane and Washtuena.

WHATCOM, WASH.—The City Council has granted the Whatcom-Skagit Interurban Railway Company a franchise over certain streets desired to connect with 70 miles of electric railway which the company is to build between Mount Vernon and Deming, on the Noosack River.

NEW INDUSTRIAL COMPANIES.

AMERICAN DISTRICT TELEGRAPH COMPANY, of New York, has been formed under the laws of Delaware to acquire and operate telegraph lines; capital $20,000.

THE GLOBE ELECTRIC CONTROLLER COMPANY, of Amsterdam, has been formed with a capital of $25,000. Directors; R. W. Brown, J. J. Rowe, and R. G. Johnson, of Amsterdam.

THE MANHATTAN SWITCHBOARD COMPANY has been formed at East Orange, N. J., to manufacture electric switchboards, capital $50,000, by Charles Loeffler, Aug. Schramm, Coal H. Von Baur.

ELECTRIC CONTROLLERS.—The International Electric Controller Company has been incorporated in New York; capital $50,000. Directors: Mortimer Stiefel, R. W. Levy and E. M. Neary, New York.

THE STROUD TELEPHONE SPECIALTY COMPANY, of Chicago, Ill., has been incorporated to manufacture telephone and electrical apparatus, with a capital stock of $10,000. Incorporators: Harold D. Stroud, J. C. Whipple and Harry Flyton.

PORTLAND, ME. The American Signal Company has been organized to deal in electrical and mechanical signals. Capital $1,000,000, $50 paid in. Par value, $10. Promotors: James T. Stevens, South Baintree, Mass.; Albert M. Bullard, Somerville, Mass.; A. J. Desmond, president; Harry L. Crom, treasurer; H. P. Sweetser, Portland.

THE WESCO COMPANY has been incorporated under the laws of Maine for making and dealing in electric motors, dynamos and appliances; capital, $1,000,000, of which nothing is paid in. President, M. W. Baldwin; treasurer, J. J. Hernan. Directors: M. W. Baldwin, J. J. Hernan, A. S. Conant and J. E. Mantner, all of Portland, Me.

HAMILTON ELECTRIC COMPANY.—This concern has been formed under the laws of Maine for making and dealing in electrical apparatus; capital, $200,000, of which nothing is paid in. President, J. G. Robinson, Melrose, Mass.; treasurer, E. W. Freeman, Portland, Me. Directors: J. G. Robinson, Melrose, Mass.; E. W. Farnum, Portland, Me.; M. J. Session, Portland, Me.; and Thos. Hamilton, Boston, Mass.

PHILADELPHIA, PA.—The Susquehanna Power Company, recently incorporated for the purpose of harnessing the water power of the Susquehanna River, and conveying current to Baltimore, has secured subscriptions to nearly $10,000,000 of its capital and is about to sign a contract with the General Electric Company for electrical machinery involving $2,500,000 to $3,000,000.

HENRY ELECTRIC EQUIPMENT COMPANY. It is stated that the Henry Electric Equipment Company, incorporated under the laws of Colorado, with a capital stock of $1,000,000, will erect its plant at Springfield, Ohio. C. F. Elliott, president of the company, has been looking over sites and the Commercial Club will take hold of the enterprise. The main offices of the company will be in Chicago. General A. S. Bushnell, former Governor of Ohio, is interested in the company.

YOUNGSTOWN, OHIO. The General Electric & Manufacturing Company has been incorporated to succeed the Central Electric & Manufacturing Company. The officers are the same as those of the old company, the only change being in the name. The new company purchased the business and plant of the Warren Brass Company, of Warren. The company has secured a site for a factory at Struthers, but it is probable that the Warren factory will be retained. Edward S. Whiting has become general manager of the new company.

LEGAL.

WESTERN UNION AND LABOR. Special Master in Chancery H. N. Blake, at Butte, Mont., has reported to the Federal Court his findings in the hearing of the Western Union Telegraph Company against the American Labor Union and other labor unions of Butte for an injunction to restrain the labor organizations from interfering with the business of the telegraph company, because the latter had been declared unfair in a strike of messenger boys. Judge Blake recommended that a permanent injunction be granted the Western Union.

CHICAGO STREET CAR LITIGATION. Two bills have been filed in the Superior Court, at Chicago, asking for the appointment of receivers for the North Chicago Street Railroad Company and the West Chicago Street Railroad Company. The actions are begun by bondholders in the two companies, who declare that the action in the United States court against the Union Traction Company and the two subsidiary companies will not afford the proper protection to the creditors of the two lesser companies.

TELEPHONE SUBSCRIBER DISCONNECTION. Reversing a decision in favor of a physician who brought suit against the Cumberland Tel. & Tel. Company, the court of appeals of Kentucky held that the physician could not recover primitive damages. It appears that by mistake, a physician's telephone was disconnected for nonpayment of rent when the rent was in fact paid. During the 18 hours that the telephone was disconnected persons endeavoring to reach the physician by telephone were informed the telephone had been disconnected for nonpayment of rent. The physician suffered no pecuniary injury. The appeal court also decided that where, by mistake, a telephone is disconnected for nonpayment of rent when it is in fact paid, and the subscriber suffers no pecuniary injury, the measure of damages is the amount paid for the service for the time the telephone was disconnected, taking as a basis the amount paid per month.

WATER POWER RIGHTS. The Supreme Court of Dakota, in modifying but affirming a judgment in favor of the plaintiffs in the suit of the Lone Tree Ditch Company against the Rapid City Elec. & Gas Light Company, decided among other points as follows: Comp. Laws, § 5593, limiting the time for the commencement of an action to recover damages for land overflown by reason of a mill-dam, has no application to an action to restrain one from maintaining a dam, or interfering thereby with prior water rights. 3. In an action to restrain defendant from maintaining a dam or from interfering with plaintiff's use of the water for irrigation and domestic purposes, the evidence being examined, it was held to show that defendant's custom of holding the water during the day and letting it down in large quantities during the night was the immediate cause of an injury to plaintiff, who used the water for irrigating and domestic purposes. 4. Where the waters of a stream, across which a dam had been constructed, were capable of driving the machinery there situated only when the water was retained during the day and discharged at night, and where this procedure was the only thing in connection with the use of the dam of which the owners of prior water rights could justly complain, an injunction against the maintenance of the dam was not justified, a restraining of the injurious practice being sufficient.

HAVERHILL COMPETITIVE LIGHTING.—The Massachusetts Board of Gas and Electric Commissioners has handed down a decision, sustaining the appeal of the Haverhill Electric Company, and annulling the action of the Haverhill Board of Aldermen in granting a franchise to and contracting with the Haverhill Illuminating Company for furnishing electric lighting to the city. This was an appeal by the Haverhill Electric Company from a decision of the Board of Aldermen, of Haverhill, in favor of the Haverhill Illuminating Company. It was held that there appeared to be nothing in either the management or the proposed equipment of the new company which would enable it for any length of time to successfully supply electricity at lower prices or with greater public satisfaction than might be done by the existing company. There was no offer by the new company relative to commercial lighting either as to prices or volume of business to be undertaken, except that it would probably desire to do such business in the central and more thickly settled sections of the city. There was no claim by the new company that it would supply either commercial lights or power at less than the prices now charged. The present company has invested in the business about $250,000, while the new company proposes to invest about $150,000. It is more than probable that the proposed investment would be found too small to carry on a business of equal volume with that now done, and it is, therefore, very doubtful if the new company contemplates an equal extension of business. The new company rested its case almost entirely upon the fact that it had offered to do street lighting at a price which would be about $6,000 per year less than the offer of the existing company. It is suggested in the decision that the old company revise its own figures of service to the city.

PERSONAL.

MR. GEORGE WESTINGHOUSE has returned from England this week on *Kaiser Wilhelm II.*

MR. J. J. WELCH, formerly in charge of the Paterson district of the New York & New Jersey Telephone Company, now takes the management of the Jersey City district, and H. I. Sergeant goes to Paterson in his place.

MR. JOHN B. ORR, late partner of the electrical engineering and contracting firm of James Mitchell & Company, of Rio de Janeiro, Brazil, has opened offices in the city named to make a specialty of handling American electrical machinery for lighting, traction and general power purposes.

LIEUT. LUIZ DIAS CARNEIRO, of the Brazilian Navy, who has been visiting Europe, is now in this country for a few months with the object of seeing something of the work of American electrical and other manufacturers as well as of studying some of the latest civil and electrical engineering.

MR. HENRY J. HALLBERG, lately with the General Incandescent Arc Light Company, of New York, has left for Cincinnati, to take up actively at once his duties as superintendent of the electric lighting department of the Cincinnati Gas & Electric Company, which is to make extensive additions to its system.

PROF. R. A. FESSENDEN has accepted the position of consulting electrical engineer with the Collins Marine Wireless Telephone Company. Prof. Fessenden is continuing work at Old Point Comfort on his wireless telegraph system, which is stated to have about reached the stage of commercial application.

MR. ARTHUR WILLIAMS, past president of the New York Electrical Society, has just returned from a trip to Europe taken for rest and to observe in behalf of the New York Edison Company, recent methods of light and power business. He will present a paper on the subject next month to the Edison convention.

MR. C. L. EDGAR, president of the Edison Electric Illuminating Company, of Boston, and president of the National Electric Light Association, has been spending the past week in New York at the association offices, clearing up matters and arranging for the convention next May in Boston. A great deal of effective work on plan and scope is being done.

MR. J. K. ROBINSON, of Iquique, Chili, who represents the Westinghouse and allied interests on the west coast of South America returned to New York this week from Panama. He is about to place further substantial orders for the electrical equipment of Chilian nitrate plants. Mr. Robinson is making his headquarters with William E. Peck Company, 116 Broad Street.

MR. C. T. MALCOLMSON, the electrical engineer, who has lately been on the staff of the department of machinery at the St. Louis Exposition has resigned to accept the position of chief engineer to the important Lanyon Zinc Company, of Iola, Kan., etc., of which Mr. F. E. Drake is president. The zinc industry affords an excellent opportunity to Mr. Malcolmson's experience and ability.

MR. C. M. GOULD, of the Gould Storage Battery Company, was out in his automobile last week with Mrs. Gould, near his summer residence at Bayside, Long Island, when a startled horse caused the machine to be overturned with serious injury to both Mr. and Mrs. Gould. We are very glad to learn that they are doing well in the doctor's hands, and on the way to recovery from the results of the accident.

MR. JAMES BURKE, the dynamo electric designing engineer, who has been abroad some six years, has returned to this country and has taken an office in the St. Paul Building, New York City. He will still spend part of his time abroad each year. He has been very actively occupied at the Bergmann Dynamo Works, in Germany, which has sent his apparatus all over Europe, and he will still act as consulting engineer for those interests.

MR. SAMUEL INSULL, president of the Chicago Edison Company and of the General Incandescent Arc Light Company, was in New York last week. The "G. I." Company, whose real estate was recently sold to the Pennsylvania Railroad and whose business has been acquired from Mr. Insull by the General Electric Company, has transferred the bulk of its manufacturing plant to the Stanley shops at Pittsfield, and Mr. Insull has been busy cleaning up the details of these important deals.

MISS BOGART, manager of the New York offices in the Havemeyer Building of the electrical engineering and contracting firm of Macartney, McElroy & Company, Limited, is expected back from a short European trip next week. On her arrival here, it is expected that some substantial contracts will be given out for equipment, etc., in connection with the Malta electric traction system for the construction and equipment of which the British concern recently secured the contract.

MR. T. A. EDISON has perfected his commercial phonograph for taking court testimony and other dictation. The record used is nine inches long and capable of taking several "letters." It can be shaved 175 times, making it as cheap as letter paper, and there is a mechanism controlled by the foot of the operator taking dictation from it which stops and starts the machine at the end of a phrase, sentence, or paragraph the operator is capable of remembering while transcribing and a device for making it repeat a given number of words. It is said that with one pair of machines—one for recording, the other for reproducing—one typewriter can, by keeping steadily at his machine, do the work of eight under the present system.

MR. I. L. STOREY, the well-known inventor and motor designer, joined the forces of the Magneto Electric Company, of Amsterdam, N. Y., a few months ago, and since that time has been very busy in developing a line of motors from one up to ten horse power. The company has increased its facilities in order to place these on the market in large quantities, and Mr. Storey when on a visit to New York this week found an immediate appreciation of his new apparatus, securing at once a number of excellent orders. The curves of output and efficiency shown by him to his friends are most striking. Mr. Storey also intimated that the company, which has active men and plenty of capital behind it, would also soon be ready with some other valuable specialties in the electric lighting and power field.

PROF. A. G. BELL.—At Halifax, N. S., on August 11, Prof. Alexander Graham Bell made a statement about his aerial navigation experiments with kites at his Summer home. He denied the report that he had an airship ready to be launched, but he expects to have a flying machine in successful operation before the Summer is over. Asked whether it would be possible to work in a calm a flying machine built on the kite principle, Prof. Bell replied: "The invention of a flying machine is a possibility for the near future. No one who has noticed the flight of birds can for one moment doubt the possibility of flight by a body specifically heavier than the air. I am convinced that the flying machine of the future certainly will be built on the aeroplane theory. A machine capable of combating atmospheric conditions successfully must be heavier than the air, and to a certain extent capable of utilizing these atmospheric conditions." Prof. Bell will now spend his time mostly in experimenting on minor details with the view of giving his machine a greater rigidity of frame at less weight.

MR. STEPHEN T. LOCKWOOD, of Buffalo, N. Y., is interested in a company being formed there to extract radium from uranium ores that are being worked in Grand County, Utah. The Utah bed is of carnotite, a combination of uranium, vanadium, iron, copper and barium, and as later researches showed, radium and polonium. Prof. Becquerel's announcement of the radio-activity of uranium, followed as it was by the discovery of radium, started Mr. Lockwood to thinking whether the uranium from Utah would not give up radium as well as the uranium extracted from the flinty pitchblende. The carnotite from Utah was much easier to work than the pitchblende. They enlisted the attention of the scientists in the eastern universities. Great aid was given them from the laboratories of Columbia and Princeton. "And at last a sample of radium-barium compound was produced which showed a potentiality of 365 on the delicate electroscope in Columbia University." A testing plant will soon be built at Buffalo with a capacity for the reduction of two tons of ore a day. Such a plant would turn out daily 100 pounds of uranium oxide, worth $2 a pound; 10,000 grammes of crude radium-barium compound of ten units activity due to the radium, worth about two cents a gramme, and 100 pounds of other metallic residues known to contain another radiant metal, polonium. The crude radium-barium product will be removed to a laboratory and there reduced to the ultimate radium.

MR. E. W. COLEMAN.—We have not the pleasure of knowing Mr. Coleman, but after reading the subjoined from the *Carrollton Free Press* feel that it would be a privilege to do so: Tuesday morning, while burrowing through a carload of exchanges, Ed. W. Coleman, manager of the Bell Telephone Company here, came into our sanctum. Both of our chairs were in use at the time of his arrival, but we winked at the local man, and he immediately remembered that he had neglected to get the real estate transfers and at once "hiked" for the Recorder's office. We were then at liberty to ask Mr. Coleman to "sit down." We did. He did. Mr. Coleman is a printer by trade, and naturally became reminiscent during his visit. He told us that there should be nothing in a paper that could not be read aloud in the circle where characters are made and where sweetness and delicacy and purity rule absolute. Up to this time we appreciated every word that he had spoken and thought that he was going to "thaw" for a year in advance; but within the next fifteen minutes he had changed the subject entirely and had convinced us "beyond the existence of a reasonable doubt" that in order to successfully run a newspaper it was necessary to place a telephone in our office. Mr. Coleman carries his head high on the telephone boulevard and never shies at independent companies or cuss words. He is a good newspaper man and a good telephone man. When he walks down the street everybody owing telephone rents grins and hurries on and Helfrich's sign of the "big watch" wig-wags in the joyousness of his presence. To have him near cures dyspepsia, removes warts, abrogates that tired feeling and charges the heyday in the blood with rejuvenation and renascence.

Trade Notes.

LAMBERT SCHMIDT TELEPHONES.—The Lambert Schmidt Telephone Mfg. Company has disbanded its New York office and consolidated its selling department with its factory, at 85 Maple Street, Weehawken, N. J., the mailing address being Station 1, Hoboken, N. J.

ROCHESTER ELECTRIC MOTOR COMPANY, of Rochester, N. Y., have issued a neat illustrated catalogue of their direct current factory motors of various styles and sizes and in different positions. Details of construction are also shown, such as coils, armatures, bearings, etc., and there are some characteristic efficiency curves.

REYNOLDS CORLISS ENGINES.—The Allis Chalmers Company have issued a very handsome oblong catalogue relative to their Reynolds Corliss engines. Nearly 200 pages are occupied by data, descriptions of types and details, and views of some fine installations in different parts of the world, in electric and other heavy classes of service.

A NEW TELEPHONE CATALOGUE and up-to-date price list for same have just been issued and are now being sent out by the Electric Appliance Company, Chicago. Any one in the telephone business who has been missed in the distribution will receive a copy of this catalogue by writing to the Electric Appliance Company, 92 W. Van Buren St., Chicago.

PUMPING BY COMPRESSED AIR is the title of a most interesting and well prepared pamphlet just issued by the Pneumatic Engineering Company, of 128 Broadway, New York City, which controls the Titus "air lift" system. Details are given of the apparatus, and a number of handsome views are presented of plants where the company's system and apparatus is in use.

JEFFREY MFG. COMPANY, Columbus, Ohio, have issued a circular, N 73, describing in a brief way their various lines of manufacture. Their new complete catalogue of 376 pages is now ready for distribution and should be applied for, as a valuable and useful piece of trade literature devoted specially to coal mining apparatus, chain belting, elevating and conveying machinery, etc.

NEW YORK SAFETY STEAM POWER COMPANY, of 113 Liberty Street, New York City, have just issued a very neat new catalogue on their automatic engines. It illustrates and describes in excellent manner both the horizontal and the vertical types, and gives data as to many details. The sectional views of the engines are admirable, and full particulars are given as to sizes, etc.

CENTRAL ENERGY TELEPHONES.—The Stromberg-Carlson Telephone Mfg. Company, of Chicago, Rochester, etc., have just issued Bulletin No. 5 in their useful and valuable series of pamphlets on telephone apparatus. This number is devoted to central energy telephones, of which it shows a great variety, assembled and in detail, with the utmost clearness and accuracy. A great deal of data is given also as to telephone parts, including receivers, transmitters, arresters, etc.

A RUBEROID ALBUM is the title of a handsome little pamphlet issued by the Standard Paint Company, of 100 William Street, New York City, to celebrate the twelfth year of Ruberoid roofing, and to give an idea of the large amount of important work that has been done with this material. A large number of views are shown of buildings protected by this roofing, and some interesting details are given as to its composition and ingredients. There is also a profusion of convincing testimonials.

A WIRELESS TELEGRAPH SCHOOL.—The Thos. E. Clark Wireless Telegraph-Telephone Company, Detroit and Pontiac, Mich., have recently instituted a wireless telegraph school for the benefit of those who desire to become familiar with the Clark apparatus. This school is under the tutorship of Capt. R. W. Holmes, an expert wireless telegraph operator. This is an opportunity for students to become familiar with the latest electrical apparatus and also to acquire a knowledge of the instruments which would be impossible to obtain unless by purchasing the student sets.

"SMALL TOOLS" is the title of a handy little 16mo pamphlet issued by the Pratt & Whitney Company in behalf of their small tool department at Hartford, Conn. Its 182 pages enumerate, describe and illustrate a large variety of gauges, taps, drills, reamers, milling cutters, taper pins, dies, etc. The section and data with regard to gauges are most interesting showing how far standardization of screws, bolts, gauges, etc., of various kinds has already been pushed, with enormous gain and economy. The concern has issued also in separate form two pamphlets, one on new model turret lathes and the other on thread milling machinery.

THE GERMANIA ELECTRIC LAMP COMPANY, Harrison, N. J., resumed lamp manufacturing August 17, after an interval of two weeks. During this period the making of incandescent lamps was entirely stopped, a new warehouse was erected, and the stock of lamps which was formerly carried in the factory was moved to the new building. In the factory, new machinery was then added, occupying the space formerly given over to stock; and with this new machinery the company has increased its output about 25 per cent. This increase has been made necessary by the fact that the Germania lamps have experienced a demand which can only be accounted for by the thorough workmanship that is put into each and the entire satisfaction that they all give.

CONDUIT FOR INTERBOROUGH SUBWAY CARS.—A recent testimony to the value of flexible metallic conduit was made by Vice-president and General Manager Bryan, of the Interborough Rapid Transit Company, in an interview published in the New York *Sun*, August 12th. Speaking of the fireproof construction of the new cars for the subway, and the impossibility of the Paris accident being repeated in New York, he says, according to the New York *Sun*: "The wiring for lighting the cars is one roof away from the passengers. Two small wires are insulated with asbestos and carried in conduits of flexible metal." The flexible metallic conduit which he refers to is that manufactured by the Sprague Electric Company, who received the order. This type of conduit is admirable for car wiring as well as the wiring of buildings where thorough protection to wires and insulation is essential. Its flexibility is such that it can be bent around corners and over obstructions with ease, the energy required to bend it being no more than is required to bend a Manila rope of the same diameter. No elbows, therefore, are required and the installation is reduced to absolute simplicity. It is self-evident that this type of conduit is well fitted to car wiring, and it is gratifying to note that the Interborough Company has taken a step forward in improving upon the hitherto careless methods of car wiring.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 11, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

735,708. ELECTRIC ARC LAMP; T. L. Carbone, Berlin, Germany. App. filed May 8, 1902. The arc is maintained in a constant magnetic field, in order to steady it.

735,714. CONTROLLING SYSTEM FOR RAILWAY VEHICLES OR TRAINS; J. L. Crouse, New York, N. Y. App. filed Feb. 20, 1903. Means for interrupting the power circuit and returning the motor controller drum to its initial position when the brakes are applied.

735,755. ELECTROMAGNET; A. Green, Rochester, N. Y. App. filed Nov. 14, 1901. Two cup-shaped parts adapted to telescope each other; one of them carrying a coil and having grooved pole-pieces which, it is alleged, increases the magnetic attraction.

735,760. METHOD OF MAKING ELECTRIC LAMP GLOWERS; M. W. Hanks, Pittsburg, Pa. App. filed May 18, 1901. The end of the glower is held in a fusing arc and its image is at the same time thrown upon a screen, so that its formation can be easily watched, and the glower removed from the arc, when the image indicates that it is of the desired size.

735,761. APPARATUS FOR TREATING ELECTRIC LAMP GLOWERS; M. W. Hanks, Pittsburg, Pa. App. filed July 12, 1901. A machine by which the preceding method may be practised.

735,773. METHOD OF MAKING FIBER INSULATING LININGS FOR INCANDESCENT LAMP SOCKETS; O. E. Kenney, Toledo, Ohio. App. filed Dec. 31, 1902. The fiber cylinder is subjected to a pressing and vulcanizing process to prevent it from swelling, or otherwise changing its size or shape after insertion in the lamp socket.

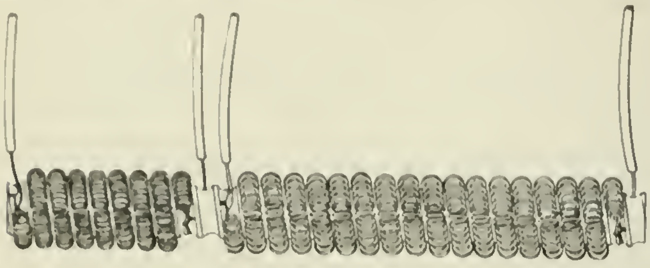
735,786. SYNCHRONIZING APPARATUS FOR ELECTRICAL MACHINES; F. M. Lincoln, Pittsburg, Pa. App. filed Dec. 29, 1902. Comprises two stationary members and two rotatable members having concentric shafts in connection with a single dial plate, and two indexes respectively connected to and actuated by said shafts.

735,798. ELECTRIC HEATER; J. F. McElroy, Albany, N. Y. App. filed April 10, 1903. An electric heater having its heating coil divided into sections of different intensity, each section occupying a longitudinal space on the core, proportionate to its fraction of the total heat intensity.

735,808. COMPOSITION OF MATTER FOR BATTERY ELECTROLYTES; William Peto and James William Thomas Cadett, Ashtead, England. App. March 14, 1903. (See page 304.)

735,817. APPARATUS FOR THE PURIFICATION OF WATER; Samuel S. Pridham, Newark, N. J. App. filed July 20, 1901. (See page 304.)

735,826. METHOD OF TREATING LEAD PLATES FOR USE IN SECONDARY BATTERIES; Charles J. Reed, Philadelphia, Pa. App. filed Feb. 1, 1902. (See page 304.)


735,798.—Electric Heater.

735,821. CLAMPING DEVICE FOR ELECTRIC METAL WORKING APPARATUS; A. F. Rietzel, Lynn, Mass. App. filed July 28, 1902. This invention relates to the clamping devices which are especially designed for use with heavy work and readily adjustable for different kinds of work.

735,841. ELECTRIC SWITCH; H. O. Swoboda, East Orange, N. J. App. filed Sept. 6, 1902. Details.

735,893. CONTROL OF ELECTRIC MOTORS; F. A. Merrick, Johnstown, Pa. App. filed Jan. 14, 1901. A method of carrying a pair of motors across an open circuit position of the controller, consisting in making the period of open circuit of brief duration, and preceding and following such open circuit position by circuit relations, whose connections can be super-imposed without producing short circuits or other undesirable circuit conditions.

735,922. TICKER ATTACHMENT; R. D. Westcote, New York, N. Y. App. filed Aug. 18, 1902. A trough arranged as a continuation of the paper outlet from the ticker, and over which the tape runs so that it can be readily observed.

735,966. ELECTRIC SWITCH; C. C. Gould, Philadelphia, Pa. App. filed March 19, 1902. Details of construction.

735,971. ELECTRIC BATTERY; Henry Halsey, New York, N. Y. App. filed April 18, 1902. (See page 304.)

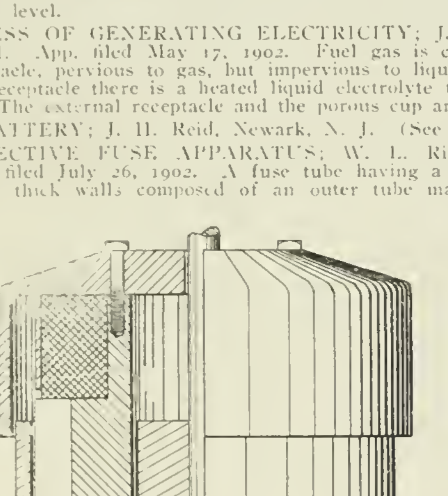
735,990. REGULATING SYSTEM OF ELECTRICAL DISTRIBUTION; Larmar Lyndon, New York, N. Y. App. filed Aug. 16, 1902. (See page 304.)

736,006. TRAVELING CONNECTOR FOR THIRD RAIL ELECTRIC SYSTEMS; J. W. Perkins, San Jose, Cal. App. filed Sept. 23, 1902. The third rail is placed between the traction rails and protected by filling pieces inserted each side of it, which bring the surface of the road bed substantially level with the tread of the traction rail, while the third rail is below this level.

736,016. PROCESS OF GENERATING ELECTRICITY; J. H. Reid, East Orange, N. J. App. filed May 17, 1902. Fuel gas is conducted into a porous receptacle, pervious to gas, but impervious to liquid; at the other side of the receptacle there is a heated liquid electrolyte to which oxygen is supplied. The external receptacle and the porous cup are the electrodes.

736,017. GAS-BATTERY; J. H. Reid, Newark, N. J. (See above.)

736,019. PROTECTIVE FUSE APPARATUS; W. L. Richards, Malden, Mass. App. filed July 26, 1902. A fuse tube having a small bore, and comparatively thick walls composed of an outer tube made of a wound strip of fiber, and an inner tube of similar material, fitting tightly therein, the whole structure forming a strong enclosure.


735,755. Electromagnet.

736,020. APPARATUS FOR THE ELECTROLYSIS OF FUSED SUBSTANCES; Charles W. Roepper, Philadelphia, Pa. App. filed Sept. 27, 1898. (See page 303.)

736,041. CIRCUIT BREAKER; E. P. Warner, Chicago, Ill. App. filed Dec. 20, 1902. Details.

736,048. COMMUTATOR BRUSH; C. Wirt, Philadelphia, Pa. App. filed Jan. 31, 1900. A large number of thin metal plates, or gauze, alternating with layers of poor conducting material.

736,049. ELECTRIC FUSE BOX; J. J. Wood, Fort Wayne, Ind. App. filed Feb. 24, 1903. The fuse is carried in a groove over the end of a plug, which is inserted in a chamber longer in one direction than in the other, the chamber being entirely divided into two compartments by the plug, one half of the fuse being in each compartment.

736,051. ELECTRICAL SIGNALING SYSTEM; J. L. Wrenn, Washington, D. C. App. filed May 11, 1901. Details.

736,055. ELECTROMAGNETIC RAILWAY SWITCH; R. A. Baldwin, South Norwalk, Conn. App. filed Dec. 18, 1902. An improvement on the Baldwin railway switch, affording a means for locking the switch point in either of its positions, and for automatically releasing the lock when the switch is reversed.

736,064. ELECTRICAL SWITCH; R. L. Border, Pittsburg, Pa. App. filed March 24, 1902. The invention relates to a circuit closer to be attached to a trolley wire, and is shown in connection with the operation of a track switchpoint.

736,069. ELECTRIC INCANDESCENT LAMP; C. H. Carter, Brooklyn, N. Y. App. filed Oct. 15, 1902. A construction of socket for a multifilament lamp, in which the lamp has a longitudinal movement to engage with the socket, such movement being permitted to a limited extent without detaching the lamp from the socket, and for the purpose of cutting in and out the various filaments.

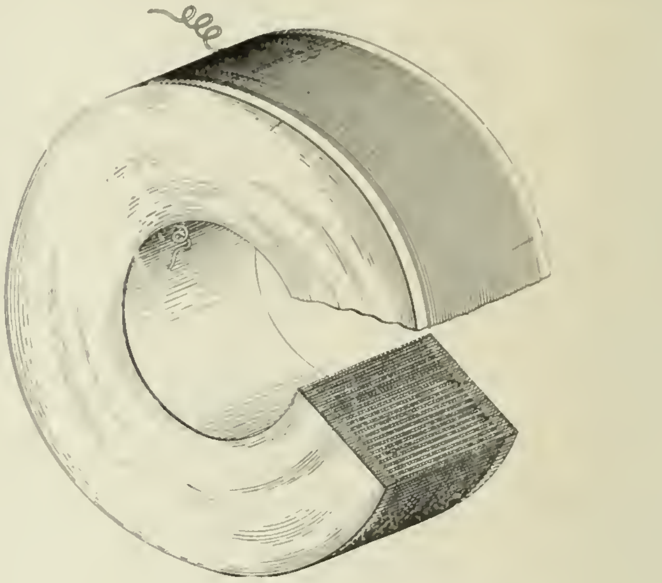
736,086. X RAY TUBE; R. Friedlander, Chicago, Ill. App. filed March 14, 1903. A ray tube having an extension neck, adapted for insertion in the mouth to directly apply the rays emanating from the anode terminal.

736,120. ELECTRIC BRAKE; G. A. Le Fevre, New York, N. Y. App. filed June 21, 1902. Separate motors are used on each car of the train for setting the brakes. The motors are electrically connected together, and automatic means are provided for cutting out each motor independent of the other as a predetermined pressure of its brakes is reached.

736,125. STORAGE BATTERY; Abraham V. Meserole, New York, N. Y. App. filed May 14, 1903. (See page 303.)

736,127. MERCURY SAFETY ATTACHMENT FOR ELECTRIC CIRCUITS; E. Mies, Budesheim, Germany. App. filed Dec. 31, 1901. A safety device for electric circuits comprising a capillary tube containing mercury, which forms a portion of a circuit and means on the tube, actuated by external pressure to restore the mercury to normal condition, should it be vaporized by excessive current.

736,154. ELECTRIC BRUSH; C. T. Richmond, Cleveland, Ohio. App. filed May 10, 1902. A carbon brush having wire gauze embedded therein, and rods of solid lubricating material extending part way through the contact end of the brush.


736,177.—Electrical Coil.

736,177. ELECTRICAL COIL; R. Varley, Providence, R. I. App. filed May 15, 1903. A magnet coil in which each layer of wire is wound upon a smooth wrapping of paper, the lateral edges of which project beyond the end turns of the layer, and are there thickened to furnish a stop which prevents the end turn from falling out.

736,178. PROCESS OF COVERING WIRE; R. Varley, Providence, R. I. App. filed May 20, 1903. In order to place a wrapping of fragile asbestos tape upon the wire, it is wound in conjunction with a paper backing which furnishes the necessary support to resist the strain encountered in the winding operation, afterwards the paper is removed by unwrapping.

736,204. REDUCTION OF NITRO AND AZO COMPOUNDS; Max Buchner, Mannheim, Germany. App. filed Sept. 24, 1900. (See page 303.)

736,205. REDUCTION OF NITRO COMPOUNDS; Max Buchner, Mannheim, Germany. App. filed Sept. 24, 1900. (See page 303.)

736,206. REDUCTION OF AROMATIC NITRO COMPOUNDS; Max Buchner, Mannheim, Germany. App. filed Dec. 14, 1901. (See page 303.)

736,216. SEPARATOR FOR SECONDARY BATTERIES; Absolam F. Clark, Philadelphia, Pa. App. filed July 22, 1901. (See page 304.)

736,217. SECONDARY-BATTERY PLATE AND METHOD OF MAKING SAME; Absolam F. Clark, Philadelphia, Pa. App. filed Dec. 28, 1901. (See page 304.)

736,248. ELECTRIC BATTERY; Henry Halsey, New York, N. Y. App. filed April 18, 1902. (See page 304.)

736,280. REGULATING SYSTEM OF ELECTRIC DISTRIBUTION; Lamar Lynden, New York, N. Y. App. filed Sept. 18, 1902. (See page 304.)

736,292. ALTERNATING CURRENT MOTOR; F. L. O'Bryan, Winston-Salem, N. C. App. filed Dec. 20, 1902. A starting coil comprising a bar, bent upon itself and connected at its end by a yoke or bridge piece.

736,297. RHEOSTAT AND RESISTANCE ELEMENT THEREFOR; C. J. Reed, Philadelphia, Pa. App. filed June 3, 1902. The resistance coils are of helically wound wire, the resistance of which is varied by compressing the helix endwise.

736,298. MEANS FOR SEPARATING MAGNETIC PARTICLES FROM PAPER PULP; Charles J. Reed, Philadelphia, Pa. App. filed Aug. 15, 1902.

736,319. ELECTRIC COIL; R. Varley, Providence, R. I. App. filed May 2, 1903. An induction coil having a cylindrical sleeve which enters an annular groove in the head of the coil, a space between the sleeve and the outer layer of the coil being filled with wax, which is poured in while in a molten state to render the whole coil waterproof.

736,331. APPARATUS FOR THE GENERATION AND APPLICATION OF ELECTRIC CURRENTS FOR ELECTROLYSIS; Francis Edward Elmore, London, England. App. filed Jan. 2, 1903. (See page 303.)

Electrical World and Engineer

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ELECTROLYSIS IN ELECTRIC RAILWAY RETURN CIRCUITS.

In a paper recently read before the annual meeting of the German Electrochemical Society in Mannheim, Mr. Gaisberg described the damage effected in the buried metal pipes of Hamburg by return currents from the street railway mains. It was stated that while lead pipes showed a fairly uniform oxidation, wrought iron pipes were deeply pitted in many places, while cast iron pipes were unaffected. An explanation which suggests itself for these observed conditions, is that wrought iron pipes are usually connected closely together by screw joints, and thus make good continuous metallic connection, while cast iron pipes are not usually closely united in metallic connection, and are thus electrically divided into a series of short lengths. Long conductors buried are naturally subjected to much greater danger from electrolysis than short conductors, because they serve to connect remote areas between which a considerable difference of electric potential may occur. Consequently wrought iron pipes are specially likely to carry return currents, and to be electrolytically disintegrated by them. On the other hand, when the difference of potential in the ground is sufficient to corrode cast iron pipes, the damage is apt to be more serious, since it repeats itself at every pipe joint.

THE TENDENCIES OF INTERURBAN ROADS.

Of the immense growth reported by the United States Census Office in Bulletin No. 3 on street railways, by far the largest part is due rather to the increase of suburban and interurban lines than to great extensions of tramways. During the years since 1900 in particular the former classes have increased in numbers and in mileage with astonishing rapidity. From an engineering standpoint, this growth is very interesting because it is the line of most rapid development, and because it demands the solution of new problems. In the course of this expansion of suburban and interurban service an unconscious but most effective evolution has been going on, resulting in the differentiation of two distinct species of roads, which ought to be separated in any complete study of the statistics of the subject. The one species is the extended street railway, which, while covering a far greater mileage than usual, still retains the essential characteristics that originally belonged to the class. Such a road runs upon track space granted it on public highways, has a continuous route through and between towns, serving as a regular tramway in the more densely populated districts where it operates at very moderate speed and stops practically at the convenience of the passengers. Only in sparsely settled districts between towns does it run at speeds greater than usual in tramway service, or save time by stopping only at certain designated points. The other is in all essential particulars an ordinary railway in which motor cars have been substituted for locomotors and which habitually runs single cars or short trains instead of long trains. These roads most commonly operate on a private right of way, at least in part, do not attempt to do a tramway business in the termini save to a limited extent, and have a train service modeled upon railway rather than tramway practice. Such roads have rolling stock heavier than can advantageously be operated on tramways, equipped with extra powerful motors and power brakes, and habitually operate at speeds which are too great for roads having their tracks on the public highways.

The tramway class derives its working current either from an electrically equipped slotted or a trolley conduit; the other from trolley, or in many instances from a third rail laid at or near the level of the tracks. The line of demarcation between the two classes is by no means sharp, but there is little difficulty in assigning a road to its proper class, and each year separates the species more distinctly. A clear distinction between them is desirable since the relation of the two classes to public needs and convenience is quite different, and it is questionable whether their legal status does not require separate definition. It is not easy to see what material distinction can be drawn between an electric road operating over its own right of way, making infrequent stops at designated points, running one or more long and heavy cars equipped with motors of 100 horse-power or more, and designed to operate at from 20 to 50 miles per hour, and a common railroad covering the same ground and using ordinary locomotives. The obvious line of evolution indicates the abolition of any artificial distinctions that now exist, and in some recent systems the road is frankly and openly put upon a railroad basis in every essential. It would seem that the ordinary terminology of the art has failed properly to designate these important additions to the list of electric roads. Possibly they might advantageously be called "motor railways" to separate them from electric tramways proper, and from interurban tramways which have extended their sphere of activity without changing radically the equipment or methods of operation. This last-mentioned class has perhaps no greater public usefulness than the motor railways, but it is in closer touch with the daily traffic of the streets and may properly be included among the public conveniences to which use of public ways may properly be granted.

The tendency of motor railways is steadily away from tramway equipment and method toward higher speeds, longer distances and heavier service. Some experiments are even being tried with dining cars and sleeping cars to operate on such systems. At present, however, they do not cover distances or make speeds comparable with railway trunk lines, nor do they even when interconnecting go far in the operation of a through passenger service. In the long run it is possible that the motor railways may develop great trunk lines working at speeds far higher than are now in sight, but until they are organized for through service such a result will be withheld. The fundamental necessity for very high speeds lies in long-distance runs between important centers and the first stop in the evolution of motor railways for high speed must, therefore, be "through" accommodations.

Interurban tramways, however, have a very different trend. They tend very strongly to build up long stretches of country into connecting chains of villages and suburbs. Running through these they are necessarily limited to the highways they have tended to populate, and cannot readily progress in the direction of increased speed. They act, therefore, as distributors of population without involving the centralizing process that normally follows the opening of high-speed lines running to large centers. The most useful added function which they could acquire by evolution would be a logical extension into rural service. This is going on to no small extent, and the number of isolated communities which have benefited by the touch of an interurban tramway is in the aggregate very large. The increase in rural values due to this influence has never been computed, but it is quite certainly greater than the cost of the roads required to produce it, probably several times greater. The interurban tramway is a far less sensational affair than the motor railway, but its effect on the general welfare is conspicuously great. The article which we publish in this issue, anent the Saratoga convention, on Schenectady as a trolley railway centre, bears interesting and typical testimony to these processes now going on all over the country.

The Evolution of the Railway Motor.

Nothing impresses more forcibly on the mind the immense growth of electric traction than a comparison, mental or actual, between the motors that were built in the early stages of the art and the hundred or hundred and fifty horse-power machines that in pairs or fours spin the big interurban cars of to-day over forty or fifty miles per hour. The traction motor has gone through many vicissitudes, but the general course of its evolution has been well defined, moving always under necessity toward the goal set by the advance in requirements. In looking back to the early days it will not do to forget that the design of electric motors was very imperfectly understood when Siemens, Edison and others began the early experiments in traction. In the early eighties the idea of magnetic flux and the measurements concerned with it were very imperfectly grasped, ventilation and, in fact, proper lamination of the armature cores was little understood and less practised, and castings of good permeability were not to be had. Considering the crudeness of the dynamos of 1880 to 1885 the wonder is that the beginnings of electric traction offered even the hope of future success. Without disparagement of other notable pioneers it was unquestionably Mr. Sprague's Richmond road that put electric traction on a commercial footing. That was only sixteen years ago, yet the apparatus of that day seems fairly antediluvian. One of the main features of the early Sprague cars was the then wonderful 7½-hp. motor, with its double reduction gear and two commutators. Out of date as it is, that old motor represented progress not so much in design as in adaptability. The previous motors, including some of Sprague's early ones, had been designed for a single gear reduction, and, while in this respect of advanced modern type, they were totally unable to live up to their gearing. Design was too much of a gamble then to justify a low-speed armature, and the little old flat Sprague machine did run, up to the limit of its power, with fair regularity.

It was very hard for the public to understand why a car that had previously been drawn at as great speed as required by a pair of brindled stub-tailed mules could possibly find use for a power so prodigious as 7½ horse-power, so in a laudable but misguided attempt to find out, the public proceeded to hitch on trailers one or more, as the traffic required. Then the grief began, for the public wanted both more trailers and more speed, and the motors protested in smoke. By that time they had shaken the life out of most of the old horse cars, and with better running gear came the 15-hp. Sprague and Thomson-Houston motors that temporarily relieved the situation. These, amid mutual revilings, got down to business and held the field. They were over-rated, according to our modern notions, and were pretty thin-skinned and sensitive to moisture; but they yanked the cars along, trailers and all, and the gears sang merrily the while; but since adamant went out of fashion no man was able to find gears with more than ephemeral life. By that time substantial trucks were attainable, and heavier cars and increased speeds had pounded the life out of the old strap rail, so that tracks were something more than rotten stringers and streaks of rust. Thus a dozen years ago it became possible to build a solider and better designed motor, and the first crop of modern machines ripened. These were at last ironclad with single gear reduction on very powerful armatures, and the new machines, generally rated at 20 and 25 horse-power, did excellent service. The enclosed single gearing ran, thanks to lessened armature speed, fairly quietly, and had an appreciable life, while the iron clad construction kept out at least part of the usual ration of dirt and water. Out of this group of motors sprang the real possibilities of electric traction. We fancy one might still find the old W. P. motor, and some of its contemporaries in occasional use even now.

To almost the same date, when powerful armatures and multipolar construction came into vogue and the demand for slow rotating speed was almost a monomania, belong those curious freaks—the gearless railway motors of which two or three varieties were industriously exploited for some months. No one who saw them could figure out just where the counter e.m.f. was to come from, and to the best of our recollection it didn't come—any to speak of. A few gearless motors were put into service in out-of-the-way places, and by sufficient choking with the rheostat were made to run slow enough to keep to the track. But the experiment has not been repeated, save in some high-speed motors for heavy traction. It is now less than a decade since the traction motor assumed something of its present shape in the use of steel frames and the adoption of series-parallel control. The possibility of getting really good steel castings revolutionized the design of traction motors, for it made it possible to get a motor of moderate speed and of reasonable armature design without the handicap of excessive weight. The series-parallel control revolutionized the speed regulation and greatly increased working efficiency. The first of the steel clad motors were slightly more powerful than their predecessors, but they were the beginning of a long line of increasing sizes. Up to the advent of the steel frame, interurban service and high speeds were rare, but as time has gone on and the requirements of the art have increased, the motor has gone from a modest twenty-five or thirty horse-power to four or five times those figures. But the motor type is substantially the same—a four-pole steel-clad field, with a short and powerful armature drum-wound in open slots. The improvements have been mostly in details like better insulation, more provisions for ventilation and a winding scheme permitting more ready repairs and needing them less. It is a very long step from the interurban motor of 1903 back to the Sprague No. 5 of 1887, but the transition types have been interesting, and somewhere the complete series ought to be open for inspection, as at the St. Louis Exposition.

THE GROWTH OF THE GAS ENGINE.

Engineers have long kept a watchful eye on the development of the internal combustion mover, and it has for some time been plain that large machines of this kind were likely to come into considerable use. In spite of this, a paper by Mr. Kirchhoff in the current number of the *Journal* of the Franklin Institute, cannot fail to give something of a shock of surprise even to those ordinarily well informed. The special topic here considered is the utilization of blast furnace gases for power by means of gas engines. While this is only a special case of gas engine practice requiring somewhat unusual conditions for the full exhibition of its inherent usefulness, the extent to which such special facilities have already been utilized is little short of revolutionary. Mr. Kirchhoff estimates that there are now in use or under construction large engines thus supplied to the extent of over 200,000 horse-power. In addition there are many large gas engines worked on natural or on "producer" gas with most excellent results. Two of these machines now building are of 4,000 horse-power each, while even larger ones are under design. Of course in blast furnace operation there is necessarily a great incidental output of gas amounting to nearly five tons per ton of pig iron produced. The excess gas not needed for heating is sufficient when utilized in gas engines of the present efficiency to produce 1,000 hp-hours for each ton per hour of pig iron produced. Perhaps a fifth of this is needed for the miscellaneous work of the plant, leaving a product of 200 hp-hours per ton of pig per hour as available surplus. As is well known in many plants, a considerable part of this is utilized for doing the work in rolling mills and similar industries often attached to blast furnaces, but most of the progress in this direction has been abroad, although some very heavy work is now under way here.

It is not so much the economic value of this special step that interests us as the effect of the same methods when applied to power generation in general. The now patent fact that the price of fuel is steadily climbing upwards ought to stimulate interest in the development of gas engines for all purposes. The average engineer has been wont to look at the explosion engine as a wheezy, stuffy little affair that smells badly and runs irregularly—fit enough to charge a little used storage battery in a summer house, but not to be relied on for serious business. This contemptuous feeling has gradually been wearing away, but it is not easy to realize that abroad the gas engine is taken in earnest as a prime-mover fit for large work. Indeed, what promises to be the striking feature of the St. Louis Exposition is the remarkable showing that there will be made of continental gas engines. The great economy of the gas engine is indubitable. There are very few modern steam plants even of large size and operated under favorable conditions of load that can show a record of better than one and a half pounds of coal per horse-power-hour, and yet this is easily double the equivalent amount needed in gas engine practice on a large scale. Just now everybody is talking steam turbine, yet the turbine in point of thermodynamic efficiency is simply on a par with first-class engines, while the gas engine is more than double the efficiency of the best of them. Twenty-five per cent. of the theoretical efficiency is regularly reckoned upon in recent Continental practice, while 38 per cent. has been reached in some late tests. So great a difference in favor of the internal combustion engine cannot be lightly passed over or pooh-poohed away as "theoretical," "unpractical," "visionary" or any of the other things which the unprogressive love to label the things which they do not understand. Add to this that the internal combustion engine requires no boiler and takes up as a whole no unreasonable amount of space, and it is sufficiently evident that nothing save the greatest difficulties of regulation and most serious depreciation can keep it from forging forward along the line of heavy power production.

As to the difficulties of regulation, they are said to have been greatly reduced in the large engines built of late. Indeed, such engines have already been applied to electric driving and to operating trains of rolls in the rolling mills. We do not yet know, however, whether the governing has been made quite good enough for certain kinds of electric service railways in particular. For such work as is fairly steady gas engines already govern with sufficient exactness, but the comparatively complicated cycle of many of these machines does not lend itself readily to sensitive governing, and actual data on governing of the big Continental machines are wanting. On the score of depreciation, it must be admitted that the very high temperatures reached in the gas engine cylinder are difficult to deal with, but great progress has been made in cooling devices and in minimizing the effects of local temperature, so that the questions of repairs and depreciation are likely to get a far more favorable answer than would have been the case a few years ago. Yet it must be said that gas engines on the large scale have not been in use long enough to get a clear idea of their real wearing properties, though on the other hand reports derived from engines driven by blast furnace gases for which service many of the largest are used, would be less favorable than normal, owing to the evil effects of dust not yet entirely obviated. Certain it is that if depreciation is as moderate as recent reports indicate is probable, and governing can be made as effective in big engines as in those of moderate size, the gas engine is likely to play a very important part in future power production.

Programme of the Street Railway Conventions at Saratoga.

From all appearances the various street railway conventions at Saratoga Springs next week will more than sustain the interest and importance of previous meetings. While Saratoga itself has not much to show in the matter of electric railways, it is the center of a very interesting interurban and long distance development, supplementing and in some respects rivaling the older steam railway system. Those who attend the convention will have an opportunity to judge of this for themselves.

The meetings of the American Street Railway Association will be held in the ball room of the Grand Union Hotel, Saratoga Springs, on the afternoon of Wednesday, September 2, and on the mornings of Thursday, September 3 and 4. The programme of the association is as follows:

Wednesday, September 2, A. M.—Registration. 2:00 P. M., First Session.—Address of welcome, by Mayor Knapp; president's address; report of the Executive Committee; report of the secretary-treasurer; presentation of papers. 8:00 P. M.—Excursion to Saratoga Casino upon invitation of the Hudson Valley Railroad Company.

Thursday, September 3, 10:00 A. M. Session.—Presentation and discussion of papers. 1:00 P. M.—Excursion to the works of the General Electric Company at Schenectady, upon invitation of the General Electric Company.

Friday, September 4, 10:00 A. M. Session.—Election of officers and any unfinished business. 1:00 P. M.—Excursion to Lake George on train drawn by electric locomotive, upon invitation of the Hudson Valley Railroad Company. 8:00 P. M.—Banquet in the ball room of the Grand Union Hotel.

The titles of the papers to be presented are announced as follows: "The Right of Way," by Herbert H. Vreeland, of New York; "Comparative Merits of Single and Double-Truck Cars for City Service," by John I. Beggs, of Milwaukee; "The Manufacture and Distribution of Alternating Currents for City Systems," by Richard McCulloch, of Chicago; "Freight and Express on Electric Railways," by J. B. McClary, of Birmingham; "Train Orders and Train Signals on Interurban Roads," by T. E. Mitten, of Buffalo; "The Evils of Maintenance and Champerty in Personal Injury Cases," by Michael Brennan, of Detroit; "Electrically-Welded Joints," by William Pestell, formerly of Worcester, and now of J. G. White & Co.; "Steam Turbines," by W. L. R. Emmet, of the General Electric Company, Schenectady.

The convention of the American Railway Mechanical and Electrical Association begins one day earlier than that of the American Street Railway Association, or of the Accountants' Association. The meetings of the association will be held in one of the club rooms of the Grand Union Hotel, very near the meeting halls of the other two associations, and the first meeting will be held on Tuesday, September 1, 10:30 A. M. An address of welcome will be extended by Hon. Edgar T. Brackett, State Senator of New York State. The meetings on September 2, 3 and 4 will be called to order at 10:00 A. M. The papers to be read are as follows: "Shop Kinks," by H. H. Adams, of Baltimore; "Type M Control," by W. O. Mundy, of St. Louis; "Improvements in Street Car Motors," by E. W. Olds, of Milwaukee; "Care and Maintenance of Car Bodies," by C. F. Baker, of Boston; "Shop Practice," by Alfred Green, of Rochester; "The Use and Abuse of Controlling Mechanism," by D. F. Carver, of Jersey City.

The meetings of the Street Railway Accountants of America Association will be held in one of the club rooms at the end of the court piazza of the Grand Union Hotel. The following programme has been adopted for the Saratoga meeting:

Wednesday, September 2, 1903, in Convention Hall, Grand Union Hotel, 10:00 A. M., sharp.—Annual address of the president; annual report of the Executive Committee; annual report of the secretary-treasurer; paper, "Freight and Express Accounts," by Irwin Fullerton, general auditor, Detroit United Railway, Detroit, Mich.; appointment of convention committee on nominations; appointment of convention committee on resolutions; replies to questions.

Thursday, September 3, 1903, 10:00 A. M., sharp.—Paper, "Car Maintenance Records," by S. C. Stivers, New Jersey & Hudson River Railway, Edgewater, N. J.; paper or address by Mr. W. M. Steuart, of the United States Census Bureau; report of the committee on a standard form of report for electric railways, chairman, William F. Ham, comptroller Washington Railway & Electric Company, Washington, D. C., replies to questions.

Friday, September 4, 1903, 10:00 A. M., sharp.—Paper, "Advantages and Disadvantages of Bag or Envelope Receiver System of Conductors' Deposit," by F. R. Henry, auditor St. Louis Transit Company, St. Louis, Mo.; "Comparison of the Municipal Tramways Association of Great Britain, Proposed Standard Classification and Form of Report with the American Standard," by C. N. Duffy, secretary Chicago City Railway, Chicago, Ill., chairman Committee on Standard Classification; report of Committee on Resolutions; report of Committee on Nominations; election and installations of officers; adjournment.

Programme of American Electrochemical Convention.

The fourth general meeting of the American Electrochemical Society will be held at Niagara Falls, N. Y., September 17th, 18th and 19th, 1903. The meeting will be held at the auditorium of the Cataract House, beginning at 9 A. M., Thursday, September 17th. Thursday and Friday afternoons will be devoted to visits to power houses and certain of the electrochemical plants which are open to visitors, and to other points of interest in the vicinity. Thursday evening there will be a smoker and entertainment at the Cataract-International. Friday evening a dance and reception will be given at the Cataract House. Saturday evening will be devoted to a trip to Niagara-on-the-Lake, Youngstown and Port Niagara by boat and trolley. The headquarters will be at the Cataract House. The special rates at the Cataract House and International Hotel are $3.50 to $5.00 per day American plan. For further information concerning hotels, the local secretary, C. L. Collins, 2nd, Niagara Falls, N. Y., should be addressed.

The following titles of papers have been announced: "A New Type of Electrolytic Cell," P. G. Salom; "Manufacture of Ferro-Alloys in the Electric Furnace," Dr. George P. Scholl; "Electrolytic Copper Refining," Dr. W. D. Bancroft; "Electrometallurgy of Gold," Dr. W. H. Walker; "Some Theoretical Considerations of Resistance Furnaces," F. A. J. Fitz-Gerald; "On the Supposed Electrolysis of Water Vapor," F. Austin Lidbury; "Efficiency of the Nickel Plating Tank," Prof. O. W. Brown; "Electrolysis of Sodium Hydroxide, by Alternating Current," Carl Hambuechen; "A Practical Utilization of the Passive State of Iron," Prof. C. F. Burgess; "The Present Status of the Theory of Electrolytic Dissociation," Dr. E. F. Roeber; "Berthelot's Law of Electrochemical Action," C. J. Reed. Other papers are expected from Dr. J. W. Richards, David H. Browne, Dr. L. Kahlenberg, Prof. C. F. Burgess, A. H. Cowles, and others. One session of the meeting will be devoted to the discussion of the theory of electrolytic dissociation, which will be opened by Dr. W. D. Bancroft.

Convention of Municipal Electricians.

The eighth annual convention of this association will be held at the Hotel Rudolf, Atlantic City, N. J., Wednesday, Thursday and Friday, September 2, 3 and 4, 1903.

The secretary, Mr. Frank P. Foster, will be at headquarters on the day preceding the opening session, i. e., September 1. Members and friends who desire to go via New York City should communicate with Mr. F. C. Mason, chairman Committee on Transportation, 16 Smith Street, Brooklyn, N. Y., at once, giving the number expected in their party. The train will leave foot of Liberty Street, via Central Railroad of New Jersey, at 3.40 P. M., Tuesday, September 1. Round trip tickets good for 15 days, $4.75. This will allow all who wish to remain over Labor Day at Atlantic City.

A very interesting programme has been outlined. There will be given a lecture on wireless telegraphy by Mr. A. Frederick Collins of New York. This will be illustrated by actual working apparatus and lantern slides. Besides this there will be given a demonstration of the Cooper-Hewitt mercury vapor lamp and static converter by Dr. M. von Recklinghausen, and Mr. Percy Thomas. There will also be shown a lamp that has never before been exhibited in public. Associate members desiring to exhibit should communicate with Mr. William E. Cochran, manager Hotel Rudolf. The opening session will be called to order promptly at 9.30 A. M., Wednesday, September 2.

Electric Traction in Sydney, New South Wales.

By Arthur C. F. Webb, M. I. E. E.

ELECTRIC traction in Sydney, New South Wales, if somewhat slow in coming has evidently come to stay, steady progress having been shown since the first city line was laid in George Street. An experimental line laid in 1890 on a short connecting line between the adjacent suburbs of Randwick and Waverly was afterwards, in 1893, removed to the North Side of the harbor and re-erected as an extension of the cable system. Various extensions were made, but all on that side of the harbor, and as continuations of the cable line to Mosman's Bay and Willoughby. The first line put down for permanent running on the South Side was an extension of the cable system also, and ran from the terminus of Ocean Street to Rose Bay, a distance of about 1¼ miles. Shortly afterwards came the inauguration of a line to run down George Street, the principal thoroughfare from Circular Quay, where many of the busiest ferry services terminate, to the railway station and on to Pyrmont. This was intended as a further experiment to prove the practicability or otherwise of displacing the steam service entirely by electric traction, but before the plans were completed it was decided to make provision for power for other lines, and eventually the power house was so planned as to allow of extensions to supply power for the whole tramway system.

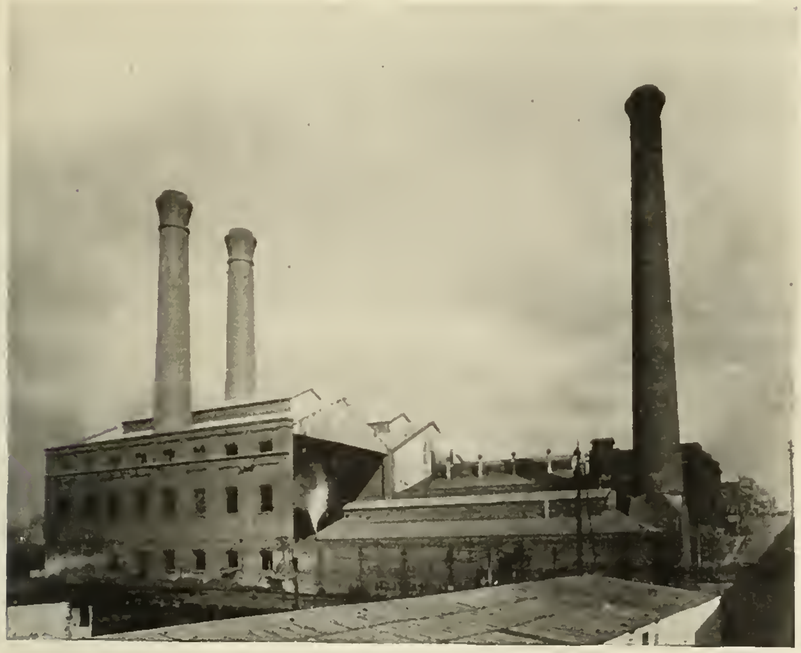
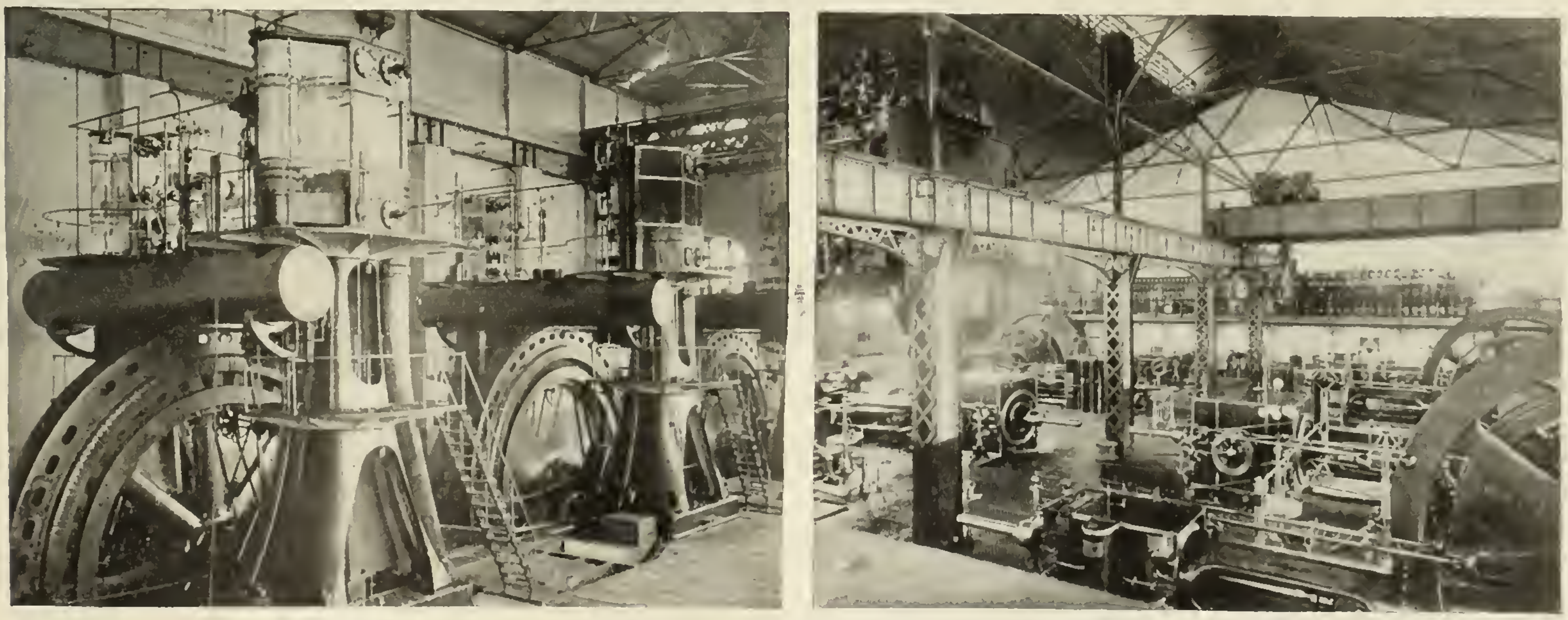


FIG. 1.—ULTIMO POWER HOUSE.


Figs. 2 and 3.—New and Old Engine Rooms, Ultimo Power House.

The power house (Fig. 1) is conveniently situated at Ultimo, close to the railway from which a special siding is run for coal-carrying purposes and not far from Darling Harbor, from which the supply of water for condensing purposes is pumped. The building is arranged with offices, battery room, pumping chambers, etc., in front, and engine house and boiler house side by side behind the office building. The engine room is 98 ft. wide and boiler room 85 ft. wide, and both are capable of extension longitudinally to an extreme length of 500 ft. The first portion constructed was 100 ft. long and extensions of 170 ft. of both engine and boiler houses have now been added.

The first portion of plant erected comprised four sets of steam generators, each of 850-kw capacity, consisting of General Electric multipolar generators (Fig. 3) directly-connected to Allis compound horizontal engines and so arranged in two rows that one condenser may serve two engines. The generators have 12 field poles, the armatures being slotted and drum-wound and weigh about 21 tons each; the fly-wheels are compound, the rims being reinforced with steel plates, turned up in position, are 20 ft. in diameter and weigh about 40 tons. Each set is capable of an overload of 50 per cent. for a period of one hour or an overload of 100 per cent. for "kicks" without injury.

The boilers are arranged in two rows, there being 14 in the first instalment. They are multitubular, of 300 hp each. The circulating pumps are Blake centrifugal, and the feed pumps Blake three-throw plunger, all electrically-driven, and the air pumps for Wheeler condensers are Blake steam-driven.

Over each row of generators is a traveling crane with a span of 48 ft., each motion is controlled by a separate motor, General Electric standard railway type being used for traveling and hoisting and a 25-hp General Electric motor for traverse, all motors being series-wound with rheostatic control. The lifting capacity of the crane is 30 tons.

The new engine room extension (Fig. 2) consists of an addition of 170 ft. to the southern end of the old engine room, making the present size 98 ft. x 270 ft. The height of this building from ridge to basement floor is 100 ft., and from tie-rods to engine room floor 55 ft. This extension provides for six 1,500-kw sets, three of which are now in operation. Each set comprises a vertical cross-compound Allis engine direct-coupled to a General Electric three-phase alternator, 25 cycles, supplying 131 amp. per phase at 6,600 volts, and designed for an overload of 25 per cent. for two hours. The engines run at 75 r.p.m. The fly-wheel carrying the rotating field is 29 ft. in diameter with a rim 36 in. x 14 in., the total weight of each set being about 450 tons.

The height of boiler room from ridge to ash tunnel floor is 118 ft. and from tie-bars to ground floor 77 ft. In addition to the old chimney stack two new chimneys 227 ft. high have been erected one on either side of the boiler room. The new boilers consist of sixteen 250-hp Babcock & Wilcox make designed for a working pressure of 100 pounds. They are fitted with Babcock & Wilcox chain grate automatic stokers, operated by a small vertical steam engine. Provision is made for bringing the total number up to 60 boilers of this type and capacity. Under normal conditions each boiler is capable of evaporating 7,500 pounds of water per hour. Automatic coal and ash handling plant is used. Coal bunkers having a capacity of 2,500 tons are placed above the upper tier of boilers, the coal is dumped from the railway trucks through a crusher, which reduces it to a 3 in. gauge and passes it on to the bucket elevator, 576 ft. long, with 288 buckets. This elevator raises at a rate of 40 tons per hour. The coal is carried by shoots to the stokers, the ash produced by the boilers is fed through shoots by gravity to ash cars standing under the ash hopper in the basement of the boiler house. These ash cars deliver the ashes to the same line of buckets that handle the coal, and ashes are thus automatically elevated to a large bin at the top of a steel tower on the outside of the boiler house. Here they are dumped and the ashes descend by gravity and are loaded into trucks and conveyed by rail to the ash dump anywhere along the line of railway.

In the auxiliary plant there are three vertical compound beam air pumps for condensers and three compound horizontal circulating pumps all of Worthington manufacture, and two combined air and circulating pumps for the exciter engines and stoker engines. The exhaust from all auxiliaries is carried to two feed water heaters, each of 1,200 sq. ft. heating surface, situated beneath the upper boiler room floor between the two new chimneys. The crusher is driven by a 20-hp enclosed motor and the bucket conveyor by a 15-hp motor.

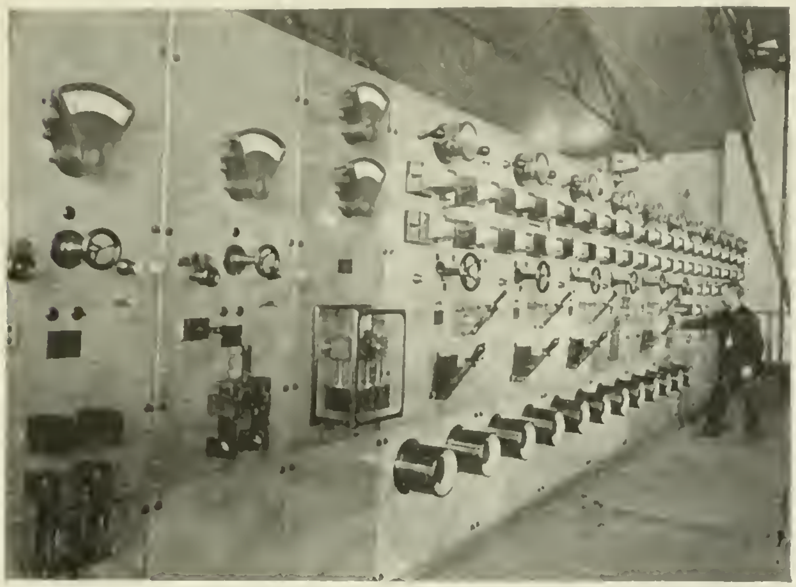


FIG. 4.—HIGH-TENSION SWITCHBOARD, ULTIMO POWER HOUSE.

Lubrication is carried out through a complete gravity system by means of oil pumps in basement and tanks in roof. The overhead crane in the new part of the building was built by the Morgan Engineering Company, and is operated by a 30-hp motor for hoist, 5-hp for travel and 50-hp for traverse, giving speeds of 10 ft., 100 ft. and 150 ft. per minute respectively, with a load of 35 tons.

The new high-tension switchboard (Fig. 4) is situated on a gallery running across the engine room between the old and new plant. There are six generator panels, five feeder panels, three exciter panels, one exciter summation panel, and one generator summation panel. Each generator panel is equipped with three single-pole, single-throw oil switches, one switch for each phase, each phase being in a separate compartment of brick and soapstone. All switches are connected by bell cranks and levers to a mechanical switch on the working face of the board. There are also two reverse-current relays, each consisting of a ⅛-hp, direct-current motor with the necessary limit stops, etc. The instruments on each generator panel comprise one induction type recording wattmeter, indicating wattmeter, ammeter for main generator, ammeter for field circuit, voltmeter reading to 8,000 volts of Thomson inclined coil edgewise type, all instruments being connected through transformers, the actual potential on the working face of the board being 110 volts. In addition there is a field switch and synchronizing plug.

There is also an arrangement by which the speed of the engine can be controlled from the board, consisting briefly of a ¼-hp series motor geared to a screw shaft, which changes the position of the governor weights and varies position of cut-off. It is provided with limit stops in each direction and is controlled by a switch on the board. Synchronism is indicated by the voltmeter and lamp method, the lamp being connected to two transformers, one for machine and the other for bus bars in such manner that the lamp is out when synchronism is attained. There is also a push button switch for signalling; it has three buttons: red, black and white; on the red being closed a lamp is lit behind the necessary signal to indicate that a certain machine should be started and rings a gong to attract the engineer's attention to the visual signal. The black button is used to operate a similar signal to indicate the necessity of shutting down the engine and the white button is used to replace either signal

The generator summation panel measures the entire output of all generators and contains a total recording wattmeter of induction type, three Thomson inclined coil edgewise ammeters, one for each phase, and three similar voltmeters to show whether the system is balanced. Also two Thomson edgewise indicating wattmeters, the readings of which added together will give the total output and the ratio of the power factor, and a small three-pole switch, which disconnects the pressure coils of all wattmeters. Of the five feeder panels there are four for double unit sub-stations and one for single unit. Each carries a switch similar to the generator switches, except that there is also an automatic attachment which lights up a red lamp to indicate that the circuit-breaker attachment has acted, and the reverse-current relay also lights up a red signal lamp. There is also on each an induction type recording wattmeter and three Thomson inclined coil ammeters.

The summation exciter panel has two voltmeters, one on bus-bars and the other can be plugged to either machine. Rheostats are all below the board and are operated by vertical shafts. The direct-current switchboard consists of four generator panels, one generator summation panel, one exciter panel, one battery panel and seventeen feeder panels, all of the usual standard General Electric Company's pattern. From this board is also supplied power for the lighting of the Central Railway station at Redfern, Eveleigh yards, Darling Harbor yards and Goods Sheds, Darling Island grain sheds, power house, etc., and power for operating grain elevators, Pyrmont and Glebe swing bridges, sewerage pumps, etc.

Sub-stations are located at Bondi, Randwick, Newtown, North Sydney and City (Macquarie Street), four being double-unit and one single-unit stations. Each unit comprises three 175-kw static transformers, one 450-kw rotary converter, having a maximum load for two hours of 600 kw; a storage battery of 600 kw maximum discharge capacity and a 100-kw reversible booster. In the transformers the pressure is reduced to 375 volts and in the rotary converter it is converted into direct current at 600 volts. The booster is wound in such manner that all of the peak above the output of the converter will be thrown on the battery.

The city sub-station, for instance, comprises two separate buildings. The converter house, 50 ft. x 30 ft. and 17 ft. in height in the clear will contain transformers, rotary converter, booster and switchboard, and is fitted with an overhead traveling crane. The battery house is in two stories, the dimensions of each room being 50 ft. x 40 ft. and 10 ft. high, and carries two Tudor batteries, each consisting of 280 cells, each of 500 amp.-hour capacity for a one-hour discharge.

The switchboard for a double-unit sub-station will contain two alternating-current rotary converter panels, two direct-current rotary converter panels, two booster motor panels, two booster generator panels, two battery panels and about five feeder panels; also two high-tension panels carrying high-tension oil-break switches and edgewise voltmeters reading to 8,000 volts. The circuit-breakers on the motor side of the booster are connected to the battery circuit-breaker and all fields are connected to discharge rheostats. The rotary converters can be either separately or self-excited. Each of the alternating-current converter panels contains a voltmeter and synchronizing lamp.

The high-tension feeder cables have triple-core paper insulation and are lead-covered. They are laid in a wood trough of double planking and run in solid with compound with a layer of bricks on top as a safeguard and warning to the ubiquitous man with the pick. The George Street and Harris Street lines are equipped with center-pole construction, except at the end of George Street, where the width of the thoroughfare did not admit of it. Mannesmann steel poles are used with iron brackets and cast-iron ornamental bases and fittings, set in concrete with a trachyte protective kerb, the track being laid with 7 ft. centers. On the latter lines, which have been equipped by the Railway Commissioners (who are responsible for the running of the trams after construction), regular span wire has been adopted, with side poles and brackets on single-line work in distant suburbs with a light service. The trolley wire is mostly figure 8 shape, having a sectional area of about 0.13 sq. in. Billings & Spencer, Pass & Seymour and English Electrical Engineering Companies' overhead material is used.

The permanent way on the George Street and other main lines consists of 83-pound rails Vignolles pattern, laid upon concrete with a wood-block roadbed, the joints being bonded with Edison-Brown plaster bonds; "Crown" and "Chicago" bonds also being used. As a supplementary return a copper cable of 0.45 sq. in. sectional area is laid between each track from Circular Quay to the railway station, and each cable is connected to alternate rails on either side. These cables are laid against the inner rails of their respective tracks and cross-connected every 60 yards, the connection between the cable and inner rail being made with a special gun metal clip bolt, which has a lug bent around and sweated to the cable, and is provided with a shank to pass through the web of the rail. A copper strip 1½ in. wide x 3/16 in., having one end bent around and sweated to the cable, joins it to the outer rail, the other end being amalgamated and clamped to the web of the rail by a gun metal bolt. The bolt heads and nuts—also amalgamated—are slightly undercut to form a receptacle for retaining a little plastic alloy. At the intersection of George and Liverpool Streets nine cables each of 0.45 sq. in. sectional area are joined to the rails as supplementary returns and return to the power house at Ultimo by a short cut. The supplementary cables are all coated with Stockholm tar and the joints between rails and copper strips are served with a coat of P. & B. paint.

The feeder cables for George Street are placed underground in Callender-Webber casing, made of a concrete of bitumen and wood fibre, laid partly under the footpath and partly under the roadway between the tracks, brick pits being employed for junction boxes with cast-iron draw boxes. The brick pits are 4 ft. x 3 ft. and 5 ft. deep and are drained into the sewer. Sealed cast-iron junction boxes were used at first, but had to be abandoned on account of the difficulty found in keeping them water-tight. A nine-way conduit is laid to the junction of Liverpool and George Streets; where the first feeder taps off there are eight-way runs, reducing to six. This conduit carries five feeder cables for the main city line and two for the North Sydney service, crossing under the harbor. The feeder cables for the low-tension work are Callender's make, 0.45 sq. in. sectional area, with an over-all diameter of about 1¾ to 1⅞ in. For extension feeders weather-proof cables have been run overhead of approximately the same sectional area.

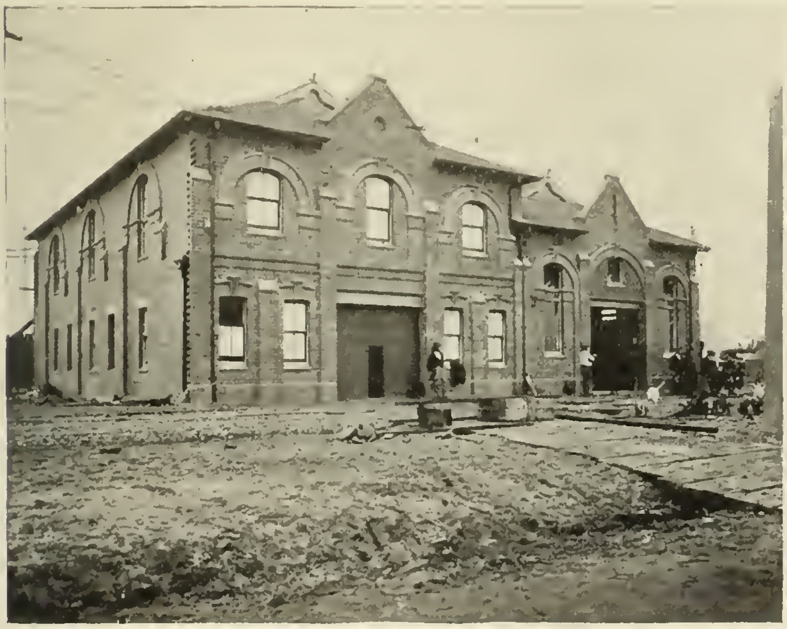


FIG. 5.—EXTERIOR OF SUB-STATION.

Several types of cars are in use, but the car which has been found most suitable for all-round work (Fig. 8) and was for some time adopted as a standard is described as a combination bogie or double-dummy car, and a large number of cars have been built of this pattern. It has an end-to-end platform length of 36 ft., with a width of 6 ft. 3 in., and is carried on two four-wheeled bogies. It weighs about 10 tons. It is constructed to seat comfortably 48 passengers, the accommodation being provided in a central compartment entirely enclosed, and open-sided seats at each end; these open-sided seats can be reversed so that passengers may be better protected from the weather if necessary and can be closed in with water-proof blinds. The under frame is of pitch pine, the car framing of Tasmanian blackwood, with Kauri pine for ceilings and panels of basswood. The trucks are of Brill & Peckham construction, and Standard and Christensen air brakes are used.

There are at present in use some 578 cars made up of 93 four-wheeled motor cars and trailers, seating 52 passengers each, 251 standard double-bogie cars, seating 48 passengers, 16 American bogie cars seating 49 passengers, 16 bogie cross-seated cars seating 70 passengers, and 202 coupled four-wheeled cross-seated cars seating 45 passengers. This latter type, which is very popular and seems likely to become the standard, is modeled on the old steam cars. For the year ending July 1, 1902, the trams ran 7,202,000 car-miles and carried 84,000,000 passengers, earning £495,000, with an expenditure of £429,000, netting well over 3 per cent. on the capital outlay of £2,059,000.

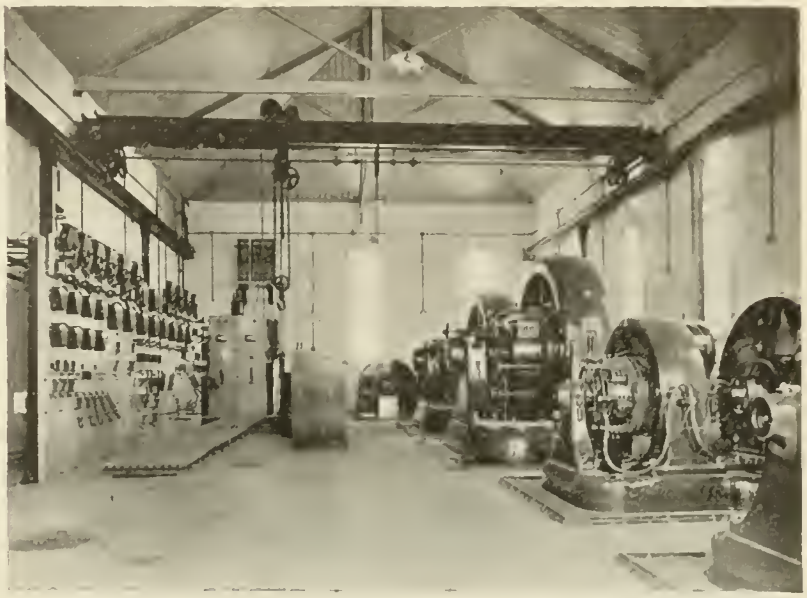


FIG. 6.—INTERIOR OF SUB-STATION.

The North Sydney system was until lately run by a separate plant located in the cable power house, and next by underground low-tension feeders laid under the harbor. Then the cable lines were all converted to electric and now there is a new sub-station supplied by means of high-tension, three-phase feeders laid under water from Dawes to Milton's Point. North Sydney, a thickly-populated suburb or collection of suburbs on the North Side of the harbor, is served by lines of ferry steamers running from the city at Circular Quay to various points. From Milton's Point until recently a cable train carried a large proportion of the traffic up the hill to Ridge Street, from which point the electric service commenced running to Gore Hill, Willoughby, Military Road and Mosman's Bay, the latter line and Neutral Bay line also running down to the shores of the harbor

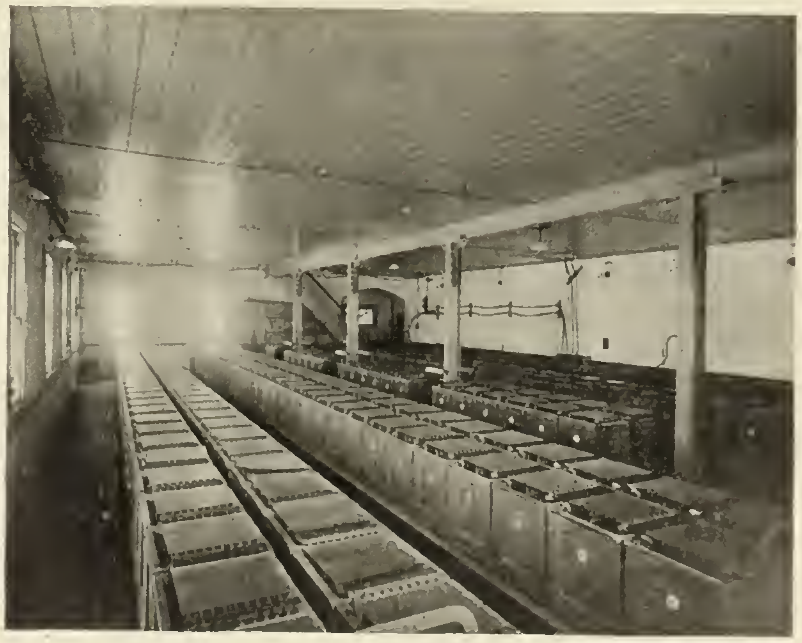


FIG. 7.—SUB-STATION STORAGE BATTERY.

and picking up passengers from other lines of ferry steamers. The North Sydney service is a heavy one, inasmuch as the ground rises steadily from the shores of the harbor until it reaches a height of about 300 ft. at the terminus of the Gore Hill line, so that a heavy load comes on as each ferry steamer comes in and discharges its load of passengers. This applies equally to the Mosman's Bay and Neutral Bay services, which also rise steadily up hill. The Mosman's Bay line, though short, is very severe, both in the way of grades and curves, as the road rises all the way from the water's edge and consequently there is a very small percentage of level or straight road, the average grade throughout being 1 in 18 and the ruling grade 1 in 12, which is on a curve of 2½ chains radius. Of the whole distance of 64 chains, 25 chains are on a grade of 1 in 13 or over.

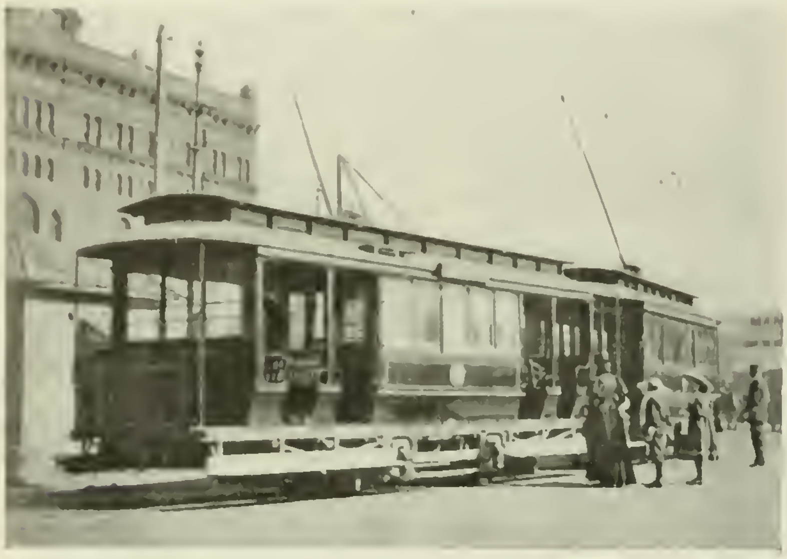


FIG. 8.—TYPE OF CAR.

The total length of all the Sydney tramways consists at present of about 115 miles of track, 45 miles of double track and 25 miles single track. The greater portion, in fact all but a very small portion, is worked electrically. It is an interesting feature of this excellent system that so much of the apparatus and material should have been furnished from the United States.

Bell Telephone Growth in Missouri.

Officials of the Bell Telephone Company of Missouri estimate that more than $700,000 will be expended for improvements in and around St. Louis during the year 1903. In the city the 17,000 ft. of conduits which were built last year are being cabled, which work will be completed in a short time. The company will then have over 1,500,000 ft. of underground conduits in St. Louis.

Two new exchanges are now building, one at Grand and McRee Avenues, and the other on Delmar Avenue, east of Lake Avenue. The one at Grand and McRee Avenues will be completed within a month, and will be called the "Grand" exchange; the other will be completed by the first of the year and will be called the "Delmar" exchange. Several other exchanges have recently been completed and in all the company now has ten exchanges situated in different parts of the city. Next year more exchanges are to be built in South St. Louis.

Additional switchboards are being installed in the main exchange at Tenth and Olive Streets. At present the company is too cramped to give its best service. With the new switchboards, however, 19,000 subscribers can be accommodated at the main exchange. The company at the present time is doing much more work out of the city than in. A line is now in the course of construction from St. Louis to Little Rock, Ark. The line from Little Rock to Poplar Bluff is almost completed. One hundred and sixty miles still remain to be finished from St. Louis to Poplar Bluff. When this line is finished it will be extended southward to the Gulf and will take in all towns on the Iron Mountain Railroad from St. Louis to Little Rock. It will carry five circuits. In the near future the company will give all towns in the southeastern part of Missouri service over connecting lines. A line will be extended to Cape Girardeau inside of two months.

Schuckert Surface-Contact Street Railway System.

By S. N. Taylor, Ph. D.

The description here given represents an experimental street railway manufactured at the Schuckert Works, Nuremberg, Germany, known as the "Contact-Knob" system. While it costs more to install this system than it does the trolley system, yet it costs less than the ordinary conduit system, and it is claimed that when once installed it costs little or nothing to keep it in working order.

In the center of the track is a row of iron knobs or contact studs. The studs are separately insulated and imbedded in blocks of stone, and sunk in the track bed at intervals of some six feet apart midway between the rails. The knobs thus located project about an inch above the pavement, and it is from these that the current is to be received. From each knob a wire goes first to a relay then to the positive main; and both lead wires and positive main are carefully and permanently insulated and buried underground, requiring no further attention. The purpose of the relay is to throw the contact stud into circuit as the car passes over it and to throw it out again immediately after.

The track is divided into sections of say one hundred yards each, and for each section there is a section box into which the relays for that section are placed. The section boxes are fitted up with relays and placed in proper adjustment before they leave the factory, so that all that is to be done with respect to them after the new track has been laid is to place the boxes in position and to connect the lead wires to them. They are usually sunk in the ground by the side of the track and closed in by a water-proof cover. They are easily accessible and made large enough for a man to enter them to inspect the relays at regular intervals.

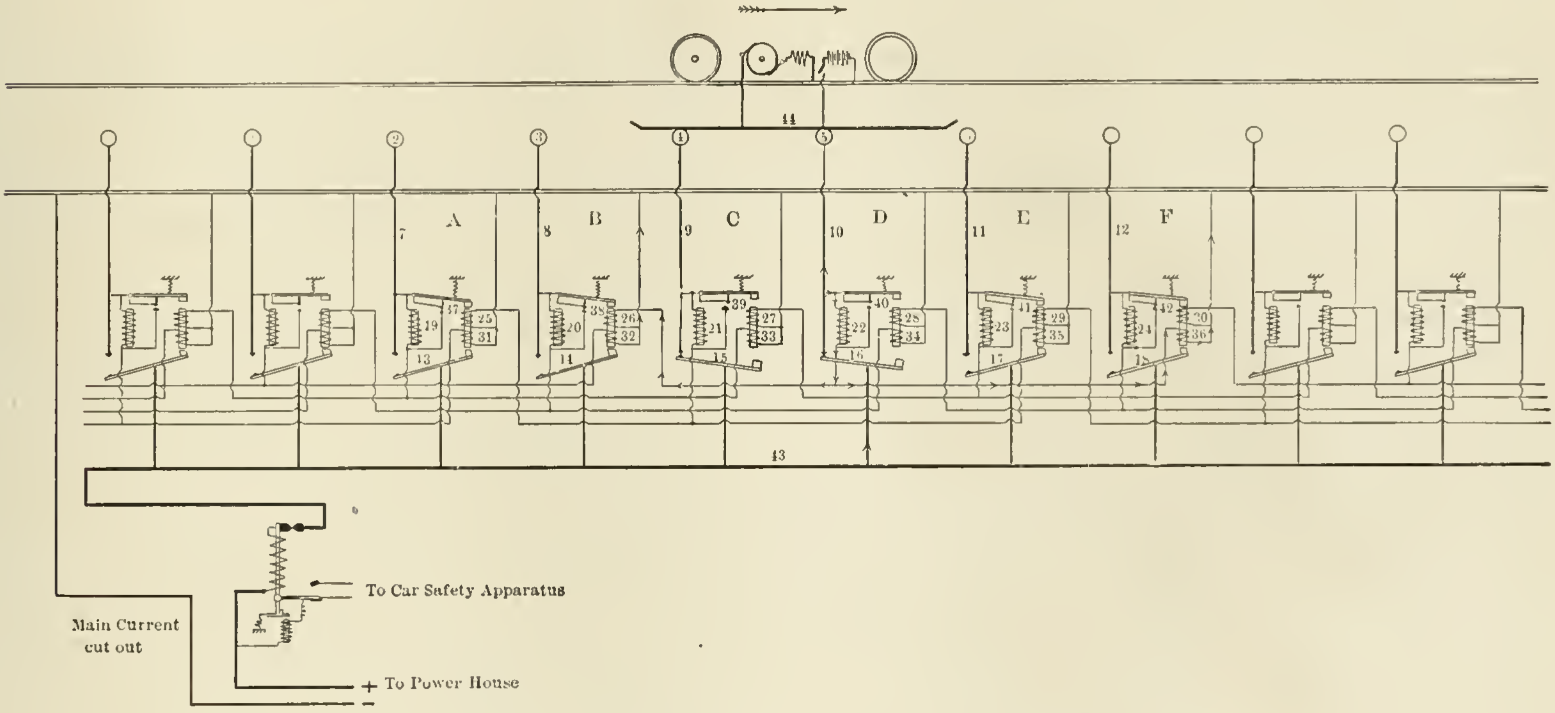
The cars and motors of this system are the same as those of all ordinary electric street railways with very slight exceptions. The current enters the motor by means of an especially-constructed contact chain, which is stretched beneath the car just above the street surface. As the car moves forward or backward, this chain rubs upon the row of contact knobs in the middle of the track. The current enters the motor from these knobs and leaves it in the usual manner, passing to the rails. The important part of the system is the mechanism by which these knobs are thrown into circuit as the car passes over them and thrown out again as soon as the car has passed. The relay connections are given in the accompanying sketch and their method of operation is as follows:

Assume that the car is moving toward the right in the figure and that for the time being the contact chain is resting on the contact knobs 3 and 4. The current then enters the motor through both of these contacts, which at this time are connected directly to the positive main, 43. While the current is passing through 9 and 3 to the motor, it is also passing from 9 through magnet 21; on the one side it goes through magnet 25 of relay *A* to the negative rails, and on the other side through magnet 35 of relay *E*, likewise to the rails. In like manner in relay *D* the current is passing not only into the motor through 4, but also from 10 through magnet 22, thence through magnet 26 of relay *B* on the one side and through magnet 36 of relay *F* on the other.

The action produced by the passage of the current through magnets 25 and 26 is first to short-circuit magnets 19 and 20 by pulling down armature 37 and 38, then to disconnect 1 and 2 from the positive main by forcibly breaking the circuit at 13 and 14. Thus, if 1 and 2 had not been thrown out of circuit till now they would have been disconnected at this instant. In the further progress of the car, however, if the contact chain touches 5 before it has left contact 3, then at first the current does not pass through magnet 23 of relay *E*, for that coil remains short-circuited by armature 41 as long as the current from relay *C* passes through magnet 35. For the first instant, therefore, the current from 11 passes through shunt 41, thence through magnet 27 of relay *C* to the rails. The effect of this is first to short-circuit magnet 21 by pulling down the shunt armature 39 and then to forcibly separate armature 15 from connection 9. Thus contact knob 3 is thrown out of circuit even before the contact chain has left it. But the instant that the circuit is broken at 15, magnet 35 in relay *E* is also thrown out of circuit, so that the shunt armature, 41, is immediately pulled up by the spring. The current from 1 then passes through magnet 23, pulls the armature 17 into contact with 11, and thus completes the working circuit from the positive main to the motor through contact 5 and the contact chain, 44. This operation is repeated every time the contact chain reaches a new contact knob, and the process is perfectly automatic whether the car is moving forward or backward.

With all these precautions taken to disconnect the lead wires from the main it would hardly be possible for a surface knob to remain alive after the contact chain has left it. But if by any accident this should occur there are still other safeguards for rectifying the defect before the knob has passed from under the car.

Beneath each end of the car there is a special testing apparatus which sweeps each contact knob just after the contact chain has left it. If the knob is still alive then a cut-out, which is connected to the main, is immediately opened by means of the testing apparatus and by it a whole section of say 100 yards of track is left without current. And even if this should fail still it would not be possible for a live knob to be passed unnoticed, for the relays which have been described have also other connections not described here, such that it is not possible for any three successive relays to remain under current at the same time, nor for any two relays which are dependent upon each other. One or the other of these combinations must occur in order that any contact knob may be passed without disjunction. In either of these cases the automatic cut-out is immediately placed in action and disconnects the section. When the defect is removed, however, the main current cut-out automatically closes the circuit again.



SCHUCKERT SURFACE CONTACT STREET RAILWAY SYSTEM.

A small amount of current is required to operate the automatic relays, about half an ampere, during the passage of the car. This is cut off over night or when the car is not in action.

The activity of a relay requires that current shall first be received from the contact chain. Upon receipt of the current the relay then places the lead wire and knob into the working circuit, in the manner described. Thus, if the contact chain has once been disconnected from the main, the relays under it must first be energized through the chain from some external source, before those relays can place in circuit the lead wires which are connected to them. For this purpose each car usually carries a small hand magneto machine, a few revolutions of which will energize the relays and bring the motor into action, after which the system is entirely automatic.

The advantages claimed for this system are as follows:

1. The greatest security possible for public traffic. 2. No unsightly overhead wires. 3. No protection necessary against short-circuits from telephone wires. 4. Affords the greatest possible security to the roller stock in action. 5. Simple and rapid construction of track possible without street obstruction. 6. The relays can be mounted and tested in the section boxes ready for immediate use before the boxes are taken from the factory. 7. Very slight attention and repairs needed to keep the plant in good order. 8. Very little expert attention needed and the inspection can be performed while traffic is in progress. 9. No more unskilled labor required for this system than for any other. 10. The surface knobs and contact chains last for years without repairs. 11. The current required is less than for other electric roads. 12. Total insulation far more perfect than in any other system. 13. The contact-knob system can be easily combined and operated with the trolley system.

The Earth as a Condenser and Its Role in Wireless Telegraphy.

In the past, ideas relating to the earth as an electrical factor have been extremely vague. This is mostly due to the fact that the first step of the development of the science of electricity was the establishment of an elaborate mathematical theory of electrostatics, and it became customary to set the potential of the earth once for all equal to zero. As in practice we have to do only with differences of potential, it does not matter how we fix the absolute value of the potential and we may fix it by assuming the earth to be at zero potential; then the potential of any other body is determined by its potential difference with respect to earth. This assumption is unattackable as long as we restrict our considerations to the values of the potentials of all points of any system of bodies *at a given moment.* But this arbitrary assumption has led to the popular belief that whatever changes take place in the electrostatic configuration of a system above earth, they have no appreciable effect on the potential of the earth; and as the geometrical dimensions of the earth are so very big compared with those of any electrical apparatus in common use, it has been popularly assumed that the potential of the earth remains unaffected by mundane electrical disturbances. This assumption, however, would be right only if the earth's electrostatic capacity had an infinite value, and it is easy to show that this is not the case.

To find the capacity of the earth, we may apply the formula well known in ordinary electrostatics, for the potential of a charged globe. If a globe of a radius of r cm. is charged with e electrostatic c.g.s. units of electric quantity, then its potential in electrostatic c.g.s. units is the ratio of e to r; hence the capacity of the globe. i. e., the ratio of charge to potential, is r. If measured in electrostatic c.g.s. units, the capacity of the earth is, therefore, equal to its radius in cm., i. e., about 637,000,000. In order to pass from electrostatic c.g.s. units to the practical unit of microfarads, we have to divide by 900,000, and thus find the capacity of the earth to be 708 microfarads. It will then be seen that its value is not at all infinite, compared with capacities which are used in practice.

Dr. A. Koepsel, a German electrical engineer, well-known as the designer of some accurate measuring instruments, points out in an interesting recent article in Dingler's *Polytechnisches Journal* (June, 1903), that, in view of this comparatively small capacity of the earth, it is quite possible that the earth plays a very important rôle in wireless telegraphy; in fact, from his calculations it appears plausible that Marconi's celebrated ocean telegraphy was accomplished not by transmitting waves through the ether, but by setting the earth into resonance.

The question of the rôle which the earth plays in wireless telegraphy has often been discussed, and in Marconi's first experiments earthing of the receiver and transmitter was found to be necessary. Afterwards in Braun's system earthing was avoided, and, moreover, it was found that wireless telegraphy was possible from balloons without earthing; these facts were then considered as a proof that the earth plays no important rôle in the transmission, and that the propagation of the waves should be considered as analogous to that of light waves. There remained, however, one principal difficulty, namely, the explanation of the fact that the waves used in wireless telegraphy do not seem to travel in a straight forward direction, but follow the curvature of the earth. The argument that the wave length of these waves is very large compared with those of light waves, does not fully overcome this difficulty. Moreover, Braun's apparatus may be considered as only apparently independent of the earth, because he uses appliances which are certainly in some relation to the earth.

Dr. Koepsel discusses this matter from a new point of view. We know that the length of the vertical wire used in every wireless telegraphy station is in a very close relation to the wave length of transmission, it being one-fourth of the wave length. Dr. Slaby's analogy with a tuning fork is very instructive. The tuning fork is at rest at one end and its vibrations are a maximum at the other end; these two ends correspond to a loop and a node of the electric wave, and the distance between is one-quarter of a wave length. The vertical wire in wireless telegraphy is connected to one pole of the spark-gap, while the other pole is usually earthed. Now, Dr. Koepsel puts the question in this way: Cannot this earthing wire, together with the earth, be brought into resonance with the whole system? In this case we would have both poles of the spark-gap connected with what the author calls two resonance wires, i. e., two sources of reactance and capacity. One resonance wire would be the vertical wire; the other resonance wire would be represented by the combination of earthing wire and earth. What Dr. Koepsel discusses mathematically is the question whether the electrostatic capacity of the earth, as above determined, has such a value that, together with the earthing wire, it can be made to represent a source of inductance and capacity, corresponding to the condition of resonance.

If we again apply Slaby's analogy with the tuning fork, Koepsel's argument may perhaps become clearer. We usually place a tuning fork on a resonance box, and this box must be so designed that it is in acoustic resonance with the fork. The tuning fork corresponds to the vertical wire in wireless telegraphy; the resonance box corresponds to the earthing wire, together with the earth. If we can arrange our whole system of electric wave transmission in such a way that the earth acts like a resonance box, we have, of course, in the earth a powerful help. For the transmission of sound to a distance the resonance box is much more effective than the tuning fork; likewise, in wireless telegraphy over very long distances, the rôle of the earth may be much more effective than the ether waves transmitted from the vertical wire.

The problem which thus is placed before the designer is, however, different in both cases. In the one case the tuning fork is given and we design the resonance box so that it suits the conditions. In the case of wireless telegraphy the earth and its capacity are given. The earth, together with the earthing wire, corresponds to the resonance box; therefore, while we still are at liberty to choose the earthing wire at will, yet the main element of our electric resonance box, i. e., the capacity of the earth, is fixed, and we must arrange our telegraph apparatus to suit the earth.

For the condition of resonance it is essential that the product of the self-inductance, L (in henrys) and the capacity C (in microfarads) of each "resonance wire" (as defined above) have a certain value. The earth and the earthing wire form one "resonance wire"; both together represent a certain set of values of L and C, of which C is determined by the fixed capacity of the earth. The product, LC, depends on the wave length used for the transmission. We are at liberty to choose the wave length of transmission and the self-inductance, L, of the earthing wire. We must choose both values so that C then becomes the value of the capacity of the earth.

Dr. Koepsel solves this problem by a method of trial. He calculates tables for wave lengths of different values; for each wave length he has a given value of LC, which has to correspond to a combination of a wire and a globe. He assumes wire of 1 mm. (0.04 in.) diameter and calculates for different lengths of the wire the size of the globe which must be added. He finds that the numerical value of the size of globe becomes more and more that of the earth, the larger the wave length and the smaller the self-inductance of the earthing wire.

We may assume that we use wires of 1 mm. (0.04 in.) diameter. Dr. Koepsel proposes to make the small self-induction, L, equal to 0.000001 henry. This is approximately the case if we use an earthing wire of 10 cm. (4 in.) length. The value of the product, LC, is thus fixed and we find that if there shall be resonance, the wave length of transmission must be 10,000 m. (6.2 miles, or 10,900 yards). This would require a vertical wire of 2,500 m. (2,700 yards). Under these conditions the earth would be in resonance. The long vertical wire acts like a tuning fork, and the earth acts like a resonance box. We may now determine the exact value of the oscillations of the potential of the earth under these conditions.

The capacity of the vertical wire is 0.009 microfarad; that of the earth is 708 microfarads; hence the ratio of the two capacities is 0.000013. The potentials relate to each other inversely as the capacities. Hence if we assume the potential of the vertical wire as 100,000—which value can be obtained in practice—the potential variation of the earth would be $100{,}000 \times 0.000013 = 1.3$ volt. The electric quantity required for this purpose is 0.0009 coulomb. The maximum rush of current at minimum damping would not be over 15 amp.

If a plurality of vertical wires is used, this value of the variation of the potential may be increased at will. By increasing the number of wires the capacity increases in a ratio different from that of the decrease of self-inductance. The resonance length is, therefore, decreased. If we design our vertical wires accordingly, the value of LC is not changed, and nothing is changed with reference to the resonance of the earth. But as the capacity of the vertical wire system has increased, its ratio to the capacity of the earth has also increased; and from the calculation, given above, it will be seen that the potential variations of the earth are then also increased. If, for instance, 400 wires are used at a distance of about 0.5 m. (20 in.) from one another, then if the corresponding shortening of length is taken into account, the capacity of the vertical wire system would become about one-ninth microfarad; hence its ratio to the capacity of the earth would be 0.00016. If we assume again a potential of the vertical wire of 100,000 volts, the variations of the potential of the earth would be about 16 volts.

While Marconi in his apparatus for ocean telegraphy may not have reached complete resonance, as his wave length is still too short, it is probable that he comes near this condition. While the figures of Dr. Koepsel's calculations cannot be considered as absolutely exact on account of certain approximative assumptions, he believes that they are correct as to the order of magnitude.

An interesting conclusion drawn by the author is that if his theory is correct it should be possible to receive signals without the use of a vertical wire at the receiving station, if the transmitting station be designed so as to set the earth into resonance. The author believes this to be possible even without a vertical wire at the transmitting station of the enormous height of 2,700 yards.

How to Stop a Street Car.

"Any street car motorman brought before me on a substantial charge of passing passengers at street corners will be fined the limit of the law," said Judge Tracy, in a St. Louis police court as he discharged Beverley S. Warden on a charge of disturbing the peace on August 17. Warden was arrested because he wanted to board a car at Eighth Street and Park Avenue and none would stop for him until, after three had passed, he drew a revolver, and forced the motorman of the fourth to come to a halt. "It is small wonder," said the judge, "that anarchistic feeling prevails among people who support the street car lines. Every day they see their rights trampled upon by the employees of the transit company. No doubt these employees work under orders. But it is time the officials and employees of the Transit Company, no matter how powerful they may feel themselves to be, recognize the laws and rights of the people are paramount." Judge Tracy spoke of having seen people at the corner where he usually boards a car to come down town each morning hurl stones at motormen who would not stop and take them aboard their cars. He said the actions were caused by desperation, and that they would continue until the cause was removed.

Feeder Calculations for Direct Current Railways.

By WM. A. DEL MAR.

The usual mathematical problem in feeder design is to arrange the copper so as to get a certain drop to the end of the line with the smallest expendtture of metal. This permissible drop is settled by considerations of economy of energy and copper, and may be calculated approximately. In all feeder calculations the first thing to be settled is the distribution of load along the line. Although the drain of current along any railway feeders is not at all uniform, no great error will arise, when the spacing of the cars is approximately even and the cars are moving, if the current be considered as diminishing evenly from its maximum value at the power station to zero at the far end of the line. Hence in most feeder calculations for urban railroads, the current curve is, as shown in Fig. 1, a straight line.

On a suburban railroad, where the cars are not closely spaced, it is not safe to assume the drain of current to be uniform along the line. In such a case a profile of the railroad should be made, the cars set thereon at their average positions, and calculation made of the current taken off at each car. A curve of current can then be made and the calculations for drop, etc., based on that. In such a case it is advisable to try the effect of concentrating the load in different places in order to be assured that the current density is not excessive under such conditions.

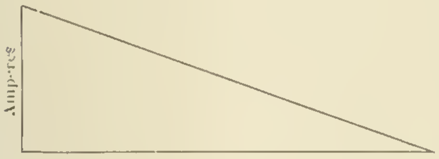
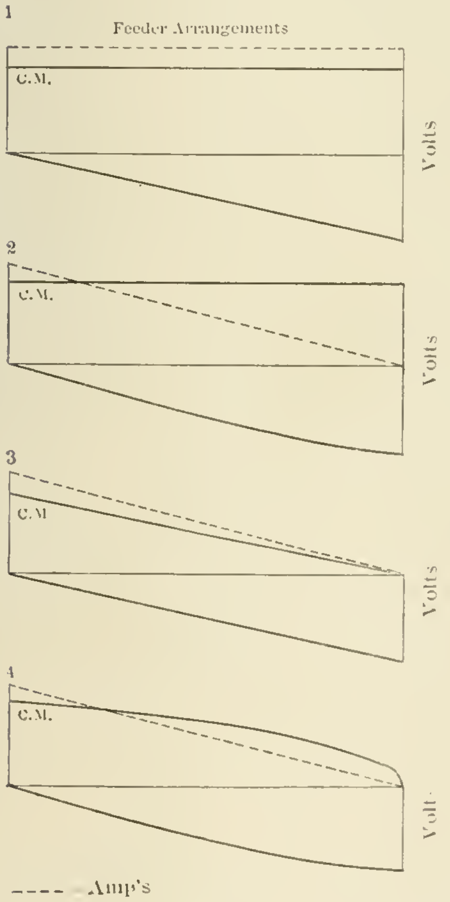


FIG. 1.

It is usual to connect together the feeder conductors by "equalizer" cables at frequent points, so that, however the cars may be distributed along the line, the current will be evenly distributed between the cables.

Four typical cases are shown in Fig. 2 with their respective formulæ for circular mils, c.m.-feet, and potential drop. These will be found to cover most practical cases.



$$\text{C.M.} = 10.5\frac{A}{V}L \qquad \text{C.M.-Ft.} = 10.5\frac{A}{V}L^2 \qquad \text{Drop} = \frac{10.5}{\text{C.M.}}Ax \qquad \text{Watts Lost} = AV$$

$$\text{C.M.} = \frac{10.5}{2}\frac{A}{V}L \qquad \text{C.M. Ft.} = \frac{10.5}{2}\frac{A}{V}L^2 \qquad \text{Drop} = \frac{1}{2}\frac{10.5}{\text{C.M.}}\frac{A}{L}x^2 \qquad \text{Watts Lost} = \frac{2}{3}AV$$

$$\text{C.M.} = 10.5\frac{A}{V}x \qquad \text{C.M. Ft.} = \frac{10.5}{2}\frac{A}{V}L^2 \qquad \text{Drop} = \frac{10.5}{\text{C.M.}}Ax \qquad \text{Watts Lost} = \frac{1}{2}AV$$

$$\text{C.M.} = \frac{2}{3}\,10.5\frac{A}{V}\sqrt{L}\,\sqrt{x} \qquad \text{C.M. Ft.} = \frac{4}{9}\,10.5\frac{A}{V}L^2 \qquad \text{Drop} = \frac{V}{\sqrt{L^3}}\sqrt{x^3} \qquad \text{Watts Lost} = \frac{3}{5}AV$$

X = is any distance (ft.) from far end "Drop" is from far end. L = Total length of line

A = Amps at station. V = Drop to end of line.

FIG. 2.—MOST IMPORTANT DISTRIBUTIONS OF COPPER AND CURRENT.

Where the drain of current is uniform along the line, the calculations may be according to cases 2, 3 or 4. Case 4 gives the arrangement by which a given drop to the end is obtained with the smallest amount of copper.

The class of railroads on which the cars are infrequently spaced will be considered last of all. The drop as given by the formulæ in Fig. 2 is in every case from the end of the line farthest from the power station. Hence, referring to Fig. 3, it is seen that what these formulæ give is not AB, but BC. The total drop, V may be found by making $x = L$ in the drop formula. Knowing this, the drop from the power station to any point may be obtained by subtracting the drop from the far end, from V.

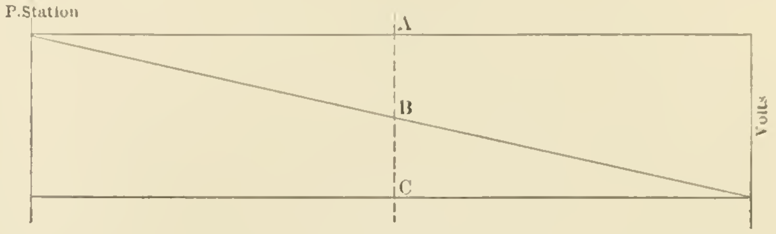


FIG. 3.

A circular mil (c.m.) is the area of a circle having a diameter of $\frac{1}{1000}$ inch. A copper wire 1 ft. long, with a sectional area of 1 cm, has a resistance of about 10.5 ohms.

The following notation is made use of in the proofs given below:

A = Total amperes used on section under consideration.

V = Total drop (volts) from power station (or sub-station) to far end of line.

r = Ohms per foot.

This is equal to 10.5, or, approximately, 10.5 divided by the circular mils of copper.

L = Total length of section, in feet.

$a = \frac{A}{L}$ = Amperes per foot taken from line.

x = Distance in feet from the end of the line farthest from the power station.

y = Circular mils of copper at dist. x from far end of line.

Y = Circular mils of copper at power station end of line.

c.m.-ft. = circular mil-feet. This quantity divided by any number gives the feet of cable of that number of circular mils. Thus, if 25,000,000,000 c.m.-ft. are required, it may be made up of 10,000 ft. of 2½ million c.m. cable.

Following are the proofs of the formulas given in Fig. 2:

CASE I.

Current uniform = A.

Circular mils uniform = Y.

(1) Drop:

Volts drop = $A \times$ *resistance,*

$$= 10.5\,\frac{A}{Y}\,x.$$

(2) Circular mils:

$$Y = 10.5 \div \textit{ohms..per ft.}$$

$$= 10.5\,\frac{A}{V}\,.L.$$

(3) C.M.-ft:

$$\textit{C.M.-ft.} = 10.5\,\frac{A}{V}\,.L^2.$$

CASE II.

Current decreasing uniformly from power station $= \frac{A}{L}.x = a\,x.$

Circular mils uniform = Y.

(1) Drop:

The resistance of a short-length $d\,x$ is $r.\,d\,x$, and $d\,v$, the drop in $d\,x$, is $r.d\,x.a\,x$, or

$$d v = a\,r\,x\,d\,x$$

$$\therefore v = a\,r \int x\,.\,d\,x$$

$$= \tfrac{1}{2}\,a\,r\,x^2$$

$$= \tfrac{1}{2}\,.\,10.5\,\frac{a}{Y}\,x^2$$

(2) Circular mils.

$$\text{As } v = \tfrac{1}{2}\;10.5\,\frac{a}{Y}\,x^2$$

$$V = \tfrac{1}{2}\,.\,10.5\,\frac{a}{Y}\,.\,L^2$$

$$\therefore Y = \tfrac{1}{2}\,.\,10.5\,\frac{a\,L}{V}\,.\,\mathrm{L}$$

$$\text{or } Y = \tfrac{1}{2}\;10.5\,\frac{A}{V}\,.\,L.$$

(3) C.M.-feet:

$$= L\,Y$$

$$= \tfrac{1}{2}\,.\,10.5\,\frac{A}{V}\,.\,L^2.$$

CASE III.

$$\text{Current decreasing uniformly from power station} = \frac{A}{L}\,.\,x = a\,x.$$

$$\text{Circular mils decreasing uniformly from power station} = \frac{Y}{L}\,.\,x.$$

(1) Drop:
The resistance of a short-length $d\,x$ is $r\,.\,d\,x$, or

$$10.5\,\frac{L}{Y}\,.\,\frac{1}{x}\,.\,d\,x.$$

The drop in $d\,x$ is $a\,x\,.\,r\,d\,x$, or

$$d\,v = 10.5\,\frac{L}{Y}\,.\,a\,x\,.\,\frac{1}{x}\,.\,d\,x,$$

$$= 10.5\,\frac{L}{Y}\,.\,a\,.\,d\,x,$$

$$\therefore v = 10.5\,\frac{La}{Y}\,.\,x,$$

$$= 10.5\,\frac{A}{Y}\,x.$$

(2) Circular mils:
The last equation shows that the "curve" of drop is a straight line. Hence it may be written

$$v = \frac{V}{L}\,.\,(L - x),$$

$$= V - \frac{V}{L}\,x.$$

Hence, $d\,v$, the drop in $d\,x$, is given by

$$d\,v = -\frac{V}{L}\,.\,d\,x.$$

The resistance of $d\,x$, which may be called $d\,R$, is $d\,v \div$ amperes.

$$\text{Hence, } d\,R = \frac{1}{a\,x}\,\frac{V}{L}\,.\,d\,x,$$

$$= \frac{V}{A}\,.\,\frac{1}{x}\,.\,d\,x.$$

$$\therefore \frac{d\,R}{d\,x} = \frac{V}{A}\,.\,\frac{1}{x}$$

Now $\dfrac{d\,R}{d\,x} =$ ohms per foot, hence

$$\text{C.M.} = 10.5\,\frac{A}{V}\,.\,x.$$

(3) C.M.-ft:
This is equivalent to the *area* of the triangle of circular mils, or

$$\tfrac{1}{2}\,.\,10.5\,\frac{A}{V}\,.\,L^2.$$

CASE IV.

The current decreases uniformly from the power station to the end of the line, where a drop of V volts is to be obtained. Required to find the arrangement which will give this drop with the minimum amount of copper:

(1.) Divide the line into a number of short pieces of length l.

The current in the first section from the far end $= a\,l$, in the second section $2\,a\,l$, in the third, $3\,a\,l$, and so on.

The copper in the first section may be called $y_1 l$, in the second $y_2 l$, in the third $y_3 l$, and so on, these quantities being C.M.-ft.
in the third $y^3 l$, and so on, these quantities being C.M.-ft.

The resistance of the first section is $\dfrac{10.5}{y_1}\,.\,l$, of the second $\dfrac{10.5}{y_2}\,.\,l$, of the third $\dfrac{10.5}{y_3}\,.\,l$, etc.

The drop in the first section is $10.5\,a\,l^2\,\dfrac{1}{y_1}$, in the second $10.5\,a\,l^2\,\dfrac{2}{y_2}$, in the third, $10.5\,a\,l^2\,\dfrac{3}{y_3}$, and so forth.

The total copper $= l\,(y_1 + y_2 + y_3 +$, etc.)

$$\text{Total drop} = 10.5\,a\,l^2\left(\frac{1}{y_1} + \frac{2}{y_2} + \frac{3}{y_3} +, \text{ etc.}\right)$$

It is required to make $l\,(y_1 + y_2 + y_3 +$ etc.) a minimum subject to the condition that $\left(\dfrac{1}{y_1} + \dfrac{2}{y_2} + \dfrac{3}{y_3} + \text{etc.}\right)$ shall be a constant.

If these two series be added, the following one is obtained:

$$\left(\frac{1}{y_1} + l\,y_1\right) + \left(\frac{2}{y_2} + l\,y_2\right) + \left(\frac{3}{y_3} + l\,y_3\right) + \text{etc.}$$

The series $l\,(y_1 + y_2 + y_3 +$, etc.) is a minimum when the above series is a minimum. This occurs when its differential coefficient with regard to y is zero. Hence differentiating and equating to zero,

$$\frac{d}{d\,y_1}\left(\frac{1}{y_1} + l\,y_1\right) + \frac{d}{d\,y_2}\left(\frac{2}{y_2} + l\,y_2\right) + \frac{d}{d\,y_3}\left(\frac{3}{y_3} + l\,y_3\right)$$

$$+ \text{ etc.} = 0$$

$$\therefore \left(l - \frac{1}{y_1^2}\right) + \left(l - \frac{2}{y_2^{\,2}}\right) + \left(l - \frac{3}{y_2^{\,3}}\right) + \text{etc.} = 0,$$

$$\therefore \quad l = \frac{1}{y_1{}^2} = \frac{2}{y_2{}^2} = \frac{3}{y_3{}^2} = \text{etc.};$$

or generally, $\dfrac{n}{y_n} = l$,

$$\therefore \quad y_n = \sqrt{\frac{n}{l}}$$

$$= \frac{\sqrt{nl}}{l}$$

Now, $n\,l$ is x, the distance from the far end, and l is a constant

Hence, $y = \dfrac{1}{l}\sqrt{x}.$

The value of the constant $\dfrac{1}{l}$ must be found. The drop in $d\,x$, which may be called $d\,v$, equals current at distance x from the end multiplied by $\dfrac{10.5\,.\,d\,x}{C.M \textit{ at that distance.}}$

Hence, $d\,v = a\,x\,.\,\dfrac{10.5}{y}\,d\,x$,

$$= 10.5\,a\,l\,\frac{x}{v\,x}\,.d\,x,$$

$$= 10.5\,a\,l\,\sqrt{x}\,.d\,x,$$

$$\therefore \quad V = 10.5\,a\,l\int_o^L \sqrt{x}\,.\,d\,x,$$

$$= 10.5\,a\,l\,\frac{2}{3}\,.L^{\frac{3}{2}},$$

$$\therefore \quad \frac{1}{l} = \frac{2}{3} \times 10.5\,\frac{A}{V}\sqrt{L}$$

$$\therefore \quad y = \frac{2}{3} \times 10.5\,\frac{A}{V}\sqrt{L}\,.\,\sqrt{x}.$$

This formula gives a parabola of circular mils that represents the most economical distribution of copper.

(2) The C.M.-ft. of copper equals

$$\int_o^L y\,.\,d\,x,$$

$$= \frac{2}{3} \times 10.5\,\frac{A}{V}\,.\sqrt{L}\int_o^L \sqrt{x}\,.\,d\,x,$$

$$= \frac{2}{3} \times \frac{2}{3} \times 10.5\,\frac{A}{V}\,\sqrt{L}\,.\,\sqrt{L^3},$$

$$= \frac{4}{9} \times 10.5\,\frac{A}{V}\,L^2$$

(3) Drop:

$$\text{Ohms per ft.} = \frac{10.5}{y} = \frac{10.5\ \ V}{\frac{2}{3} \times 10.5\,A\,\sqrt{L}\,.\,\sqrt{x}} = \frac{3}{2}\,.\,\frac{V}{A}\,\frac{1}{\sqrt{L}\,.\sqrt{x}.}$$

If R be the resistance of a length x,

$$d\,R = v\,\,.\,\,d\,x,$$

$$= \frac{3}{2}\,.\,\frac{V}{A}\,.\,\frac{1}{\sqrt{L}}\,.\,\frac{1}{\sqrt{x}}\,.d\,x.$$

The drop in $d\,x$ is $d\,v$, and $d\,v =$ current $\times\ d\,R$,

$$= \frac{A}{V}\,.\,x\,.\,\frac{3}{2}\,.\,\frac{V}{A}\,.\,\frac{1}{\sqrt{L}}\,.\,\frac{1}{\sqrt{x}}\,.\,dx$$

$$= \frac{3}{2}\,\frac{V}{L\sqrt{L}}\,\cdot\,\sqrt{x}\,.\,dx$$

$$\therefore \quad V = \frac{3}{2}\cdot\,\frac{V}{L\sqrt{L}}\int\sqrt{x}\,.\,dx$$

$$= \frac{3}{2}\cdot\frac{V}{L\sqrt{L}}\,\cdot\,\frac{2}{3}\,x^{\frac{3}{2}}$$

$$= \frac{V}{\sqrt{L^3}}\cdot\sqrt{x^3}$$

WATTS LOST.

$W =$ Total watts lost.

Current assumed to decrease uniformly from power station.

$$d\,R = \textit{Resistance of length } d\,x,$$

$$= 10.5\,\frac{1}{y}\,.\,dx$$

$$d\,W = \frac{A^2}{L^2}\,.\,x^2 \times 10.5\,\frac{1}{y}\,.\,dx.$$

$$\therefore W = 10.5\,\frac{A^2}{L^2}\int_o^l \frac{x^2}{y}\,.\,dx.$$

Case (2).

$$y = \frac{1}{2} \times 10.5\,\frac{A}{V}\,.\,L$$

$$\therefore W = 10.5\,\frac{A^2}{L^2}\int_o^L \frac{2\,x^2\,V}{10.5\,A\,L}\,dx$$

$$= \frac{2}{3}\,A\,V$$

Case (3).

$$y = 10.5\,\frac{A}{V}\,.\,x$$

$$\therefore W = 10.5\,\frac{A^2}{L^2}\int_o^L \frac{x^2 V}{10\,5\,A x}\,.\,dx.$$

$$= \frac{1}{2}\,A\,V$$

Case (4).

$$y = \frac{2}{3} \times 10.5\,\frac{A}{V}\,\sqrt{L}.\,\sqrt{x}$$

$$\therefore W = 10.5\,\frac{A^2}{L^2}\int_o^L \frac{3\quad x^2\quad V}{2 \times 10.5\,A\,\sqrt{L}.\,\sqrt{x}}.\,dx$$

$$= \frac{3}{2}\,\frac{A^2}{L^2}\cdot\frac{V}{A}\cdot\frac{1}{\sqrt{L}}\int_o^L x\,\frac{3}{2}.\,dx$$

$$= \frac{3}{5}\,A\,V$$

There is a general formula for the watts lost which is especially useful when the copper is distributed in steps. It is obtained as follows:

Let $d\,W =$ watts lost in a short length $d\,x$, and $d\,v =$ volts drop in $d\,x$. Then

$$d\,W = \text{current in } d\,x \times d\,v$$

$$= \frac{A}{L}\,x\,.\,d\,v$$

$$\therefore W = \frac{A}{L}\int x.\,dv$$

$$= \frac{A}{L} \times \text{area of "Drop" curve expressed in volt-feet.}$$

This is very easy to apply with the aid of a planimeter.

COMPARISON OF CASES 3 AND 4.

(1) C.M. at power station end:

Case 3: C.M. $= 10.5\dfrac{A}{V}.\ L.$

$$\text{Case 4: C.M.} = \tfrac{2}{3} \times 10.5\,\frac{A}{V}\,.\,L$$

Hence in Case 4, C.M. at power station is ⅔ of what it is in Case 3

(2) Amount of copper:

$$\text{Case 3: C.M. ft.} = \frac{1}{2} \times 10.5\,\frac{A}{V}\,.\,L^2.$$

$$\text{Case 4: C.M. ft.} = \frac{4}{9} \times 10.5\,\frac{A}{V}\,.\,L^2.$$

$$\frac{4}{9} \times 2 = \frac{8}{9}$$

Hence in case 4, the amount of copper is 8/9ths of what it is in case 2.

(3) Watts lost:

Case 3: Watts lost = ½ $A\,V$.

Case 4: Watts lost = ⅔ $A\,V$.

Hence in case 4, the watts lost are 1⅓ times what they are in case 3

DISTRIBUTION OF COPPER IN STEPS.

In any case of feeder distribution it is, of course, impossible to arrange the copper exactly according to formula. The practical way is to use a number of cables and arrange them so as to approximate to the formula. In this case the copper may be regarded as distributed in steps as shown in Fig. 4. Each of these steps may be treated as an example of case 2, Fig. 2.

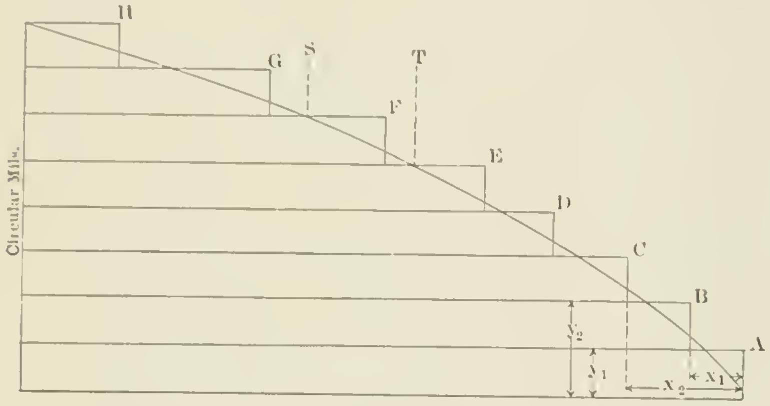


FIG. 4.—METHOD OF APPROXIMATING TO CURVE OF C.M.

In each step the drop is the same as it would be if the whole line had the same number of C.M. of copper as there are in that step. The drop in each step is illustrated in Fig. 4.

$$\text{The drop in } A\,B = \tfrac{1}{2} \times 10.5\,\frac{A}{V}\,.\,\frac{x_1^2}{y_1}$$

$$\text{The drop in } B\,C = \tfrac{1}{2} \times 10.5\,\frac{A}{L}\left(\frac{x_2^2}{y_2} - \frac{x_1^2}{y_2}\right)$$

$$\text{The drop in } C\,D = \tfrac{1}{2} \times 10.5\,\frac{A}{L}\left(\frac{x_3^2}{y_3} - \frac{x_2^2}{y_3}\right)$$

This is probably the most useful form of calculation employed in feeder work.

Let x_1 = distance from end of line of beginning of a section.

x_2 = distance from end of line of end of same section.

Y_1 = C.M. in the section.

W = watts lost in section.

Then,

$$d\,W = \frac{A^2}{L^2}\,x^2\,.\,\frac{10.5}{Y_1}\,.\,dx$$

$$\therefore\ W = 10.5\,\frac{A^2}{L^2}\,.\,\frac{1}{Y_1}\int_{x_1}^{x_2} x^2.\ dx$$

$$= \frac{1}{3} \times 10.5\,\frac{A^2}{L^2}\,.\,\frac{1}{Y_1}\,(x_1^3 - x_2^3)$$

Total watts lost in all the sections =

$$= \frac{1}{3} \times 10.5\,\frac{A^2}{L^2}\,\Sigma\,\frac{1}{Y_1}\,(x_1^3 - x_2^3)$$

This is not as easy to use as the planimeter method given above, if the curve of drop be already plotted.

In approximating to any curve of C.M. by steps, as shown in Fig. 4, in order to get the same drop with the steps as with the curve of C.M., the steps should project beyond the point S to the extent of about two thirds of the length, $S\,T$. This is because the metal is not so economically distributed when in steps as when arranged exactly according to the curve of circular mils.

KELVIN'S LAW AND COPPER DISTRIBUTION.

Kelvin's law is usually formulated to give the most economical drop *to the load center*, and Case 4 gives the most economical distribution of copper when the drop *to the end* is known. When the current falls off uniformly with the distance from the power station, the load center is the middle point of the line.

In Case 4,

$$v = V\,\frac{\sqrt{x^3}}{\sqrt{L^3}}$$

and if v_c = drop to load center,

$$v_c = V\,\frac{\sqrt{\left(\frac{L}{2}\right)^3}}{\sqrt{L^3}}$$

$$= \frac{V}{\sqrt{8}}$$

As v_c is known from Kelvin's law, V is given by

$$V = \sqrt{8}\ v_c$$

The scheme for the determination of the most economical drop given later gives the drop to the end directly and therefore does not require this correction.

EFFECT OF LOAD ON DROP.

To determine the drop for any arrangement of copper, let $d\,v$ = drop of potential in a short length having a resistance $d\,r$ and current $\frac{A}{L}\,x$.

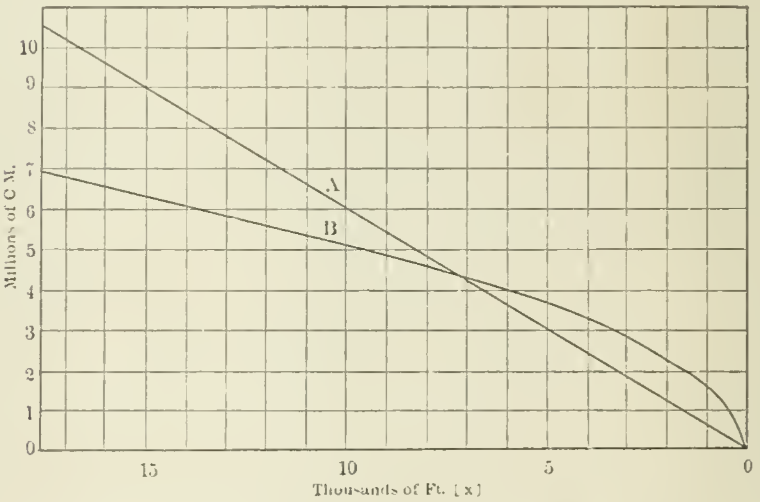


FIG. 5.—CURVES SHOWING COMPARISON OF SCHEMES 3 AND 4.

$$\text{Then, } d\,v = \frac{A}{L}\,x\ .\ d\,r,$$

$$\therefore\ v = \frac{A}{L}\int x\ .\ a\,r$$

Now $\int_{x_1}^{x_2} x\ .\,d\,r$ is the area of a curve having the resistance from the far end as ordinates, and the distance from that end as abscissæ.

From this formula it is evident that for a given distribution of copper, the drop is proportional to the total load. Hence if a drop curve be constructed for any load, the drop curve for any other load may be derived from it by merely changing the ordinates in the ratio of the two loads in question.

MOST ECONOMICAL DROP.

In order to get any particular drop V in Case 4, with a total current of A amperes $\left(\frac{4}{9} \times 10.5 \times \frac{A}{V} L^2\right)$. C.M.-ft. of copper must be used, and in this there is a continuous loss of $\left(\frac{3}{5000} A V\right)$ kw.

The copper used represents an annual expenditure which is a fixed percentage of the original cost or investment. This expense is greater, the smaller the drop. The kilowatts lost also represent an annual expense, but this one is directly proportional to the drop. There is a certain drop at which the sum of these two annual expenses is a minimum. The table given below shows how to get this.

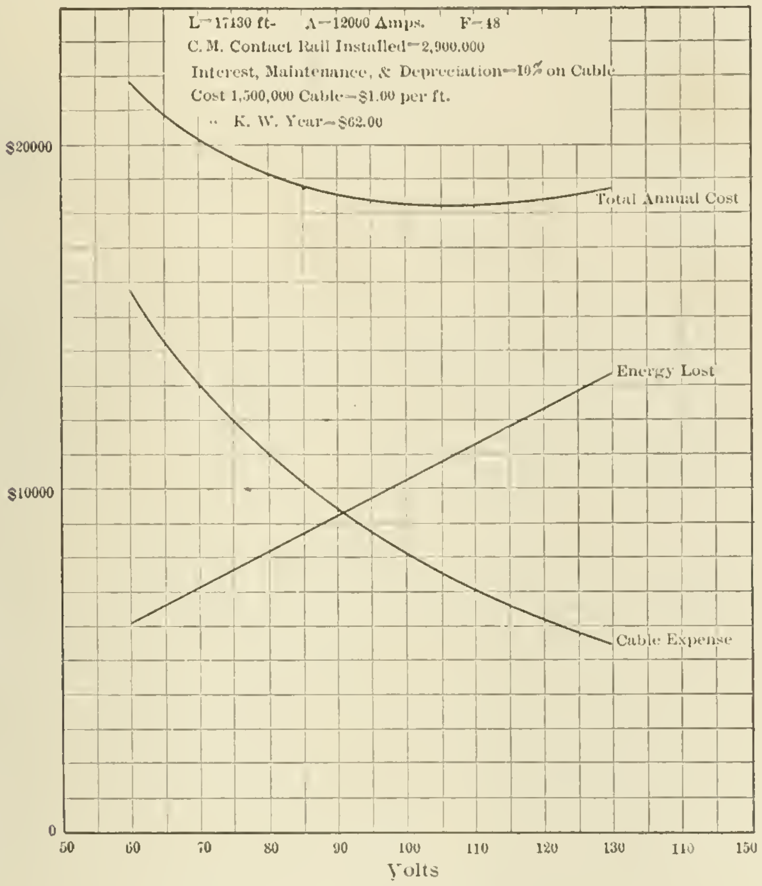


FIG. 6.—DETERMINATION OF MOST ECONOMICAL INVESTMENT.

Kelvin's law states that the total annual cost is least when the cost of the energy wasted equals the interest, maintenance and depreciation on the copper investment.

Kelvin's law does not hold when the annual expense on part of the copper is taken with the annual loss in the *whole* system. Hence if there be a contact rail or trolley wire already installed, Kelvin's law does not determine the most economical amount of copper to be added to this. Such a case must be worked out as shown in the table. An example of the curves from such a table is shown in Fig. 6. It should be observed that the curve of total cost is very flat near the minimum. Hence no great loss will be incurred if a voltage drop somewhat greater than the most economical one, be adopted.

The table and curve are made out on the supposition that the current tapers off uniformly from the station and that the feeders are distributed according to the curve of most economical distribution. In any other case the expressions for watts lost and C.M.-ft. will be different, but everything else will be the same.

KELVIN'S LAW.

Everything but the drop being fixed, the value of the kilowatt-hours lost may be expressed as $k V$, and the annual cost of the copper as $\frac{Z}{V}$. Hence, total cost equals $\frac{Z}{V} + k V$.

To get the minimum value of this differentiate with regard to V and equate to zero. Then

$$\frac{-Z}{V^2} + k = 0,$$

$$\therefore \quad \frac{Z}{V} = k V$$

or annual cost of copper = annual cost of energy.

CURRENT DENSITY.

The arrangements for most economical drop and most economical distribution are often rendered impracticable by excessive current densities. Hence in every layout it must be seen that the maximum current density is within working limits. Of course the allowable current density does not depend merely on the number of C.M., the size of cables composing the total C.M. being an important factor Tables of carrying capacities may be found in the handbooks or obtained by the formula, $C = K \sqrt{T d^3}$, where C is the current, a wire of d inches diameter will carry with a temperature rise of T degrees Centigrade. K is a constant, and is given by the following table:

Bare cable exposed in open air..................	$K = 222$
Weather-proof cable do	173
Rubber-covered cable do	163
Lead and paper-covered, in ducts, underground..	155
Lead and rubber-covered, do	166

The formula, $C = K \sqrt{T d^3}$, is easy to prove.

Let heat lost per unit length of wire $= H$, and resistance per unit length $= R$. Then,

$$H \propto C^2 R.$$

$$\propto \frac{C^2}{d^2}$$

$$T \propto \frac{H}{surface}$$

$$\propto \frac{H}{d}$$

$$\therefore \quad T \propto \frac{C^2}{d^3}$$

$$\therefore \quad C = K \sqrt{T d^3}.$$

In this connection it should be noted that diameter of any wire in inches is equal to the square root of its area expressed in millions of circular mils. Thus the diameter of a 1,500,000 C.M. cable is $\sqrt{1\frac{1}{2}}$ inches.

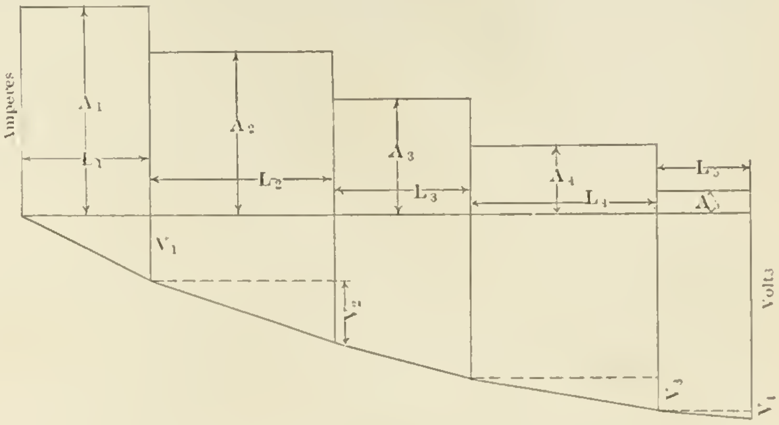


FIG. 7.

The feeder calculations of a suburban road with infrequent service are covered by Case 1, Fig. 2. The current and drop curves would be as represented in Fig. 7, each section of which is covered by the formulæ relating to Case 1:

$$C.M._1 = 10.5 \frac{A_1}{V_1} L_1,$$

$$C.M._2 = 10.5 \frac{A_2}{V_2} L_2, \text{ etc.};$$

$$V_1 = 10.5\,\frac{A_1\,L_1}{C.M._1}$$

$$V_2 = 10.5\,\frac{A_2\,L_2}{C.M._2}\ \text{etc.}$$

$$\text{Total C.M. ft} = 10.5\left(\frac{A_1\,L_1^2}{V_1} + \frac{A_2\,L_2^2}{V_2} + \text{etc.}\right)$$

$$\text{Total drop} = 10.5\left(\frac{A_1\,L_1}{C_1.\,M_1.} + \frac{A_2\,L_2}{C.\,M_2} + \text{etc.}\right)$$

$$\text{Total watts lost} = (A_1V_1 + A_2V_2 + \text{etc.})$$

It may be proved by a method analogous to that used to demonstrate Case 4, Fig. 2, that the most economical distribution of copper is attained when the C.M. at every point is made proportional to the square root of the current.

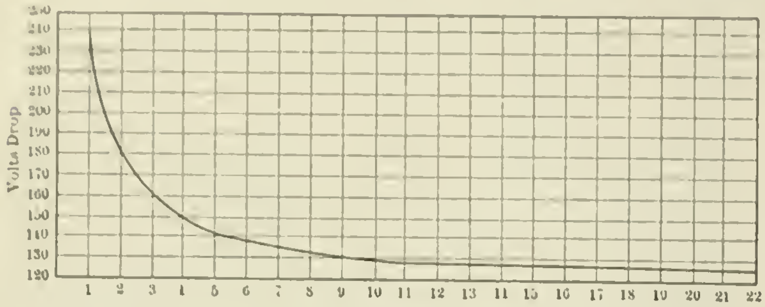


FIG. 8.

The most economical drop is also ascertainable by using the formulæ of Case 1 in the table given above for this purpose.

DIFFERENT DISTRIBUTIONS OF LOAD.

It is interesting to see how the drop varies according to the number of points the load is distributed over. For the sake of simplicity, a conductor of uniform cross-section is assumed and for a certain load at the distant end of the line the drop in this conductor is taken to be V. If the same load be equally distributed between the far end and the center point of the line, the drop from the power station to the center will be $\frac{V}{2}$, and the drop from the center to the end will be $\frac{1}{2}\cdot\frac{V}{2}$ or $\frac{V}{2}\left(\frac{2}{2}+\frac{1}{1}\right)$. If the load be equally distributed between three equidistant points one of which is the far end, the drop from the power station to the first point will be $\frac{V}{3}$ from the first point to the second $\frac{2}{3}\cdot\frac{V}{3}$, and from the second point to the end $\frac{1}{3}\cdot\frac{V}{2}$

Hence, the total drop in this case is

$$\frac{V}{3}\left(\frac{3}{3}+\frac{2}{3}+\frac{1}{2}\right)$$

Generally, if the load be equally distributed over n equidistant points, the drop will be

$$\frac{V}{n}\left(\frac{n}{n}+\frac{n-1}{n}+\frac{n-2}{n}+\text{etc.}\right).$$

Hence, drop $= \frac{V}{n^2}\quad(n + n - 1 + n - 2 + \text{etc.})$

$$= \frac{V}{2}\left(1+\frac{1}{n}\right)$$

Volts drop to end of line V	Kilowatts lost with current A $\frac{3}{5000}$ A V	Kilowatts lost with mean current $\frac{3}{5000}$ A V F	Annual cost of K. W. lost at $ per K. W year	Total C. M. feet $\frac{4}{9}\,\frac{10.5\,A\,L^2}{V}$	Existing conductors C. M. feet	Extra C. M. feet Reqd. = Total less existing.	Feet of C. M. cable reqd. from last column	Cost of extra cable at $ per ft. including installation	Interest, maintenance and depreciation on cable at % per annum	Total annual expense. Sum of the 4th and last items

Fig. 8 shows the sort of curve this equation gives. It is seen to be asymptotic to drop $\frac{V}{2}$. The curve also shows that as long as the load is distributed over a large number of points, the drop will be practically the same whatever that number may be.

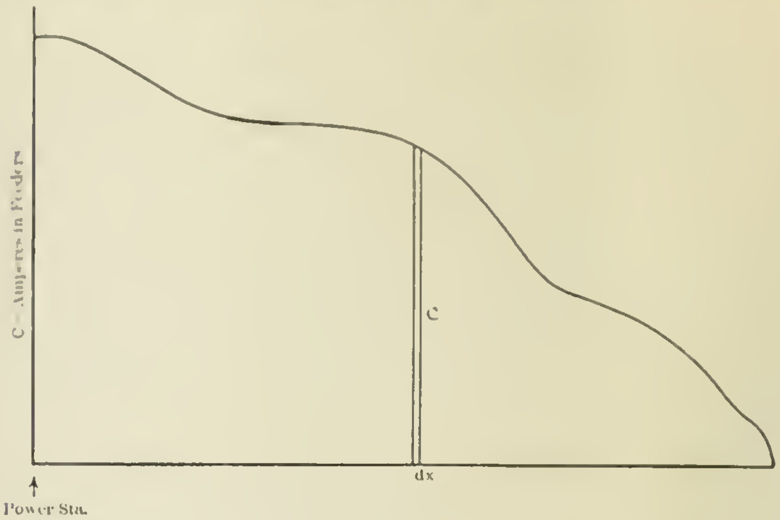


FIG. 9.

AMPERE FEET.

There is a way of getting the drop in any conductor of *uniform section* when the distribution of current is known along the conductor.

Fig. 9 shows the distribution of current along any conductor which has a resistance of r ohms per foot.

The resistance of a short length $d\,x$ is $r.\,d\,x$. The drop in $d\,x$ is $d\,v$, and

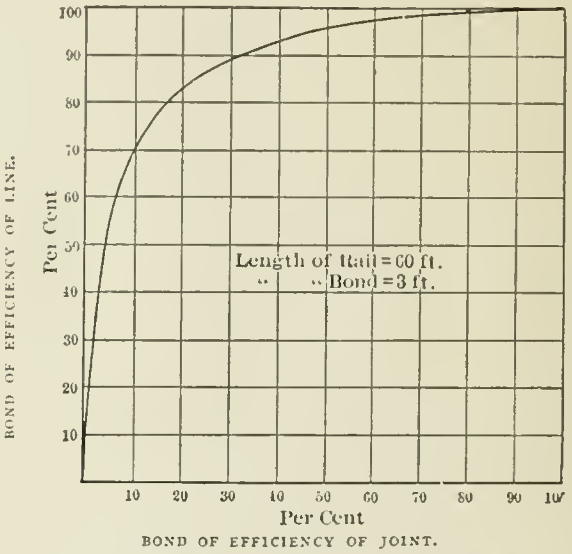


FIG. 10.—RELATION BETWEEN BOND EFFICIENCY OF JOINT AND OF LINE.

$$\begin{aligned} d\,v &= c\,r.\ d\,x, \\ &= r.c\,d\,x, \\ \therefore\quad v &= r\int_{x_1}^{x^2} c.d\,x. \\ &= r\,x \text{ area of ampere-feet curve.} \end{aligned}$$

BONDING EFFICIENCY.

The efficiency of a rail bond is the ratio of the conductivity of the bonded joint to the conductivity of an equivalent length of continuous rail. If a rail of length L has a sectional area equivalent to A C.M.'s of copper, and a bonded joint of length l, a section equivalent to a

C.M.'s, the efficiency of the bonded joint is $\frac{a}{A} = J$, say. Then $a = A J$.

The total resistance of n rail lengths of bonded rail,

$$= 10.5\, n \left(\frac{L}{A} + \frac{l}{a}\right)$$

$$= 10.5\, \frac{n}{A} \left(L + \frac{l}{J}\right)$$

The resistance of n lengths of continuous rail,

$$= 10.5\, \frac{n}{A}\, (L + l)$$

$$\text{Then } \frac{\textit{Resistance of bonded rail}}{\textit{Resistance of continuous rail}} = \frac{L + \frac{l}{J}}{L + l}$$

Hence, the bond efficiency of the line $= \frac{L + l}{L + \frac{l}{J}}$

This equation is plotted out for a rail of 60 ft. length and joint of 3 ft. length. It should be noticed that the bond efficiency may be quite low and yet the bonding efficiency of the line very high. Thus a bonded joint of 75 per cent. efficiency gives a bonding efficiency of nearly 99 per cent. for the line.

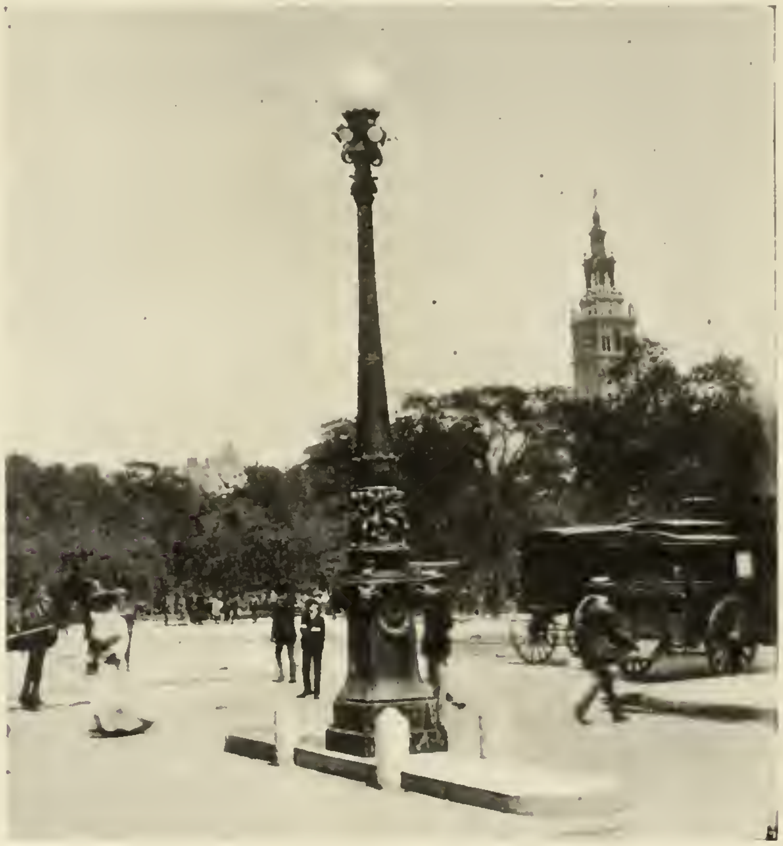
Isles of Safety for New York Street Travel.

The development of street railway travel in New York City under the electric regime has directed attention to the desirability of placing "isles of safety" for foot passengers at the points where several streets intersect and where space is available. The "isles" are a familiar object in European cities, but strange as it may seem, are virtually unknown in America, although the rush and drive of vehicular traffic in such a city as New York would apparently warrant their construction at various strategic points. The question arises how far such "isles" assist travel and help to steer vehicles as well as assist pedestrians; and many people contend that these structures are often rather an impediment than a useful guide. Be this as it may, following up work of the Municipal Art Society, to which attention was called in these columns last year, an isle designed by Ciani has now been built at the junction of Twenty-third Street with Broadway and Fifth Avenue—one of the likeliest points in the city to test the benefits of such a structure. Our readers are interested, moreover, not only in the transportation aspects of the matter, but in the feature of illumination, and we are glad to be able to give herewith a good view of the isle, just taken.

The design of the electrolier on the isle of safety is that of a wide-based column tapering gradually to the top and there surmounted by a large globe. The capital or relief work around the upper section of the shaft has included in its design four small globes in the mouths of dolphins. The large globe and the small ones held by the dolphins are part of the general design of the post and are illuminated at night. The electric equipment of this electrolier is in keeping with the artistic scheme of the post, and aims at the same time to procure the most efficient lighting effect. The globe at the top is 25 in., of a light opal glass, spherical in shape where exposed to view, but having an opening closed against a concealed holder in the capital of the shaft. The necessity of having a globe of this unusually large diameter and of having it of an exact tint in alabaster with walls of no greater thickness than that of an ordinary arc lamp globe were all requirements new to the glass manufacturers (the Gleason-Tiebout Manufacturing Company), and it was only after repeated attempts that they succeeded in making the globe. This globe as a diffusing medium for the arc lamp inside it and as part of the design of the post has been found to fully meet the requirements.

The height of the globe and the fact that but three-quarters of it is seen when viewed from the sidewalk rendered impossible the installation of an ordinary arc lamp with the arc below the mechanism and correspondingly low in the globe, as the maximum candle-power derived would be lost in the section of the globe not visible from the street. To light up this globe with an evenly distributed white light free from shadows it was found necessary to have the actual source of light well up in the globe and to have no part of the lamp mechanism in line with the direct rays of the arc. To attain this result a special arc lamp of the direct-current enclosed type, 425 watts, was constructed so that it could be operated in an inverted position. This was accomplished by constructing a mechanism that would feed the carbon upwards against the stationary carbon of opposite polarity, and that at the same time would be as reliable in operation as that of a standard gravity feed lamp. The lamp is set into the post with the inner globe uppermost in the upper quarter of the globe and is held in position by a concealed clamp. The direction of the current is opposite to that usually employed in commercial practice, and the lamp is so connected that the positive carbon is the lower carbon and the crater of the arc is on the bottom instead of the top carbon. This arrangement gives an upward direction to the arc rays, so distributing the light that the general effect is excellent. It also eliminates any possibility of shadows as the mechanism is below the arc and in a position opposite to the projected rays.

The trimming of this lamp will be done weekly, and to assist in handling the large globe an auxiliary device has been designed in the nature of an adjustable clamp with sliding rods and supporting arms. The arms are placed directly under and around the globe, and, with the sliding rods, support the globe above the lamp high enough for the trimmer to insert new carbons or to clean the inner walls. This trimming device is of light strap iron and is easily adjusted and removed.



ISLE OF SAFETY, BROADWAY, FIFTH AVENUE AND TWENTY-THIRD STREET, NEW YORK CITY.

The dolphins composing part of the capital of the post are receptacles for incandescent lamps. In the mouth of each is a 120-watt tipless "Meridian" lamp of 50 cp. so arranged that the section of the lamp in evidence conforms to the opening in and becomes a part of the artistic design. During the day the lamps represent a ball harmonious with the design, while at night the same effect is obtained, as well as the light. The position of these four lamps and the downward direction of their concentrated rays of light serve to bring out at night in relief the details of the post, which the upper direction of the arc rays do not show.

Connection has been made with the Edison main on the east side of Fifth Avenue and a three-wire service is installed in the base of the pole. A small 5-circuit (one for each lamp) slate panel board has been built into the base of the pole and each circuit is protected by a fuse, minimizing any probability of having all the lamps out at one time.

Telephone Exchanges—IX.

By Arthur V. Abbott, C. E.

MECHANICAL DETAILS.

HALF the secret of building a good receiver lies in a first-class mechanical design, for receivers are placed in situations particularly exposed to injury, and under some circumstances maintenance expenses are large. They are used by persons not only ignorant of the way in which such apparatus should be normally treated, but who are also often not only careless but malicious. From a mechanical standpoint, therefore, receiver design should be such as to produce an instrument, which, while it shall be simple and economical to construct, shall over all be reliable and unlikely to get out of order, excepting under the severest provocation.

Extended experience has not as yet shown any material equal to hard rubber from which the case may be constructed. Many substitutes have been proposed, but all of the various compositions so far advanced, have been brittle, suffer severely from changes in temperature, are more or less hygroscopic and fail adequately to protect the receiver from moisture. It is a grave mistake to make the case too light, for receivers are constantly liable to be dropped, are frequently banged about and dangle suspended from the cord which connects them to the sub-station set. Cases, therefore, should be amply strong and able to resist usage of this kind. The various models which use a case of spun metal, coated with a rubber tube, have advantage, both in cheapness and durability, but they are open to the objection of using poor insulation and the possibility of exposing the user to a disagreeable or even painful shock, due to leakage of ringing current, or what is even more dangerous a cross with an electric light or power wire, or a lightning discharge during a thunder shower. While the percentage of injury from such cases is insignificant, it is an objection always advanced by the timorous and may be a deterrent to a prospective subscriber. From many standpoints it is desirable to make the case in but two pieces—the body and the cap—although when there are good reasons on account of other constructive details, a tail piece is not a serious obstacle.

The magnetic system and the diaphragm should be so designed as to be connected to the case at only one point, for the coefficients of expansion of rubber and metal are so different that when the magnetic system and the diaphragm are separately secured to the case, at two or more places, and their relative adjustment depends on such support, it is impossible to keep them in their proper relative positions. So it is decidedly preferable to so design the receiver that the case is merely a cover which protects the organs of the apparatus from the inspection of the too curious. In this respect the Stromberg-Carlson, the Swedish-American and the Sun receivers present models of design worthy of careful consideration. Of other models, those which use the case as the framework to support the mechanism, and which secure the magnetic system by means of a screw thread upon the exterior of the case which engages with a similar thread located usually on the magnet, appear to be most desirable, while those which secure the magnetic system by a screw through the rear of the tailpiece, and hold the diaphragm upon the surface of the other end of the case, present the greatest liability to get out of adjustment.

Mechanically there is little to be said about the diaphragm, but the method of supporting it in relation to the magnetic system is worthy of the most careful attention. Diaphragms, which are buckled slightly, talk better than plain ones and a good mechanical device which shall secure the slight buckling necessary to this improvement in speech repetition is to be desired. Otherwise to secure the material which is best from the magnetic standpoint for the diaphragm, the cutting of the disc truly and accurately to size, so that it shall be flat without dishing, seems to present the best features for this portion of the receiver.

To protect the diaphragm from rusting the japan of ferrotype sheets, or the tin of common tin plate are favorite methods, between which there is not a great deal to choose. From a magnetic standpoint, ferrotype leaves something to be desired, and from a magneto-acoustic one the writer has often wondered why a spun diaphragm that was thick in the center, so that a stronger field could be used, and thin around the circumference to present as little resistance to vibration has never been advocated.

To build up the permanent magnet from a series of thin flat bars, undoubtedly presents the most expensive, but at the same time yields a better, more permanent, more perfect magnetic system. Otherwise the design and shape of the magnets is not a matter of great moment and is chiefly interesting from the manufacturing standpoint, for other things being equal, that design which can be manufactured at the least cost is undoubtedly superior. But the shape of the magnet must be considered when deciding on the proper temper, for long magnets should be somewhat softer than short ones.

For the pole pieces the most permeable possible iron should be secured, and the attachment of the pole piece to the magnet should be such as to present an extremely large surface, in order that the reluctance of even the smallest air-gap which the best mechanics can achieve, shall be reduced to a minimum. This joint should be machined and the method of securing the pole pieces to the magnet such that when taken apart they may be returned to exactly their original position, or otherwise a complete readjustment of the receiver is necessary, in order to secure the proper distance between the ends of the pole pieces and the diaphragm. One excellent method of obtaining this result is to machine the recesses into which the pole pieces fit, and to secure them by means of a non magnetic bolt that is slightly tapered and will draw the pole pieces and magnet to an accurate bearing.

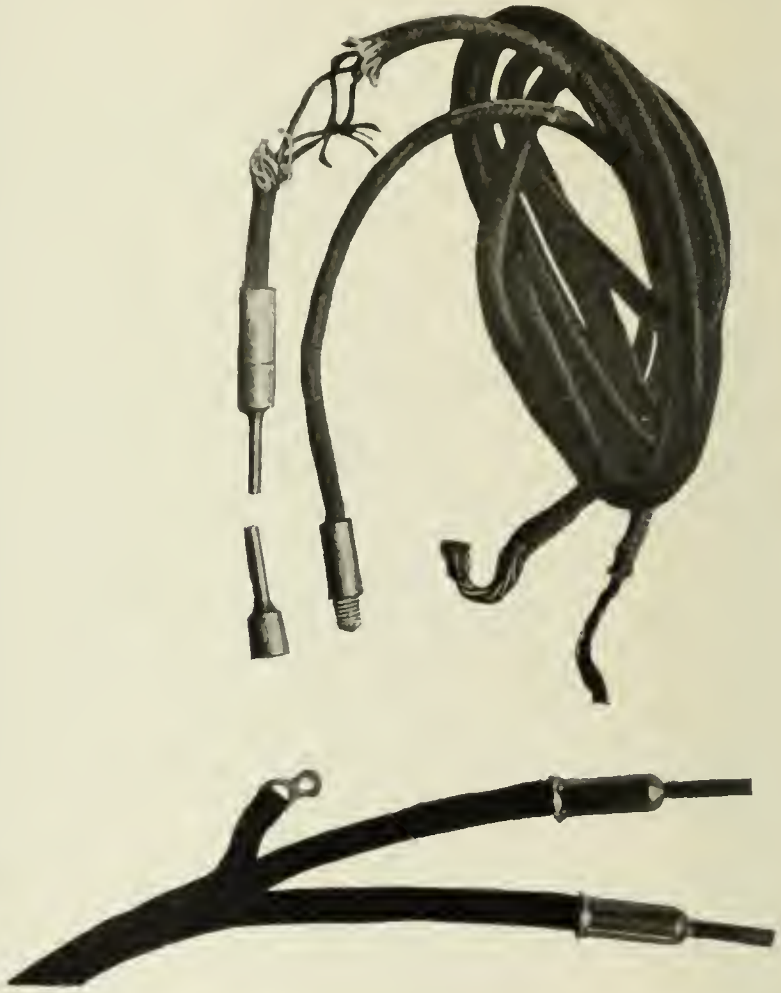


FIG. 31.—DETAILS OF CONNECTING CORD.

From an electrical standpoint, the coil spools should be made of some non-metal. Some receivers employ a spool made of fibre or similar material, while others use spools which are pressed from brass or similar sheet metal, but if made of metal the spools should be laminated. It is usual to press the spools on to the ends of the pole pieces and depend on friction or a slight heading of the pole piece after the receiver is assembled to retain them in place.

The method of attaching the receiver cord to the pole piece coils is a point of great structural weakness. Preferably the last few turns of the receiver coils should be made of quite heavy wire, which is lashed firmly into place on the coil with strong silk. Then leading-in wires of about No. 18 or 20 gauge are soldered to the end of the coil and extended to the rear of the receiver. Now there is a choice of two methods. Some models carry the leading-in wire to binding posts on the tail piece and then solder them, and attach the cord to the posts outside of the receiver. Others secure the leading-in wire firmly to a block bolted to the magnet and bring the entire cord through a hole in the tail piece and make the electrical connection at the magnet block. This latter design presents many points of excellency, for then the leading-in wires become an intrinsic part of the receiver mechanism, and when the instrument is dissected, are never broken.

The receiver cord consists of two flexible conductors, which must be overlain with the strongest possible braid of flax or cotton. This cord should be carried inside of the tail of the receiver and there substantially secured to either the case or the magnetic system by an extension of the braid, so that under no circumstances will any strain be brought upon the conductors themselves. An important detail is the receiver cord itself. It must possess the greatest flexibility and strength and secure good electrical continuity. A common construction uses two insulated conductors composed of braided or twisted fine wire; another uses one conductor of stranded wire surrounded by a spring wrapping of bronze wire, but this presents the objections of considerable resistance and inductance. The stranded conductors are universally made of very fine copper or copper bronze wire, or what is technically called tinsel, and the finer and more numerous the threads the better. The conductor insulation is usually made of silk, as preferably to stand the severe usage imposed on the cord, but it is desirable to apply some waterproofing in order that moisture from damp hands may not affect the cord insulation.

It is the universal practice to use cord tips in connecting the cords with the sub-station instruments. The cord tip is usually made by inserting a sharpened wire into the end of the cord. This wire is turned over into a hook and the tinsel of the receiver cord soldered thereto. The tip is then wrapped with wire over which a protecting funnel is soldered. The general details of this are shown in Fig. 31. Finally the receiver is an instrument of precision and its construction should receive the very best machine work in every respect and a high degree of finish. A poorly-built receiver is sure to mean large maintenance expense and constant complaint from subscribers.

The adjustment of the diaphragm and pole pieces is the most important detail. The requisites are: First, the diaphragm must be exactly perpendicular to the pole piece in all directions. Second, it must be as near the pole piece as possible without any possibility of coming in contact with them. Third, it must always retain this adjustment under all changing conditions of temperature, etc. Some receivers, like the Stromberg-Carlson, arrange the diaphragm to be adjustable. Scientifically this is admirable, but is more expensive to build and is a temptation to the curious. Other models grind the face of the case and pole pieces exactly flat after the instrument is all assembled, and then with a die dish the diaphragm, two or three sixty-fourths of an inch in the center. This is exemplified in the American and others. Models using a threaded case, machine a bearing on the top of the thread, and fasten a plate or stop on the magnetic system, which is brought to a bearing on this shoulder, and is supposed to bring the pole pieces into a correct relation to a flat diaphragm. Each plan has some excellences and some defects, but if carefully made each can secure the desired result.

Probably the acoustic properties of the diaphragm have received less attention than any other portion of the receiver, for as the general properties of vibrating plates emitting sound have been studied from time to time, investigators have for this reason probably concluded that there was nothing left worthy of investigation, but this is far from the truth. When any free body like a receiver diaphragm is acted on by a force it is set in motion, and the tendency is for it to vibrate as a whole, emitting a more or less deep note called its fundamental, and also to split up into parts, each one of which vibrates on its own account and so produce a series of higher notes called overtones. It is these overtones which confer that peculiar character whereby we are able to distinguish one musical instrument from another, even if all play the same air. In the case of the diaphragm the varying magnetic field furnishes the impelling force and the first tendency is for the diaphragm to vibrate as a whole and give forth such a note as depends on its mass and elasticity. There is also a tendency for it to split up into many small parts, each one emitting the note peculiar to itself. In addition, the problem is still further complicated by the fact that the diaphragm is clamped at its margins and by no means free to move as it may wish. Such clamping damps out the vibrations which it would make if free, and artificially introduces others totally foreign to the plate itself. Thus it is seen that there are several causes which operate to distort the fidelity with which a receiver can reproduce the sound initiated by the changing magnetic field; so the accuracy attained is indeed marvelous. Such considerations have led to the idea that the ability of the receiver to talk was really due not to a *molar* motion of the plate as a whole, but to a *molecular* motion of its component atoms, and there is much to support such an hypothesis. However this may be, it is generally believed that while a thick diaphragm can be made to give a very loud sound the distinctive overtones are wanting, there is little crispness and sharpness, and it is difficult to understand single words. With a thin diaphragm clearness is greatly improved, but at the expense of volume. A similar result can be obtained by clamping the diaphragm between sharp metal rings set around its circumference, or by dishing it. Too thin a diaphragm makes communication appear to be unnaturally shrill and high-pitched, so one has to steer between a Scylla of shrillness on the one hand and a Charybdis of "boomy" volume on the other; and in this connection it should not be forgotten that all the cavities of the receiver act as resonant chambers which should be made as small as possible, and in every design attuned to reinforce the fundamental note of the diaphragm.

Tangential Water Wheel Efficiencies.

At the recent meeting of the Pacific Coast Electric Transmission Association, Mr. George J. Henry, Jr., of the Pelton Water Wheel Company, read a paper with the above title and including an account of an experimental investigation of the relative values of different bucket shapes. The author in order to carry on his investigations devised a very complete apparatus for testing impact wheels, and took instantaneous photographs of wheels in operation, several of which are here reproduced. As will be seen, the paths of the water jet and discharge are very clearly delineated, thus enabling defects in bucket curvature to be readily detected. One of the interesting statements of the paper is concerning the high efficiency which may be attained with the tangential wheel, a test of a 750-kw wheel under 1,923 ft. head, showing an efficiency of 86.2 per cent., the nozzle and gate losses being included. The paper is largely controversial in character, but we extract the following portions dealing in a general way with the action and efficiency of tangential water wheels.

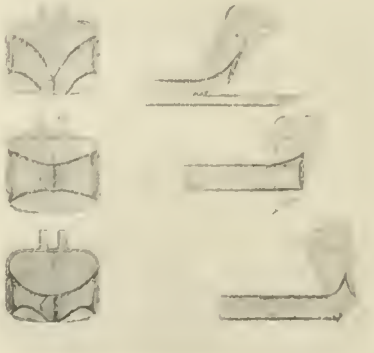


FIG 1.

FIG. 2.

The bucket of a tangential wheel does work throughout its entire path within the stream lines, and Figs. 1 and 2 give the lines taken by the water in three different positions of the bucket: First, at the moment of entering; second, at the point of developing maximum power; and third, in its final position before leaving the stream. To obtain the best possible bucket efficiency it is necessary that the water jet be taken up on the bucket surface and brought to as near rest as possible with the least loss of energy. This loss will then be made up of:

1. The discharge velocity with which the water leaves the bucket with respect to a point fixed in space, which velocity will vary with every position of the discharge as the bucket moves.
2. Air and surface friction inside the bucket.
3. Imprisoned water in the bucket.
4. Variation in the stream form, producing erratic conditions of impact and flow on the bucket surface.
5. Displacement of the stream when entering the bucket.
6. Eddy currents in the buckets.
7. When the water which does not give up all its energy to the bucket (a special case of the condition, 1).

The following methods of correcting these losses suggest themselves:

1. If the water moves in a curved path on the bucket surface, being taken up on a surface as nearly tangent to the entering jet as possible, and is turned through a curve of as nearly 180° as possible, still allowing the discharge to clear the back of the next

bucket, and the discharge is at the same distance from the wheel center at times, the first loss will be kept down to a minimum.

2. If the water moves in a smooth curved path at all times, as shown in the bucket diagram, Fig. 1, and the stream form is retained, spreading out gradually and encountering no sharp corners or angles, and the discharge is thin and fan like on the sides, and the least number of buckets used, then the air and surface friction will be a minimum.

3. The imprisoned water will cause very little loss if the bucket surfaces are smooth and so shaped on the back and front that the water, after expending its energy, will freely leave the wheel.

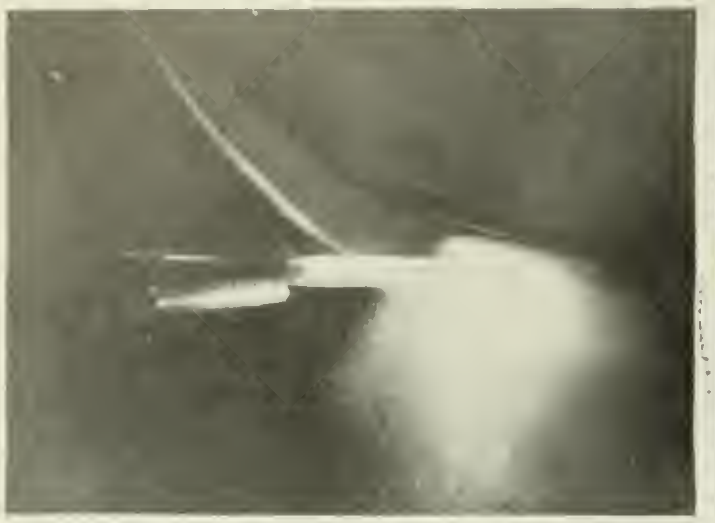


FIG. 3.

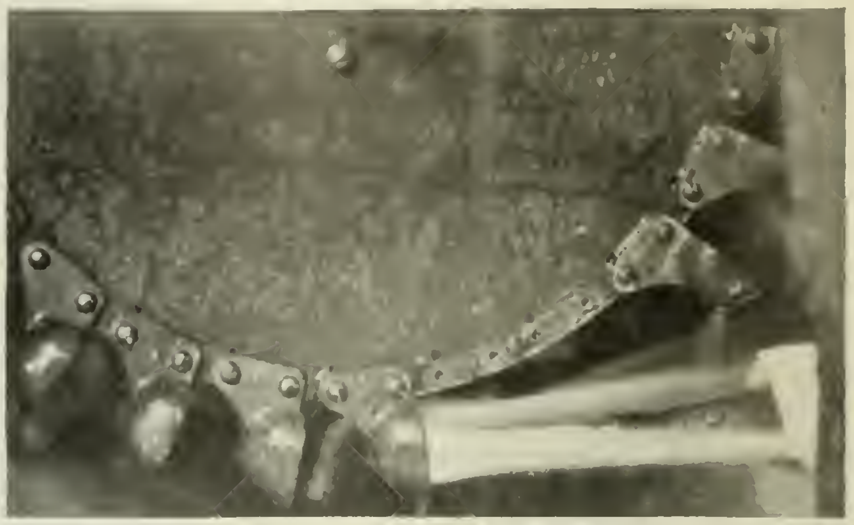


FIG. 4.

4. Variations in stream form producing erratic conditions of impact and flow will be avoided by carefully following the angle of the front and the curvature of the cavity surfaces.

5. The shape of the cutting edge and the dividing knife, and their relative angles to the stream, are the principal causes of the loss occasioned by the displaced stream.

There are still other losses which should form an important consideration in wheel design, but which are not directly affected by the bucket shapes. These are:

8. Journal friction.

9. Windage due to the wheel acting as a centrifugal blower.

10. The losses in the nozzles, gate valves and pipe lines.

Every water wheel plant has all of these losses to a greater or lesser extent, and it is obvious that when 80 per cent. is then obtained from an operating wheel, the improvement of any of these, or, for that matter, the entire elimination of any single loss, if this were possible, would not, to any great extent, improve any wheel's gross efficiency. The author has a number of times obtained as high as 90 per cent. efficiency in laboratory test on buckets only. The points to be observed in the determination of the best possible tangential water wheel bucket are as follows:

1. Given a certain stream of water at a given spouting velocity, it is advisable that this be taken upon the bucket surfaces of just enough buckets to catch every particle of water on the dividing wedges and turn it all on the curved surfaces, and discharge it as just enough velocity (and entirely in a direction at right angles to the entering stream axis) to clear the next following bucket. This resulting velocity will be the tangent of the discharge angle, multiplied by bucket velocity.

2. The air and surface friction must be maintained as small as possible by the use of a nozzle which will give a perfectly circular and solid stream. The bucket surfaces and cutting edges must be of a shape which, with a minimum wetted surface, will allow the stream, without crowding at any point, to spread out in a thin fan-like discharge on each side. The surface must be such that the water will not adhere, and as smooth as possible.

The surface may be ground and polished, or better, ground and well painted with a special compound. If all of these points are carefully studied out and the front of the bucket properly shaped and not cut away too low, the imprisoned water will not cause any appreciable loss.

The windings will also be a minimum if the number and surface of the buckets is a minimum.

The above losses and considerations for their prevention are all of such a nature and so entirely interdependent that their quantitative value cannot be predetermined except in a general way. In designing a water wheel, however, it is certain that the exercise of the most careful judgment is necessary in the laying out of the surfaces, so that all the losses, or at least their sum, or total bucket loss, will be kept down. Thus, if too much bucket surface be allowed, we increase both surface friction and windage for a given output, and if we attempt to cut these down by reducing the surface, we crowd the stream, so that eddy currents will occur and the stream will not properly discharge from the bucket side, as shown in Fig. 2.

It will now be seen that it is absolutely impossible to get equally as good results from a certain shape of bucket, under all conditions of wheel and stream diameter and water pressure, but that to get the best efficiency a bucket must be designed for each set of conditions. The author believes that there is no such thing as a bucket shape, which, by simply enlarging or reducing, may be adapted to any set of conditions. Some of the familiar bucket types are grossly deficient in the most elementary requirements for efficiency and best practical results.

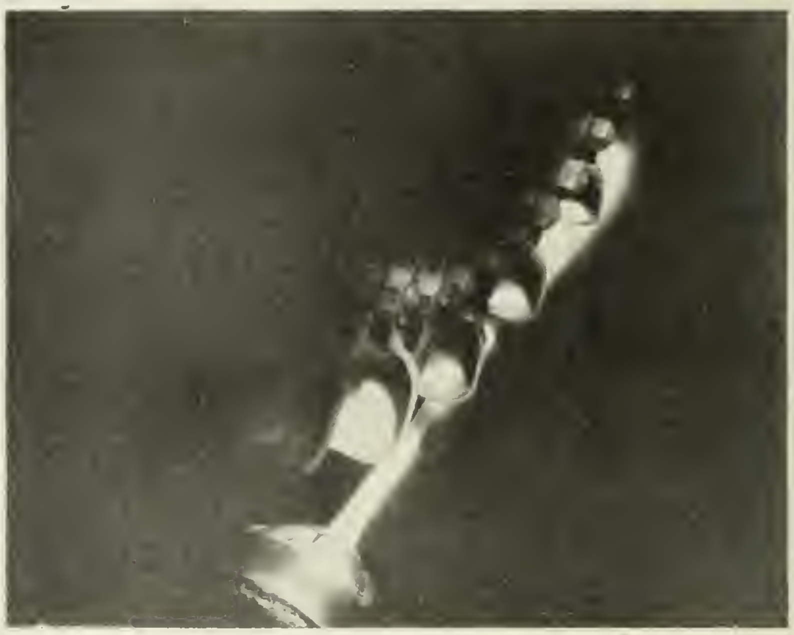


FIG. 5.

There is another branch of this subject which is of considerable interest, and one, if carefully studied, that leads us to very important conclusions, viz.: the erosion or bucket wear which occurs in every plant to a greater or less extent. As stated before, the course followed by a stream of water, after impact on a Pelton bucket, is such as to give a discharge almost entirely from the side of the bucket. This is shown diagrammatically in Fig. 1, and also experimentally in Figs. 3 and 4. The latter shows a stationary Pelton bucket receiving the correct size stream and discharging it from the sides. The course taken by the discharge will be slightly different as the wheel rotates, but the discharge will always be parallel with the entering jet. As a consequence the buckets would wear evenly, at least for a considerable time, until the slight pits, which almost invariably occur, would start local action, resulting in considerable wear spreading around these pits.

It is a fact worthy of notice that erosion met with in hydraulic practice is usually of two kinds. First, we have that due to the impact of cutting particles, which acts exactly as a sand blast—the sharp corners of the quartz sand particles cutting away the material of the bucket surface. Secondly, we have a chemical erosion or corrosion, occasioned by the escape of imprisoned air or air or other gas in solution, which released suddenly under high pressure may carry with it a certain amount of nascent oxygen, which on the clean metal surface would promote rapid oxidation. It usually starts at any imperceptible inequality in the castings, such as infinitesimal blow holes. The water moving over the surface and jumping across the blow hole crater releases the oxygen of the air, possibly more readily than the nitrogen. This gives us a small pocket, or blow hole, having clean surfaces from the water friction, filled largely with oxygen gas. The oxygen combines with the clean metal, forming an oxide coating, which is cleaned off by the water friction, which will invariably occur at the slightest change in position of bucket. The result is that the oxidizing process is repeated—the hole rapidly growing larger.

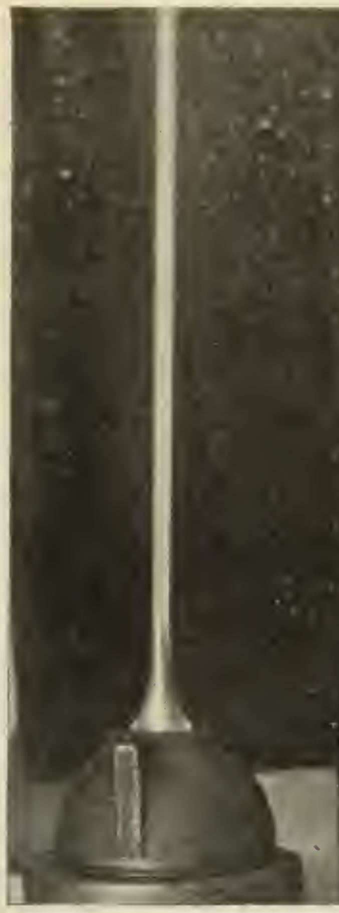


FIG. 6.

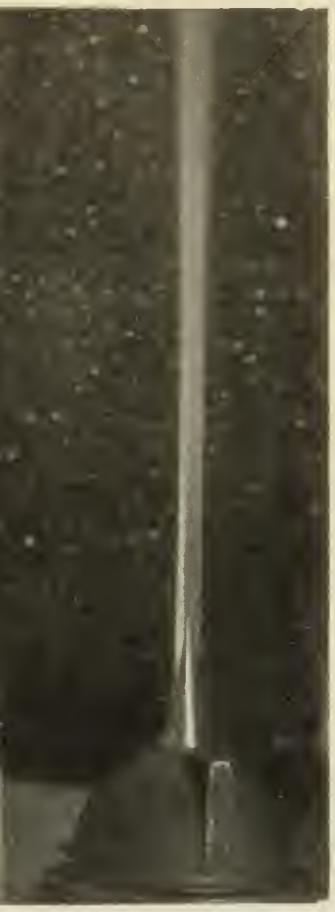


FIG 7.

We would expect, if the above theory of chemical erosion is correct, to find the oxidized pits, as they become larger, increasing more rapidly in the direction of the bucket wedge, or creeping towards the direction from which the stream approaches, rather than from it, as the oxygen would naturally be released on the side of the pit from which the stream approaches. Such seems to be actually the fact where we can obtain an example of chemical erosion independent of mechanical erosion.

A bucket taken from one of the wheels at the Santa Ana Station of the Edison Electric Company after about twenty-seven months' operation, during which it was driving a 750-kw generator from a single stream under about 700 ft. head, showed the oxidized pits above mentioned, which are of the color of gun metal—the oxidized depressed surfaces being clearly outlined from the smooth steel surface over which the water flows. If the erosion of these pits were due to eddy currents, the oxidized surface would be removed by such erosion. Moreover, if mechanical erosion accounted for the pitted surface of most of our water wheels, we would find the dividing knife, or splitter, the most heavily worn part. This, however, is not the case in most instances, the pitting usually occurring in the bottom and sides of the cavities. It will be readily seen that, after these pits grow large enough to alter the course of the water, they will completely change the path of the jet in the bucket cavities, and we will then have all sorts and kinds of erratic shapes, which shapes are in no way governed by the original curves of the buckets. We thus find on the same wheel buckets worn through in entirely different spots, bearing absolutely no similarity to each other, although they all started out under exactly equal conditions.

In water jets carrying imprisoned air, or air or gas in solution, due to the high pressure, we would expect to find, on relieving this pressure, a gas discharge from the outside of the stream. A stream under fifty-ft. head, carrying air in solution, is at the instant of leaving the tip, perfectly clear; an instant later, or about two diameters from point of issue, we find a slight enlargement of the stream, which the writer believes to be due to the imprisoned gas freeing itself on the relief of pressure. This disengaging process continues in this instance for about fifteen stream diameters, after which the stream begins to again clear up, although at no point is its rigidity or shape interfered with.

Fig. 5 shows yet another example, and under such radically different conditions as to lead to the belief that this condition exists throughout the entire field of hydraulic practice. This shows a jet from a Pelton needle nozzle under a pressure in excess of 1,900 ft. head at the plant of the Edison Electric Company in southern California. The jet is of a size suitable for developing an overload on a 750-kw generator, and the fog or "water dust" immediately surrounding the jet shows clearly the disengagement of imprisoned gas. This is best observable at from one to ten diameters from the tip, and is undoubtedly a condition that exists on the bucket surface, as well as immediately surrounding the jet at point of issuance.

Figs. 6 and 7 illustrate a needle nozzle under comparatively low pressure, and the water dust is here also observable at from five to twenty stream diameters distant from the tip. In each of these cases the stream is in particularly good focus, and the water dust was more clearly observable in the investigations than it is shown in the photograph. It is perfectly obvious, if this theory is correct, that much of the wear that occurs in the interior of nozzle tips would also be explainable. For it is certain that where changes of cross-section occur, there is a corresponding change in stream velocity, and, when this is not in accordance with the laws of least resistance, the oxygen or other gas would be released in exactly the same way, causing the pitting surfaces inside of the nozzle tip. In most cases in practice we have a combination of chemical and mechanical erosion.

Paint acts exactly as a sheet of paper or rubber cushion protecting a piece of glass under a sand blast—the paper or rubber not in any way being damaged by the impact of the particles of sand, but where cut away so that the glass is exposed to the cutting grains, the hard surface of the glass or of tool steel will be very rapidly cut. By holding your finger under the sand blast, the finger nail is rapidly cut away, although the sand makes no impression on the softer skin surrounding it. The observation of this fact led the Pelton company years ago to adopt a special rule in regard to painting its buckets—the paint proving the best possible protection. In fact, in regular operating plants, if the buckets are of good design and are kept thoroughly painted, they will last an indefinite length of time.

FIG. 8.

Figs. 3 and 8 show a Pelton wheel in operation at the point of best efficiency, and show that the water impact and discharge all occurs vertically under the wheel center and within a very short arc of stream contact; that there is no disturbance occurring in the stream itself due to the front wall of the Pelton bucket entering the stream.

Schenectady as an Electric Railway Centre.

ONE of the most interesting examples in the East of the rapid rise in population and industry of a community is afforded by Schenectady, New York. From a sleepy town reminiscent of the characteristics of life a century ago, it advanced from a population of 13,000 in 1880 to 31,000 in 1900, and 53,000 in 1902. This growth is to be almost entirely attributed to the establishment there of the main factories of the General Electric Company, and the extension of the former locomotive industry by the American Locomotive Company. The average number of employees of these two companies has advanced from 4,400 in 1891 to no less than 15,408 the first quarter of the present year. While this great increase in population would naturally have led to a considerable electric railway development, this development has doubtless been greatly accelerated through the city being the seat of the greatest electrical manufacturing establishment in the world.

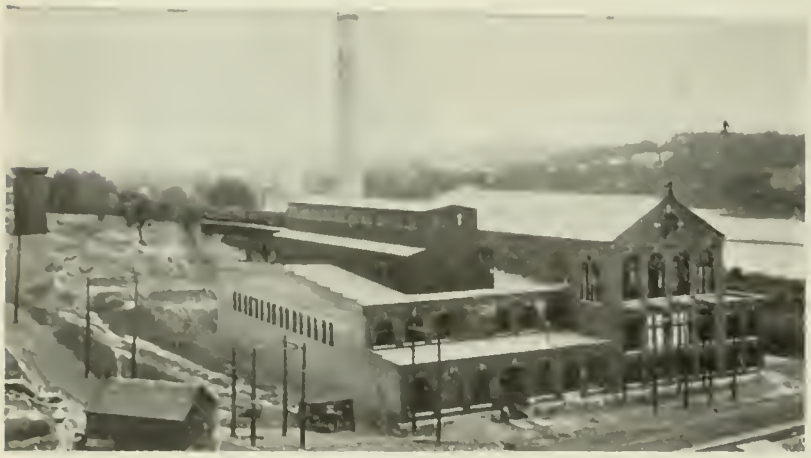


FIG. 1.—TRIBES HILL POWER HOUSE.

Within the city there are six electric railway lines, running over 22 miles of track. The main supply of power is derived from the generating plant of the Hudson River Power Transmission Company, at Mechanicsville, 18 miles distant, an auxiliary supply being furnished from the steam plant of the General Electric Company. The power from Mechanicsville is transmitted at 10,000 volts and 40 cycles over two separate lines, one being an air line and the other of about double the length, passing through Troy and Albany. Upon the completion of the Spier's Falls generating plant of the Hudson River Electric Company, another source of power will be available, which power will be transmitted 40 miles to Schenectady at a voltage of 30,000.

There is nothing of especial interest in the equipment of the Schenectady city lines, but a difficult problem in operation was the proper handling of the large number of employees of the General Electric Company in the short space of time allowed before and after shop hours. This situation has been successfully met by the building of a loop at the entrance to the works with the necessary storage tracks from which extra cars can be fed into the main line without interrupting the regular traffic. In this manner about 3,000 people are loaded and unloaded from the cars in less than half an hour without any apparent discomfort. In order to accommodate the large number of employees of the General Electric and American Locomotive Companies, who live in neighboring towns, special cars are run directly from the works over all interurban lines both morning and night.

It is with respect to interurban roads that Schenectady presents the most interesting situation. Four distinct suburban systems centering there are now in operation and a fifth is under advisement. To the north a double-track road to Ballston Spa and Saratoga, a distance of 22 miles, is about completed. To the east, a double-track road to Troy, a distance of 16 miles, was completed in March of the present year. To the southeast, a double-track road to Albany, a distance of 15½ miles, has been in operation for over two years. To the west a connection has been made with the Fonda, Johnstown & Gloversville Railroad, making it possible to ride from Albany to Gloversville, a distance of 50 miles, without change of cars; while to the south a road is contemplated which will extend to South Schenectady and Altamont, a distance of 11 miles.

The northern interurban road connects at Ballston with the line of the Hudson Valley Company, running to Saratoga, thence 18 miles to Glens Falls, and from the latter place to the southern end of Lake George and thence northward to Warrensburg. The Troy line connects at Waterford with the line of the Hudson Valley Company running northward along the banks of the Hudson to Glens Falls, and the Albany line connects with the Hudson and Albany third-rail system running to Hudson. Thus from Schenectady one can travel by electric car to all of the principal districts in the northern Hudson Valley, as indicated on the accompanying map.

The recently completed line from Schenectady to Amsterdam is 16 miles long, and forms part, as previously stated, of the Fonda, Johnstown & Gloversville system. The main power station of the system is situated at Tribes Hill on the Mohawk River, a few miles from Amsterdam, and embodies, together with the sub-stations, the most advanced practice in interurban work. Current is generated at 13,200 volts, no step-up transformers being used. There are three generating units, the engines being rated at 1,700 hp and capable of generating 2,250 hp. At the former load the steam consumption guaranteed is 13½ pounds, and 18 pounds at the overload. There are three sub-stations, one being located in Amsterdam, another at Johnstown and the third at Glenville, between Amsterdam and Schenectady. The feeders are carried without break from sub-station to sub-station, thus giving all cars between sub-stations a feed from both ends.

Each sub-station has three 300-kw converters, which are of the General Electric standard type, six-pole, running 500 r.p.m., with ventilated fields, open type collector rings, series shunt and equalizer switches mounted on machine frames, and other improvements up to the date of their manufacture. Each converter is fitted with a field break-up switch for use when starting from the alternating-current side, and this break-up switch is made double throw, the lower throw reversing the normal connections between armature and field so that the shunt field winding opposes the magnetism set up in the machine by the alternating currents. By this means the polarity of the machine is readily reversed when, in starting from the alternating-current side, the machine comes up with wrong polarity—that is, negative to trolley and positive to ground. This is a recent improvement over previous practice in which reversing was accomplished only by pulling the machine out and throwing it in again on the hit or miss principle.

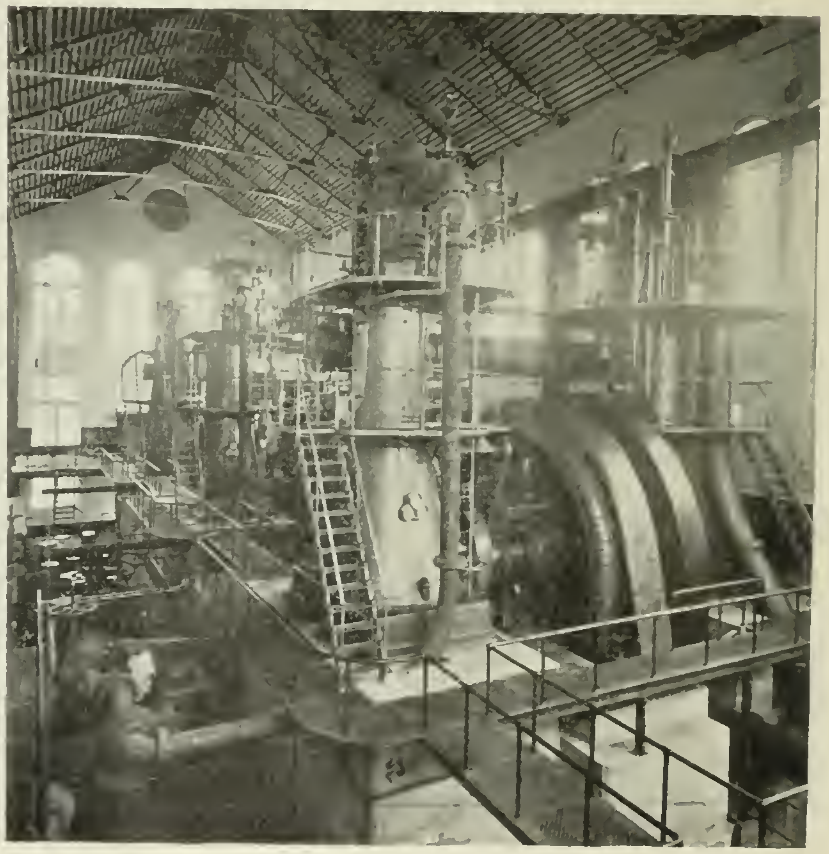


FIG. 2.—INTERIOR OF TRIBES HILL POWER HOUSE.

One 330-kw, three-phase transformer is installed with each converter. These are of the air-blast type, of shell construction, with three sets of coils similar to those of three single-phase transformers, but combined in one shell which serves as a common magnetic circuit. Primary windings are connected in Y with the secondaries in delta, the primaries being provided with taps for changing the ratio of the transformer in 2.5 per cent. steps up to 10 per cent., the secondaries being provided with one-half voltage taps in two phases for the purpose of starting. The converters are started by applying to them one-half their normal voltage obtained from one-half of the turns of the secondaries of the transformers. One corner of the delta is connected through to one collector ring of the converter in either the starting or running position of the switch. In the starting position the other two rings of the converter are connected to one-half taps in the two sides of the delta adjacent to this corner; in the running position these two rings are connected to the other two corners.

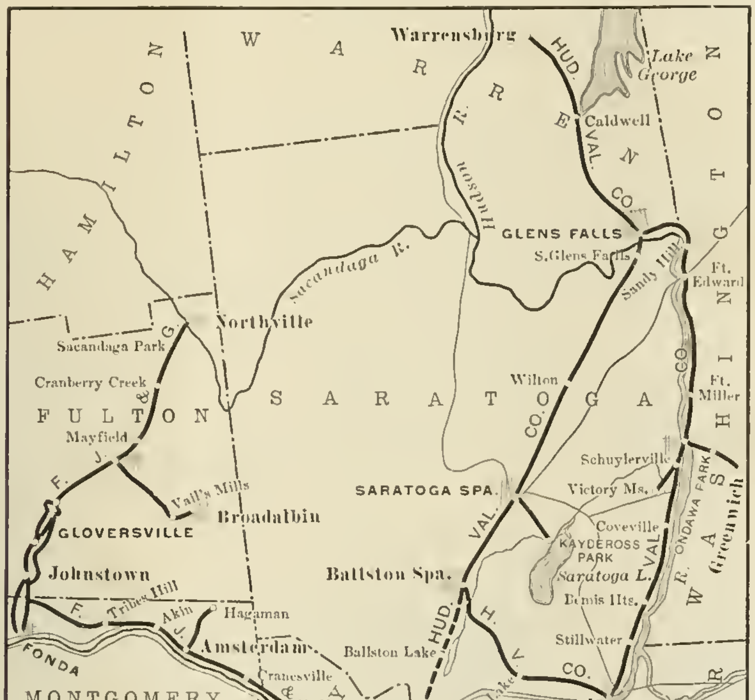


FIG. 3.—MAP SHOWING ELECTRIC RAILWAY DEVELOPMENT IN THE NORTHERN HUDSON VALLEY.

There is also provided between each transformer and the corresponding converter one three-phase reactive coil. This is designed to give a boost of about 30 volts alternating current with full load current of the converter leading, and a depression of about the same amount with full load lagging. This boost or depression in each phase amounts to about 70 volts boost or depression of the direct-current voltage. These reactive coils stand over the air-blast chamber provided for the transformers and are cooled by a small amount of air taken from them.

The high-tension line voltage chosen was the highest standard for which the General Electric Company builds generators without step-up transformers. This pressure, 13,200 volts, is ample for distribution from the generating station at Tribe's Hill to the present sub-stations, and for any extensions up to a maximum distance of about 25 or even 30 miles from the generating station, which is as far as there is any immediate prospect of an extension of this system. To take care of the high-tension power at this voltage in the sub-stations, three single-pole oil switches of the hand-operated type connected through mechanism to one handle on the switchboard panel, are provided for the supply of each step-down transformer unit. These switches are rendered automatic by the use of current transformers, relays and tripping coils, no high-tension fuses being used. Similar switches are also provided for cutting in or out either or both of two transmission lines to each sub-station, these switches being provided for each end of each of these lines. These, however, have not been utilized, as it has been considered preferable to put some of the cost of the second transmission line into the first, thus rendering the one transmission line more nearly infallible.

The line between the generating station and the Amsterdam sub-station is in operation twenty-four hours per day—all day for the railway and all night for lighting service. On this account a rather novel expedient was here tried, consisting in the use of four transmission wires for a three-phase circuit, one of the four being a spare, and connected to knife switches at each end so that any one of the other three line wires may be cut out at both ends and replaced by the spare wire. It is anticipated that by this means one wire may be killed in case of a punctured insulator, a cross or a break, and service may be continued by means of the spare wire. As this part of the line follows the track and may be reached from a tower wagon, it will be possible to replace an insulator or make other repairs on the dead wire while the other three are in use.

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The Fireproof Cars for New York Underground.

Sixteen of the new cars proposed for the Interborough underground road in New York are ready and thirty more will be delivered in a few weeks. It is expected that by the end of next month two cars will be received each day until the rolling stock necessary for operation of the tunnel has been received. A partial account has already appeared in these columns. The bodies of the cars will be sheathed with copper. The floors will be of two thicknesses of hard maple, with asbestos fire felt between them. The floor sheathing will be of one-quarter-inch asbestos board, which will cover the whole under surface of the car body. The under surface of the car directly over the motors will be sheathed with sheet steel one-quarter of an inch thick. The motor and the control cables will be incased in woven asbestos insulation, and asbestos molded forms will be used to cover certain parts of the machinery, and these forms will be attached to the car floor with brass screws.

A perfect system for the insulation of all incandescent and heater wires has been devised. They will be incased in flexible metallic conduits, and each lamp will be attached to a ventilated cast iron outlet box, and all heaters are incased in asbestos-lined metal boxes. Metal sheathing will be used in the platforms and all the switches and fuses are mounted on a marble switchboard, which is placed in a steel compartment outside of the car. Sixteen incandescent lamps will be placed in the ceiling of each car and twenty-four electric heaters will be used in addition to one in the motorman's compartment. The dimensions of the cars are as follows: Length over the buffers 51 ft. 2 in.; length of car body over corner posts, 42 ft. 7 in.; width over sills, 8 ft. 3¾ in. The seating capacity of each car is fifty-two persons. The problem of the best method for the exit and ingress of passengers has not been entirely settled. At first it was proposed to adopt, in addition to the door at each end of the car, an appliance to operate sliding doors in the center of the car. This system was adopted some time ago on the elevated railroad of Boston, but was not an entire success there.

The cars now being received are being fitted for service on the Second Avenue line and the general plan of the car as to exits had to be substantially the same. When the time comes for the actual fitting of the cars to be used in the subway there is likely to be some modifications of the upper body of the car to provide for quicker discharge of passengers.

One decided improvement will be made in all the new cars to prevent jamming of passengers while leaving and getting on the platforms. Instead of the swinging gates operated by the brakeman, there will be fitted sliding doors. All the cars will be vestibuled and the guard will stand inside and open and close the doors by a single motion of a lever, driving each door its full width into each car.

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Recent Electrochemical Developments.

LABORATORY RESISTANCE FURNACES.

Two new electric resistance furnaces for laboratory work were patented on August 10 by Mr. August Eimer, of New York City. One type (Fig. 1) is for baking or heating small articles, such as crucibles and appliances used by dentists, etc., the main feature being the simple construction of the furnace which consists of relatively few parts that may easily be taken apart. On a permanent base plate an integral housing of dome shape is fitted; heating resistance wires are placed within longitudinal holes in this dome. A plate with grooves in which other resistance wires are embedded is provided to slide within the furnace upon the base plate. On this plate a shelf or support rests for the articles to be heated; this support is formed integrally with the front cover plate of the furnace so that both are removed together.

The second type patented by Mr. Amend is a sectional furnace for use in chemical analysis and for other purposes in which heat is to be applied either progressively or over a given sectional area. For this purpose a plurality of separate resistance wires is arranged so that any one or more sections of the furnace may be cut in or out of circuit. The furnace is of an elongated trough-like form and is composed of opposite side sections of refractory material with corresponding longitudinal base and cover sections. Each set of side and base sections is provided with a resistance wire. Any two or more of the wires of these sections may be connected in series or may be disconnected at will, to provide heat to any extended or restricted portion of the apparatus.

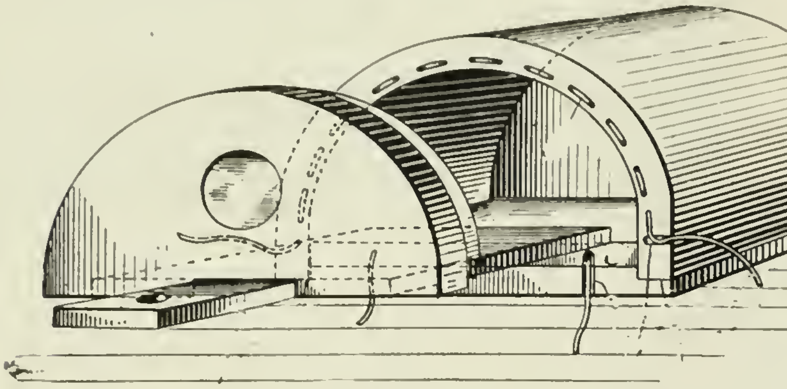

FIG. 1.—RESISTANCE FURNACE.

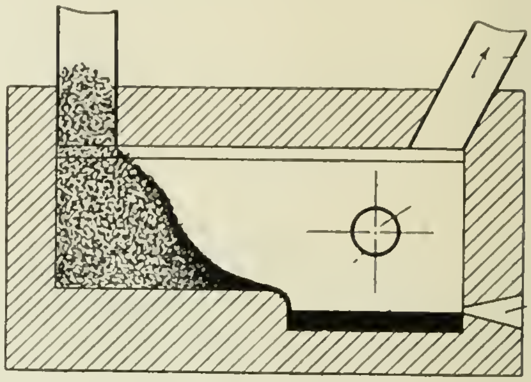

FIG. 2.—ARC FURNACE FOR DISTILLING ZINC.

ARC FURNACE FOR EXTRACTING ZINC FROM ITS ORES.

A patent was granted on August 16 to Dr. C. F. T. de Laval on the distillation of zinc from its ores, and especially from zinc-lead ores, by means of an electric furnace of the well-known type in which the radiant heat is used from an arc placed over the material to be melted. As shown in Fig. 2, the pulverized ore is introduced at one end of the longitudinal furnace chamber, so as to form a pile or stack sloping towards the other end of the furnace, where the arc is provided by means of two opposite carbons passing through the walls. By the action of the radiant heat upon the sloping surface of the pile, the non-volatile ingredients of the ore melt and flow down the slope into a basin just below the arc, from which they are removed through an outlet. As this melting and running down takes place, new surfaces of the stack are constantly exposed to the heat radiation. Simultaneously with this operation, the metal vapors mixed with the generated gases escape from the sloping surface and pass out of the chamber through an outlet above the arc. These vapors are then condensed by any suitable means.

If the pulverized zinc ore has not been previously roasted, it is preferably mixed with iron ore, while the ingredients are dry, the whole being afterwards moistened if required. The object is to eliminate the sulphur in the non-roastad zinc ore in which the zinc occurs as zinc sulphide.

ELECTRODEPOSITION OF ZINC UPON IRON AND STEEL.

The difficulties involved in the production of a good and firmly adherent deposit of zinc on iron and steel are well known and various investigators have attacked this problem in various ways. A patent granted on August 18 to Mr. Ignaz Szirmay, of Budapest, Hungary, describes a process which belongs to that large class of methods in which apparently inert substances are added to the electrolyte. This electrolyte is a solution of zinc sulphate, to which dextrose is added, together with a mixture of sulphates of aluminum and magnesium in certain proportions. The electrolyte is stirred to bring continuously fresh zinc ions to the electrodes. The deposit thus obtained is said to be a pure, homogeneous coating of zinc, free from blisters and adhering so tenaciously on sheet iron and sheet steel that it does not peel off, if these sheets are afterwards mechanically deformed.

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Precautions for Safety of Underground Travel.

President Orr, of the New York Rapid Transit Commission, has written to Chief Engineer Parsons the following letter, relating to the Paris subway catastrophe: "An accident, attended, unfortunately, with a large loss of life, has occurred in the underground railway in Paris. Apparently this accident was, in the first place, due to some derangement of the electrical machinery, thus setting fire to the train. According to the newspaper accounts many people, however, lost their lives through suffocation at the stations some distance from the point of accident. In accordance with the rapid transit act and the contract, the equipment is to be furnished by the contractor, and for which the operating company is primarily responsible. This, I understand, is also the method followed in Paris. Although the responsibility for the equipment and any accident that may arise will fall upon the company, nevertheless I wish that the commission should exercise its right of supervision to the fullest possible extent, to the end that every precaution shall be taken by the contractor and the operating company to reduce the chances of accidents to the minimum.

"I wish, therefore, that you, as chief engineer of the board, would, at your earliest convenience, ascertain all the facts in connection with the Paris accident, and also ascertain whether, in your judgment, our contractor and the operating company are making proper provisions against a repetition of such accident, or such other accident as may be foreseen and be prevented. When you have gathered together all the information that you can upon the subject, I wish that you would make a report."

In this connection, it may be stated that Mr. L. B. Stilwell, saw the importance of this provision before its necessity was emphasized by the Paris calamity. The lighting of the rapid transit subways will be effected by circuits and have no relation to those employed in operating trains. For this purpose there has already been installed a plant of three 1,250-kw alternators, driven by steam turbines.

A dispatch from Berlin, of August 19, says: "Lessons taught by the recent disaster on the Paris underground railway are being applied by the Ministry of Public Works. Orders have been issued to the officials of the Berlin underground and overhead railway to light all tunnels by wires wholly disconnected with the motor current, and to install apparatus enabling train hands to break the terrific current anywhere and thus stop trains approaching the scene of an accident. The officials are also ordered to stop the overcrowding of cars." Another dispatch from Paris, of August 20, says: "Employees of the Metropolitan Railway Company held a meeting to-day, at which they discussed the accident on the line of the company on August 11 in which about 100 persons were killed. A resolution was adopted declaring that the company was responsible for the catastrophe. The resolution also demanded that certain changes should be made in the plant and the staff of the company, and asked for the removal of the Prefect of Police and the Prefect of the Seine Department. These officers are accused in the resolution of granting special privileges to the company."

New Telephone Patents.

SELECTIVE SIGNAL ATTACHMENT.

Selective signal devices heretofore proposed have been of such a character as to require either special construction for the bells or special arrangement of circuits at the subscriber's stations. A patent has recently been issued to Mr. B. Hamilton, of Lawrence, Kan., however, for a purely mechanical attachment to the ordinary bridging bells of a party line which renders the whole operative upon a selective basis. Fig. 1 shows a view of the device with the cover removed and mounted in position upon the face of the bell box. Normally the notched projecting arm engaging the bell rod, holds it in a mid-position, clear of the gongs, and this arm is restrained in its movement by a disc within the case. Thus even though ringing current be put upon the line, the hammer cannot strike the gongs. The attempt of the hammer to respond to such ringing current does, however, serve to move the arm sufficiently to allow the disc locking to begin a rotation upon its axis, being impelled by the main spring and controlled by the escapement. An impulse from the hand generator at any station thus will start all the locking discs synchronously.

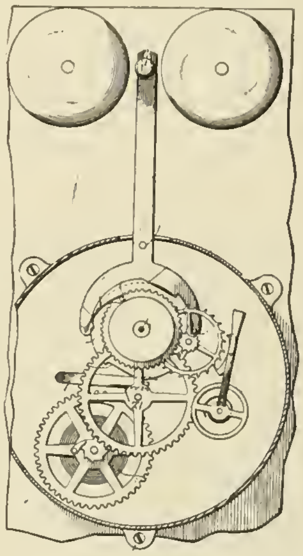


FIG. 1.—HAMILTON SELECTIVE SIGNAL.

The arbors of the discs at the various stations carry pointers which proceed over dials, while the discs themselves have notches in them so placed with reference to the pointers that a free movement of the bell hammer is permitted at any station at just such time as all pointers indicate the corresponding number. Having started the discs, the subscriber watches his pointer. When this indicates the desired number he again turns his magneto, whereupon he signals the desired station and that only.

SPECIAL BUSY TEST FOR PARTY LINE SWITCHBOARDS.

It has been proposed by some to do away with the usual code letter or number to designate the stations of party lines and instead to provide each line with a number of multiple jacks in each section of switchboard to provide one for each station. With this scheme each station is given a number just as though upon a direct line. However, the ordinary busy test applied necessarily to all lines to provide against interference from other lines serves to prohibit any calls between stations of the same line. This is the case, because when the line is made busy at the answering jack, the multiple jack of the desired station being interconnected, tests busy, receiving the test current from this answering plug. Mr. J. J. O'Connell, of Chicago, has overcome this defect by providing a countermanding tone test which becomes superimposed upon the busy test whenever the test plug and the answering plug are of the same pair of cords, and the jacks protected and tested are of the same line. The patent for this circuit has been assigned to the American telegraph & Telephone Company.

VISUAL SIGNAL.

Another patent recently assigned to this same company is one describing a novel electromagnetic signal, of which W. W. Dean is the inventor. This signal is well shown in Fig. 2. As may be seen in the plan view, the body of the signal is formed by a return pole-piece of U-shape, within which the coil and core are located and the ends of the legs of which carry the armature trunions and the signal face. The armature consists of a sheet steel frame with a tapered projection shaped to extend the range of the magnetic pull. The target of the signal forming one side of the armature frame is of aluminum and is dished to extend out through the signal face for a considerable distance to facilitate observation at an angle. Contact points carried by the armature are provided to form connections for supplementary audible signals.

TWO PROTECTIVE DEVICES.

An addition to the regular scheme of protection from stray currents has been made by A. B. Stetson, of Malden, Mass. This is a line short-circuiting device. Complete protection up to the present time has embodied three elements—a sneak current heat coil, a link fuse and between these electrically, a carbon plate, open space cutout. Mr. Stetson's addition is that of a short-circuiting cut-out connected to line outside the fuses. This is a thermal device which when subjected to an arcing due to a high potential, releases and short-circuits the line. For example, suppose one side of a line crossed with high potential; after the usual protective devices associated with that side of the line have operated, an arcing will occur across the short-circuits and thence through the open space cut-out of the second side of the line, whereupon the fuses of that side will go, completely separating the station from the line. Similar short-circuiting devices are placed at the central office, but these have the additional feature of grounding the line.

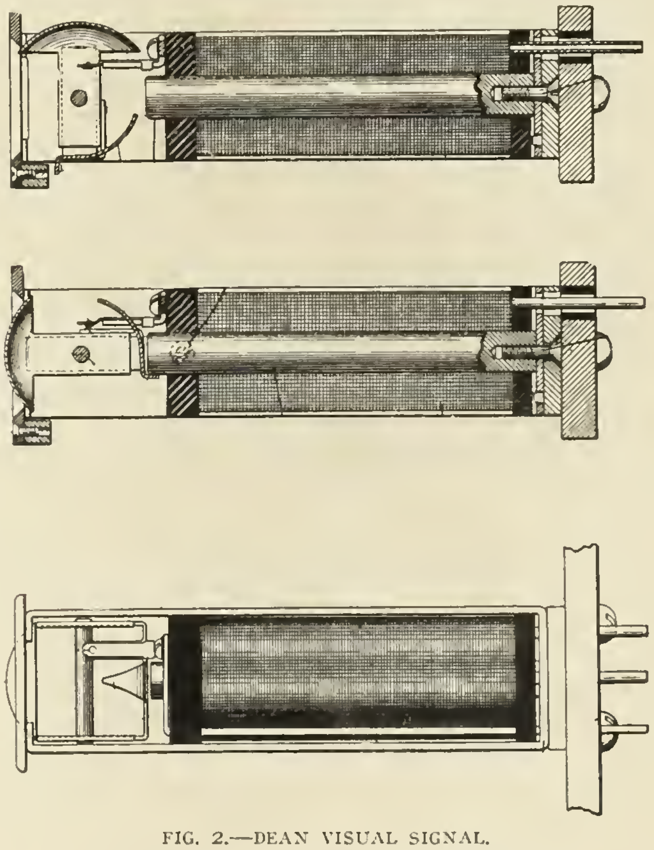


FIG. 2.—DEAN VISUAL SIGNAL.

A very different apparatus is the protective device of A. Stiles, of Martinsville, Ind., although it also serves to separate the line and station. Mr. Stiles provides a plug and socket cut into the line to form a portion of it and adapted to be disengaged from each other by means of a hand rope. This manual separation of the plug and socket during storms allows the line wire to fall to the earth and become grounded.

A NEW RECEIVER.

Mr. W. W. Dean has been granted a patent for details of construction of a receiver. The most notable feature is the provision of a hard rubber terminal block secured to the magnet near the poles. This is so designed as to allow of firm and strong electrical connection between the coils and cords. The Kellogg Switchboard & Supply Company have been assigned the patent.

CURRENT NEWS AND NOTES.

SIGNS AS STREET ILLUMINANTS.—The growing use of electric light signs has caused legislation on the subject, as in London some time ago in regard to "flashers," which were restricted. The owners of electric signs above the sidewalk in Chicago have now been officially notified that their signs must be kept alight until 11 o'clock P. M. or the licenses will be revoked.

LOCATING MINERALS ELECTRICALLY.—The long list of patents on electrical means for locating minerals received another addition August 18 in a patent issued to George I. Leonard. One earth electrode is of copper, and the other of iron. The ground in which the former is located is saturated with a solution of sulphate of copper, and the ground surrounding the latter saturated with a solution of sulphate of iron. An ammeter is placed in series with a wire joining the two electrodes, the reading of which is stated to be proportional to the resistance of the earth between the electrodes.

ST. LOUIS TROLLEY ACCIDENTS.—As seven deaths per month by street car accidents have been the average in St. Louis during the present year, the City Council has appointed a special committee to ascertain whether they have been due to the lack of stringent laws, the non-enforcement of the present laws, the lack of efficient brakes and fenders, the carelessness of the motormen and conductors, or the employment of incompetent men by the street car companies. The introducer of the motion stated that he had been in five street car accidents himself in four weeks, and was convinced that, in many cases, carelessness alone was the cause.

TELEGRAPH WIRES ON RAILROADS.—A telegraphic dispatch from Anderson, Ind., says: "The probability of conflict in the West between the Pennsylvania Railroad Company and the Western Union Telegraph Company is suggested in the statement of Secretary John P. Sears, of the Anderson Club, who has returned from New York. Mr. Sears said he met Vice-President Baker, of the Postal Telegraph Company, who told him that the Postal would enter this city and others along the Pennsylvania Railway system west of Pittsburg at the close of this year by supplanting the Western Union along the Pennsylvania system. Mr. Sears also reports Mr. Baker as saying that notice will soon be given to the Western Union to get its lines out of the way along the Pennsylvania Railway system west of Pittsburg."

TROLLEYS IN SPAIN.—Consular Agent A. E. Carleton, of Almeria, calls attention to a concession to be granted for the building of an electric tramway between Mondariz and Porvino. A second section is to be constructed later. This will extend the line to Vigo. The entire length is to be 23 miles, almost equally divided between the two sections. The first is to be 10.5 miles, the other 12.5 miles. The power is to be obtained and transmitted from two waterfalls on the River Tea, between Mondariz and Puenta Areas, and from a waterfall on the River Mino, about 15.5 miles from the middle of the line. The force at the first falls is 268 hp at the turbines, and of the second 1,375 hp. As the road requires only 375 hp the remainder will be used by various industries in the enterprising town of Vigo. The consular agent also reports that another electric tramway is to be built at Linares.

CONTROL OF WIRELESS TELEGRAPHY.—A cable dispatch from Berlin, August 14, says: "The deliberations of the wireless telegraph congress, just closed, will, it is believed, result in a death blow to the ambition of the Marconi system to monopolize the business. There is authority for stating that the congress declared unanimously in favor of making wireless telegraphy the business of the various governments as inland telegraphy is now regulated in Europe. Recommendations to that effect will be made to the various governments represented at the congress, particularly by the British delegates. The opinion expressed by the German papers upon the conclusion of the congress is that the German system is far superior to Marconi's for long-distance signalling. It is understood that a subsequent congress will give effect internationally to the recommendations of the present conference." This reads very much like an attempt to grind some German axe at Marconi's expense, and everybody else's.

OMAHA ELECTRIC LIGHTING.—The City Council of Omaha, Neb., will shortly ask for bids for street lighting in the territory at present covered by gas and gasoline lights. The contract with the gas company will expire January 1 next. The contract with the electric light company has nearly two years to run before its expiration. It is stated that the Omaha Electric Light & Power Company will offer to furnish 1,300 arc lights at $70 per year each instead of their present agreement of 500 arc lights at $94.50 each. The electric light company will ask for a ten-year contract as one of the conditions for this new rate of service. Considerable objection to a long time contract is expressed by some of the citizens. The position which the gas company will take has not yet been disclosed, but it is expected that very sharp competition will prevail when the matter is brought up for consideration, which probably will be early in September. Several large water power electric transmission schemes are being considered by local and outside capitalists for supplying light and power in the cities of Omaha, South Omaha, Council Bluffs, Iowa, and other points within easy distance, and the citizens of Omaha expect to receive great benefit by means of the cheaper power thus available. The street lighting contract will no doubt be somewhat influenced by the proposed transmission plant. The *Omaha Bee* and *World-Herald* oppose a ten-year contract, and while admitting that the price of $70 per year for street arcs offered by the present company is reasonable at the present time, it is contended that in a few years the cost of production may be considerably reduced, in which case the city would not receive the benefit if it is bound by a long term contract.

WIRELESS TELEGRAPHY IN JAPAN.—In a recent letter, Mr. Samuel S. Lyon, United States Consul at Kobe, Japan, states that Japanese warships equipped with wireless telegraph apparatus have sent and received messages to and from Japan at a distance of about fifty miles. Since the great value of wireless telegraphy has been fully demonstrated, the system will be further extended at an early date by the Japanese Navy Department. An English journal at Kobe states that the necessary plant is now being erected for the establishment of communication by wireless telegraphy between Miesaki, in Nagasaki prefecture, and Sharyo Island, off Kelung, Formosa, a distance of about 850 miles. The installation was commenced in January last and the expenditure on the enterprise is estimated at about $20,000. Mr. Saiki, an engineer in the Department of Communications, is in charge of operations at Miesaki, and the instruments are now well on the road to completion. The station at Sharyo was commenced in March last, and is in charge of Mr. Ichimura, an engineer in the same department. Experiments with wireless telegraphy, it seems, have been continuously made by the Department of Communications and by the Navy since 1896. The experiments were first made with satisfactory results over a distance of eleven miles and afterwards between the shore and ships in Tokyo Bay, a distance of over twenty miles. The system of wireless telegraphy employed in Japan is stated to differ materially from the Marconi system. An application of Signor Marconi for letters patent on his inventions in Japan was refused and the system now being established between Formosa and Kyushu has been developed by a Japanese inventor.

ACETYLENE AT ST. LOUIS FAIR.—At the annual meeting in Chicago of the International Acetylene Association, the Committee on the St. Louis Exposition reported that they had called on the Exposition officials and found it impossible to induce them to appropriate any money for a separate building for acetylene; also that it was impossible for the manufacturers to exhibit the acetylene generators in operation in any of the buildings of the Exposition company. The committee were informed that if the acetylene generator manufacturers would make a proposition in definite shape as to how much they would contribute for the erection of an acetylene building and its maintenance in the grounds of the Exposition company, the matter would be presented to the directors of the Exposition company for consideration. The committee found it impossible to secure a sufficient number of pledges for financial support, so that they were unable to push the matter further. Through the efforts of the Union Carbide Company, a separate space has been set aside in the manufacturers' building for the use of the manufacturers of acetylene, and a certain space to be lighted by acetylene gas by a pipe from an outside plant has been arranged for.

TELEPHONIC INTELLIGIBILITY.—It is alleged that the telephone employees in Paris have discovered that French is more easily understood over the telephone than English. In telephoning between Paris and London during a storm conversation in English is impossible, but French is easily understood because it has not so many sibilant sounds and unequally accented syllables.

A LONG ELEVATED TRAIN.—The ten-car train that took the Twenty-third Regiment to Manhattan Beach about a fortnight ago is said to have been the longest train of electric cars that had ever been run on an elevated road. The train was made up of ten motor cars. Each car had four 60-hp motors—forty motors in all. These forty motors were all connected on the circuit, giving the train a propelling power equal to 2,400 hp. It will be remembered there were some very long electric trains on the elevated road at the Chicago World's Fair in 1893.

ELECTRICITY FOR LONG TUNNEL.—The construction officials of the Denver, Northwestern & Pacific Railway have decided to do away with the inconvenience from smoke in passing through tunnels. "We have about made up our minds," said D. H. Moffat, "to take our trains through the James Peak tunnel by electric engines. The great length of the tunnel will make it almost impossible to keep it clear of the smoke and foul air that steam engines make. Electric power will solve this problem to a nicety." The tunnel will be two and a quarter miles long.

CONTROL OF BLACK SEA CABLE.—Referring to the troubles in Turkey and the statement made by the Constantinople correspondent of the *London Times* that, besides demanding the execution of reforms in Macedonia, Russia also demands the concession of the Black Sea cable, now held by the Eastern Telegraph Company, a British concern, the officials of the company explain that the concession was granted by Russia, who reserved the right to take over the cable at the end of a certain period. Consequently, the alleged demand upon Turkey is unnecessary. The company expects that Russia will grant compensation for taking over the cable.

WIRELESS TELEGRAPHY AT THE YACHT RACES.—Three different systems of wireless telegraphy are being used in reporting the international yacht races which are now in progress off Sandy Hook. The result, as far as we can learn at present writing, is practically what would occur on a single Morse wire if three different offices tried to send messages at the same time. One system is tuned, but is said to be knocked out of tune frequently by the higher pressure of one of the other systems, and the third contributes largely to the general discord. We are informed, however, that one of the systems is, notwithstanding these serious drawbacks, rendering fairly good service. After the races are over we shall be better able to compare results, and draw conclusions. The situation reminds us of the difficulty, sometimes experienced, of "getting a word in edgeways" when others monopolize conversation. It is said that actually no fewer than nine wireless transmissions were being tried out the first day of the races.

INCREASE IN TELEGRAPH RATES.—Orders have been issued from the executive departments of the Western Union and Postal Telegraph Companies in New York abolishing the 20-cent. rate on ten-word messages sent between New York and Philadelphia or Baltimore. Twenty-five cents is now charged. The 20-cent rate had been in force for about ten years, and was started at a time when the competition between the telegraph companies was very keen. A Western Union officer said that the increase in the rate was made necessary by the cost of sending and delivering a message. He said that the cost to the company of a message was about 22 cents, and therefore thousands of dollars had been lost by the low rate. Simultaneously with the increase in the telegraph rates comes the announcement of the Bell Telephone Company of an increase in its charges for telephone service between New York and Philadelphia. The new rate is 75 cents for three minutes' service and 25 cents for each additional minute, as against the old rate of 65 cents for three minutes or less and 20 cents each minute thereafter.

GERMAN GALVANIC BATTERIES.—Mr. O. J. D. Hughes, U. S. Consul-General at Coburg, Germany, says: A new German patent relating to galvanic batteries of the class which is composed of a series or plurality of separate dry cells has been issued. The improvements cover the production of a battery which is capable of being kept in store, of being transported in an absolutely dry condition, and of being rendered fit for use at a moment's notice by the introduction of a suitable liquid or electrolyte into the separate cells constituting the battery. The object aimed at appears to have been secured by certain novel features of construction and combinations of parts. The dry cells consist each of a zinc or other metallic cylindrical electrode, and of a carbon electrode having a cylindrical or prismatic cross-sectional area placed within the metallic cylinder. The space between the two electrodes is filled up with blotting paper or other suitable material capable of absorbing the electrolyte. A plurality of these cells is arranged within a suitable socket or frame-shaped casing, the cells being separated from each other and the surrounding casing by asphalt or other insulating material. When required for use the covers are removed from the cells and filled up with the blotting paper soaked with any convenient electrolyte, such as ammoniac solution, etc. The covers are then replaced and the battery is ready for use. Insulating rings at the open ends of the cells or zinc cylinders prevent short-circuiting of the cells by any overflowing electrolyte.

GERMAN STANDARD GAUGE ELECTRIC ROAD.—Mr. Frank H. Mason, United States Consul-General at Berlin, says: "Berlin has entered definitely upon the employment of electrical traction for suburban service on the State railways of standard gauge. Since the middle of May experiments have been in progress on the line from the Potsdamer Railway Station in Berlin—the focal point of suburban traffic within the city limits—to Gross Lichterfelde, a distance of 5½ miles. These experiments having proven entirely successful, regular traffic was begun on July 15 with trains of three cars each, which depart in each direction every ten minutes and are permitted by ordinance to make a speed of 60 kilometers (37.2 miles) per hour. The current is supplied from the southwestern power station of the already existing circular railway (Ringbahn) and is transmitted by third rail and contact shoe. Each train is made up of one second and two third-class cars, each 63 ft. long by 9 ft. wide, and which weigh—all three together—128 tons and seat 200 passengers. The second-class car is at the middle of the train and carries no motor. Each third-class car carries a motor at one end and these, being put at the front and rear of each train, enable it to run forward or backward as desired. The cars are new and as handsomely finished as their purpose would justify. They are equipped with heating apparatus for winter and would be considered comfortable and up-to-date even in the United States. The opening of this line is noteworthy because it marks the beginning of a general change from steam to electricity for the important and rapidly growing suburban service of Berlin. So comfortable, rapid and convenient have the electric street railway connections become—especially the overhead and subterranean line which was opened in February, 1902—that aside from all considerations of economy the steam lines are constrained to go over to the new, clean, convenient and more economical system of traction in order to hold their traffic and secure their business for the future. A second line, which leads to Cöpenick—several miles distant up the Spree—is in process of conversion to electricity, and will inaugurate the new method of traction during the summer."

LETTERS TO THE EDITORS.

Water Wheel Tests.

To the Editors of Electrical World and Engineer:

Sirs.—Our attention has been called to one of your recent issues, in which appears a note on the subject of the Mill Creek station of the Redlands plant of the Edison Electric Company, near Los Angeles, Cal. The impression that might be produced on a reader of this note is that the Pelton wheel there referred to as in competition with another wheel was lacking in efficiency. I feel sure that you would not wish your readers to be misled in regard to this point, and therefore take pleasure in stating that the Pelton wheel at the above station showed in efficiency measurements made by independent engineers, an efficiency of 86.2 per cent, whereas the efficiency of the other type of wheel was materially below this amount. The tests on the latter wheel were conducted by Mr. Samuel Star-tow, of the Douglas Building, Los Angeles, and Prof. Hoskins, and those on the Pelton wheel by Prof Leconte, of the University of California

I am authorized by the Edison Electric Company to state that such orders for water wheels as they gave for other than Pelton wheels were placed before competitive measurements of any kind were made on the wheels, and before the plant was put in service operation We trust that you will do ourselves and your readers the justice to publish these statements so that there may be no misconception in regard to the results obtained by Pelton wheels.

Geo. J. Henry, Jr.,
Chief Engineer, Pelton Water Wheel Co.

San Francisco, Cal

Sprinklers for Underground Roads.

To the Editors of Electrical World and Engineer:

Sirs.—Regarding the recent accident on the underground railway in Paris, it is suggested that a carefully laid out sprinkler system should be installed on all subways and tunnels

The pipes should be so placed that the risk of breakage arising from a collision or otherwise would be nil It is also suggested that subways should be at least dimly lighted at all times, and that these circuits should be separate from the operating lines. There should be a guarded walk between stations to say nothing of the absolute elimination of wood and other inflammable material wherever possible

Geo D Hale.

Chicago, Ill.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Hunting of Alternating-Current Machines.—Hopkinson.—A paper communicated to the Royal Society, England. The phenomenon of hunting has received much attention from the practical side; in its theoretical treatment it has been ascribed by Kapp and others to resonance. The author believes that it is probable that some cases of hunting are due to resonance, but thinks that there have been cases in which it has been difficult or impossible to discover any external disturbing cause of approximately the same period as that of the oscillation, and he himself has noted one case of this kind. A certain small single-phase synchronous motor hunted violently under certain conditions. The period of the oscillations could be varied continuously from about 0.35 to 0.45 seconds by an appropriate variation of the self-induction in series with the motor. The hunting occurred equally and with the same period with either of two different generators working in the same power station, one being three times the size of the other. It was clear, therefore, that in this case, at any rate, hunting was not due to resonance, but to some essential instability in the motion of the motor itself. In order to explain this instability, attention is called to the fact that there is a term in the equation of the torque, dependent on the velocity, whereas in Kapp's equation it is assumed that the torque is dependent only on the relative position of motor and generator and not on their velocity. If the coefficient of velocity be positive, the amplitude of the oscillations continually decreases, but if it were negative, though even very small, the oscillations would constantly increase and the motion be essentially unstable. Systems are not unknown in which the coefficient is negative; Watt's governor is such a system, the oscillations of which are given by a cubic equation, the two complex rods of which have positive real parts and correspond to constantly increasing oscillations. The author states that there is no doubt that the motion of a synchronous motor is under certain conditions another instance of the same thing. The author then investigates mathematically a case in which the motor has a permanent magnet or saturated field and is working against a constant load, assuming first that the field is unaffected by the oscillations and afterwards also taking the disturbance into account. He then investigates the damping effect of the damping coils of copper, or "amortisseurs," which are put around the field coils of the magnets. The result as far as damping is concerned, is the same whether this additional copper is put into a separate short-circuited winding or into the field coils. In the latter form it assists in reducing the ordinary losses in these coils. From the equations which he gets he deduces the following conclusions: Increased fly-wheel effect always results in better damping owing to the increase in the period. Increasing the self-induction has the same effect and it also works in favor of stability by diminishing the coefficient of instability. For a fixed field excitation, the damping term is about proportional to the square of the load; the more the machines are loaded, the better they will run in parallel. If with a constant load the field current is diminished, more stable running is obtained. If the resistance to the induced currents in and about the pole-pieces be diminished, the damping effect first increases to a maximum and then diminishes. It is possible, therefore, to carry the application of "amortisseurs" too far, which is obvious if one considers that a coil of no resistance around the pole-pieces would completely destroy all variation of induction and all the damping effect which depends on such variations.—Lond. *Elec.*, August 7.

Commutator Diagram.—Cramer.—The author experimentally investigated the sources of error in the commutator diagram. If the voltage of a direct-current machine measured directly is compared with that calculated from the number of windings and the mean voltage obtained from the commutator diagram, there are always found several per cent. difference, the directly-measured voltage being the greater. The sources of error in the taking of the field curve are first that the voltage between the auxiliary brushes is not constant, but oscillating; secondly, that between brush and commutator segment there is a considerable contact resistance which is subject to change, as the strength of the current is different in the different positions. Both of these causes combine to bring about the result that a voltmeter does not show the true value of the potential of a coil, but a lower one. The author investigates the first point mathematically and comes to the conclusion that the action is such as if there was a pure direct current in the voltmeter circuit, superimposed upon which is an alternating current. The latter has a wave form of a rather complicated nature, which can perhaps be expressed by Fourier's series. This pulsating voltage can be shown by connecting two instruments in parallel to the auxiliary brushes, one of which depends on the principle of polarization and the other on the caloric or dynamometric principle. These instruments will show different readings, for which the author gives several examples. By connecting a condenser capacity in parallel with the voltmeter, the pulsations of the current can be damped, so that the differences in the readings of the instruments become considerably smaller. The author then investigates the contact resistance of the brushes and gives a table of values of the latter, with different current strengths.—*Zeit. f. Elek.*, July 26.

Lights and Lighting.

Reference.

Bremer Arc Lamps.—An illustrated description of the Westinghouse Bremer type of this lamp, a large number of which are in use in various places in England.—Lond. *Elec.*, July 31.

Power

Central Electric Power Stations for Gold Mines.—Kirkland.—A paper read before the Mechanical Engineers' Association of the Witwatersrand. The author states that for stamp driving, the steam engine system lacks flexibility and in the early stages of working a mine, the engine is frequently loaded to only a fraction of its maximum power; it is, therefore, very inefficient, while with the electric drive the power can be subdivided and new motors procured as additional stamps are needed. The author thinks that another disadvantage of the steam-driven mill is the necessity of placing the engine and boiler house close to the mill, which is a bad arrangement, as the mill ought to be located with a view to proximity to the mine, ample supply of water and sloping ground, while the engine house ought to be located near a railway to permit of economical handling of the coal. Electric driving solves this difficulty, as the power house may be situated in any convenient place, and power transmitted to low-speed motors in the mill, which drive the cam shafts by belts, each motor driving 10 or 20 stamps. The number of stamps in operation can in this way be varied to suit the supply of ore, coal, labor, etc., as desired. The mill provides a fairly steady load, and by permitting the use of large generators, renders the plant more economical than if small-sized generators are used for other sections of the work only. It helps also to solve the underground hoisting difficulty, as the variable load is not felt so severely by the generators as it would be if the steady load provided by the mill were absent. In the discussion following the paper the relative economy of Corliss engines and turbo-generators was considered and tables with sets of tests are given. The article with the discussion is abstracted in Lond. *Elec. Rev.*, August 7.

Motor-Driven Horizontal Boring Machine.—A short article describing a recent English construction, which has been especially designed for operations on large field magnets. It is so arranged that it can stand inside of the magnet frame and swing round from the center to the various positions required on the ring. The construction is such that holes can be bored by the machine either parallel to the base or at right angles, without removing the machine bodily. Power is furnished by a 5-hp motor, which is fitted with a switch by means of which the speed can be varied from 900 to 1,350 r.p.m. This, with the changes provided in the machine, has been found ample for all purposes. The machine has a slow feed motion for cutting and a quick motion for return.—Lond. *Eng'ing*, August 7.

REFERENCE.

Electric Power in Plowing.—Guarini.—An illustrated description of various methods for the application of electric power to the driving of large plows. The statement is made that it is possible to plow about 10 acres in 10 hours, with furrows 35 cm. deep, and using only 90 kw-hours.—*Elec. Rev.*, August 8.

TRACTION.

Trackless Traction.—Stobrawa.—A long article dealing first with the history of the subject of traction over ordinary roads, by electric power from overhead wires. A description is then given of a recent installation for the purpose of conveying daily up to 200 tons of limestone for a distance of 1.5 km. The overhead construction consists of wooden masts supporting two line wires of profiled copper. The motor car carries two trolley poles, which are so constructed that the car can go to a distance of 3 to 4 meters to the side of the line wires, without slipping the contacts. Thus the train can pass any other vehicle on the street. Each of the two shafts is driven by an electric motor of normally 17.5 maximum 25 hp. By completely utilizing the weight of the motor car, as adhesion weight, it has become possible to draw loads of 4 to 5 times the weight of the car, which is 5.62 tons. The speed of the loaded train averages 6 km. per hour. The consumption of current is dependent on the condition of the road. Under unfavorable conditions in the spring, the consumption was 15 to 20 amp. for the empty and 25 to 30 amp. for the loaded train of about 22 tons, at 550 volts in the central station. The yearly average is expected to be far below these figures. It is calculated that this method of hauling the limestone represents a saving of 45 per cent. over hauling by teams.—*Elek. Anz.*, July 5, 12, 19, 26.

Distribution System for Switching Yards.—An article outlining a plan which has been devised for use on suburban electric divisions of large railroads where there are large switching yards at the terminals. Locomotives for heavy trains require from 1,500 to 2,000 amp. at from 500 to 700 volts, and if the ordinary overhead system is used the contact of the collectors would have to be so large that a very heavy superstructure would be required. On the other hand, if the third rail is used its danger in such a place is considerable. The proposed system contemplates the erection of pillars supporting horizontal, overhead I-beams perpendicularly to the track, and spaced about 70 ft. apart. Current is taken from them by means of an elongated shoe or skate over 70 ft. long, carried on the top of the locomotive. In order that the locomotive may span from one I-beam to another it must be considerably longer than ordinarily; it is believed that it would not have to be longer than an ordinary American passenger car.—*St. R'y. Jour.*, August 8.

Newcastle, England, Power Station.—Rossignol.—A paper read before the recent meeting of the Municipal Electrical Association of England. The current is furnished for traction purposes. Steam is produced in eight Lancashire boilers, feeding four generating sets. A fifth set of 3,000 hp is being added. The engines are coupled directly to compound-wound, direct-current dynamos. One engine is of the triple-expansion, high speed type, giving an output of 400 kw; two others are of the compound, low-speed type with Corliss gear, each giving 635 kw, and the fourth is of the triple-expansion, low-speed type with Corliss gear, giving 1,300 kw. There is also a motor-driven booster for charging a battery of 1,500 amp.-hour capacity. The author gives a detailed table of the total cost per unit for generating energy, including all labor, materials, maintenance, capital charges, depreciation and management expenses, worked out on the basis of 7,000,000 units per annum.—Lond. *Elec. Eng.*, July 24.

Steam and Electric Railway Returns.—Emerson.—A comparison between the total income account of all the electric railways in the United States, as shown by the recent Census Reports, with that of one of the steam railroad lines, the Pennsylvania Railroad, whose total earnings and operating expenses do not differ greatly from the aggregate figures of the electric railroads. The percentage between operating expenses and gross earnings is more favorable for the electric railways than for the Pennsylvania Railroad. The author, however, does not place much value upon any lessons taught by an operating ratio, as this varies with the location and physical conditions of the country through which a road passes. Moreover, the Pennsylvania Railroad is known to charge betterments largely into operating expenses. The writer then considers the item, "Other Income," which is considerably larger for the Pennsylvania Railroad than for the electric railways, and the "fixed charges" which are also larger. The surplus after payment of charges is considerably larger for the Pennsylvania Railroad, while the capitalization is smaller. Other comparisons are made.—*St. R'y. Jour.*, August 8.

Interurban Railway Development in Great Britain.—Porter.—A long article, in which the author first gives statistics of the investment in electric tramway enterprises in the United Kingdom, and shows that since 1896 the investment in electric traction has increased $205,000,000. Of this amount, $52,000,000 represents municipal tramway investments. For a long time the construction of city and interurban tramways was strangled in Great Britain by an act passed in 1870 which provided that tramway enterprises should have a life of only twenty-one years. This gave rise to deterioration during the last years of the franchise, and bad service, which encouraged municipal enterprise. Interurban roads, however, have been under private ownership. The author then considers the general subject of electric railway construction, and first gives particulars of some of the private tramways in London. After discussing other tramway systems he takes up the difficulties caused by the inability of the magistrates of the different cities to unite harmoniously in constructing through systems between towns. An act called "The Light Tramways Act" was passed recently, which in some respects is more favorable for free enterprise than the Tramways Act of 1870. There are certain clauses in the new act, however, which permit the steam railroad companies to offer formidable opposition to the construction of an interurban electric railway; instances of this kind are given—*St. R'y. Jour.*, August 8, 15.

REFERENCES.

The Present Condition of Electromobile-Building.—Loewy.—A long, illustrated article. The author divides the electromobiles into three classes, namely, those which use a battery alone as source of motive power, those which have an explosion motor which drives a dynamo, to which a buffer battery and the motors are connected in parallel, and those in which the energy supplied by the explosion motor is sent directly from the dynamo into the electric motor. The principal representatives of each class are described, and a number of them illustrated. Data about the weight of the battery, the performance, etc., are given. A section is devoted to a description of recent American types of storage cells for automobile purposes.—*Zeitsch. f. Elek.*, July 26, August 2, August 9.

Rotherham, England, Tramways and Power Plant.—An illustrated description of a recent addition, consisting of a high-speed, three-cylinder, compound, enclosed, forced-lubrication engine of 600 ihp, when condensing, coupled direct to a compound-multipolar generator capable of giving 350 kw at 460 to 520 volts as a shunt machine, and 500 to 550 volts as a compound machine, at 340 rev. per min. Trial results and steam consumption of the engine are given in detail.—Lond. *Elec. Times*, August 6.

New Central Station and Electric Installations of the Brussels' Tramways.—The first part of an article describing the new central station at Anderlecht. The boiler room equipment and the steam engines are described in this part.—*L'Industrie Elec.*, July 10.

Cost of Power at Newcastle.—An article containing an itemized cost of power station operation in Newcastle, England.—*St. R'y. Jour.*, August 8.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Economy of Fuel in Electric Generating Stations.—McLAREN.—An abstract of a paper read before the English Inst. of Mech. Eng. The author deals with the difference in steam consumption between condensing and non-condensing steam engines. He considers that engines fitted with their own condensers have a great advantage over those exhausting into one main serving several engines, and states that by the former method usually a saving of 5 to 10 per cent., due to the better vacuum, is obtained. He states that the steam losses in electric generating stations are wholly due to valve or piston leakage, especially the former. This applies more specially to condensing stations using engines fitted with piston valves; unless these are very carefully looked after heavy leakage is likely to occur, the steam passing directly to the condenser. He thinks that many station engineers do not appear to realize how serious this loss may be, and allow their piston valves to run in a very leaky condition. He recommends most careful attention to this subject.—Lond. *Elec.*, July 31.

Refuse Destructor at Hackney, England.—An illustrated article, containing a description of the house-refuse destructors, which are used to supply a large part of the steam for the generation of electricity in the Hackney Municipal Electricity Works. The plant consists of twelve destructor-cells, arranged in three groups, each group having a central supplementary combustion and dust-depositing chamber. There are three large water-tube boilers fired by the destructor gases, built for a working pressure of 250 pounds per sq. inch. The average amount of refuse destroyed was 120 tons per day; the value of the steam supplied to the electric station is placed at about $11,300 per year, but the plant was not able to use a considerable amount of the steam supplied by the destructors. Detailed results of a steam test of the destructors and kilowatt-hours generated during the test, are given. The kilowatt-hours per ton of refuse burnt amounted to 55 [illegible], with engines non-condensing, and 88.6 with engines condensing.—Lond. *Elec. Times*, July 23.

REFERENCES.

Electricity Supply and Methods of Stimulating Demand.—PANTON.—A paper read before the English Municipal Electrical Association, entitled, "Some Observations on Electricity Supply and Methods of Stimulating Demand." It deals with conditions obtaining in England.—Lond. *Elec.*, August 7.

Electric Light and Waterworks Plant.—An illustrated description of the plant at Kamloops, B. C. The plant is used for lighting. Power is furnished by a tandem-compound engine, belted to a 120-kw composite-wound, single-phase alternator, of 125 cycles, 1,000 volts, running at 1,070 rev. per. min.—Canad. *Elec. News*, August.

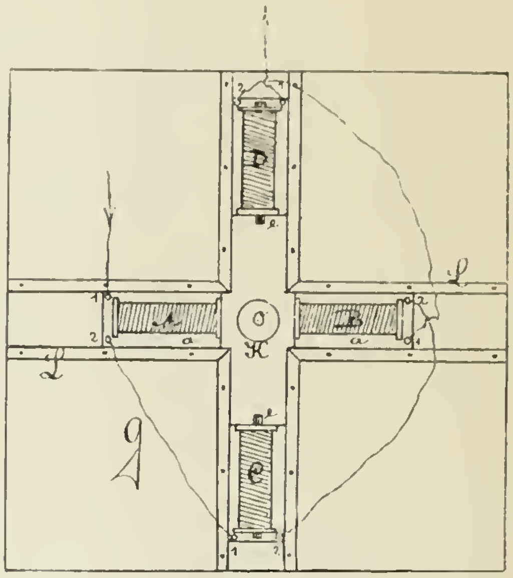
WIRES, WIRING AND CONDUITS.

Heating of Underground Cables.—HUMANN.—An article illustrated by a number of diagrams in which the author gives the results of an investigation of the heating of cables of different constructances, placed underground. The tests were carried out with a view to find the constants for the construction of a table, in order to determine the maximum current which could safely be carried by such cables. He first investigated single-core, asphalted lead cables and lead cells with iron-band armatures for low-potential currents. He finds the constant for both kinds of cables about the same, the average value being 0.018. The current strength for single cells is therefore equal to the square root of the following fraction: the product of the admissible rise in temperature and the cross-section in sq. millimeters, divided by the above-mentioned constant. He recommends allowing more than 15 deg. C. rise of temperature. He also finds that strongly-insulated cables cannot be loaded as much as those with a thin layer of insulation. A table is also given with the results for armored concentric and "biconcentric" cables, and for armored double and triple covered cables. The author has also carried out tests with high potential cables, for 2,000, 5,000, 10,000 and 15,000 volts, the constants for which are given in table.—*Elek. Zeit.*, July 30.

Electric Power Regulations in France.—The text of the Electric Power Regulations made by the government of the French republic. High pressure installations are defined as those with direct current of over 600 volts, and with alternating currents equal to or "under" (apparently meaning "over") 120 volts. Low pressure installations are those using alternating current over multiple wires, "wherein the permanent earth connection of one of the wires ensures at 120 volts the maximum pressure between the other wires and earth." There are four sections, covering in the order named, overhead wires, underground wires, tramways and general rules.—Lond. *Elec.*, August 7.

ELECTRO-PHYSICS AND MAGNETISM.

Hysteresis and Eddy Current Motor.—KANN.—An article in which the author describes an arrangement for the utilization of the hysteresis and eddy currents for the operation of motors. The construction is illustrated in the adjoining figure. Four guiding strips, *L*, are arranged in the shape of a cross on a board, *G*, supporting the coils, *A*, *B*, *C*, *D*, which can slide in the guides. In the center, *O*, of the board there is provided a point on which the cap of a small short-circuited armature, *K*, is fastened. An alternating current is sent through the coils in such a way that each two opposite coils are traversed in the same direction, and produce together a field in their longitudinal direction. One pair of opposite coils, for instance, *C* and *D*, are provided with cores, *e*. The coils which carry the cores are a little further from the point *O* than the coreless ones, in order to make the fields of both sets more similar. If cores of a relatively large diameter are taken, a surprisingly strong rotation manifests itself. Experiments, however, soon showed that this was caused chiefly by hysteresis currents in the iron cores. If instead of a massive iron rod bundles of iron wire of smaller and smaller diameters are taken, the velocity of rotation decreases very quickly, until below a certain thickness of the wires it is no longer influenced by a further decrease of thickness. The author accounts for these phenomena by regarding the coil with iron core as a transformer with a short-circuited secondary of comparatively small resistance.—*Phys. Zeit.*, July 15; abstracted briefly in Lond. *Elec.*, July 31.



HYSTERESIS AND EDDY CURRENT MOTOR.

Ionization of Air by Water.—HIMSTEDT.—The author found that air bubbled through water becomes highly radioactive. The radioactivity disappears very slowly, taking several weeks to disappear altogether. On conducting the air through a copper tube surrounded by liquid air, the radioactivity disappears, but reappears again on heating up the tube. There is, therefore, a kind of emanation which can be condensed and evaporated, like the radium emanation. The addition of a salt to the water makes no difference. Other liquids have no effect, with the possible exception of alcohol and nitrobenzine, both of which have a rather high conductivity. The transmission of the air through a tube filled with moistened glass wool, is as effective as bubbling it through water. The author supposes that molecules or groups of molecules of air are enclosed in a very thin sheath of water, so thin that it does not make them settle down like drops of spray and allows them to traverse cotton wool. The water might still preserve its great ionizing power and release the ionized molecules by the breaking of the sheath. This is in concordance with Kohlrausch's theory of electrolytic conductivity.—*Ann. der Physik.*, No. 9; abstracted in Lond. *Elec.*, August 7.

ELECTRO-CHEMISTRY AND BATTERIES.

The Jungner-Edison Accumulator.—SCHOOP.—An experimental investigation carried out with a Jungner alkali accumulator and an ordinary storage battery for the purpose of comparing the two as to their behavior during charge and discharge, their capacity, temperature and concentration changes of the electrolytes and the relation between capacity and current strength. The author thinks that it is more correct to call the former a Jungner-Edison accumulator than the reverse, in so far as the English and German patent offices have considerably modified Edison's patent claims on account of Jungner's objection, and the latter apparently found out before Edison did that nickel oxide is a depolarizer which can be used on a practical scale if it is suitably fastened to a support. The Jungner accumulator was composed of 5 negative and 4 positive plates, the plates being formed of pockets of perforated nickel-plated sheet steel, which contained the active material. The latter is composed of nickel oxide for one plate and cadmium or iron in finely divided state for the other; they are introduced in a pasty form into the pockets. The lead accumulator was constructed with the same number of plates and weighed about the same; it was always connected in series with the alkali cells. The author comes to the following conclusions respecting the Jungner accumulator: The alkaline electrolyte does not change its physical or chemical nature during charge and discharge and merely transports the oxygen from one electrode to the other; small amounts of liquid are, therefore, sufficient. The electrolyte diffuses during discharge from the pores of the nickel electrode into those of the cadmium electrode, while the density between the plates is not changed. This diffusion is quite rapid owing to the small distances between the plates. The best conducting alkali does not conduct as well as the best conducting sulphuric acid and tends to absorb carbonic acid from the air. The proper working of the electrodes is independent of the concentration of the electrolyte within comparatively wide limits. The active materials have to be carried in pockets and have a bad conductivity; the internal resistance is, therefore, two to three times as large as in the lead accumulator. The capacity is influenced by the strength of the discharge current to considerably lesser degree than in the lead accumulator; the influence of the temperature of the electrolyte on the capacity is inconsiderable. The loss of potential amounts to 35 to 40 per cent., and still more with slow discharges. The efficiency in ampere-hours is about 80 and in watt-hours about 65 per cent.—*Elek. Zeit.*, August 6.

Electrolytic Lead Refining.—BETTS.—An illustrated paper giving details of his electrolytic lead-refining process, which is in operation at the plant of the Canadian Smelting Works, Trail, B. C. The main feature of the process is the electrolyte, which is a solution of lead-fluosilicate containing an excess of fluosilicic acid; it is easily made from inexpensive materials, it conducts the current well, is easily handled and stored, non-volatile and stable under electrolysis; it may be made to contain a considerable amount of dissolved lead, while it takes up no impurities, except possibly a very small part of iron and zinc. In order to prevent the formation of lead trees and to obtain a dense, coherent and solid cathodic deposit of lead, some gelatine or glue is added in small quantity to the electrolyte; this simple means is very effective. Details are given of the plant, the operation and the cost of the process, with analysis of the material treated and of the refined lead.—*Electrochem. Ind.*, August.

Chlorine Smelting with Electrolysis.—SWINBURNE.—The conclusion of his paper before the Faraday Society of England, previously noted in the Digest. The present issue deals with the question of the cost of the process. The author states that all that comes into the works is ore and electrical energy, the chlorine goes round and round, and no appreciable amount of it is lost, as a leak that would show in the balance sheet would suffice to make the works uninhabitable. The iron is, however, apt to contain some oxychloride, and some hydrochloric acid is lost in the boiling down of zinc chloride, therefore some chlorine has to be continually added. This is best done by buying zinc chloride. A detailed estimate of the cost of installation and working is then given, showing a profit of over 60 per cent. on the capital, not including royalties, however, paid to the owners of the patents.—Lond. *Elec.*, July 24. The whole paper is abstracted in *Electrochemical Industry*, August.

Electrolytic Apparatus.—PERKIN.—A paper read before the recent meeting of the English Faraday Society. The author deals with apparatus for electro-analysis, and describes and illustrates several forms of platinum electrodes which are comparatively inexpensive. One of the forms of the cathode consists of a piece of platinum gauze in the shape of a flag, which is surrounded by a platinum iridium frame roughened by means of the sandblast. The anode is made of iridio-platinum wire and bent upon itself in such a way that when it is placed in position for electrolysis, an even current density is obtained at all parts of the cathode. Apparatus for rotating electrodes are also described.—*Electro-Chemist and Metallurgist*, July. The paper is abstracted in *Electrochemical Industry*, August.

Electrolysis of Non-Aqueous Solutions.—PATTEN AND MOTT.—Abstracts of six chemical society papers giving the results of experimental investigation which form separate parts of a systematic attack upon the problems of the course and mechanism of electrolysis in non-aqueous solutions. The subjects discussed are the rôle of water in the electrodeposition of lithium from pyridine and from acetone; the deposition of metallic calcium from alcoholic solutions; the deposition of zinc from zinc chloride dissolved in acetone; the deposition of lithium from various alcohols; the deposition of sodium from a solution of odium iodide in acetone; and a determination of the "C R line" for lithium chloride in typical solvents, especially such as yield poorly-conducting solutions.—*Electrochem. Ind.*, August.

Electrical Osmosis.—PERRIN.—A paper read before the French Academy of Sciences. The author investigated the conditions which determine the sign and the amount of electrical osmosis and electrification by contact. He arrives at the following results. The nature of the liquid has an influence on the osmosis, it being very notable with water, less with methyl alcohol, still less with ethyl and less yet with amyl alcohol. No osmosis could be observed with benzine, terebenthene and ether, not even in ether saturated with water. The author concludes, therefore, that the osmosis is intense only in the ionizing liquids.—*L'Eclairage Elec.*, July 11.

REFERENCES.

Copper Refining.—HOFMAN.—A detailed comparison of the operation of the Great Falls and Anaconda refineries. These two plants in the Butte district, one of which uses water power, the other steam, treat similar anode-copper by the multiple system of cells. The comparison of both plants is summed up in a table.—*Electrochem. Ind.*, August.

Determination of Carbon in Carbides.—FITZGERALD AND LOOMIS.—A description of a method, based on the use of sodium peroxide, for the analysis of various electrometallurgical products, more particularly the carbides, such as those of silicon, titanium, etc.—*Electrochem. Ind.*, August.

Course in Electrometallurgy.—RICHARDS.—An account of the course of study in electrometallurgy in Lehigh University.—*Electrochem. Ind.*, August.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Wehnelt Interrupter.—HAUSER.—The author has found that the rate of interruption of the Wehnelt interrupter may be greatly increased and its starting potential lowered by using dilute sulphuric acid and adding to it 20 per cent. of its weight of sulphate of magnesia. With sulphuric acid solution of 1.05 specific gravity, the maximum current is lowered from nearly 40 amp. to 12.5 amp. at 118 volts, and the starting of the interrupter occurs at 20 volts with 5.5 amp. A still lower starting current is obtained with a half-saturated solution of sodium bichromate, to which 11 per cent. by volume of sulphuric acid is added. The interrupter in that case works with only 3.5 amp. The starting voltage (50 volts) is, however, much higher than in the case of magnesium sulphate. The depolarizing liquid used in the Radiguet cell, consisting of 120 grams sodium bichromate, 250 cc. sulphuric acid and 720 cc. water, gives a starting voltage of 20, a starting current of 12 amp. and a maximum voltage and current of 118 and 40 respectively.—*Soc. Fisica y Quimica*, Madrid, May 25; abstracted in Lond. *Elec.*, August 7.

REFERENCES.

Power Station Record.—An illustrated description of a new chart for plotting the output of a power station. The records are made automatically by a new form of recording instrument, which makes a dot on the chart every minute, showing the load in kilowatts. At the upper part of the chart the number of generators in use is graphically indicated. The temperature is recorded as well as other statistics. Diagrams are shown reproduced from the actual prints, indicating three average days and one holiday.—*St. R'y Jour.*, August 15.

Electrometer Equations.—Koenig.—An article in which the author deduces a graphical method for a simplified solution of equations met with in electrometer measurements.—*Elek. Anz.*, July 20.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCE.

New Italian Telephone Law.—Meyer.—The new law makes a distinction between local and long-distance lines. The former are left to private or municipal exploitation, while the latter are placed under governmental control and maintenance. The government is planning the installation of 84 double lines with about 9,100 km. of bronze wire, to connect the principal cities and the capital.—*Elek. Zeit.*, July 30.

MISCELLANEOUS.

Destruction of the Water Hyacinth.—Hering.—In the discussion of a paper on the water hyacinth, which is seriously obstructing navigation in the southern rivers of this country, he suggests destroying the weed by means of electricity. He purposes carrying a high-voltage transformer on a boat, grounding one pole in the water and connecting the other to a horizontal bar having numerous short vertical wires attached to it, like a comb; these wires are to be trailed over the tops of the plants; the current passing through them into the water, it is thought, would destroy the plants.—*Proceed.* Eng. Club of Philadelphia, July.

REFERENCES.

Electric Blue-Printing Machine.—Jones.—A popular illustrated article, describing the construction.—*Sci. Am. Suppl.*, July 18.

Baking Oven Heated by Electricity.—Boehm-Raffay.—An illustrated description of a baking furnace 12 ft. long, 10 ft. wide and 9½ ft. high.—*Elek. Neing. Anz.*, July 15.

New Books.

Annuaire Pour L'An, 1903. Publié par le Bureau des Longitudes. Avec notices scientifiques. Paris: Gauther-Villars. 668 pages. Price, 1.50 francs.

This welcome little pink pocketbook is a most valuable *vade mecum*, series of tables, and fund of information. It was originally issued under a law of the Messidor 7th, year III, of the French Republic, corresponding to the 25th June, 1795, of the Christian era, which ordered the Bureau of Longitudes to publish a year-book annually "suitable for regulating the affairs of the entire Republic." The Annuaire has been kept going ever since.

The tables are excellent and they are official for France, which is a great comfort. The tables are constantly finding fresh material and are becoming more extensive and valuable year by year. Consequently the Bureau gives notice that in future it will publish certain tables and data bienially and alternately, so as to give the information required and yet keep down the size of the book.

There is a full line of graphical, sociological, astronomical, chemical and physical statistics. At the end there are appendices, one of which is a long and excellent article on meteors and comets by M. Radau, and another an essay by M. Janssen, on "Science and Poetry."

A work by A. Frederick Collins, entitled "Wireless Telegraphy, Its History, Theory and Practice," will soon be published. The various chapters are as follows: Ether—Wave Motion—Electric Waves—Electric Oscillations—Disruptive Discharge—Inductance, Capacity and Resistance—Oscillations—Mutual Induction—Induction Coils—Vibrations—Oscillating Current Generators—Electric Wave Action—Electric Wave Detectors—Transmitters—Receivers—Auxiliary Apparatus—Antennæ and Earths—Resonance—Syntonization—Wireless Telegraphy. Each chapter begins with a brief historical review of the subject under consideration; its theory is then treated both physically and mathematically; its experimental investigation follows, the chapter finally closing with the practical results attained.

Prime Movers at the St. Louis Exposition.

Engines representing 60,000 hp will be installed on the main floor of Machinery Hall of the World's Fair, St. Louis, 1904. This showing will embrace more horse-power than ever seen at any exposition in this or in any other country. Fully 40,000 hp will be utilized in performing various functions of the Exposition, while the remaining 20,000 hp will appear in exhibit form only. An area of more than 200,000 sq. ft. is demanded for 40,000 hp employed in the Exposition work. This area represents a size greater than many of the ordinary blocks of New York City. The total floor area comprised in Machinery Hall and in the Steam, Gas and Fuel Building is equivalent to more than nine acres, and already the floor space in Machinery Hall alone has been applied for several times over. The engines, condensers, pumps, moving machinery and accessories making up the power plant will be all installed in the westerly half of Machinery Hall. In the easterly section the floor space will be devoted to machine tools, the wood-working machinery and fire engines and apparatus.

The chief of the Machinery Department is Mr. Thomas M. Moore. This gentleman had charge of the machinery display at the Pan-American Exposition in 1901, and at the close of the Buffalo show Mr. Moore was called to St. Louis to take charge of the World's Fair Machinery Department. Many of the items of the power plant are of foreign origin, and these were negotiated for by Lieut. Godfrey L. Carden, R. C. S., of the Machinery Department, who spent some eight months in Europe under Mr. Moore's instructions. The idea originated with Mr. Moore that power could be secured for the Exposition on a strictly exhibit basis, and under his instructions the manufacturing establishments of the Old World were secured for late types of engines, boilers and other accessories essential for a power plant.

MAIN ENTRANCE MACHINERY PALACE, ST. LOUIS FAIR.

The installation plans are now so well advanced that Mr. Moore is able to announce the location points of the principal items comprising the power display. As now arranged the visitor will find on passing into Machinery Hall through the central entrance to the north, in front and slightly to the left, a 5,000-hp reciprocating steam engine. This engine and its base have a total height of 54 ft., 20 ft. of which is depressed below the floor level, the remaining 34 ft. being elevated above the floor level. Its base occupies a space approximately 35 to 45 ft. The foundations for its support cost $6,000, and its weight with electric generator is over 500 tons. The approximate of this unit is $150,000. This engine comes from the works of the Allis-Chalmers Company.

Proceeding to the west through the central portion of Machinery Hall the visitor will see in succession the following installations: A 1,750-hp gas engine from Tegel, near Berlin, Germany; a 600-hp high-speed steam engine from Harrisburg, Pa.; a 750-hp medium-speed steam engine from Cincinnati, Ohio; a 1,000-hp slow-speed steam engine from Burlington, Iowa; a tangential water wheel from San Francisco, Cal., operated by water forced through a pipe and nozzle at the rate of 1,200 gallons per minute and under a pressure of 300 pounds per sq. in. by a steam pump from Jeanesville, Pa. This great volume of water under enormous pressure will strike the buckets of the wheel and transmit its energy and fall as quietly as if poured from an ordinary basin. The water wheel will make 900 r.p.m. Its speed will be regulated by a governor from Boston, Mass., and the flow of water will be measured by a meter from Providence, R. I. Next to the west will be found a 3,000-hp gas engine from Seraing, Belgium, then an 8,000-hp steam turbine from New York, then a 5,000-hp steam turbine from Pittsburg, Pa., then four 3,000-hp reciprocating steam engines; near to the western end of the central bay this notable line of engines will end with three 80-hp exciter sets.

This is but one of the three lines of prime-movers which will be installed in the western half of Machinery Hall. The line to the north will consist of steam engines largely of European build and drawn from the greatest works in England, France, Sweden and Germany. The line to the south will, for the main part, be made up of gas and oil engines, the products of the great machine shops of the world. All types, speeds and sizes will be shown, from the little one-half hp gas engine for domestic use to the great 8,000-hp steam turbine for the operation of lighting plants and trolley railroads.

The Belgian furnace gas engine of 3,000 hp is from the same builders who exhibited at the Paris Exposition of 1900 a gas engine of 600 horse-power, which excited more interest and comment than any other individual item in that exposition. Here will be one of five times the capacity of the Paris engine. The unit to be installed in this exposition covers a floor space about 85 ft. long and 45 ft. wide. Its fly-wheel weighs 34 tons, has a diameter of 28 ft. and its rim travels at the rate of nearly a mile and three-quarters a minute. A medium-sized horse can be driven through its cylinders and its two pistons each travel 10 ft. at every complete stroke, and each makes 100 strokes per minute. The shipping weight of this engine is approximately 300 tons. About 30 tons of coal per day will be consumed in the generation of the gas to operate it.

At the end of the northerly line of engines and in the northwest corner of Machinery Hall will be found a French reciprocating steam engine of 1,500 hp, with its main shaft making 330 r.p.m., a high speed for so heavy and powerful an engine. The French engine is directly-coupled to an electric generator built in Paris, which operates in parallel on alternating-current arc lighting service with a generator built in Belfort, France, and directly-coupled to a tandem-compound steam engine (from Mulhouse, Germany) of 1,000 hp and 94 r.p.m.

One hundred ft. to the west of Machinery Hall will be found the Steam, Gas and Fuels Building, which covers an area of about 100,000 sq. ft., and is itself an example of the most modern fire-proof construction. In this building will be found great hoppers for storing the 4,000 tons reserve supply of coal and mechanical means for automatically conveying this coal from the cars to the bunkers and from the bunkers to the furnaces and gas plants. The daily consumption of coal will exceed 400 tons and the total length of the automatic conveyers lines will be about three-quarters of a mile. Here there will be found boilers to furnish steam and the gas producers to supply the gas for the operation of the engines in Machinery Hall. Briquette making, various types of mechanical stokers, force draft apparatus, water purifiers and exhibits of items directly germane to the subject of steam generation and control will be installed in this building.

The intermural railway will be operated by four items of the Machinery Hall power plant, and it is interesting to note that the intermural railway consists of a double-track trolley road, standard gauge and standard type of open cars. The motor equipment and control is furnished by the General Electric Company; the brake equipment and control is furnished as an exhibit by the National Electric Company; the power plant for the operation of the road will be located in the central portion of Machinery Hall and the prime-movers in this plant are as follows:

(1) A 1,500-brake-hp Oechelhauser system gas engine, 100 r.p.m., built and exhibited by A. Borsig, Tegel, Berlin, and supplied with gas from a producer plant built by Julius Pintsch, of Berlin.

(2) A 900-hp Corliss type steam engine, 85 r.p.m., built and exhibited by the Murray Iron Works Company, of Burlington, Iowa.

(3) A 750-hp modified Corliss steam engine 100 r.p.m., built and exhibited by the Lane & Bodley Company, of Cincinnati, Ohio.

(4) A 600-hp four-valve steam engine 150 r.p.m., built and exhibited by the Harrisburg Foundry & Machine Works, Harrisburg, Pa.

The Crocker-Wheeler Company, of Ampere, N. J., will build the generators, which in every instance will be directly coupled to the prime-movers and deliver current at 550 volts at the switchboard.

In connection with the water ways it is interesting to note that the main one consists of a grand basin with lateral lagoons. The water is delivered into this basin from a niche in front of Festival Hall and from fountains in front of two ornate restaurant buildings which flank the Terrace of States. From these three points it flows over cascades, and it is to be illuminated by electric lights placed under the lip of each step which breaks the spill. The water is to be lifted by three centrifugal pumps built and exhibited by the Henry R. Worthington Company. Each pump is planned to deliver 30,000 gallons of water per minute against a total head and suck of 158 ft. Three induction type motors, each of 2,000 hp rating, are to operate the pumps. The magnitude of this feature will be better appreciated by those who recall that the total water moved in the Paris Exposition of 1900 was about 4,500 gallons per minute and at the Buffalo Exposition of 1901 about 7,000 gallons per minute, while here in this cascade feature alone we are to move 90,000 gallons per minute. The energy required for the operation of this feature equals the total energy had from the Niagara power plant by the Pan-American Exposition.

Electrical Power Installation of a Crane Factory.

The Industrial Works, of Bay City, Mich., one of the largest manufacturers of railroad wrecking cranes in the world, has recently added to its electrical power equipment four Westinghouse generators and a number of induction motors. In addition to wrecking cranes, the establishment also manufactures smaller cranes and transfer tables.

The new generators consist of one 150-kw, direct-current, 110-volt multipolar; two 30-kw, 110-volt multipolar, and one 200-kw, alternating-current, 220-volt, three-phase machine operating at 60 cycles. This combination of machines gives a very flexible power system. The alternating-current machine is used for power purposes entirely, giving the best results for motors located in inaccessible places. The large direct-current generator is also used exclusively for supplying power, and furnishes current for the operation of cranes and transfer tables and testing direct-current motors on cranes. The two 30-kw generators are used for lighting. The switchboard arrangement is such that these two machines may be run either in series or multiple, the latter case being desirable when they are usd for testing purposes on a 220-volt circuit.

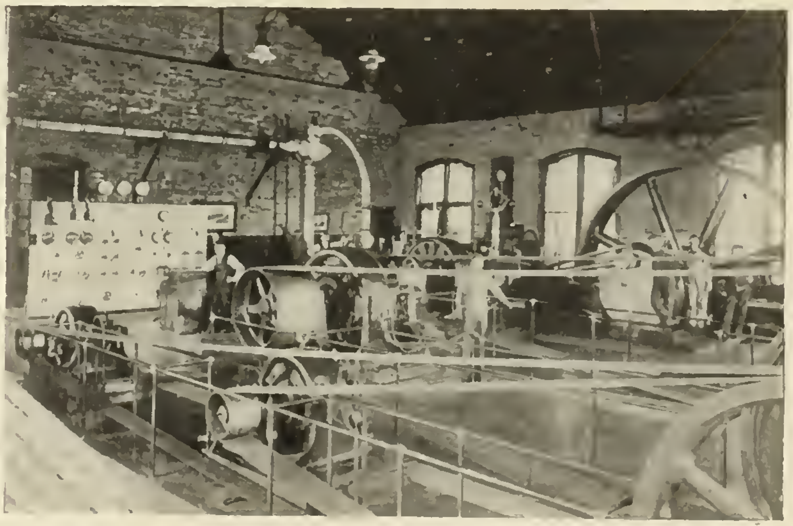


FIG. 1.—GENERAL VIEW OF ENGINE ROOM.

The distribution of power and light is accomplished by means of distributing switchboards placed in the various shops, these being located at some distance from the power house. Communication between power house and shops is obtained through an underground tunnel, supports being provided in the tunnel for carrying the main feed line. In this manner, while all of the main circuits are controlled from the engine room switchboard, small individual light and motor circuits are at the same time under the control of the foreman in the various shops. Fig. 1 shows the main switchboard, one of the engines, and other portions of the engine room equipment. Fig. 2 is an interior view of the power house, showing the four generators, and the jack shaft with its connections between engines and generators. The jack shaft with the rope drive is well shown in Fig. No. 2. A fact worthy of particular attention is that the shaft may be driven independently or simultaneously from either end, it being possible to cut off either engine by means of the friction clutches shown in the illustration. Each generator is also furnished with a friction clutch. Furthermore, either half of the shaft may be run separately by removing the plate between the two flanges of the solid coupling, shown in the center of the shaft. The system shown, while taking rather a large amount of room, is a very flexible one as far as the addition of new machines is concerned, and where room is not a very important item. The Industrial Works consider this arrangement quite as satisfactory as a direct-connected system.

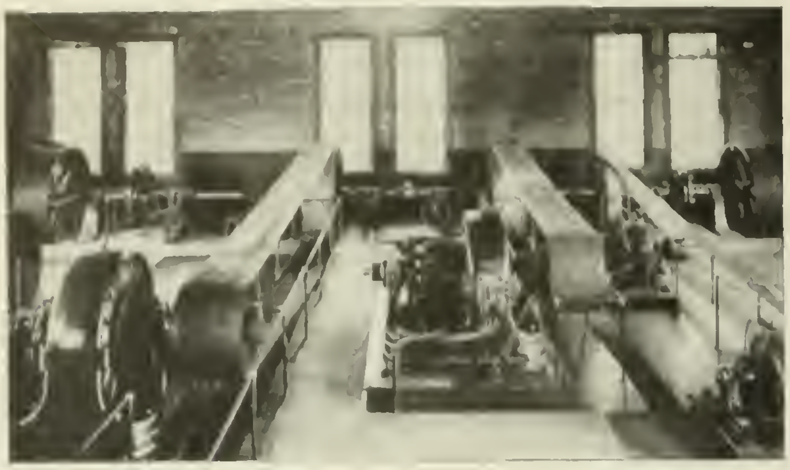


FIG. 2.—INTERIOR OF POWER HOUSE.

Power is transmitted to the jack shaft by means of two engines, one a 400-hp. tandem-compound condensing Hamilton-Corliss engine, connected by a rope drive. This engine drives the shaft alone, the other, a simple Allis-Corliss engine of 200 hp. being held in reserve in case repairs are necessary to the larger engine, or for special work not requiring full amount of power.

The Diesel Oil Engine for Central Station Work.

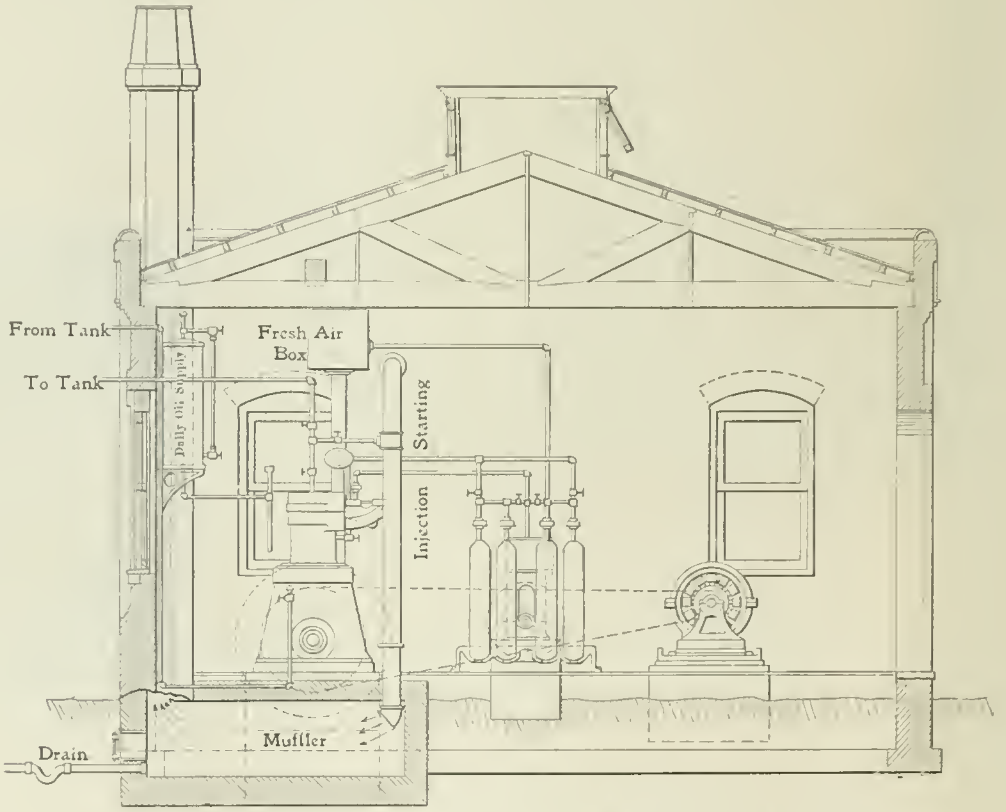
A departure in central station practice that is of particular interest to small stations and to municipal electricians is embodied in a municipal plant recently erected in Jewett City, a Connecticut town, of about 3,000 inhabitants. A cross-section of the generating rooms is shown in the accompanying illustration. The electrical generating apparatus consists of two 60-kw. 2,200-volt, 60-cycle Westinghouse machines, and the novel feature consists of the use of oil engines for furnishing power. These engines, which were supplied by the American Diesel Engine Company, New York, are of the Diesel type, which in operation differs in several particulars radically from other types of oil and gas engines. While employing the Otto cycle, instead of an explosion at the beginning of the working stroke, there is steady combustion throughout the stroke.

During the compression stroke the cylinder contains air only, and the temperature due to compression ignites the combustible charge without the need of electric spark or ignition tube apparatus. The clearance is about 7 per cent. of the cylinder volume, and the combustion of the vaporized oil does not increase the pressure caused by the compression.

The valve operating cams are on the usual secondary shaft driven by the main shaft through an intermediate gear. The admission and exhaust valves are driven by two of these cams. The movement of the admission valve in particular is very slight. The oil is driven into the cylinders by compressed air through a series of perforated brass washers, and enters the cylinders in the form of a fine spray; an auxiliary air compressor, driven by belt from the engine, supplies the air for this purpose. The air which supports the combustion is drawn into the cylinder through an automatic mushroom valve, and is compressed on the up stroke to between 450 and 525 pounds pressure per square inch, corresponding to a temperature of about 1,000° F. The fuel valve is open for about one-tenth of the working stroke, and the fuel is let in and consumed during the whole or a part of this period as determined by the action of the governor. At the termination of the fuel supply, the resulting gases of combustion work expansively during the remainder of the stroke. The combustion is very complete on account of the large quantity of oxygen in the cylinder at the beginning of the working stroke. Any grade of crude or fuel oil may be employed in the engine.

The fuel oil is delivered to the fuel-admission valve by a pump driven from the cam shaft. One pump cylinder is provided for each of the main cylinders, and back of each is a by-pass valve, which, when open, allows the oil to flow again to the suction side of the pump instead of to the fuel valves. The length of time that these by-pass valves are open is controlled by the governor, which is of the centrifugal type. The by-pass valves are opened by three arms that are pivoted at one end on a shaft that the governor raises or lowers. These arms are operated by connecting rods driven by eccentrics on the pump-driving shaft. By a link connection, the governor collar thus increases or lessens the distance between the top of the by-pass valve rods and the arms which open them. Upon the relative distance between the top of each valve rod and its corresponding arm depends the length of time the valves are open, and the consequent duration of oil supply for combustion purposes.

After the fuel valve closes, the gases work expansively, and the atmospheric and terminal pressures differ but little. The effect of the compressed air used to inject the fuel is inappreciable. The admission valve is open a constant length of time, but the fuel supply is controlled by the governor as just described, so that only at full loads is it injected into the cylinder during the entire period that the valve is open. It has been stated that the thermal efficiency of the Diesel engine runs as high as 38 per cent.



CROSS SECTION VIEW OF GENERATING ROOM.

In general outward appearance the engine resembles the ordinary marine type of steam engine. The connecting rod is carried directly to a pin inside the piston, as usual in single-acting engines. The reciprocating parts are all enclosed within the engine housing, which is fitted with detachable plates for easy access. Lubrication is automatic, a large oil well in the lower part of the housing serving as a bath into which the connecting rod crank end plunges at every revolution. Double fly-wheels are provided for each engine in addition to the driving wheel.

The manufacturers claim an extremely high economy for this type of engine. It is stated that while the best oil engines of the explosive type have an efficiency of 16 per cent. and the best gas engines an efficiency of 19 per cent., the Diesel oil engine works at an efficiency of 28 per cent., with the cheapest grades of fuel oil. Moreover, at partial loads the efficiency is much less reduced, the consumption at half load being, for example, only 60 per cent. of that at full load. It is further claimed that a brake horse-power-hour can be produced on .58 pint of kerosene or .61 pint of Texas crude oil.

Electric Car Heaters.

A new style of car heater for large interurban electric cars has recently been placed on the market by the H. W. Johns-Manville Co. The construction of this heater is similar to their well-known heater, which has been on the market for several years, and is used in cars having cross seats. Each heater is 30 in. in length and 5 in. in height, containing two ¾-in. double enameled angle irons held firmly in place by reconstructed granite heads or supports located at each end of the heater. These irons support the resistance coils and furnish superior insulation, thereby preventing short-circuits and the cutting out of resistance due to contact formed by sagging coils. The casing is very strong and ornamental and will stand a foot pressure without injury.

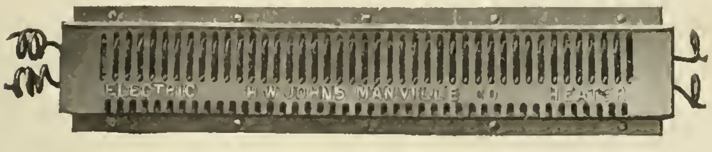


FIG. 1.—HEATER.

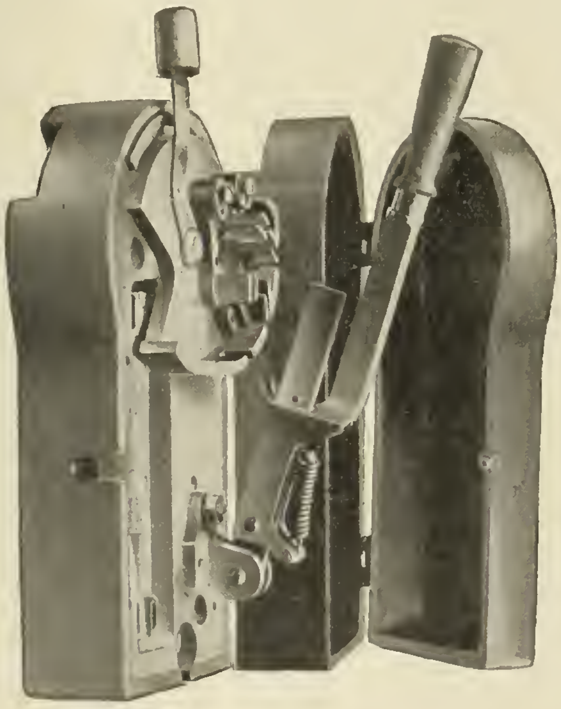


FIG. 2.—3-POINT REGULATING HEATER SWITCH.

In order to meet the increasing demand of large electric cars requiring a greater number of heaters, the H. W. Johns-Manville Co. have enlarged their 3-point car heater regulating switch, increasing its capacity to 60 amp., and mounting in the insulating base block a Sachs "Noark" enclosed fuse. This complete controlling and protective device is now combined and enclosed in an iron box, requiring less room than heretofore and being absolutely safe and reliable under all conditions. Closing the quick-break knife blade locks the switch automatically, which is necessary before the cover of the box can be closed; and any movement of the regulator handles is prevented until the knife blade is released.

Electric Dumbwaiters.

The Navy Department has ordered from the Otis Elevator Company an electric dumbwaiter, with push-button control, to be installed on the United States receiving ship *Hancock*. The car will run from the galley on the lower deck to the mess-room on the upper deck, with a third landing at the deck intermediate. The rated capacity of the dumbwaiter will be 250 pounds at 75 ft. per minute, and the car travel will be 30 ft.

Nelson Loose Pulley.

This loose pulley is somewhat of a departure from the average attempt at producing a satisfactory loose pulley for the high speeds to which they are subjected. The sleeve, fastened to the shaft, provides for the bearing surface not only by its increased diameter but also by having in each end a bearing for the pulley.

The ordinary loose pulley hub is too short and the diameter of the shaft too small to provide sufficient bearing surface to prevent the belt tension forcing the oil from between the surfaces and nearly all failures of loose pulleys can be justly attributed to this cause. As, however, the oil is retained in any bearing by the capillary attraction, and forced out by the pressure on the bearing, it is obvious that there must be provided some means of producing sufficient capillary attraction to prevent the oil being pressed out from between the surfaces; or, the capillary attraction remaining the same, there should be provided sufficient bearing surface so that the pressure per square inch will be reduced to an amount where it is incapable of forcing out the oil. It should be noticed that in this pulley the oil chamber is between the bearing surface and the shaft, so that centrifugal force assists lubrication, and as the higher the speed the greater this force, lubrication is greatest when most needed.

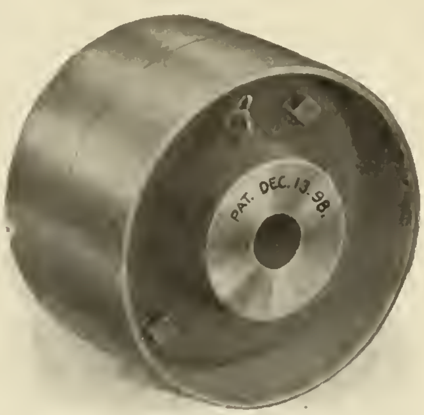


FIG. 1.—LOOSE PULLEY.

The makers claim that in these pulleys the film of oil interposed between the bearing surfaces is so thick that at no time is there a metal-to-metal contact, and the pulley thus virtually floats on the oil and no wear is perceptible even after years of use. This pulley is, in addition, so constructed that it is impossible for either the oil to get out or dust to enter. The oil, therefore, remains clean and a perfect lubricant, so that but very little of this is required.

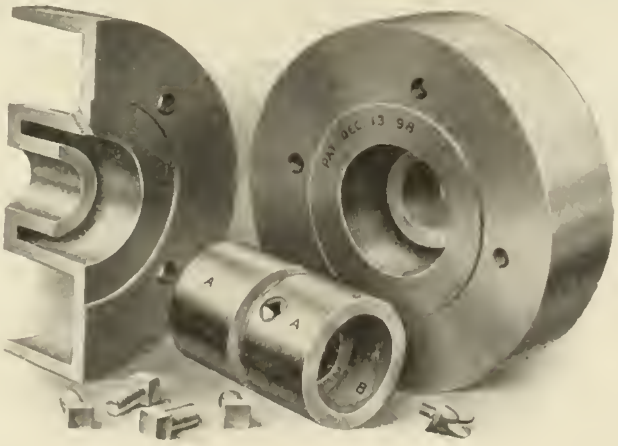


FIG. 2.—PARTS OF PULLEY.

Aside from the above the makers state that in every other feature this pulley is equally desirable. Its oil tightness prevents its throwing oil on the belts. Its design is such that it does not wear the shaft and needs but little oil. It is noiseless, runs very easily and requires but little power. While this pulley, as above indicated, is not entirely new, it is, nevertheless, comparatively unknown, as it has been made for five years without being advertised, but the present makers, the Wilmarth & Morman Company, of Grand Rapids, Mich., were attracted by its remarkable record, and having purchased the patents have now taken up its manufacture.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market reacted from the improvement in prices noted last week, the short interest having apparently covered while investor buying and support from large interests were both suspended at the higher range of values. The undertone, however, was good. Some stress has been laid on the probability of much higher rates for call money when the crop moving demands for funds appear, and the rather backward state of corn is cited as a reason for speculative hesitation. Foreign interests have realized largely on their recent heavy purchases of securities in the New York market. There was a general weakness in the electric and traction lists. General Electric closed at 162, this being a net loss of 3 points, and a rally of one point from the lowest price of the week, the highest being 168¾. Westinghouse, common, was steady at 170, and preferred closed at 175, a net gain of 5 points. In the tractions, Metropolitan Street Railway led in the declines, closing at 113¼, and Brooklyn Rapid Transit at 44, being net losses of 1¾ and ¾, respectively. Western Union closed at 83½, a net loss of ¾ points. The following are the closing quotations of Aug. 25:

NEW YORK.

	Aug. 18	Aug. 25		Aug. 18	Aug. 25
American Tel. & Cable	77	79	General Electric	168	162
American Tel. & Tel.	138	..	Hudson River Tel.	..	..
American Dist. Tel	25	25	Metropolitan St. Ry.	116	112¾
Brooklyn Rapid Transit	47¾	45⅛	N. E. Elec. Veh. Trns.	6¼	..
Commercial Cable.	149	.	N. Y. & N. J. Tel.	..	..
Electric Boat	16	15	Marconi Tel.	1⅝	..
Electric Boat pfd	40	40	Western Union Tel.	83¾	84⅛
Electric Lead Reduction	1¾	1¼	Westinghouse com	170	165
Electric Vehicle	8	6	Westinghouse pfd.	175	170
Electric Vehicle pfd.	11	9			

BOSTON.

	Aug. 18	Aug. 25		Aug. 18	Aug. 25
American Tel. & Tel	136	134	Western Tel. & Tel. pfd.	83	80
Cumberland Telephone	..	..	Mexican Telephone	..	1¼
Edison Elec. Illum.	238	..	New England Telephone	126½	123
General Electric	168	162½	Mass. Elec. Ry.	23¼	21½
Western Tel. & Tel	13	13	Mass. Elec. Ry. pfd.	80½	79

PHILADELPHIA.

	Aug. 18	Aug. 25		Aug. 18	Aug. 25
American Railways	43	..	Phila. Traction	95½	95½
Elec. Storage Battery	..	57	Phila. Electric	5¾	6⅝
Elec. Storage Battery pfd.	57⅛	57	Phila. Rapid Trans.	13	..
Elec. Co. of America	8⅛	8⅛			

CHICAGO.

	Aug. 18	Aug. 25		Aug. 18	Aug. 25
Central Union Tel.	..	..	National Carbon pfd.	91	95
Chicago Edison	..	..	Metropolitan Elev. com.	23	..
Chicago City Ry.	170	165	Union Traction	..	5
Chicago Tel. Co	..	123	Union Traction pfd.	..	30
National Carbon	23½	26			

ROCHESTER (N. Y.) TROLLEYS.—The Rochester Railway reports as follows for the year ended June 30, 1903:

	1903.	1902.
Gross	$1,291,369	$1,044,006
Expenses	692,931	572,983
Net	$598,438	$471,023
Other income	32,983	24,216
Total income	$631,421	$495,239
Charges	392,882	313,540
Surplus	$238,539	$181,699
Dividends	156,250	54,110
Surplus	$82,289	$127,589

CENTRAL AMERICAN TELEGRAPH.—Some attention has been attracted, according to the *New York Times,* to a sale of Central and South American Telegraph, which had not been dealt in previously since August, 1895. It took the full brunt of the fall intervening in one leap from 122 to 95, making a decline of 27 between sales. In the interval it had paid 50 per cent. in dividends, which have been undisturbed all through the troubled times. There was no news about it, and the fair inference is that the seller sold for the usual reason—he preferred the money to the stock. Possibly the stock may be thought to have sympathized with other Mexican properties which have suffered in price even although their prospects were improving, not only with Mexico's but exceptionally through benefits of anticipation of currency reforms.

DIVIDENDS.—The directors of the National Lead Company have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable September 15. The Columbus (Ohio) Railway Company has declared a quarterly dividend of 1¼ per cent. on its common stock, payable September 1. The Chestnut Hill Railway Company, Philadelphia, has declared a dividend of 1½ per cent. on its common stock, payable September 4. The Philadelphia, Germantown & Norristown Railway has declared a dividend of 3 per cent., payable September 4.

Commercial Intelligence.

THE WEEK IN TRADE.—Satisfactory reports of trade continue to be received from all sections of the country. The weather and crop conditions are favorable. In the Northwest, Southwest and South buyers are energetic and reports from these quarters are as good if not better than a year ago. In the East, fall jobbing has started in well. Retail trade is seasonably quiet and collections are reported backward in a number of instances. Crop developments as a whole are favorable, improvement being noted especially in cotton and spring wheat, and to a smaller extent in corn. Among the industries there were few changes of importance. One of the notable developments is the general softening of pig iron prices following the heavy buying of the past two weeks. A feature of the week was the selling to the leading interests of the last remaining large area of iron ore lands in the Northwest hitherto unplaced. The lumber trade is active in the West and North. In the East it has not yet recovered from the depression produced by labor troubles, which are now, however, drawing to a close. Railway earnings for the first half of August showed a gain of 11 per cent in gross returns as compared with last year, while additional reports as to the fiscal year ending June 30 indicate a gain in gross receipts for the year of about 9½ per cent and a net of 4 per cent over 1902. The copper market was active throughout the week, and prices were marked up. The improvement in the financial markets, it is stated, has brought about a complete change of sentiment, and consumers both here and abroad bought freely for spot as well as for future delivery. The closing prices are 13¼@13½c. for Lake; 13@13¼c. for electrolytic; 12¾@13c. for cathodes, and 12½@12¾c. for casting stock. There were 166 business failures during the week ending August 20, according to *Bradstreets'* returns, against 160 the previous week, and 181 in the corresponding week of last year.

SHAW ELECTRIC CRANE CONTRACTS.—The Shaw Electric Crane Company, of Muskegon, Mich., has lately secured a number of contracts through Manning, Maxwell & Moore, 85 Liberty Street, for electric crane equipments, to be installed in various new plants and additions to plants. The new shops of the Southern Pacific Railroad at Los Angeles, Cal., are to be installed with a 30-ton Shaw crane to be operated by a 35-hp. motor. The new plant at Astoria, Long Island, of the Astoria Steel Company, is to have a 50-ton crane driven by a 65-hp. motor, also a 5-ton one to be operated by a 6-hp. motor. The American Frog & Switch Company's new shops, Kansas City, Mo., are to be equipped with a crane of 10-ton capacity, worked by a 12-hp. motor. Clark's Island Granite Company, of Rockland, Me., has ordered a 15-ton crane for its new plant, driven by a 20-hp. motor. A new round house is to be built at Hollidaysburg by the Pennsylvania Railroad. It will have two five-ton cranes, each operated by 6-hp. motors. Four 20-ton cranes driven by 25-hp. motors, have been requisitioned by the New York Edison Company. The Northern Central Railroad Company, of Baltimore; the United States Coal & Coke Company, West Virginia and the Allentown (Pa.) Foundry & Machine Company have all ordered 10-ton cranes, with 12-hp. motors for installation in new shops. The Brooklyn Heights Railroad Company has sent in an order for a 20-ton crane, operated by a 25-hp. motor. Pratt & Letchworth Company, of Buffalo, N. Y., has ordered a 10-ton crane and a 12-hp. motor. The Riverside Bridge Company, of Wheeling, W. Va., and the Farrell Foundry & Machine Company, of Waterbury, Conn., will also install similar equipments in their plants now being extended. The Thomas West Foundry Company, of Sharpsville, has ordered two 5-ton cranes, with 6-hp. motors. The Standard Steel Car Company, of Butler, Pa., has ordered four 7½-ton cranes to be operated by 10-hp. motors. The Crucible Steel Company, Pittsburg, has also ordered a small Shaw crane and motor.

ROSSITER, MACGOVERN & CO. have been very busy on street railway orders. The units purchased by the Massachusetts Electric Companies from Rossiter, MacGovern & Co. have just been installed. They are of the most recent General Electric type, 550 volts, driven by Pennsylvania Iron Works Corliss engines. They were originally installed by the Metropolitan Street Railway Company, of New York, but owing to the consolidation of the street railway interests of New York and the adoption of high-voltage apparatus, necessitating rotaries, were no longer needed. Rossiter, MacGovern & Co. have installed in all seven of these 850-kw units in the various stations of the Massachusetts Electric Companies, as follows: Two 850-kw units at Woburn, one 850-kw unit at Lawrence, one 850-kw unit at Lowell, one 850-kw unit at Gloucester, one 850-kw unit at Taunton, and one 425-kw unit at Abington. Rossiter, MacGovern & Co. have also just completed an order from the Oakland Transit Consolidated Railway Company for two engine-driven units; one 850-kw, 550-volt, direct-current General Electric generator, direct-connected to Pennsylvania Iron Works cross-compound engine, and one 630-kw Westinghouse engine-driven generator, direct-connected to a cross-compound St. Louis Corliss engine.

MEXICAN TRACTION SYSTEM.—Contracts are expected to be let early next month for the power house equipment of the Compania Mexicana de Traccion (Mexican Traction Company) recently organized under Mexican laws, principally by New York and Pittsburg capitalists for constructing an extensive electric traction system in Mexico City and suburbs. Isaac M. Hutchison, of Mexico City, who represents the St. Louis Car Company and other prominent American manufacturing interests, held the nominal presidency of the company. He has now retired, and is succeeded by M. R. McAdoo, of 15 Wall Street, New York, a special partner of the Denver banking house of William P. Bonbright & Co. The Bonbrights are largely interested in the Guanajuato Power & Electric Company, and in the project to construct a 10,000-hp. transmission plant for the El Oro mining district. The Pittsburg people, who are substantial stockholders in the traction project, include James Boliver, Julius Bieler and Reuben Miller, Sr. These gentlemen act as a consulting board of directors. Mr. Oliver is president, and Mr. Bieler, treasurer. Ultimately the company expects to operate over 100 miles of track.

THE EDISON STORAGE BATTERY.—The Edison Storage Battery Company is turning out 150 cells a week, which, it is expected, will be increased to 100 cells a day. These cells are now being sold to automobile manufacturers and the general trade at $15 each. The Edison battery now being tested in Boston by President Edgar, of the Edison Company, has 68 cells, and its record is 76 miles on one charge at an average speed of 15 miles an hour. Corey Hill, Greater Boston's steepest hill, was successfully climbed by Mr. Edgar's automobile. His battery is the sixteenth turned out by Mr. Edison. The maximum distance covered by one of the Edison batteries is 85 miles. The battery comprised but 27 cells and was on a light vehicle. When the Edison Storage Battery Company has completed its additions to its plant to meet the present demand, it is expected the present price will be reduced. The Edison Storage Battery Company is a close corporation with Mr. Thomas A. Edison president and largest stockholder. Hamilton McK. Twombly and Samuel Sloan are largely interested in the company.

JAPANESE GOVERNMENT TO BUILD MOTORS, ETC.—Some $5,000,000 is to be expended in the completion of the Japanese Government steel plant at Wakamatsu. The original estimate for the construction and equipment of the works, which are the first of their description in the Far East, was about $2,000,000, but more than $11,500,000 has already been expended. Considerable of the heavy equipment is German. Several of the machine tools were purchased here. The plant is to engage in the manufacture of electric motors, etc., and Manning, Maxwell & Moore, 85 Liberty Street, have just received a substantial contract for several tools to be thus utilized. Japanese advices state that a large steel plant is also to be constructed at Kure, which will necessitate the purchase of a big lot of machinery. The contracts placed in Germany for the Wakamatsu works would have been let here but for our higher prices.

TROLLEY OVERHEAD CONSTRUCTION.—The Cincinnati & Columbus Traction Company, of Cincinnati, Ohio, have recently placed with the H. W. Johns-Manville Company, through their Cleveland branch a contract for sufficient overhead line material to build 55 miles of new road. Their construction will consist of parallel trolley wires of the 000 grooved wire type. It was decided to adopt the well-known Johns-Manville extra heavy galvanized round top hangers with 3/4-in. studs provided with deep petticoats, insuring the best of surface insulation. These are attached to galvanized straight line yokes, having a center dimension of 6 in. between trolley wires. The combination mechanical and solder clip 15 in. in length, being one piece only, which has proven so successful in the East on extra heavy construction, will also be used in conjunction with the extra heavy hangers and "Giant" type of pull-overs. "Giant" strains and "Philadelphia" section insulators will be used throughout.

EQUIPMENT FOR BIG PITTSBURG ENGINEERING SHOPS.—The Pittsburg Engineering Company is at present letting some heavy contracts for the equipment of its shops to be built in Pittsburg, Pa. The contracts for electric crane equipment calls for nine cranes, aggregating a capacity of more than 200 tons. They will be of Shaw build. The motors will also be of Shaw manufacture. The contract calls for one 100-ton crane to be operated by a 125-hp. motor; one crane of 30-ton capacity and a 35-hp. motor; two of 15 tons with 20-hp. motors; four 10-ton ones with 12-hp. motors, and one crane of 5-ton capacity, to be driven by a 6-hp. motor.

EQUIPMENT FOR KEIHIN SYSTEM.—Further contracts have been let for the Keihin Traction Company, which concern is to build the first high speed electric railway in the Far East. The line will run between Yokohama and Tokio, Japan. Its speed will be 40 miles per hour. The Japanese house of Mitsu & Co has let the contract to the General Electric Company for the generators, two machines of 400 kw. capacity each. The engine contract, which was secured by Bagnall & Hilles, Yokohama, will be filled by Russell & Co., of Massillon, O., with two engines of 600 hp. each. The contracts for the rails, boilers, pumps, etc., have not yet been determined on.

BALL ENGINE ORDERS.—The Whiting Foundry Equipment Company, of Harvey, Ill., has recently purchased from the Ball Engine Company, Erie, Pa., a 400-hp Corliss engine of a new design, similar to the one now running at Chicago University, which has attracted considerable attention among engineers on account of improvements in the valve gear. The Ball Engine Company are also installing eight 150-hp engines, direct-connected to centrifugal pumps, for the condensing system of the Seventy-fourth Street Station of the Manhattan Railway Company, of New York.

FLEXIBLE CONDUIT TRADE AGREEMENT.—The four principal makers of flexible conduit have entered into an agreement for the sale of conduit of jobbers and supply houses somewhat different from that in vogue previous to August 1, 1903. The old arrangement was to allow discounts depending on the amount ordered. The new arrangement is to sell at a living discount only to supply companies and jobbers on a preferred list compiled by a committee of the manufacturers.

MUSEUM OF NATURAL HISTORY, NEW YORK.—The contract for the engines to be installed in the new power station at the Museum of Natural History, New York, has been awarded by Charles L. Eidlitz to the Hooven, Owens & Rentschler Company, 39-41 Cortland Street, for two tandem compound Corliss non-condensing engines, direct-connected to 200-kw generators. Mr. C. O. Mailloux is consulting electrical engineer.

ESCALATOR INSTALLATION.—The Interborough Rapid Transit Company have contracted with the Otis Elevator Company for an escalator to be installed at the Thirty-third Street Station of the Sixth Avenue Elevated road. The escalator will be placed on Broadway just north of Thirty-third Street and will carry passengers direct to the down-town station. A foot bridge will extend over the tracks to the up-town station.

CARS FOR LITTLE ROCK, ARK., ROAD.—The St. Louis Car Company, New York offices Broad Exchange Building, has secured a contract through Ford, Bacon & Davis, 24 Broad Street, for fifteen cars to be used by the Little Rock (Ark.) Electric Light & Traction Company, in which the banking house of Isidore Newman & Sons is primarily interested. The motor equipments will be of General Electric build.

J. G. WHITE & CO., LIMITED, of London, have secured the contract for the overhead line equipment of the Rochdale tramways for slightly over $100,000. They have also received the contract for the construction of the Colchester Tramways, including permanent way and overhead construction, amounting to $175,000.

LIGHTING A PRIVATE CAR.—A private car has just been brought out on the New York Central Railroad for Vice-President Wilgus. The United States Light & Heating Company equipped the car with its system of car lighting, installing sixty-five incandescent lights and four fans.

LIGHT AND TRACTION SYSTEMS FOR SAN BLAS.—San Blas, a seaport town of some 2,000 population, in the State of Jalisco, Mexico, is to have up-to-date American electric lighting and traction systems. H. B. Masset, representing California capitalists, is now in Mexico on the matter.

THE LEA ELECTRIC MANUFACTURING COMPANY, of Elwood, Ind., has gone into the hands of a receiver, Mr. W. A. Ramsey, having been appointed as such. Insufficient capital is stated to have been the cause of the company's embarrassment.

General News.

THE TELEPHONE.

BOISE, IDA.—Mr. S. J. Fenton of Salt Lake City, Utah, a director of the Utah Home Telephone Company, was in the city recently consulting with the officers of the Independent Telephone Company, with a view to bringing about a consolidation of all independent systems throughout this section in order to actively compete with the Rocky Mountain Bell Telephone Company. Mr. Fenton states that the promoters of the plan have ample capital behind them and believes there is no doubt of an early merger of the telephone systems being effected. It is further planned to run a parallel system to the Bell Company's lines throughout the inter-mountain states. Where independent systems cannot be purchased direct, they will be leased for a term of years. It is anticipated that such an immense undertaking will involve the expenditure of several millions of dollars.

CHICAGO, ILL.—The Stroud Telephone Specialty Company has been incorporated with $10,000 capital. Directors: H. D. Stroud and others.

SULLIVAN, ILL.—The Sullivan Exchange operates a full metallic circuit, has 300-drop board capacity and 250 subscribers, with a large expected increase. Thirty-two miles of toll line are owned by the company, and 10 other lines connect with the exchange.

CHESTERFIELD, ILL.—The Chesterfield Telephone & Telegraph Company has been incorporated for the purpose of operating a telephone and telegraph system. Incorporators: William J. Finch, Jr., William H. Drood and Frank Towse. Capital, $15,000.

SPRINGFIELD, ILL.—The committee of business men appointed to make inquiry into the telephone systems in this city have made their report, and they recommend in favor of but one system. The establishment of a second company's system pronases lively conflict. The new company claims to have 1,500 telephones in operation already.

FISHER STATION, IND.—The Fisher Telephone Company has been formed by J. A. Young and others. Capital, $5,000.

WATERLOO, IND.—The patrons of the Waterloo Telephone Company are now given free use of the exchange to Auburn, Garrett and St. Joe.

NEW ROSS, IND.—The New Ross Co-operative Telephone Company has a Eureka 100-drop board with 82 subscribers. Prospects are very good.

FRANKFORT, IND.—The Central Energy Telephone Company of this city is placing its wires underground throughout the business section of the city.

VINCENNES, IND.—The Home Telephone Company is installing an additional switchboard. With the extensions now being made and the additional capacity being provided the company will be able to give service to all who may apply for it.

INDIANAPOLIS, IND.—The following telephone companies were incorporated during the past week: The Sharpsville Telephone Company, capital stock $7,500. The principal office and exchange will be at Sharpsville. J. L. Ranack, president. The Bryant Telephone Company, of Portland, capital $10,000. L. G. Holmes, T. J. Taylor, E. C. Magginite and others incorporators.

CLINTON, IA.—The Lehigh Telephone Company has been incorporated with $10,000 capital.

CRESTON, IA.—The Bell Telephone Company is putting a new line in from Creston to Stewart.

DES MOINES, IA.—The New Monona Telephone Company has been incorporated with $100,000 capital.

DUBUQUE, IA.—The Iowa Telephone Company will construct a conduit system here and make extensive improvements to the local exchange.

EDDYVILLE, IA.—The Eddyville Telephone Company has just completed two new party lines west of town, one on Gray's Creek, the other to Miller's Creek.

CHARITON, IA.—The Curtis Electric Company projects putting in a central exchange to connect all the rural lines that run through the surrounding country.

STATE CENTER, IA.—The State Center Telephone Company reports a very encouraging outlook. It uses a Eureka switchboard of 200 drops and has 150 town subscribers and 200 farmers.

CLAY CENTER, KAN.—The Clay Center Telephone Company reports a favorable increase of business with encouraging outlook. It operates a board of 400 drops and has 375 subscribers with 50 miles of toll line. Country party lines are projected.

TOPEKA, KAN.—Work on the Kansas City-Topeka independent telephone toll line has been commenced from the Topeka end. The line is being built by the Western Independent Telephone Company, which is one of the numerous independent companies with universal connections in Kansas. The line from Kansas City to Lawrence has been completed and now the rest of the work will be carried on from Topeka. When the Kansas City-Topeka line has been finished a toll line from Topeka to Wichita will be built by the same company.

AMITYVILLE, L. I.—A franchise has been granted to D. James Cronk, manager of the New York & Long Island Telephone Company, to erect poles on the highway and operate a telephone line between Babylon and Amityville.

NEW BEDFORD, MASS.—The Automatic Telephone Company, having extended its line to Fall River, advertised lower rates than those charged by the Southern Massachusetts Company, whereupon the latter cut its toll rate to five cents for five minutes' talk.

STARBUCK, MINN.—The Glenwood Telephone Company and R. R. Johnson, of Benson, have applied for a franchise to establish a local telephone exchange.

ST. JAMES, MINN.—The officers of the new St. James Telephone Company are: J. K. Sonnesyn, president; E. A. Gibbs, vice-president; Frank Schollman, treasurer, and W. M. Barrett, secretary.

LANESBORO, MINN.—The Root River Telephone Company runs its line into the central at Lanesboro, which is operated by the Phoenix Telephone Company, of Winona, Minn. This company has [illegible] subscribers and [illegible] miles of toll line.

ST. LOUIS, MO.—The Central Telephone & Electric Company, of St. Louis, has filed articles for an increase in its capital stock from $10,000 to $50,000.

GARDEN CITY, MO.—The Cleartalk Telephone Company has two boards of 200 and 100 drops respectively, and 316 subscribers. There are 119 miles of toll line at 75c. per month. An extension is contemplated.

LIVINGSTON, MONT.—The Yellowstone Park Telephone Company has 200 miles of toll line and projects an increase of 100 more.

BILLINGS, MONT.—The system of the Montana & Wyoming Telephone Company from Cody to Meeteetse and Basin has been transferred to the Rocky Mountain Bell Telephone Company, and further purchases by the latter company of telephone lines in this state are under contemplation. The Bell Company will shortly have its lines in Wyoming completed so that it will be possible to communicate by telephone from Butte to Denver and Cheyenne.

BEATRICE, NEB.—The Virginia Telephone Company has been incorporated with $4,000 capital stock.

ALAMAGORDA, N. MEX.—The Alamo Telephone Company uses American Electric apparatus and has 110 subscribers. It operates 140 miles of toll line connecting with six or seven other towns in New Mexico.

GENEVA, N. Y.—The Geneva Telephone Company reports rapid and satisfactory growth. Switchboard capacity is 1,500 drops, with 591 subscribers.

WESTVILLE, N. Y.—The Westville Telephone Company has been formed, capital $1,000. Incorporators: Frank Green, Almarin Baldwin, Thos. Gurney, E. B. Coats, M. A. Stilwell, John M. Cady, K. H. Baldwin, all of Westville, N. Y.

JAMESTOWN, N. Y.—The Home Telephone Company has 8,700 feet of underground duct and reaches all points in Southern New York west of Binghamton via Inter-Ocean toll lines. It has a switchboard capacity of 3,000 lines, 1,200 installed; 1,800 subscribers, and projects a large increase.

ASHEVILLE, N. C.—The Asheville Telephone & Telegraph Company has been formed with an authorized capital of $300,000, by C. R. Craig, W. S. Proctor, Frank Carter and others.

ASHEVILLE, N. C.—It is reported that a syndicate is being organized in New York to start a new telephone system in Asheville where much discussion has arisen over the proposed consolidation of the Bell and independent interests.

OBERON, N. D.—The long distance telephone line has reached Oberon.

EDMORE, N. D.—The Northwestern Telephone Exchange will install a local exchange here at once.

BUCKLAND, OHIO.—The farmers around Buckland have organized an independent telephone company with a capital stock of $7,000.

NEWPORT, OHIO.—The Telephone Company and the Street Railway Company have reached an agreement by which the poles will not be placed on one side of the street.

ST. MARYS, OHIO.—The local telephone company has begun work on the installing of an entire new plant. The lines on the business streets will all be buried, and the central station will be automatic.

ONTARIO, ORE.—The Eastern Oregon Telephone Company, which was organized for the purpose of establishing a telephone line between Ontario and Owyhee, has applied to the court for an order restraining the Rocky Mountain Bell Telephone Company from constructing a line between Myssa and the Owyhee, claiming that the Bell Company could only do such construction through breach of agreement.

MITCHELL, S. D.—The Telephone Company will erect a new exchange building.

CASTLEWOOD, S. D.—The Bryant Telephone Company has been granted a right of way in Hamlin County.

LONE OAK, TEX.—The Citizens Telephone Company operates a 200-drop board at Lone Oak, 100 at Emory and 12 at Point. In all there are 210 subscribers, with 30 miles of toll line. An exchange has recently been put in at Emory and the company covers all the country closely.

EL PASO, TEX.—The city council has declared the franchise of the Bell telephone company forfeited and ordered the company to discontinue doing business. The city clerk was authorized to advertise for bids for a telephone franchise. The old company's refusal to put its wires underground is the cause of the city's action.

SPOKANE, WASH.—As one of the results of the strike among employees of the Pacific States Telephone & Telegraph Company, another group of capitalists is asking for a franchise.

SPOKANE, WASH.—The San Francisco Labor Council has addressed a communication to the president of the Pacific States Telephone and Telegraph Company in relation to the recent strike of the linemen, and has notified him that a boycott has been declared against the use of the company's service. An adjustment of the trouble seems at present to be distant. The decree of the trade council here that union men remove their telephones on account of the company's failure to accede to the demands of the striking telephone girls, is being enforced, and several union men who have failed to remove their telephones have been fined.

EAU CLAIRE, WIS.—The Eau Claire County Telephone Company has been incorporated with $5,000 capital by C. A. Stillworth and others.

MILWAUKEE, WIS.—The Interstate Telephone Company, of Milwaukee, has been incorporated, capital $4,000. J. A. Hull, of Odon, Ind., is its agent.

MILWAUKEE, WIS.—The Boughton Independent Telephone Company has been incorporated with a capital stock of $45,000. R. R. Freeman is a director.

ASHLAND, WIS. The Bayfield County Telephone Company has been formed, capital stock $30,000. Incorporators: T. C. Jacks, C. F. Latimer, C. A. Lamoreaux.

WASHBURN, WIS.—The Home Telephone Company of Ashland has entered this city with a toll line and expects to install a local exchange here in the near future.

MILWAUKEE, WIS.—The Stoughton Independent Telephone Company has incorporated, capital stock $45,000, divided into 200 shares of 20 each. Incorporators: Robert R. Freeman, Clarence S. Pierce and William G. Whitehead.

CHEYENNE, WYO. The Rocky Mountain Bell Telephone Company has acquired over 500 miles of telephone lines by the purchase of the systems of the Sheridan Telephone Company, and Powder River Telephone Company, and the Moeller system. This gives the Bell Company control of all the lines in northern Wyoming.

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ELECTRIC LIGHT AND POWER.

FRESNO, CAL.—President Balch of the San Joaquin Power Company states that the corporation had taken up all the power that could be acquired from the San Joaquin River or its tributaries in the mountains and that Engineer John S. Eastwood had been in the mountains for over a year making choice of locations and water rights and filing claims which will enable the development of a large additional amount of current.

NEW HARTFORD, CONN. It is stated that the New Boston & Springfield Electrical Power Company, with a capital of $4,000,000, has been organized by New York capitalists, and has secured the principal water privileges along the west branch of the Farmington River from Otis to New Hartford, Conn., a distance of about 20 miles, and also the Greenswoods property owned by the Mt. Vernon and Woodbury cotton duck combine, and the rights recently secured in Otis and Sandisfield, by Messrs. Flint, Gile and others, of New York. Current will be transmitted to Springfield, where it is said contracts have already been made to furnish 10,000 horse power.

WASHINGTON, D. C.—There are now operated under contract by the Potomac Electric Power Company 965 arc electric lamps in the city of Washington, and 919 incandescent electric lamps on the roads and in the towns outside of the city. A recent extension of the incandescent service has been the establishment of 148 new lights in the section across the Eastern Branch, taking in Nichols Avenue to Congress Heights and through the Congress Heights subdivision, also Sheridan, Elvans, Stanton, Stevens, Sumner, Wade and Howard Avenues and part of the Morris Road, all being in part of Hillsdale.

OMAHA, NEB.—At the regular meeting of the City Council of Omaha, Aug. 12, the Omaha Electric Light & Power Company gave a formal notice to the council that it had acquired all the property, franchises, contracts and rights of the New Omaha Thomson-Houston Electric Light Company.

BALTIMORE, MD.- The contract for the special illumination project for East Baltimore Street has been awarded to the Convention Electric Company.

ALPENA, MICH.—The Alpena Light, Heat & Power Company has been organized at Lockport, N. Y., with a capital of $500,000, to develop water power on Thunder Bay River and generate and transmit power to the manufacturing institutions. The new corporation will also take over the water works, electric lighting plant and gas plant, all owned at present by separate corporations. Geo. P. Smith, of Syracuse, N. Y., is president. Much money will be expended in improving these plants.

BUTTE, MONT.—The Electrical Development Company of Ontario is preparing to enlarge the capacity of its water power plant in Madison County, which provides electrical power for a large number of mines and smelters in this city. The company plans the development of a plant of 125,000 horse power and the total cost of the system will be $7,000,000. A reservoir is to be constructed in a canyon on the Madison River.

BAKER CITY, ORE.—The Baker City Gas & Electric Company has contracted for a water wheel, dynamos, transmission lines and all the equipment necessary for its Rock Creek Power plant.

REDFIELD, SO. DAK. On Aug. 4 the South Dakota Board of Charities and Correction awarded the contract for plumbing and for installation of plant for heating and lighting of the Northern Hospital for Insane at Redfield to Messrs. Hess & Rau, of Watertown.

ALEXANDRIA, VA.—Articles of consolidation and merger between the Norfolk County Industrial Company and the Montgomery Power Company have been filed. The new company will be known as the "Potomac Power Company," and will have a capital stock of $110,000, divided into 110 shares of the par value of $100 each. The corporation controls valuable water rights along the Potomac River between Great Falls and Washington. The government of the company and the management of its affairs will be vested in the following officers of the Norfolk County Industrial Company: Horace G. Williams, president; Clifford L. Pullen, vice-president; William E. Stokes, secretary; George S. Gandy, treasurer. The Great Falls Power Company has nothing to do with the new concern.

SPOKANE, WASH.—Contracts have been completed by the Crackerjack Company, operating in Buffalo Hump for the erection of a 200-hp electric plant to cost about $20,000. Geo. Nixon has closed a contract for electric and hydraulic fixtures. The plant will be run by water power furnished through Pelton wheels on Lake Creek. At the mine a 100-hp motor will be installed to work the stamp mill and compressor.

THE ELECTRIC RAILWAY.

LOS ANGELES, CAL. Col. J. W. Eddy has been granted a right of way through Griffith Park for an electric railway to connect with an inclined railway.

REDWOOD CITY, CAL. Charles Clark and Henry Dowie, of San Mateo, have applied for a franchise to construct an electric railway from San Mateo over the mountains to Half Moon Bay.

MONTEREY, CAL. R. C. Smith has been awarded the contract to construct and operate a single or double-track electric street railway on several streets leading to the United States military reservation.

RED BLUFF, CAL.—The Board of Supervisors of Tehama County has granted a franchise to the Tuscan Mineral Springs Corporation to construct and operate an electric railway on the public highways from Red Bluff to Tuscan Springs, also the privilege of crossing the county bridge across the Sacramento River at Red Bluff.

LOS ANGELES, CAL.—Sub-stations are being built by the Pacific Electric Railway Company at Arcadia, Long Beach, Dominguez, Watt, Eastlake Park and Laguna. The company will also build $2,500 station buildings in the Mission style of architecture at the Junction of the Pasadena and Monrovia and the Long Beach and Whittier lines.

LOS ANGELES, CAL.—The Los Angeles & Pacific Railroad Company has begun the erection of a new sub-station at Sixteenth and Bush Streets, to have a capacity of 300-hp. It is about three miles from the large power house on Sixteenth Street outside the city limits, and will greatly increase the service of the Santa Monica, Ocean Park, Playa del Rey and Redondo lines.

EUREKA, CAL.—Articles of incorporation of the Humboldt Transit Company have been filed. The purpose is to build 20 miles of electric railway in Eureka and an additional 54 miles in Humboldt County. The capital stock is $300,000, of which $75,000 has been subscribed. The directors are J. C. Bull, Jr., of Eureka; George Henderson, of Oakland; R. W. Bull and John C. Bull, of Arcata, and Charles P. Cutten, of Eureka.

ALAMEDA, CAL.—Another application to operate an electric line over the north and south side lines now operated by the Southern Pacific has been filed with the executive committee of fifty chosen by the City Trustees to assist them in settling the matter of local franchises. P. N. Beringer, as agent of Eastern parties, submitted the application. It is stated that the Eastern people are the firms of Mechem, Mitchell & Company, and Kay, DeWolf & Company, both of New York.

LOS ANGELES, CAL.—Work will begin at once on the extension of the main line of the Pacific Electric Railway Company from San Gabriel to Covina, Pomona, Ontario and Riverside. The Board of Trustees of Covina has sold a franchise for one mile along Badillo Street to the company for $100, covering the only gap in this county for the proposed Los Angeles-Riverside electric road. Chief Engineer George Pillsbury says cars will be running into Riverside before Christmas.

GREELEY, COL.—Application has been made to the City Council by George J. Spear for a twenty-year franchise for an electric railway from Greeley to La Falle, a distance of seven miles; another from Greeley to Seeley's Lake, a pleasure resort five miles from town, and one connecting the city with Ault, three miles distant.

PENSACOLA, FLA.—The Pensacola Electric Terminal Railway Company will shortly submit a proposition to the City Council asking for additional privileges. It is the desire to extend all of the lines and electrify the present steam division to Fort Barrancas. The Council recently granted these privileges, but the terms were such that the company refused to accept them.

ATLANTA, GA.—The County Commissioners have granted the Piedmont Electric Company a franchise for an electric railway between Atlanta and Roswell.

ATLANTA, GA.—The city council has passed an ordinance granting the Central Passenger Railway Company the privilege of building an electric railway on Virginia, Adriatic and South Carolina Avenues. The company is promoted by William McLaughlin.

ATLANTA, GA.—Application has been made to the Secretary of State for a charter for the Atlanta, Buford & Gainesville Electric Railway Company. The plan of the company is to build to connect Gainesville and Flowery Branch, in Hall County, Buford, Suwanee, Duluth and Norcross, in Gwinnett County, and run through the upper portion of DeKalb and Fulton Counties "into or near" Atlanta. From Buford there will be a branch line in a northwesterly direction to the Winding Shoals on the Chattahoochee River, the evident intention being to establish the power station at that point. The charter is applied for by H. D. Jacquish and C. C. Sanders, of Gainesville, Ga.

TAYLORVILLE, ILL.—J. N. C. Shumway and Benjamin Sharpe are promoting an interurban electric railway from Taylorville southeast through Assumption, Shelbyville and beyond.

OTTAWA, ILL. The Northern Illinois Light & Traction Company has been formed, capital $250,000, to build a street railroad and light plant. Incorporators: L. W. Ilees, J. I. Warner, C. E. Woodward.

LINCOLN, ILL.—The Lincoln Street Car & Heating Company has been incorporated in New Jersey, with $110,000 capital stock. The incorporators are Louis B. Dailey, Warren U. Akers and H. O. Coughlan.

STERLING, ILL.—The Columbia Construction Company is pushing the work of building the Sterling, Dixon & Eastern Electric Railway from Sterling to Dixon. Over a mile of track has already been laid east from the city limits.

DECATUR, ILL.—The Decatur, Tuscola & Champaign Interurban Railway has been incorporated, with headquarters at Decatur, Ill., to construct an electric railway to connect with the McKinley line, now building through Springfield to St. Louis.

OTTAWA, ILL.—The Northern Illinois Light & Traction Company, Ottawa, capitalized at $250,000, has been incorporated to operate a system of street rail-ward and the one [illegible]. The incorporators are Louis W. Hess, Jacob L. Wagner, Charles L. Woodward.

VIRDEN, ILL.—The city of Virden has granted a franchise to the Decatur, Springfield & St. Louis Electric Railway to run its lines on the streets of Virden. The City Council of Carlinville is discussing an ordinance whereby the same company may have the use of certain streets in that place.

CHICAGO, ILL.—The Oxford Terminal Railroad Company has been incorporated, capital $[illegible], to be constructed from a point in the city of Chicago to the city limits. Incorporators and first board of directors: W. W. Barely, E. H. Brush, F. O. Stanland, George Goldman, O. B. Green, all of Chicago.

QUINCY, ILL.—At the annual meeting of the Quincy & Western Illinois Railway Company, which has franchises for building interurban lines in Quincy, the franchises voted the company by the City of Quincy were accepted and Gen. A. B. Nettleton, S. H. Bracey, L. L. Lomas, James Potter, W. A. Howard, L. J. Highland and John Pesce were elected directors. The meeting voted to increase the capital stock from $500,000 to $1,000,000, and to authorize a bond issue for $1,000,000.

LA GRANGE, IND.—The council has granted a franchise to the St. Joseph Valley Traction Company.

ANDERSON, IND.—Wallace B. Campbell is promoting a 48-mile electric railway from Anderson to Lapel, Noblesville, Westfield and Lebanon.

HAMMOND, IND.—Russell B. Harrison has asked for a franchise for an interurban line from Michigan City to Hammond. The South Chicago Electric Street Railway Company is opposing the grant.

GREENSBURG, IND.—It is said that all the capital required has been subscribed for building the Madison, Greensburg & Indianapolis Traction Company's line. The length of the line is 49 miles.

SHELBYVILLE, IND.—The County Commissioners have granted the Indianapolis & Cincinnati Traction Company a franchise permitting it to construct a line through the northern part of Shelby County.

INDIANAPOLIS, IND.—The commissioners of Marion County have granted the Indianapolis & Southwestern Traction Company a franchise for a single or double track from the city limits along the Bluff Road to the south line of Marion County.

ANDERSON, IND.—W. B. Campbell and others are projecting an electric railway from Anderson through Noblesville to Lebanon. The line would complete a great cross state line north of Indianapolis and connect with nearly a dozen lines running north, east and west.

LOGANSPORT, IND.—The Frankfort-Logansport Traction Company, composed of Frankfort and Logansport capitalists, which proposes to build an electric railway between the two cities, has been granted an extension of six months, in which to begin construction work.

ANDERSON, IND.—Ground has been broken for the new interurban line to Elwood by the Indiana Union Traction Company. The line will add 20 miles to the company's system. F. N. Stillwell has the contract to construct the grade and track work. The line is to be completed in 90 days.

WABASH, IND.—Jilson J. Coleman, of New York, and John C. Calhoun have recently financed the Indiana & Northern Railway. J. G. White & Company, of New York, have the contract to build the road. The terminals of the road are Marion and Wabash, Ind., separated by a distance of 20 miles.

VINCENNES, IND.—S. N. Chambers, president of the Vincennes, Petersburg & Jasper Traction Company, announces that he has organized a syndicate of Cincinnati, Cleveland and Indianapolis capitalists who will purchase and combine the Vincennes Street Railway Company with the Southern Indiana Traction Company.

RICHMOND, IND.—The council has granted a franchise to the Richmond & Northwestern Traction Company. The franchise provides that no car shall be run over Doran bridge heavier than the capacity of the bridge as fixed by expert opinion. The franchise grants the use of certain streets on which the local company operates, but in order to use them the company will have to make traffic arrangements with the Richmond Company. The term of the franchise is thirty-five years.

MUSKOGEE, I. T.—The city council has granted a street railway franchise to C. N. Haskell and W. R. Eaton for about six miles of street railway. The Muskogee Traction Company will be organized to carry out the project.

MOUNT PLEASANT, IA.—The citizens of this place have voted to grant a street railway franchise to Henry Traut.

KALONA, IA.—Articles of incorporation have been drawn by the Iowa City, Kalona & Washington Railway Construction Company. The company is to connect these places.

OELWEIN, IA.—The Oelwein & Northeastern Interurban Railway Company is preparing to survey as soon as the Board of Supervisors of Fayette County grants permission for the construction of the line over the highways of Fayette County.

TABOR, IA.—President Robert McClellan, of the Tabor & Northern Railway Company, extending from Tabor, Fremont County, to Malvern Mills County, Iowa, a distance of eight or nine miles, has been inspecting the road, with a view to installing electricity as the motive power in place of steam.

DUBUQUE, IA.—The Dubuque Northern Railway Company is surveying a route for an interurban electric railway from Dubuque to Greeley, in Delaware County, about 30 miles north and west of Dubuque. The Dubuque Northern Company also proposes to construct several other interurban lines out from Dubuque, both in a northerly and southerly direction.

WINFIELD, KAN.—Plans are being discussed for building an electric railway to connect Winfield, Wellington and Arkansas City. A proposition has been made by a St. Louis company to build the road if franchises are granted by the towns along the line. J. Mack Love, of Arkansas City, is interested.

NORTON, VA.—The Wise County Electric Railway Company will build an electric railway in the mining district.

LOUISVILLE, KY.—The Louisville Railway Company will soon begin the erection of a power house at Meadow Brook Station. It will be brick, two stories in height and cost about $60,000.

LOUISVILLE, KY.—Articles of incorporation for the Madisonville Traction Company, capital $10,000, have been filed. The intention is to build an electric railway from Madisonville to Earlington, a distance of five miles, and later to extend it to Nortonville and White Plains, if it is deemed advisable.

FRANKFORT, KY.—The Louisa Railway Company, of Lawrence County, has filed articles of incorporation, capital stock $80,000, to construct a railroad from Levisa Fork of the Big Sandy River to connect with the Ohio & Big Sandy Railroad. J. S. McConnell, Mount Vernon, Ohio, M. G. Watson, R. H. Casterline, C. A. Hays, W. L. Watson, L. L. Dixon and M. Carter, Louisa, and Ashland people are the incorporators.

LOUISVILLE, KY.—The Louisville & Southern Indiana Traction Company, successor of the Southern Interurban Railway Company and the United Gas & Electric Company, has elected officers as follows: Samuel Insull, of Chicago, president; R. W. Waite, of New Albany, vice-president and treasurer; J. O. English, of New Albany, secretary. It is said that the company will build an electric railway from New Albany to Paoli, French Lick and West Baden Springs, traversing the counties of Floyd, Washington, Harrison and Orange.

MINEOLA, L. I.—The Board of Supervisors of Nassau County has granted two franchises for the construction of trolley roads. One of these is for the Mineola and Port Washington Traction Company, to construct a line from this place to Port Washington, contingent upon local consent. The other is to the Glen Cove Company, which is to build a line from the station at Glen Cove to the station at Sea Cliff with extensions to the piers in each place.

CAMBRIDGE, MD.—The Eastern Shore Transportation Company proposes an electric railway from Cambridge, Md., to Wye Station, 24 miles long, through a thickly settled and prosperous agricultural section of Talbot County.

IPSWICH, MASS.—The Board of Railroad Commissioners has issued an order approving the locations granted to the Haverhill, Danvers & Ipswich Street Railway Company in Topsfield, Ipswich, Rowley, Georgetown, Groveland and Boxford, and allowing the company to operate over private land in those towns.

ST. JOSEPH, MICH.—J. C. McMichael, president of the Atlas Railway Supply Company, of Chicago, has made a proposition to construct an electric railway from St. Joseph through the Fairplain District, twelve miles to Tobor's resort.

ST. PAUL, MINN.—The County Commissioners have granted to Dr. C. O. Straub and others the franchise for building an electric railway from Minneapolis to Anoka, and to Shakopee. The franchise must be accepted within thirty days, work commenced by May 1, 1904, and the road completed within two years.

BILLINGS, MONT.—The Montana Construction Company has filed articles of incorporation, with a capitalization of $500,000. P. B. Moss, W. H. Rowley and I. D. O'Donnell are the directors, all being residents of this place. The company will build an electric road from Butte, Mont., to the Salmon River District in Idaho.

OMAHA, NEB.—General Manager Smith states that the Omaha & Council Bluffs Street Railway will be extended to Fort Crook, a distance of ten miles from Omaha.

OMAHA, NEB.—Capitalists of Akron, Ohio, are interested in an electric road from Omaha to Lincoln. E. C. Hurd, of Lincoln, is surveying the line, and W. J. C. Kenyon, general manager of the stock yards, Omaha, is the promoter.

OMAHA, NEB.—The Omaha Street Railway Company has let the contract for the construction of its new power house. The contract for the structural iron work for the power house was let to a Minneapolis firm. An award for generators went to the General Electric Company; that for the engines to a St. Louis firm; that for the condensers to a New Jersey firm, and that for furnaces to a Pittsburg firm.

SOUTH SIOUX CITY, NEB.—The company that proposed to build an electric railway between Sioux City, Ia., and Homer, Neb., has not yet completed its organization and plans. It will be a standard gage road, and will be sixteen miles long, passing through South Sioux City, Neb., Dakota City, Neb., the county seat of Dakota County, and on to Homer, Neb., on the edge of the Winnebago Indian Reservation. The whole 16 miles is perfectly level and will require no grading. The road will be operated for both freight and passengers. Steam locomotives will be used during the construction of the road. The high tension system of power distribution will be used, the plan being to erect one main station and necessary sub-stations.

MILLVILLE, N. J.—The People's Traction Company is now making final arrangements to connect most of the important cities and towns in South Jersey below Pitman by trolley.

SEA ISLAND CITY, N. J.—The City Council has passed an ordinance granting the People's Traction Company the right to build an electric railway through the city limits, along Landis Avenue.

CAMDEN, N. J.—The General Traction Company, which will build about 85 miles of electric railway to reach from Camden to Atlantic City, Cape May and other seashore resorts, has filed articles of association in Camden. The capital stock is $1,000,000, and the officers are M. W. Benson, president; George A. Aldrich, vice-president; Charles G. Willis, secretary and treasurer.

DOVER, N. J.—The Morris County Traction Company has been granted a franchise to build a line over Blackwell Street from the eastern to the western boundary lines, forming part of a line between Rockaway and Wharton, a distance of six miles. The company is to pay the town two per cent. of its gross receipts, counting the money received within the town of Dover, during the first seven years after cars shall have begun running;

three per cent. the next five years, and after the twelfth year the rate shall not be less than three per cent. nor more than five per cent. The franchise is perpetual.

WASHINGTON, N. J.—The Easton & Belvidere Street Railway Company will extend its line from Belvidere to Washington and Phillipsburg, entering over the Lehigh Valley Traction line. This would form a complete loop, about 50 miles around. The Easton & Washington Traction Company is building its line between the two places, having started work in Phillipsburg. The Easton & Belvidere Company now has a force of men engaged in constructing the line between Nazareth and Bath, and Nazareth and Belvidere, in Northampton County. It also has a charter for a line parallelling that of the Northampton Traction Company between Easton and Nazareth.

EAST LAS VEGAS, N. MEX.—The Las Vegas & Hot Springs Electric Railway, Light & Power Company will begin at once the extension of its lines around the city.

NEWBURG, N. Y.—The Intervale Traction Company has made application for a franchise to operate an electric railway through the city over the Snake Hill Turnpike, entering at Lake Street.

GLENS FALLS, N. Y. The stockholders of the Hudson Valley Railway Company have ratified the lease of the property and franchises of the North River Railway Company which has just been authorized by the Railroad Commissioners to increase its capital stock from $180,000 to $200,000, and to issue a mortgage of $500,000, of which $200,000 is to be available for immediate use.

HEMPSTEAD, N. Y. The New York & Long Island Traction Company has been given a franchise from Freeport to the easterly line of the town of Hempstead. All but about 800 feet of the proposed line is over private right of way. The term of the franchise is for ninety-nine years, and the fare will be ten cents from the eastern line of the town to Freeport, and ten cents from Freeport to the city line of the Greater New York, at Valley Stream.

LONG ISLAND CITY, N. Y.—The new board of directors of the New York & Queens County Railroad has been made public, as follows: Arthur Turnbull, president; E. T. Perine, secretary and treasurer; J. J. Rollins, Calvert Brewer, W. C. Ivison, W. K. Matthews, A. J. Elias, V. P. Snyder, all of New York, and Francis Rawle, of Philadelphia. President Turnbull declares that he and his associates have bought the road for themselves, and will operate it. He denies that the Pennsylvania or the Long Island Railroad had any interest in the property.

DAYTON, OHIO.—The Dayton & Lebanon Traction Company has been incorporated by James P. Wolf, Wayland P. Sunderland, Frank M. Hamilton, W. C. Ely and O. F. Davidson. The line is to extend from Dayton to Lebanon.

CINCINNATI, OHIO. The People's Rapid Transit Railway Company, which proposes to build from Toledo to Cincinnati, has opened an office in Cincinnati. The company has secured most of the required right of way, and grading has been done. J. Morgan, of Toledo, is president and general manager of the company, and L. J. Weadock, of Toledo, secretary.

EAST LIVERPOOL, OHIO.—An electric railway is projected from East Liverpool to Salem by T. A. Wright, E. W. Mulligan, F. W. Kirby, J. B. Yeager, J. L. Dunn, W. J. Harvey and others, of Wilkesbarre, Pa. Franchises have been asked for in East Liverpool, Lisbon and Salem, and the company offers to start work within ninety days if granted the franchises.

YOUNGSTOWN, OHIO. Several improvements are being made at the power house of the Pennsylvania & Mahoning Valley Railway Company, necessary by the extension of the company's system in Mahoning Avenue and the building of the Struthers line. On July 1 a new boiler was put in operation and a Slater engine and a generator are being installed. The generator will have a capacity of 300-kw. The new engine and generator will be placed in a new addition which is being built on the east side of the power house.

HAMILTON, ONT.—Representatives of the city and the Street Railway Company have come to an agreement regarding a railway service to the International Harvester Company's works. The company undertakes to expend $50,000 in double-tracking the line and in making other improvements.

PITTSTON, PA. Negotiations are being conducted between the officials of West Pittston and the American Trackless Trolley Company, of Boston, Mass., for a trackless trolley line.

KANE, PA. The Kane Electric Street Railway Company has been incorporated to build four miles of electric railway. Capital, $24,000. Thomas S. Cunningham, of Kane, is president.

READING, PA.—Ties, poles and rails have been delivered along the route of the Pottstown & Reading Electric Railway, and the construction of the road will be begun by Smethhurst & Allen, of Philadelphia, the contractors.

NEW CASTLE, PA. The Pennsylvania & Mahoning Valley Railway Company is endeavoring to secure a franchise to extend its local line in order to provide entrance to the center of the city for the Sharon & New Castle Railway.

ALLIANCE, PA. The Alliance & Cherryville Street Railway Company has been incorporated to build 7.83 miles of electric railway in Northampton County, running from Alliance to Cherryville. Capital, $50,000. The president is Jay S. Moyer, of Bethlehem.

BATH, PA. The Bath & Chapman Street Railway Company has been incorporated to build an electric railway 1.2 miles long in Northampton County, from Bath to Chapman Quarries. The capital stock of the company is $12,000. J. S. Moyer, of Bethlehem, is president.

NAZARETH, PA. The Township Line Street Railway Company has been incorporated to build 10½ miles of road in Northampton County, from Nazareth to Christian Springs, thence to Bath, New Centerville and Georgetown. Capital, $65,000. The president is Jay S. Moyer, of Bethlehem.

ALTOONA, PA. The Altoona & Logan Valley Electric Railway Company and the Tyrone Electric Railway Company have been consolidated as the Altoona & Logan Valley Electric Railway Company. The total authorized capital stock of the united companies is $800,000. Both companies were controlled by the American Railways Company.

MEADVILLE, PA.—F. A. Pease, general manager of the Pease Engineering Company, of Cleveland, has just finished surveying a route for an electric railway from Geneva, Ohio, to Meadville, Pa., a distance of almost 50 miles. The proposed line passes by Conneaut Lake, which is a summer resort for residents of Western Pennsylvania. C. W. Goodrich, of Geneva, Ohio, is the promoter of the road.

ALLIANCE, PA.—The Northampton Central Railroad Company has been incorporated to build a 12-mile electric railway in Northampton County, beginning at the borough of Alliance and extending to Bath, and thence to Nazareth. Capital, $120,000. Jay S. Moyer, of Bethlehem, is president, and also of the Alliance & Bath Street Railway Company, incorporated to build 12.2 miles of electric railway in Northampton County, running from Alliance to Bath and Catasuqua. Capital, $75,000.

READING, PA.—Another electric railway is to be built between Birdsboro, Berks County, and Reading, by the Reading & Birdsboro Street Railway Company. It will be a part of the United Traction Company's system, and will start from the terminus of that company's line at Black Bear. From there it will run down the east side of the Schuylkill River, crossing the Big Dam, and go on through Seyfert's, Naomia, Gibraltar and Clingan to Birdsboro. The company is capitalized at $12,000.

JEANNETTE, PA.—An electric railway from Jeannette through Adamsburg, Madison, Arona and other coal mining towns to West Newton has been planned and will be built by Jeannette capital. The length of the line will be 14 miles. It is estimated that the new line is to be in reality a part of the Pittsburg, McKeesport & Connellsville line, and that it will ultimately be connected with the Greensburg & Southern Company's line at Ludwick, west of Greensburg. W. A. Cribbs, of Jeannette, is interested.

DONORA, PA.—The borough council has been asked for a franchise for the Donora & Carroll Street Railway, to traverse the principal streets of Donora as a connecting link between the Castle Shannon and Charleroi line of the Pittsburg Railways Company and numerous towns in the Monongahela Valley. The distance to be covered is five miles, and the capitalization of the company is $150,000. The incorporators of the new road are Bert W. Kastner, William T. Whitledge, William Lewis, Culin Armstrong, James B. Castner, of Donora, and Isaac N. Kibler, of Charleroi.

PITTSBURG, PA.—Interests identified with the Beaver Valley Traction Company, which operates 35 miles of line in Western Pennsylvania, have taken out charters at Harrisburg for two companies that will build 13 miles of electric railway between Aliquippa, Coraopolis and Monaca. The charters are as follows: To the Coraopolis & Aliquippa Electric Street Railway Company, to build five miles of road, capital $30,000; president, William Redwood Wright, of Philadelphia. To the Monaca & Aliquippa Electric Street Railway Company, to build ten miles of road, beginning at Monaca, Beaver County, and extending through the townships of Moon and Hopewell to Aliquippa, capital $60,000; William Redwood Wright, of Philadelphia, president. Tbe directors, all Philadelphians, are W. Frederick Snyder, Sydney L. Wright, William Henry Snyder and Walter T. Bilyue. A. H. Engstron, of Philadelphia, will be in charge of the work.

CORPUS CHRISTI, TEX.—Moling Brothers have applied for a franchise for an electric railway and an electric light plant.

LAREDO, TEX.—The Laredo Electric & Railway Company is about to build a 2¼-mile extension, and plans to add to its power station equipment a new 250-hp engine and a 150-kw alternator.

HOUSTON, TEX.—Engineer H. C. Kehm, of Rowley, Kehm & Johnson, of New York and Chicago, who are promoting the project for an interurban electric railway to Galveston, a distance of 51 miles, says that it is also proposed to build a branch line from Harrisburg to La Porte, Morgan's Point, Seabrook and Alvin.

BEAUMONT, TEX.—The capitalists interested in the construction of an electric railway from Beaumont to Sour Lake, Saratoga and Port Arthur have come to an agreement, the capital has been furnished and work will proceed rapidly. The corporation will be known as the Beaumont, Sour Lake & Port Arthur Traction Company, and will be capitalized at $300,000. The incorporators are D. W. Meeker, George H. Hill, P. R. Norvell, Capt. William Wiess, W. C. Averill, G. W. Carroll, Capt. G. W. O'Brien, R. C. Duff, all of Beaumont; G. M. Craig, of Port Arthur; J. M. Carpenter, of Sour Lake; John B. Linn, of Springfield, Ohio; Hugh E. Smith, of Columbus, and William Abbott Smith, of Columbus. The directors of the company are G. W. Meeker, B. R. Norvell, William Wiess, Capt. G. W. O'Brien and R. C. Duff, of Beaumont; George A. Hill, of Sour Lake; George M. Craig, of Port Arthur; John H. Linn, of Springfield, Ohio; William Abbott Smith, Hugh E. Smith and Theodore Weyant, of Columbus, Ohio. The line will be 52 miles long. The power house will be located in Beaumont and will also furnish power to rice plants and pumping stations along the route as well as light for the towns through which it passes.

CLARKSVILLE, TENN.—Franchises have been granted by the City Council to the Clarksville Electric Street Railway over various streets of the city, with spurs to Dunbar Cave and New Providence.

NASHVILLE, TENN.—Surveyors have been engaged to locate the lines of the Interurban Railway Company from Nashville to Gallatin and from Nashville to Columbia. C. W. Ruth, of Pittsburg, is the principal promoter of the line.

MEMPHIS, TENN.—F. R. Harris, of St. Louis; R. P. Cary, W. A. Buckner, M. M. Bosworth and others have applied for a fifty-year franchise for a new double-track street railway in Memphis, to be known as the City Street Railway, capital stock, $50,000 nominal, and will be made $1,000,000. In consideration for the franchise the petitioners offer the city one per cent. per annum of the gross receipts for the first ten years and two per cent. during the other forty years of the franchise.

GRAHAM, VA.—The contracts for constructing the Bluefield & Hinton Electric Railway from Graham, Va., to Bluefield will be let at once. John Walters is president.

EVERETT, WASH.—The Council of Marysville has granted the Everett Railway & Electric Company's franchise to light the city for a period of fifty years.

SNOHOMISH, WASH.—Local interests are to build an electric railway from Snohomish to Monroe and Cherry Valley, a distance of 15 miles. W. M. Snyder, cashier of the First National Bank, is interested.

WHEELING, W. VA.—The County Commissioners have granted the Wheeling-West Liberty Belt Line Company a franchise to build from Stockyards to Greggsville, with a few spurs and branch lines on the side.

WHEELING, W. VA.—The Nicholas Short Line Railroad, of Charleston, W. Va., has been formed to build a railroad from Belva, W. Va., up Little Elk Creek to its headwaters; capital, $100,000. Incorporators, C. C. Sharp, Gauley Bridge, W. Va.; Peter Carroll, W. E. Chilton, J. E. Chilton, T. S. Clark, Charleston, W. Va.

MADISON, WIS.—The Interstate Electric Railway has been incorporated to build an electric railway from Madison to a point on the Wisconsin-Illinois State line in the southeastern part of Green County about 50 miles. The company is incorporated with a capital stock of $50,000, by Charles E. Bross, of Madison, N. F. Thompson, M. A. Beal, F. H. Keeler and H. N. Starr, of Rockford.

SHEBOYGAN, WIS.—The Sheboygan Light, Power & Railway Company has secured $2,500,000 from the Mercantile Trust Company, of New York, to build an extension of 30 miles to Port Washington. The loan was secured by consolidated first mortgage five per cent. thirty year gold bonds, retiring the present indebtedness of $100,000. The entire plant will be equipped with modern appliances.

NEW INDUSTRIAL COMPANIES.

PITTSBURG, PA.—The Pittsburg Electric Manufacturing & Engineering Company has been incorporated under the laws of New Jersey; capital $60,000. Incorporators: J. S. Cole, H. A. Cox, Henry C. Evert, Albert H. Moeser.

THE EMPIRE ELECTRIC SUPPLY COMPANY, of Chicago, has been incorporated with a capital stock of $10,000. The incorporators are Charles W. Farr, Arpad M. Barethy and Charles L. Hibbard. It is the purpose of the company to manufacture and deal in electrical devices.

THE MILLER ANCHOR COMPANY, Norwalk, Ohio, has been incorporated for $20,000. The officers will be Mr. G. H. Miller, president; A. E. Rowley, secretary. The reason for incorporating are to put more money behind the concern and do a larger manufacturing business. Their anchors have been upon the market now a little over one year and have met with great success with some of the largest companies in the United States.

LEGAL.

BLACK LIST LAWFUL.—At St. Louis, on August 17, Judge Rogers, in the United States Circuit Court, refused to issue a restraining order against the Western Union Telegraph Company on the application of the Commercial Telegraphers' Union of America, or to interfere in any way. The decision grows out of charges of blacklisting. The suit was brought to prevent the Western Union from discharging employees because of their connection with the union. The opinion holds that the telegraph company has the absolute right to dismiss employees because they belong to the union or for any other reason; that there can be no conspiracy to do a lawful act; and that the so-called "black list," composed of the names of discharged employees, may be maintained and given out for the use of others.

TELEPHONE AND TROLLEY WIRES.—The American Telephone & Telegraph Company gets somewhat the better of the fight with the Cincinnati & Columbus Traction Company over the right of way on the route between Milford and New Boston. The traction company some days ago began putting up its line of wires within a few feet of the wires of the American Company, so close that it was claimed the induction from the high tension trolley currents would ruin the telephone and telegraph lines. It was on this account that the American Company appealed for an injunction. The judge granted it after hearing affidavits from a number of persons. The injunction prohibits the Cincinnati & Columbus Company from interfering in any way with the lines of the plaintiff on the Cahoon tract until the Cincinnati & Columbus Company has granted a permanent right of way to the plaintiff in lieu of the present right of way. And the Cincinnati & Columbus Company is also enjoined from constructing a trolley line parallel to the telephone lines except at a distance of twenty feet or more.

TELEPHONE RIGHT OF WAY.—The Supreme Court of Georgia in reversing a judgment for defendants in the suit of the Southern Bell Telephone Company against M. C. Harris et al. held that, 1. Where one enters into a written contract granting to a telephone and telegraph company the right to construct lines of telephone and telegraph over property which he owns or in which he has an interest, it is error, in a suit brought by the company to enforce the contract to admit parol evidence showing that it was the understanding of the parties, when the contract was entered into, that the contemplated line of telephone and telegraph was to be erected along a specified portion of property owned by the other party to the contract. 2. Where a contract contains a recital of the payment of one dollar as its consideration, the contract is valid, though the sum named was not actually paid. It creates an obligation to pay that sum, which can be enforced by the other party. 3. In a suit brought by the telephone and telegraph company to enforce a contract of the nature indicated in the first headnote, it is not competent for the other party to set up as a reason for its nonenforcement that he was not the sole owner of the property, his alleged co-owners not being parties, and raising no objection.

CHICAGO TRACTION FIGHT.—Two bills have been filed in the Superior Court asking that receivers be appointed for the North and West Chicago Street Railway Companies, the underlying corporations of the Chicago Union Traction Company. It is asserted that this move is merely a precautionary one to protect the bondholders in certain proceedings, should they arise. A bill for an injunction will probably be filed in a few days by Levy Mayer, who is acting for the objecting stockholders of the two underlying companies, seeking to restrain the officers of the said companies from perfecting at the stockholders' meeting to be held, the changes in the contract relations between the Union Traction and the West and North Chicago Street Railway Companies contemplated in the proposed plan of the reorganization. It is contended on the one hand that a vote of a majority of the stockholders of the two underlying companies is sufficient to ratify the new agreement, whereas on the other hand, the contention is made that as the new plan contemplates a change in the contracts, it is necessary to secure the unanimous consent of the stockholders, as each one has a vested interest in the contract, which cannot be lost without his consent.

TROLLEY TRANSFER TIME LIMIT.—The Supreme Court of Maryland has held, in the case of Garrison vs. United Railways & Electric Company, that a statute of the State requiring the street car company of Baltimore City to give, on request, to each passenger paying a cash fare a transfer for a "continuous" ride does not prohibit the company from limiting the time within which a transfer can be used. It was further held that when the time limit of a transfer issued by a street railway has expired the transfer is void on its face, and a conductor is justified in refusing to honor it, and in demanding a fare. It was also decided that when a conductor has given a passenger a reasonable time and opportunity to pay his fare and the passenger has refused, and the conductor has commenced the process of ejecting the passenger, the ejection may be completed, even though a fare be tendered, as the passenger has forfeited his rights as such. The court said that "in the nature of the case, regard being had to the character and magnitude of the business of conveying on street cars hundreds of thousands of passengers, it would seem to be a very proper precaution for the company to protect itself against imposition by affixing to the transfers which it is required to issue a limit beyond which they should not be available for use."

OBITUARY.

MR. GEORGE B. STRONG for several years manager of the Postal Telegraph Company's office in Saratoga, died last week. He was attached to the 109th Regiment, New York Volunteer Infantry, during the Civil War.

COL. M. W. OFFUTT.—Col. Milton W. Offutt, vice-president of the Electric Light & Power Company, of Baltimore, and a leading Maryland Democrat, died at his home in Towson, Md., last week. He was 44 years old, and interested in many enterprises. He was president of the Maryland Biscuit Company and a director in the Towson Bank.

PERSONAL.

MR. J. M. ANDERSON, treasurer of the Albert & J. M. Anderson Manufacturing Company, of Boston, has returned from a short trip to Europe.

MR. GEORGE R. BABCOCK has been made superintendent of fire alarms and police telegraphs at Oakland, Cal., in place of Mr. L. E. Flemming.

MR. JAMES ROSS.—Owing to the differences between the directorate of the Dominion Iron & Steel and the Dominion Coal Companies, Mr. James Ross, the street railway capitalist, has resigned as president and director of the former company.

THE HON. ALBERT WARE PAINE, of Bangor, Me., who has just passed his ninety-first birthday, is still in the active practice of his profession, the law. He is president of the Maine Telegraph Company. He has voted at every Presidential election but one since he came of age, when President Zachary Taylor was elected.

COL. JAMES ALLEN, U. S. Signal Corps, has arrived at Seattle, to assume general charge of the laying of the Seattle-Sitka submarine cable. The Sitka-Juneau section will be laid first, and then they will begin at Sitka to lay the long section to Seattle. The cable has been taken out by the *Texan* and will be laid by the *Burnside*.

MR. C. L. HIBBARD, who for the past few years has been Chicago representative of the Varley Duplex Magnet Company, has tendered his resignation, to take effect Sept. 1st. Mr. Hibbard will take charge of a new company which will manufacture and handle several electrical specialties. The Chicago office of the Varley Company will temporarily be in charge of Mr. William Balke, who for the past five years has been chief inspector at the Varley factory.

MR. GEORGE STUART LANE, until recently of the General Electric Company's Schenectady staff, has been engaged by the export house of Beeche Duval & Co., Broad Exchange Building, New York, to proceed to Chili for the purpose of taking charge of a new department which that firm is to establish for the handling of electrical equipment, machine tools, etc., for sale on the West Coast of South America. Mr. Lane's headquarters will be at Valparaiso.

MR. MARCONI is a passenger on the Cunard Line Steamship *Lucania*, which sailed for New York on August 22. During the voyage across the Atlantic he intends to make important experiments in wireless telegraphy, for which apparatus has been specially fitted to the masts of the vessel. These experiments will be made with the object of ascertaining the actual power required to send messages certain distances on moving stations. Mr. Marconi expresses confidence in the development of his system and satisfaction with the present results.

MR. THOMAS ESPY, of Kenton, Ohio, who has been superintendent of the electric light plant at Waukesha, Wis., has accepted the superintendency of the Consolidated Gas & Electric Lighting Company's plant at Tiffin, Ohio, owned by the Kerlin Bros., capitalists of Toledo. They also own the plant at Waukesha and several others. Mr. Charles B. Evey, who was formerly chief engineer of the Kenton Gas & Electric Company's plant and who has been working in Columbus for some time, has been called to take the position of chief engineer of the plant at Tiffin.

MR. FREDERICK LEWIS has been appointed superintendent of the Rockingham County Light & Power Company at Portsmouth, N. H. D. F. Burritt, whom he succeeds is, it is understood, going to Springfield to take a position there. Mr. Lewis is a native of Haverhill, Mass., and married there also. After graduating from the Mass. Institute of Technology he took a position with the United Illuminating Company of New Haven. He was connected with that corporation for fourteen years. For the last three years he has been the general manager of the General Gas, Electric & Power Company, of Connersville, Ind.

ANDREWS-BEECHER.- The engagement is announced of Miss Helen Horton Beecher, of Ballston Spa., a daughter of the late George Beecher and a niece of Judge James L. Scott, of Saratoga, to Major James Madison Andrews, Jr., of the Second Regiment National Guard and assistant general manager of the selling department of the General Electric Company, at Schenectady. Major Andrews is the son of Capt. and Mrs. James M. Andrews, whose town house is at 48 West Fifty-seventh Street, New York, and a nephew of William D. Ellis, for many years president of the Ellis Locomotive Works, the largest property absorbed by the American Locomotive Company.

MR. C. J. GLIDDEN.—Post cards have been received in London and Boston as to the arctic automobile trip of this daring telephonist and his wife. One of the most recent, dated Sundesvall, August 10, says he reached there the second day out from Stockholm, going north. He had done 190 miles in eight hours without any delays, and got a great reception on the roads from people who had never seen an automobile before, but some were very much frightened and ran away on the approach of the machine. On the first day out from Stockholm he experienced very bad roads, but the last three-quarters of the journey were better, though not what could be called good. He adds that the hotels were excellent everywhere.

MR. JAMES CORR AND MR. W. C. GOULD, electricians for the New Omaha Thomson-Houston Electric Light Company at Omaha, on July 27 had what might have proved very serious accidents. While making some changes in the switchboard connections Mr. Corr accidentally grasped a 5,000-volt lead with both hands. While the wire was well insulated the pressure held him fast for an instant, severely burning several fingers of both hands. Fortunately he was able to kick from under him a scaffolding upon which he was standing in time to release his grasp and thus save his life. Within an hour of this accident Mr. Gould was severely burned on one of his limbs by coming into too close contact between a 5,000-volt lead to a transformer and a grounded iron bar in the building, thus forming a grounded circuit through his body. Both men are again at their work after being incapacitated some days.

EDUCATIONAL.

DREXEL INSTITUTE, Philadelphia, has issued an announcement of the school of Mechanical and Electrical Engineering. While engineering study at Drexel Institute is nearly as old as the Institution itself, a new plan of organization particularly adapts the courses to the requirements of young men who, after completing high school or equivalent education, have gone directly into commercial engineering work only to find themselves handicapped by lack of adequate technical training. The deficiencies which such men have may be made up in these courses with the least expenditure of time and money. These special two year courses aim to be as thorough and comprehensive as the more usual ones occupying four years. They are only completed in the shorter time because the practical experience of the student in mechanical drafting and in shop methods, if sufficient, takes the place of similar work in a four year curriculum; and because a greater maturity and a larger outlook enable him to advance both more rapidly and more surely. The moderate expenditure required for tuition and books opens the door to a large number who could not consider courses of the more usual kind. Full details are given in the "School of Engineering" circular which may be had on application to the Institute.

Trade Notes.

ELECTRIC EFFECTS AT LUNA PARK. One of the most brilliant illuminating spectacles in and around New York is the exhibition of incandescent electric lighting at Luna Park, Coney Island. Lamps in all combinations of shape and design and with colored effects make a harmonious and not too dazzling display. In the decorative work have been used a large number of the Norbitt temporary sockets made by the Crouse-Hinds Electric Company, of Syracuse, the sale taking place through its New York representative, Mr. F. M. Hawkins.

SAWYER-MAN SUPPLY DEPOTS.—To facilitate the prompt filling of orders, the Sawyer-Man Electric Company has recently established a distribution depot at the Central Stores of the Terminal Warehouse, in West 28th Street, New York. Here are kept over a million lamps in stock, so that any and all calls may be speedily and completely answered. A similar depot is situated at 30th and Market Streets, Philadelphia, and others in Boston, Buffalo, Syracuse, Pittsburg, Charlotte, Chicago, Denver, St. Louis, Atlanta, New Orleans, San Francisco, Seattle and other centers of trade.

INCANDESCENT LAMP ADVERTISING.—Writers of advertising matter in any branch of trade will find much to interest them in a series of six handsome booklets issued by the Buckeye Electric Company, Cleveland, Ohio, having for an object to set forth the merits of the Buckeye incandescent lamp. As examples of the art of effective advertising this series is instructive in plan, matter and mechanical execution. The first of the series deals with the filament, and the succeeding ones with the mount, sealing in, exhausting, photometry and final inspection. A couple of well-executed engravings in each case illustrate the text, which is short and directly to the point. In mechanical execution the booklets are of surprising excellence. The cover designs are of real artistic merit, the subject of the booklet being taken in each case for a "motif." In each booklet the subject of the following one is announced, and the advertising matter is confined to the sentence "Better buy Buckeye" on the back cover, and the following sentence isolated in the text: "If you read all of our series of booklets you will know something of lamp manufacture and its difficulties, and why a good lamp is cheapest to buy."

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 18, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

12,148. METHOD OF DETERMINING THE DIRECTION OF SPACE TELEGRAPH SIGNALS; John S. Stone, Boston, Mass. App. filed Dec. 16, 1902. The direction whence the received waves come is determined by receiving the waves in a number of conductors or parts of conductors, in conveying the oscillations produced therein to a translating device and in changing the positions of the conductors relatively to the direction of motion of the waves till a position is found in which the combined effect upon the translating device of the several oscillations is zero.

736,345. ELECTRIC RAILWAY SIGNAL; Henry A. Ammann and Albert D. Campbell, Spokane, Wash. App. filed Nov. 19, 1902. The invention relates to the details of construction of a circuit closer to be attached to the trolley wire and actuated by the passing trolley wheel.

736,351. ELECTRIC CABLE; Karl T. Bennet, Helsingborg, and Johan T. Johansson, Stockholm, Sweden. App. filed Oct. 25, 1901. The wires of a cable are arranged at the four corners of a square and held apart by sets of spacing blocks interlaced between them.

736,362. DYNAMO ELECTRIC MACHINERY; Henry Chitty, South Norwood, Eng. App. filed Nov. 14, 1902. Relates to the ventilating passages of the machine, those formed in the field magnet cores being in line with those in the armature core.

736,390. SECONDARY BATTERY; George E. Hatch, Quincy, Mass. App. filed July 14, 1899. A storage battery in which rigid supports are used for the active material of the positive pole electrodes only; the active surface of the other plates is directly exposed to the action of the electrolyte.

736,393. MEANS FOR CONTROLLING ELECTRIC OPERATING APPARATUS; Karl Hertwig, Frankfort-on-the-Main, Germany. App. filed Dec. 27, 1902. A push button system for electric elevators in which the operation of any button will cause the others to be locked and rendered inoperative to move the car.

736,417. ARMATURE COIL; Frank A. Merrick, Johnstown, Pa. App. filed Feb. 19, 1901. The invention relates to the manner of disposing of the ends of the coils at the head of the armature so that they will occupy but little space.

736,420. SECONDARY BATTERY; Joseph Middleby, Jr., Malden, Mass. App. filed Nov. 22, 1899. Details of construction of a zinc-lead storage battery with porous separators between the plates.

736,432. APPARATUS FOR ASCERTAINING POSITION RELATIVE TO A PREARRANGED GUIDING SYSTEM; Robert B. Owens, Montreal, Canada. App. filed March 11, 1902. A submerged electric conductor is located along the course to be followed by a vessel, a shore circuit supplies the conductor with a current which creates a magnetic field within which the vessel moves, and a double-coil indicating device carried by the vessel is effected by this field in a manner to show the vessel's position with respect to the submerged conductor.

736,447. ELECTRIC SWITCH; William M Scott, Philadelphia, Pa. App. filed July 19, 1902. Details.

736,461. ELECTRIC MOTOR AND BRAKE; Alfred A. Thresher, Dayton, O. App. filed June 17, 1903. A magnetically released friction brake for the armature shaft is located between the armature and one of the heads of the casing.

736,476. ELECTRICALLY CONTROLLING MOTORS FROM A DISTANCE; William Baxter, Jr., Jersey City, N. J. App. filed April 24, 1901. A system of control including the usual motor switches, rheostats, etc., for starting, stopping and reversing, an electro-magnetic device which actuates the controller and an operating switch located at a distance from the latter and adapted to control its movement.

736,483. TELEGRAPHIC TRANSMITTING AND RECEIVING APPARATUS; Georg F. R. Blochmann, Kiel, Germany. App. filed June 7, 1901. The transmitter is contained in a box having walls opaque to the emitted waves, and the source of such waves is placed at the focus of a lens in the wall of the box and capable of refracting the rays. The receiving devices are located in a similar box having a similar lens which concentrates the rays at a particular point.

736,490. ELECTRIC DAMPER REGULATOR; Albert M. Butz, Oakpark, Ill. App. filed Feb. 24, 1902. Details.

[illegible] CONTROLLER FOR ELECTRIC MOTORS; William H. Chapman, Portland, Me. App. filed [illegible]. A device for controlling electric motors consisting of a series of contact segments and a [illegible] contact [illegible] over the segments, the end segments of the [illegible] being connected respectively with the positive and negative [illegible] of [illegible]. With this arrangement the motor may be started in either direction gradually or stopped suddenly.

[illegible] CIRCUIT BREAKER; Thomas J. Douglas, Jr., Provo, Utah. App. filed [illegible]. A switch consisting of a long wooden handle having a metal hook at its extremity adapted to be hooked over an overhead line conductor; a flexible circuit leads from the hook.

[illegible] ELECTRIC FURNACE OR OVEN; August Eimer, New York, N. Y. App. filed May [illegible], 1903. (See page 346.)

[illegible] ELECTRIC TRIP MECHANISM; Charles C. Ely and Adolph [illegible], Kansas City, Mo. App. filed Oct. 9, 1902. A weight released by an electromagnet falls and moves a valve.

[illegible] ELECTRIC SYSTEM OF TRANSMISSION; Robert A. Ripley, Stamford, Conn. App. filed June 13, 1902. Electrical transmission over a line which is neither grounded nor connected so as to form a complete circuit. A capacity is connected to each end of the line and electrical disturbances created at either end are received by a suitable receiving apparatus at the opposite end of the line.

[illegible] RAILWAY SIGNAL; John G. Schreuder, Edgewood, Pa. App. filed Sept. [illegible], 1902. Details.

[illegible] LAMP SOCKET; Walter A. Chinnock, Binghamton, N. Y. App. filed Dec. 6, 1902. Details.

[illegible] PROCESS OF ZINCING OBJECTS BY ELECTROLYSIS; Ignaz Szirmay, Budapest, Austria-Hungary. App. filed Nov. 17, 1900. (See page 346.)

736,587. SYSTEM OF ELECTRIC MOTOR CONTROL; Gano S. Dunn and Edwin R. Douglass, East Orange, N. J. App. filed July 2, 1903. An arithmetical multiple-voltage system is combined with a secondary system of motor regulation so as to give a series of motor speeds intermediate of the speeds at successive voltage positions, which intermediate speeds have a uniform percentage difference between successive speeds.

736,598. CUT OUT; Wallis M. Hall and Wilson K. Eldridge, Waterbury, Conn. App. filed Feb. 5, 1903. Relates to the mounting of the terminals on the base block.

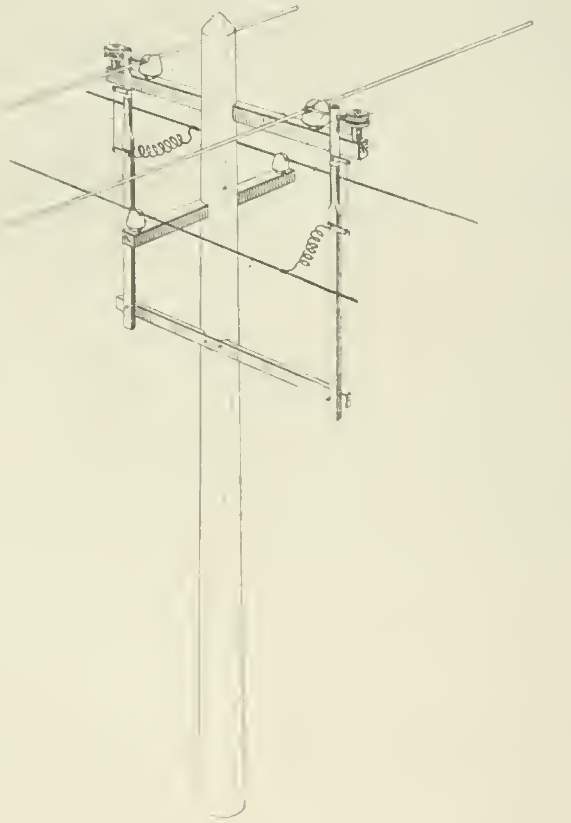
736,608. BRAKE APPARATUS FOR ELECTRIC RAILWAY OR TRAMWAY VEHICLES; Johan G. V. Lang, London, England. App. filed Feb. 17, 1903. According to this invention the automatic retarding function of a regenerative motor is supplemented by mechanical or other self-acting power brakes and these two braking systems are so arranged that upon any failure of the braking function of the primary electric equipment, it would be automatically replaced by the mechanical braking system.

736,610. TROLLEY; Louis Lavagne and Louis Bertrand, Marseilles, France. App. filed Feb. 21, 1903. A trolley guard intended to prevent the wheel from leaving the wire and arranged to tilt backward when an obstruction is encountered.

736,611. PROCESS OF EXTRACTING ZINC FROM ITS ORES; Carl Gustav Patrik De Laval, Stockholm, Sweden. App. filed Nov. 15, 1900. (See page 346.)

736,616. INDICATOR ATTACHMENT FOR BELLS; Charles E. Monroe, New York, N. Y. App. filed Jan. 5, 1903. Details of an annunciator which is secured to the bell hammer and changes its position whenever the bell rings to indicate the fact that the bell has been operated.

736,641. TROLLEY; Thomas P. Seastrunk and James P. Archer, Dallas, Texas. App. filed Jan. 14, 1903. A device permitting the wheel to swing or tilt in passing around curves.



736,50[illegible]. Circuit Breaker.

736,667. MULTIVOLTAGE SYSTEM; Clinton F. Woods, Chicago, Ill. App. filed June 12, 1902. A multivoltage system including a storage battery with the generator and means for subjecting the armatures and field windings of various motors to the several potentials of the system.

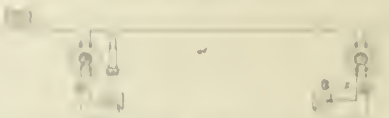
736,669. METHOD OF CLEANING FILTERS; Theodore J. Zoeller, Nashville, Tenn. App. filed [illegible]. A current of [illegible] is passed through the filtering [illegible] of [illegible] water to [illegible].

[illegible] TUBE; Cooper Hewitt, Brooklyn, N. Y. App. filed May [illegible], 1903. A compound tube within the lower of which a resistance coil is embedded for protection and insulation.

[illegible] CIRCUIT BREAKER FOR JUMP SPARK COILS; Arthur H. [illegible], Franklin, Ind. App. filed April 13, 1903. A vibrator in which the armature strikes a hammer blow on a spring carrying one of the contacts and thus ensures a separation at each movement.

[illegible] TROLLEY; [illegible] Hall, Whitestone, N. Y. App. filed May [illegible], 1903. Details of a trolley wheel guard.

[illegible] ELECTRIC RAILWAY SYSTEM; Timothy Mahoney, San Francisco, Cal. App. filed Feb. [illegible], 1903. A circuit closer for surface contact systems consisting of a hermetically sealed casing having a pivoted bar therein which is swung on its axis by a magnet carried by the car to close and open the circuit between the feeder and contact button or rail.

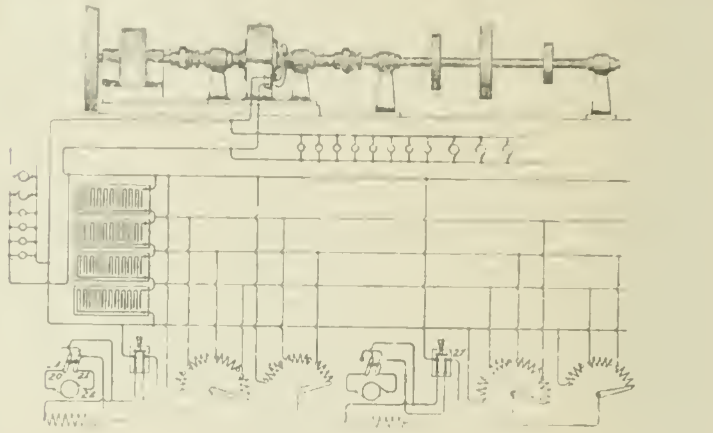


[illegible] Electric System of Transmission.

[illegible] ELECTRIC FIRE ALARM; George B. Martin, Zanesville, Ohio. App. filed May [illegible], 1903. The heat of a conflagration melts a fuse plug and permits a weight to fall into a pan on one end of a balanced lever, which then swings and closes an alarm circuit.

736,789. ELECTROMAGNETIC FRICTION CLUTCH; Wenzel Schuster and Heinrich Alt, Vienna, Austria-Hungary. App. filed July 10, 1902. The mechanical friction is created between two non-magnetic surfaces which do not permit the magnetic surfaces to come into contact with each other and thus "stick."

736,794. APPARATUS FOR CONTROLLING THE WORKING OF ELECTRICALLY DRIVEN CARS; Alexander Siemens, Milford, England. App. filed Feb. 10, 1902. A rotary controlling cylinder operates or is operated by an electrically controlled three-position armature mounted on the controller shaft; the train circuit comprises relay switches having two definite positions; circuits and resistances all controlled by these switches and connected by them to the controller. The operations in passing from one stage to another is automatically performed by means of the resistance switches.



736,667. Multivoltage System.

736,816. SYSTEM OF TRAIN CONTROL; Frank E. Case, Schenectady, N. Y. App. filed Feb. 28, 1898. One of the earlier systems of multiple unit control and comprising a master controller having power, reversing and brake switches, motor controllers having power reversing and brake switches, and mechanism under the control of the master controller for regulating the action of the motor controllers.

736,817. ELECTRIC BRAKE; Frank E. Case, Schenectady, N. Y. App. filed Dec. 17, 1898. In a system where the motors are used as generators to supply current for operating brake shoes, an auxiliary source of current is used to increase the current supplied to the shoes as the current generated by the motors decreases with the decrease of momentum.

736,868. PROCESS OF DECOMPOSING WATER BY ELECTROLYSIS; William F. Mason McCarty, Rockyridge, Md. App. filed April 22, 1902. For the production of oxygen and hydrogen by the electrolysis of water, he adds to the water one pound of an alkali salt to each 1,000 pounds of water and an acid in the proportion of 1 of acid to 500 of water.

736,884. ART OF ELECTRIC SIGNALING; Harry Shoemaker and Homer C. Snock, Philadelphia, Pa. App. filed April 8, 1903. A method of increasing the frequency of an undulatory current to an extent to make the high-frequency energy available for use in a wireless telegraph system.

736,897. TROLLEY CATCH; Morris C. White and Otho C. Duryea, Los Angeles, Cal. App. filed July 5, 1902. A spring-drum, pawl and ratchet are attached to the trolley pole and tripped by an electro magnet in the trolley circuit to thereby lock the cord and prevent the trolley from rising.

736,910. FIELD WINDING FOR ELECTRIC MACHINES; Emil Ziehl, Berlin, Germany. App. filed Jan. 12, 1903. The reaction of the armature on the field magnet is neutralized by winding the field with the three circuits of a three-phase system, one of which furnishes the regular field excitation while the other two oppose the effects of armature reaction.

736,913. METHOD OF DISRUPTING ARCS; Frank E. Case, Schenectady, N. Y. App. filed Feb. 28, 1898. The arc is drawn laterally between the contacts and through a magnetic field, and then expanded in the direction of movement of the contacts until it is disrupted.

736,914. METHOD OF OPERATING ELECTRIC BRAKES; Frank E. Case, Schenectady, N. Y. App. filed Dec. 17, 1898. This method is carried out with the apparatus described in the companion patent No. 736,817.

736,917. ELECTRICAL SECTIONAL FURNACE; August Eimer, New York, N. Y. App. filed May 28, 1903. (See page 346.)

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THE SARATOGA CONVENTION.

Although this is an early and, in many respects, inconvenient season of the year for street railway men to get together, the meeting of the American Street Railway Association at Saratoga Springs during the current week has been a far greater success than those interested dared hope. After all, there are advantages in holding a convention, sometimes, away from the distractions of a great city; and as this is the end of the Saratoga season, when the racing is all over and the fashionable crowd has flitted, the street railway men have been able to stick to business, with little to tempt them away. Hence, while the attendance has been large, and the exhibition of apparatus well up to the standard, the papers and discussions have been quite superior to the average.

It will be interesting to note in the future how far the division of the convention work between three bodies meeting at or about the same time, affects the relative importance of each. While we do not believe that the standing and influence of the parent national body will suffer in any way, it does seem to us that the work of the new engineering body will steadily gain in recognition and put it on a high plane. The technique of the art is, indeed, one of its most vital considerations, and we are glad to see the mechanical and electrical association—to use only part of its long name—start out so seriously and effectively to make a record for itself. Indeed, the excellence of such work must prove a stimulus to the ambition of the other bodies, and these in turn by their wise dealing with the broad topics of the industry, and with its finances, will help impress on the electrical engineers and the master mechanics the value and significance of every attempt to improve or standardize methods and materials. No branch of the industry can stand alone; all are of the greatest importance for its development; and the annual convention with its free and frank discussion of problems and difficulties is the best way known as a supplement to the publicity of the press in securing an equable advance all along the line.

◆

STATISTICS OF THE AMERICAN ELECTRIC LIGHT INDUSTRY.

There is a satisfactory substantiality in statistics that appeals to the argumentative mind, especially when the statistics and the arguments are on one and the same side. But woe betide the inferences that rest upon the sands of incorrect or imperfect statistics. It is the first duty of all good statistics to be impartial, and the second duty to be complete, and not fragmentary. We published recently, at page 212, the summary of an important series of statistics issued in a preliminary report from the United States Census Office, concerning the electric light and power central station industry in the United States. These are certainly the most complete and trustworthy data that have yet been published on the status of that industry, and as such we have already commented on them. They convey, moreover, a number of inferences on the subject of municipal electric lighting that are more valuable than all the tirades which have been launched on either side of this much-vexed question. They show that nearly one plant in four (22.5 per cent) of all the lighting plants (excluding isolated plants) in the United States, is a municipal plant. But whereas the average cost of a private plant is about $170,000, the average cost of a municipal plant is $27,000. This means that the average private plant is about six times as large as the average municipal plant, and also that whereas the number of municipal plants is 22.5 per cent of the total, the cost of municipal plants is only 4.4 per cent of the total cost.

In regard to gross income, the data show that the private plants average 16.3 per cent on their cost, and the municipals average 31.6. In this respect the municipals give apparently nearly double the return of the privates, per dollar invested. In total expense of operation the privates show an average of 13 per cent on their cost, and 65 per cent of their gross income, while the municipals show an average of 24 per cent on their cost, and 68 per cent of their gross income. Consequently, in regard to investment, the municipals are nearly twice as expensive as the privates; but in regard to gross income, the relative expense of operation is much the same. The wages per horse-power of installed plant comes out very nearly the same for both types, being nearly $12 per horse-power per annum. This indicates that the cost in wages of municipal plants is sensibly the same as that of private plants. The cost of supplies for local companies is about $12.50 per horse-power per annum, and for the municipals about $15.30, indicating that the municipal plants are, relatively, decidedly more expensive in materials. This, however, may be explained, at least in part, by the small average size of the municipal dynamos, which is 83.5 hp; while the average size of the private dynamos is nearly twice as large, or 137 hp. The items of taxes and building rent are relatively too low for the municipal plants, and indicates that the costs both of installation and of operation are somewhat unduly magnified in private plants, owing to their having to carry the full burden of these items, from which the municipals are represented as almost exempt. It is not fair to charge taxes against private plants and to charge no taxes against municipals.

The municipal plants carry about 13 per cent of the total arc lamps, and about 9 per cent of the total incandescent lamps, showing that municipal arc-lighting is distinctly more in vogue than municipal incandescent lighting. The total horse-power in municipal dynamos is just about 10 per cent of the total horse-power in private dynamos. This is probably the fairest basis of comparison between the two types of plants. The private plants work their dynamos distinctly harder, averaging 5.6 hours daily per kilowatt of generated capacity, against 4.75 for the municipals. This is perhaps accounted for by the greater share of short-hour arc-lighting carried on by the municipals. The latter virtually operate their machines under full load for one hour daily less than the privates.

The average salary to officials and clerks is $860 per annum for private plants, and $482 per annum for municipals. This means that the average private central station officer is nearly twice as highly paid as the average municipal officer. As regards wages to workingmen, the comparison is more nearly uniform, being $650 per annum for private plants and $575 per annum for municipals. Assuming that the statements filed with the Census Office are reliable, they explode the theory that municipal plants are always operated more extravagantly than private central stations; but the trouble lies in the vagueness of municipal figuring. So far as wages are concerned, the reverse appears to be the case. The figures indicate that the average municipal plant is, in general, a comparatively small arc-lighting plant, operated without extravagance, under the watchful eyes of a small community. Each dollar expended in labor produces 120 kw.-hours per annum from the private plants and 104 kw.-hours per annum from the municipal plants. This is not a very large disparity, especially if the relative sizes of plants be considered. Considered in another way, it also means that the cost of wages and superintendence in both types of plants is not far from one cent per kw hour (0.85 cent). At this rate we may reasonably expect municipal plants to increase both in number and in size, but, of course, the risk involved in their mismanagement increases as they become larger and occupy a more important place in municipal affairs. Moreover, it is mainly in large cities that the danger of mismanagement through political influences is greatest. A single year of mismanagement of any mechanical plant may well bring about disastrous results in the way of depreciation and destruction.

In theory, it is a matter of very little consequence whether the electric lighting of a community be conducted by a select few of their body under the title of a corporation, or by the same men under the badge of that larger corporation called a municipality. Incidentally and practically, however, the difference is apt to be considerable. The adoption of a certain line of industry by a government or municipality is apt to be subversive of competition, and of the improvements which competition develops. On the other hand, there are possibilities for economy when the governing body operates a large business, which the ordinary corporation does not possess. Again, the modern municipal lighting plant, if it does other than plain arc lighting, calls for the exercise of considerable technical skill, and political methods may be fatal to the selection of men adequate to the task. For these reasons the question of municipal electric lighting is one of the most interesting sociological questions of the day. The census data show that the municipal plants employ 10.7 per cent of all the steam power used in central station lighting, but only 3 per cent of all the water-power so used. This may mean that municipalities have not yet seriously undertaken the transmission of water power. Of constant potential dynamos expressed in kilowatt capacity, both alternating and direct, the municipal plants have 8 per cent, while of the constant-current dynamos they have 19.3 per cent, a disparity which again indicates the tendency towards the easier and limited arc-lighting in existing municipal central stations.

Wireless Telegraphy in its National Aspect.

We are pleased to be able to record that all reports of the naval and military manœuvers indicate that wireless telegraphy has proved a most successful arm of the information service. Last year, as our readers will remember, the wireless service played no part in the operations, and the attempts made to utilize it to a certain extent were abject failures. It is most gratifying to record the present improvement in the situation, both as evidence of the growth in the art and as proof that the naval and military authorities have finally awakened to the necessity of keeping up with the times. With the enormous extent of coast line to be guarded, the value of wireless telegraphy to the United States is, or ought to be, exceptionally great, but, as usual, the procrastination bureau is just a few laps behind in the race and has done this year what it should have done year before last. Every improvement in the material of war has been taken up here long after its importance has been acknowledged elsewhere, and thus wireless telegraphy is in nowise exceptionally treated. We hope that the advent of General Staff methods will result in greater promptness in taking up various improvements, and in particular that the wireless service will be systematically developed, not only for coast guard work, but for general communication between military and naval posts. This latter use might conceivably be of enormous importance. It is utterly absurd for the military communications of the government in time of need to be dependent entirely on the overhead wires of private corporations, even temporarily. However loyally such corporations may subordinate their service to government necessities, the mere chance of fatal interruption of wires is reason enough for an independent system of communications.

If the government is to take up wireless telegraphy as it should for the purposes of national defense, it is absolutely necessary that it should be possible to prevent casual or wilful interference with government messages. If this end can be reached by some method of working we do not see anything feasible, save governmental control of the whole wireless situation. The recent conference abroad looking to international regulation of wireless telegraphy was a very necessary step, and unless the rival systems can or will abstain from interfering with each other they will undoubtedly feel the heavy hand of the government in a way that will be distinctly unpleasant. In short, the syntonic bluff is in a fair way to be called. The possibility of non-interference has been loudly and insistently proclaimed by the advocates of all the wireless systems; it has been attested by engineers who ought to know the facts, and yet when put to the test of trial interference seems to be painfully in evidence. If it can be effectively suppressed it is "up to" the wireless gentlemen to suppress it without further delay. If it cannot be suppressed then the necessities of national defense, in this country and elsewhere, will compel united action to preserve the integrity of the military and naval communications. We believe that this question of interference is of so fundamental commercial importance, so far transcending all the other problems in hand, that until it is settled wireless telegraphy will make very slow progress. It is of no particular importance to establish a trans-Atlantic service if it is to result in crippling coastwise service, or is to be demoralized by any rival experimenter who sets up shop within a few hundred miles of the termini. Long-distance wireless telegraphy is indeed a splendid achievement, but it is fruitless unless serviceable all day and every day, and free from accidental or malicious interference. And to comment on another phase of the wireless telegraph situation, it is indeed a pity that one of the finest discoveries of the age has become, through the manner in which it is exploited commercially and the utterly undignified squabbles to which it gives rise, a subject with which the public is getting heartily disgusted.

MAGNETIC FLUX SIFTERS.

An interesting principle in rotary field alternating current transformers as applied by M. Maurice Leblanc to the problem of current rectification is described in a recent issue. The fundamental problems may be stated under various forms. Thus, given an alternating-current e.m.f. of an irregular, or complex-harmonic type, it is required to transform it into an e.m.f. of the simple harmonic type. Or, required a transformer which when supplied with a complicated wave of alternating e.m.f. at its primary terminals, shall deliver a simple alternating wave of e.m.f. at its secondary terminals. Or, required a transformer which shall sift out harmonics from the current it delivers. The simple alternating-current wave is the type to which designers of alternating-current machinery tend to follow. It is not only the simplest in computation, but is also the simplest in operation. It is true that the alternating-current transformer consumes less energy in hysteresis when supplied by peaked e.m.f. waves, than when supplied by sinusoidal waves, other things being equal; but, on the other hand, the sinusoidal wave is easier to rectify, and easier to transmit to long distances. Near the beach, and over shallow water, the ocean waves are sharper-peaked, but over the great expanses, and for long distance transmission, the ocean swell is sinusoidal in profile. In the rotary-field magnetic circuit, harmonic magnetic fluxes circulate with different speeds. If the fundamental flux rotates with a speed of, say, six revolutions per second, the triple harmonic flux rotates with a speed of eighteen revolutions per second, the quintuple harmonic flux rotates with a speed of thirty revolutions per second, and so on. Hence traps can be set to catch the higher-speed fluxes, while the fundamental travels undisturbed.

In the case considered, the transformer behaves as though it had a short-circuited secondary winding for the harmonics. The compensating secondary windings act like short circuits to all frequencies above the fundamental, and have no effect on the fundamental. In the closed voltaic circuit, the principal law is that the total electromotive force in the circuit, including potential difference, must be equal to zero. That is to say, the algebraic sum of the electromotive forces, plus the drops of pressure due to current flow, must be equal to zero. In the magnetic circuit the principal law is that the total magnetomotive force in the circuit must be equal to zero, including potential difference. That is to say, the total number of ampere-hours, including the drop of gilbertage, due to magnetic flux traversing the reluctance of the circuit, must be equal to zero. Consequently, in a short-circuited transformer receiving a constant primary current, and therefore a constant primary magnetomotive force, the secondary ampere-turns adjust themselves automatically into equality of magnitude and opposition of phase with the primary ampere-turns, so that the resulting magnetomotive force is practically nil. The power absorbed from the primary circuit is confined to the losses of power in the copper and iron of the transformer. Similarly, if a transformer be provided with two separate secondary windings, one of which is short-circuited, while the other is connected to a secondary circuit, the former will absorb the entire primary m.m.f., and no appreciable power will be developed in the latter.

The transformer in question virtually provides short-circuited secondary windings for the harmonic frequencies, and a non-short-circuited or working secondary winding for the fundamental frequency. By this means the magnetomotive force of the harmonic current components is neutralized by the short-circuiting currents, without sensible waste of power, while the magnetomotive force of the fundamental current, which is, of course, sinusoidal, is left free to be neutralized by the working secondary sinusoidal current. This working sinusoidal current absorbs power from the primary circuit. The resulting arrangement constitutes a harmonic sifter. The harmonic magnetic fluxes are not suppressed in the magnetic circuit, but only modified in phase. They are, however, confined in their operation to producing secondary magnetomotive forces that are almost devoid of power; since they produce a certain number of amperes and ampere-turns in short-circuited windings that have but little resistance. Incidentally, the principle is sought to be applied to a converter of the non-rotary type. This machine is provided with a closed magnetic circuit, although the magnetic flux rotates. The brushes for the direct-current delivery also rotate at synchronous speed, and for adjustment of the direct e.m.f., the poles of the brush-driving motor are shifted mechanically.

If such a type of current-rectifier could be successfully developed in large sizes, there would be considerable advantage in having the windings and magnetic cores all stationary, and no moving parts except the brushes. With such rectifying machinery in general use, the term "rotary converter," which is now supererogatory, would be almost rendered necessary. The term "converter," which is now sufficient to define machines with rotating armatures for converting alternating currents to direct currents would no longer be adequate. A condenser, or a choking coil, serves in the voltaic circuit to sift out alternating currents from continuous currents. The principle above discussed serves in the magnetic circuit to sift multiple frequency fluxes from the fundamental.

Mr. Westinghouse on the Third Rail.

The *New York Times* of Sept. 1 prints a letter over the signature of Mr. George Westinghouse, which is reproduced in full below:

"The public as well as those financially interested in the development of electric traction should feel indebted to the *Times* for its thoughtful editorial articles on the recent Paris underground electric railway accident in which it makes doubly clear by quoting Mr. Yerkes that combustible materials should be avoided, particularly in train construction and in station work of underground and elevated railways.

"I agree with the *Times* that the lessons to be drawn from this accident are important, and believe they will lead to the adoption of apparatus and methods which ought to make an electrically-propelled train as safe as one drawn by a steam locomotive, and thus insure a realization of the great advantages of the former.

"The supreme importance of the subject prompts me to again urge such a revision in the heretofore accepted plans as will insure safety to passengers and employees, as well as the avoidance of ultimate great losses to companies operating electric railways.

"It will be recalled that, following the collision between steam-propelled trains in New York City in the Fourth Avenue tunnel on the New York Central Railroad in January, 1902, involving great loss of life due to escaping steam, there was an exciting discussion of the event, with a widespread expression of a belief that had such trains been operated by electricity there would have been no loss of life; and for days almost the entire press of New York devoted columns to the subject and urged prompt legislation which would compel the New York Central Railroad Company to use electricity instead of steam for the operation of its trains within the city tunnels.

"Having had a long experience in matters pertaining to the safe working of railway trains and having acquired a very considerable knowledge of the power and peculiarities of electricity, I believed I might do a public service by drawing attention through the press to the elementary fact that the electric operation of trains could not lessen some of the risks, but might, on the contrary, add new ones of a serious character, and I therefore wrote a letter which you published in your columns at the time, and which has recently been extensively republished.

"That letter was criticized favorably by some, but was belittled and denounced by interested parties as calculated to impede the introduction of electricity for traction purposes.

"Since then as a result of that discussion, there have undoubtedly been great improvements demanded and made in the character of electrical apparatus for railway use; but as often happens, it has required an awful experience to bring home to those charged with the responsibility of guarding against railway accidents the fact that there is no margin for use in tunnels of combustible material in proximity to a heavily-charged electric conductor.

"The recent injury to a number of workmen engaged upon the elevated railway is only another illustration of the need for a revision of the plans which have heretofore prevailed and which have evidently been regarded by many railway officials as reasonably safe.

"The realization of the great cost of such an accident as the recent one in Paris, regardless of the horror of it, will undoubtedly cause the plans already decided upon to be most carefully reviewed, and should bring to the officials of the companies interested the highest skill in determining the requirements, the compliance with which will render the carrying of passengers on trains operated by electricity as safe at least as if propelled by other means.

"It seems almost axiomatic that the third rail should only be charged with electricity when required to operate a train; that there should never be more electric energy at any point of a third rail than sufficient to operate one train; that the electric machinery required upon a train should be reduced to a minimum, and should be so located as to be under the convenient supervision of the train attendants; and in all tunnel and elevated railroad work there should be no material to create fire or dense smoke.

"The following requirements, among others, can easily be complied with, and are respectfully suggested for consideration and discussion:

"1. Trains to be constructed of iron or steel, with the interior finish of incombustible materials. 2. The division of the third rail for the supply of electric current into suitable sections, each section being supplied with current only when required to propel a train. 3. The limitation, by suitable devices, of the amount of current supplied to each section, so that in the event of a short-circuit on the train the current will be automatically and instantaneously cut off at a point some distance from such section of the third rail. 4. Provision for the cutting off of the current from each supply section of the third rail at the will of the motorman. 5. No other live conductors than the third rail to be in close proximity to the line. 6. No wires carrying high voltages except upon motor cars, and motor cars only at the ends of a train.

"The state of the electric art has so advanced that compliance with the foregoing requirements is simply a matter of additional expense, incomparable, however, to the financial losses which the companies will suffer if they do not make the electric operation of their railways absolutely safe.

"Believing the foregoing requirements can be complied with, I have read with amazement the opinions quoted in your Friday's issue under the heading: "No Device to Stop Third-Rail Killings." I am sure Mr. Hedley must have been misquoted in regard to the possibility of collisions due to the temporary shutting off of the current from the third rail, for, as a matter of fact, the stopping of the trains on the elevated railway is not in the slightest degree affected by the temporary cessation of the current on the third rail.

"It is true, however, that the system of train control in use upon the elevated road, and which has been ordered for the rapid transit trains, is so organized that its correct operation is dependent upon a constant supply of current to the third rail, and that therefore the division of the third rail into sections and the temporary supply of current only as needed, might, with the existing system of train control, be inoperative; but there are available well-tried controls which are operative regardless of a temporary interruption in the supply of current.

"It is well and sorrowfully recognized by our great railway engineers that early mistakes, due to inexperience, in the dimensions adopted for tunnels, gauge of track, and in the method of coupling cars have established practices which cannot now be escaped from because of the necessity for a uniform practice, in the points cited, on connecting railways.

"The advantages to accrue from this necessity for uniformity in railway practice to that concern which can secure the adoption of its plans covered by patents has led to a commercial rivalry, the influence of which for evil cannot well be appreciated. This intense rivalry between the two great electric manufacturing companies of the country, each enjoying the same rights under numerous patents, has undoubtedly led to a great improvement in the electric art, but to that rivalry, where none should exist, can also be attributed much of the cause for the present alarm concerning the unsatisfactory method of electric operation of trains.

"If, therefore, a frequently-adopted practice be adhered to, viz.: that having already expended a large sum for electric plant and equipment of a certain character, there must hereafter be used for extensions and upon connecting lines only such apparatus and methods as will fit in with the existing plans, however imperfect they may be, then there is small hope for a safe system of electric traction.

"The most recent accident on the Paris underground railway, where passengers were frightened and jumped from the train, illustrates how necessary it is to so install electric apparatus that there can be no such alarming occurrences.

"Being sure of my ground and of the necessity for public pressure in securing the desired reforms, and with a full belief that electric traction can be made safe, I am, respectfully yours," [Signature.]

In commenting on the letter, the *Times* says that Mr. Westinghouse touches upon one difficulty, the remedy for which is not easily found. "That is the absence of anything approaching standardization in electrical equipments, and the fact that when one patented system is adopted, however defective experience may show it to be, additions and extensions must be made in conformity with it, thus in some degree blocking the way for progress in the direction of as complete provision for safety as the advancing state of the art might permit. This points in a direction which may mean the extinction of existing commercial rivalries in the manufacture of electrical appliances—something difficult of accomplishment while valuable basic patents remain vital and operative. The progress is toward standardization in electrical equipment, but the ultimate is not likely to be attained as long as the field is divided between two controlling concerns in sharp and active competition. If the suggestion of Mr. Westinghouse foreshadows the merger of his interests and the interests of the General Electric, it will be of great moment to a great many people."

Central Avenue Power Station, Kansas City, Kan.

By H. S. Badger and G. E. Schreiber.

Among the recent installations of power plants in the West is the Central Avenue Power Station of the Consolidated Electric Light & Power Company, of Kansas City, Kan. By reason of its size and modern equipment in both the mechanical and electrical features, a detailed description of the plant, will no doubt prove of interest to central station engineers.

The plant was designed and equipped to furnish light and power to Kansas City, Mo., and Kansas City, Kan. As far as electric service is concerned these two cities are one community, for a busy thoroughfare forms the artificial division line between the two cities.

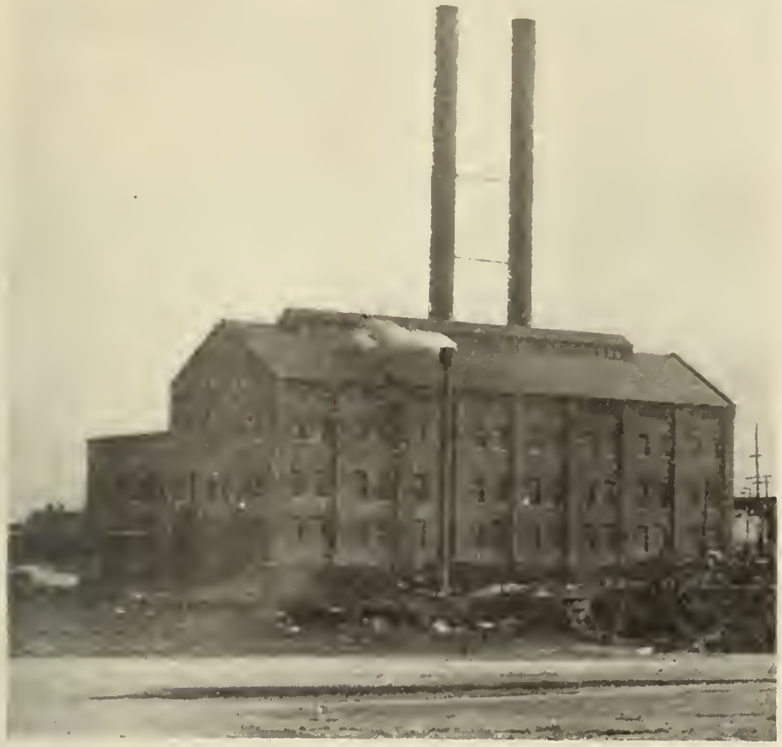

FIG. 1.—VIEW OF EXTERIOR OF POWER STATION.

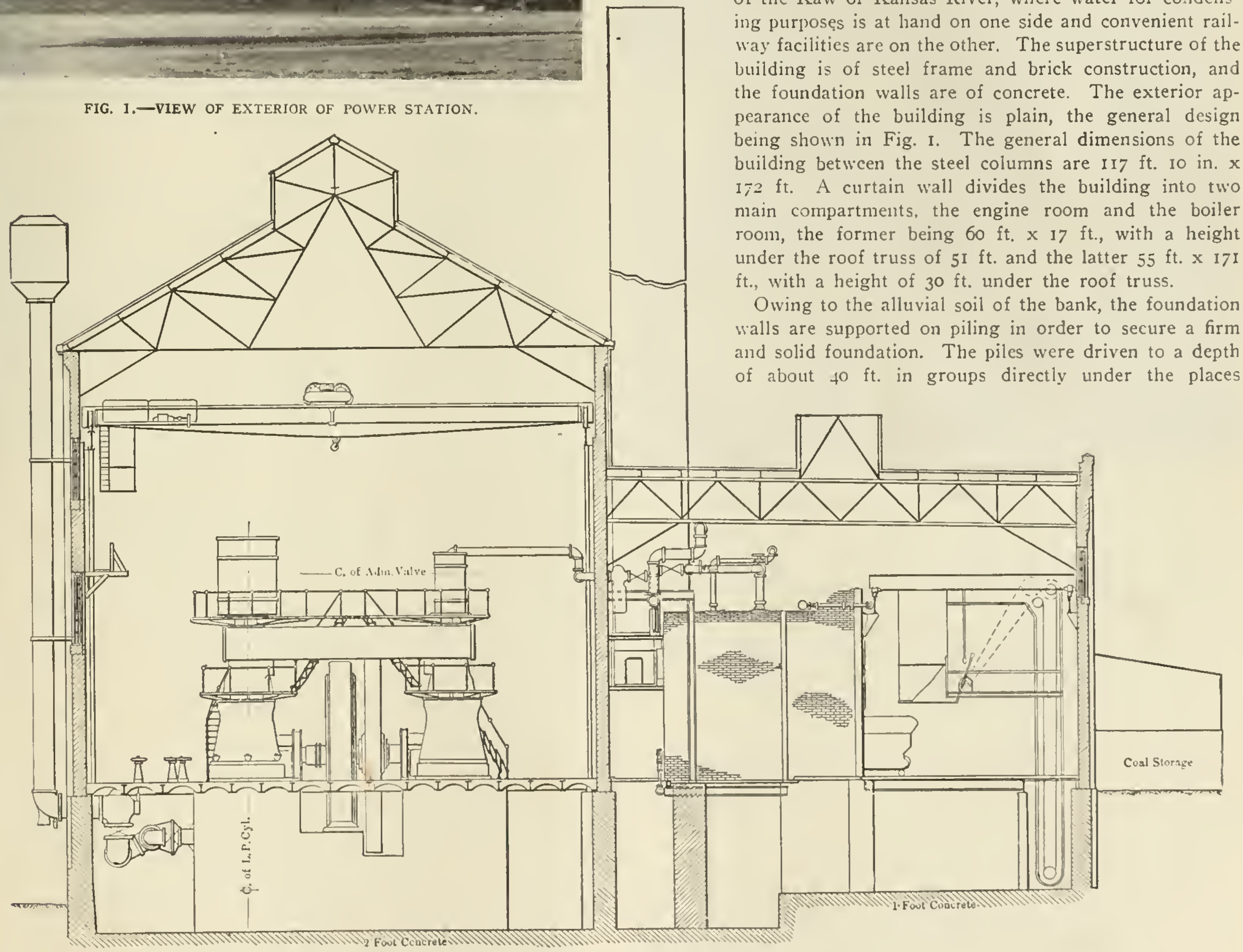

Fig. 2.—Cross-Section of Power Station.

At the time of the inception of the Central Avenue Station the power and lighting service for these two cities was supplied by a number of scattered stations, which, owing to the continually increasing demand for light and power, were unable to economically supply the service; thus the Central Avenue Station as a central power station was designed to supplant these scattered stations.

This was the purpose for which the plant was originally designed, but before its completion, by an agreement between the Consolidated Electric Light Company and the Metropolitan Street Railway Company, of Kansas City, Mo., necessary changes, to be explained later, were made in the switchboard equipment, so that besides supplying lighting and power service, power is furnished for the rotary substations of the Metropolitan Company, for their street railway service. In consequence of this agreement some of the old power stations will continue in operation until the completion of an immense plant now being built by the Metropolitan Company, and to be known as the Missouri River Power Station.

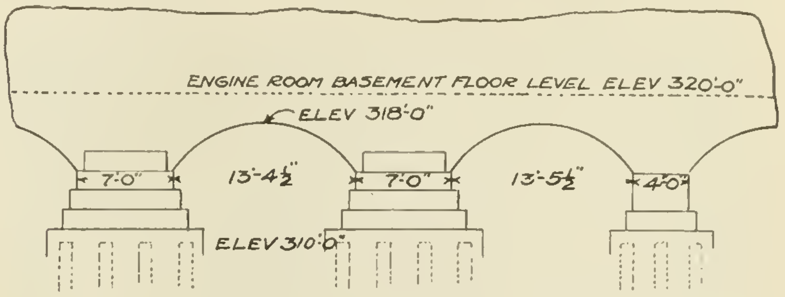

FIG. 3.—FOUNDATIONS OF POWER STATION.

BUILDING.

The site of the Central Avenue Power Station is on the east bank of the Kaw or Kansas River, where water for condensing purposes is at hand on one side and convenient railway facilities are on the other. The superstructure of the building is of steel frame and brick construction, and the foundation walls are of concrete. The exterior appearance of the building is plain, the general design being shown in Fig. 1. The general dimensions of the building between the steel columns are 117 ft. 10 in. x 172 ft. A curtain wall divides the building into two main compartments, the engine room and the boiler room, the former being 60 ft. x 17 ft., with a height under the roof truss of 51 ft. and the latter 55 ft. x 171 ft., with a height of 30 ft. under the roof truss.

Owing to the alluvial soil of the bank, the foundation walls are supported on piling in order to secure a firm and solid foundation. The piles were driven to a depth of about 40 ft. in groups directly under the places at which the steel columns were to rest on foundation walls. The lower portion of the foundation walls is a series of arches whose abutments rise from the several groups of piling. Fig. 3 is an elevation of a portion of the foundation walls clearly showing the manner in which the walls start from the piling. The tops of the arches are two feet below the engine room basement, whose elevation is 320 ft. The foundation walls are built up to elevation 336.5, which is 18 in. below the engine room floor level. From this elevation the steel work and brick superstructure starts.

The boiler and engine room floors are at the same level. Only that portion of the boiler room basement floor back of the ash pits is down to the same level, as the engine room basement floor. The portion of the boiler room basement in front of and to the back of the ash pits is 4 ft. 3 in. above this level. This difference in level in the boiler room basement was made to provide for a future installation of economizers back of the ash pits.

The engine room and boiler room floors are of expanded metal, concrete and steel I-beam construction. Only that portion of the floors in engine and boiler rooms around the present apparatus has been installed, thus leaving large wells in both rooms, which space will be taken up by future installations.

All of the auxiliary steam apparatus, excepting the feed water heater and boiler feed pumps, which are placed on a wing of the boiler room floor, are located on the engine room basement on the north side of the present engine foundations. On the opposite side of the engine foundations are located the transformers, oil switches and high-tension bus-bars. The steam engine, which is belted to the exciters on the engine room floor above, is located near the west building wall between the engine foundations. A Whiting three-motor, 30-ton, electric traveling crane spans the engine room, and it travels the whole length of same. The crane runways are supported by the steel building columns.

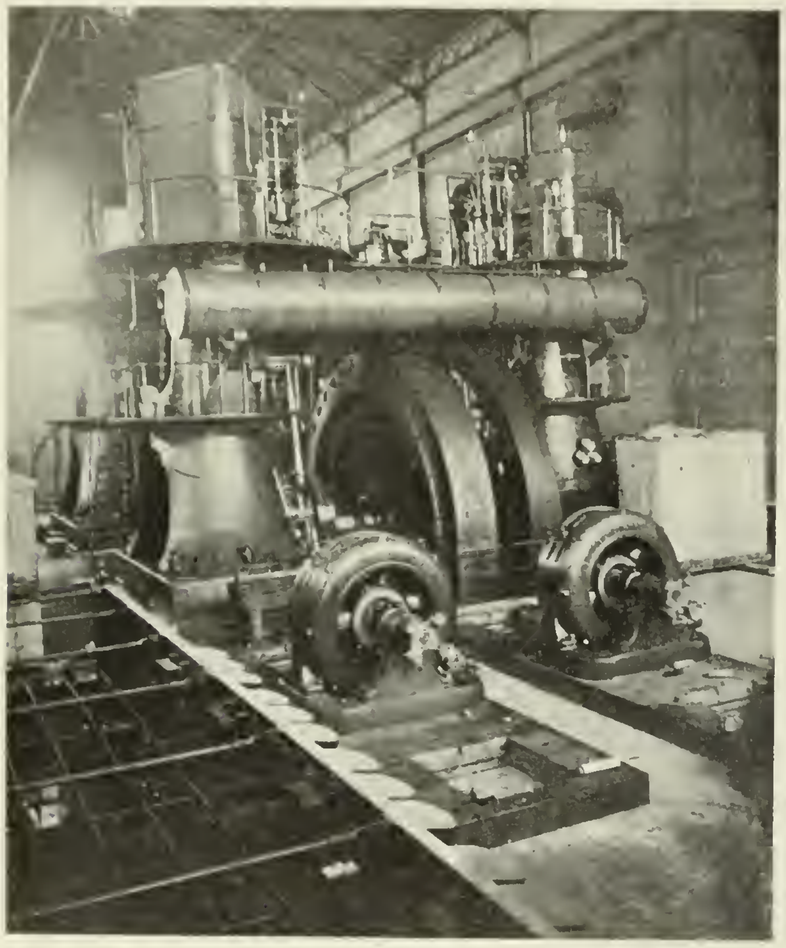

FIG. 4.—VIEW OF ENGINES FROM TOP OF SWITCHBOARD.

The foundations for the engines are built of concrete, resting on a continuous concrete base, which ties together the tops of piling. There are 206 piles under the base, driven 3 ft. 3 in. on centers. The foundations for condenser, air pumps, boiler supports and interior columns all rest on piling.

Two 1,500-kw, 6,600-volt, three-phase, 25-cycle generators have been installed, each direct-connected to a 2,250-hp Allis-Chalmers vertical cross-compound, condensing engine. Space has been reserved in the engine room for a 2,000-kw unit, as well as space in the boiler room for an additional battery. The low frequency of 25 cycles was chosen on account of its adaptability to motor and rotary converter service, which will be the greater part of the total load to be carried by the station. As this frequency is too low for satisfactory lighting, 2,300 volt, 60-cycle, two-phase generators, direct-connected to 6,600-volt, three-phase, 25-cycle synchronous motors are used to supply the lighting service.

MAIN GENERATORS.

The generators are of the revolving field type. The armature frame is of cast iron, so mounted that it can be moved parallel to the shaft into a position clear of the revolving field, leaving both the armature and field open for inspection, cleaning or repairing. On the revolving field the poles are attached by bolts to a steel ring carried on the field spider. The field coils are of copper ribbon, wound edgewise, and insulated by means of wooden collars at each end, and a wrapping of insulating fabric, on the poles. The fly-wheel effect of the revolving field is 58,000 foot-pounds at a radius of six feet. The tests and guarantees on the machines were as follows:

The insulation between the armature windings and armature core was subjected to a pressure of 13,200 volts alternating for one minute without piercing the insulation. This is just double the voltage of the generator. The insulation between the field winding and the core stood 1,500 volts alternating for one minute.

The temperature of any part of the machine as measured by a thermometer is guaranteed not to be more than 35° C. above that of the surrounding air after 24 hours run at rated load and speed, nor more than 55° C. after two hours run at 50 per cent. overload, provided that the temperature of the surrounding air does not exceed 25° C. In the event of the room temperature differing from 25° C. the observed rise in temperature is to be corrected one-half a degree for each degree Centigrade that the room temperature differs from 25° C.

The full load efficiency of the generators is 94.5 per cent., ¾ load, 93.5 per cent., and ½ load 91.5 per cent. The inherent regulation, that is the rise in potential when full non-inductive load at rated potential, is thrown off the machine, will not exceed 6 per cent., the speed and the field excitation remaining constant.

An idea of the general appearance of the engines can be obtained from Fig. 4, which shows a view taken from the top of switchboard. The reheating receiver rests on brackets attached to each frame. There are two galleries for each engine, the top galleries connecting between engines.

The diameters of the high and low-pressure cylinders are 34 in. and 70 in. respectively and the stroke 48 in. The cranks are set 90° apart. Each exhaust chamber is separated by an air space from its cylinder barrel. In the event of the high-pressure crank being on dead center at the starting up of the engine, a small steam pipe leading from the throttle valve will let steam from the boilers into the low-pressure space of the receiver. This connection may be used to supply steam to the low-pressure cylinder when operating non-condensing to increase the horse-power. A safety valve is placed in the exhaust pipe from the high-pressure cylinder to the receiver. If for any reason the low-pressure valves should fail to take steam, the inertia of the engine would run up the pressure in the receiver by forcing the exhaust of the high-pressure cylinder into it, which would cause serious damage, were it not for this safety valve.

The engine governor is located on the low-pressure side of the engine, and is of the Allis special weighted type for operating both the high and low-pressure cylinder valve gears. This governor has attached to it the special mechanism for changing the speed of the engine in order to bring the alternators into synchronism and step. This interesting device is described later. In addition to the speed governor there is a safety governor located on the high-pressure side of the engine, which operates the release catch on the butterfly valve in case the engine speed increases to the predetermined limit for which the release catch is set. The valve is closed by means of a heavy weight, which when falling over its vertical guiding rod in the gallery floor, closes the valve by means of a connecting rod.

The main journals are made so that the bottom parts are spherical in shape, fitting into spherical sockets in the bed plate, thus making a perfect ball and socket joint. This arrangement for securing a self-aligning shaft is common on electrical apparatus, but it is not on engines. The lower half of the journal shell is hollow, so that circulating water can pass through to cool the bearing.

The fly-wheel is 25 ft. in diameter, made in ten segments, and weighs approximately 150,000 pounds. The cranks are of the counter-balanced type, and were pressed on the shaft with a 400-ton hydraulic press and keyed in place. The crank pins are 12 in. in diameter, and 10 in. in length, and were forced in place by the same means and riveted over.

The guarantees on this engine are as follows: With 175 pounds steam pressure at the throttle and 26 in. vacuum in the condenser the engine will develop at its rated speed 75 r.p.m., 2,250 indicated hp, with a steam consumption not exceeding 12½ pounds of dry steam per indicated hp-hour. The engine will stand 50 per cent. overload under the control of the governor. The regulation from no load to full load is within 1 per cent.

In order to insure the successful operation in parallel of the generators, the maximum allowable variation in angular velocity from mean angular velocity at any load from no load to 50 per cent. over the economical rating is not more than .125 of one degree.

The indicated horse-power, when running at full speed with a steam pressure of 175 pounds at the throttle and no load on the generator, is guaranteed to be not more than 135. The maximum indicated horse-power obtainable at the latest point of cut off at which the governor will regulate within 3 per cent., the initial steam pressure being 175 pounds, is 3,940.

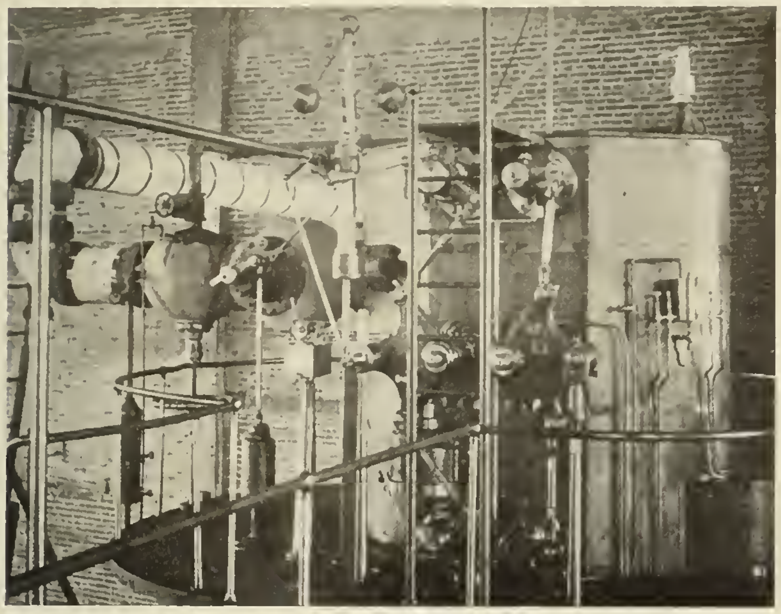

FIG. 5.—VIEW OF HIGH-PRESSURE CYLINDER.

The device for changing the leverage of the governor weight and consequently the speed of the engine can best be described by the accompanying diagram in Fig. 7. *A* is the vertical post at whose top are attached the governor balls. *B* is the cast-iron collar which is held in position on *A* by set screws. It has two legs, as shown, which supports a knife-edged shaft, *T*. A cast-iron platform, *P*, with a yoke, *Y*, is rigidly held on this shaft by set screws. On this platform is mounted a small direct-current motor, *M*, reversible at the switchboard, whose shaft end is a worm, *W*, which turns a gear, *G*, which is free to turn independently. A jaw clutch, *C*, sliding on a feather, engages this gear with the screw, *S*, which in turning moves the weight, *E*, along the screw, the weight being compelled to slide as a feather, *F*, on the yoke, prevents it from turning with the screw. The yoke, as shown, supports a screw at each end, the turning gear end being provided with a double thrust bearing. At *L* is attached one end of a link, whose other end is attached to the sliding part of the governor. From the description of the parts it will be seen that the shaft, *T*, is the moment axis for the governor pull at *L*, multiplied by its perpendicular distance from the moment axis and the combined weight of the motor, the platform, the weight and the attachments times the perpendicular distance of their resultant center of gravity from the moment axis. By the moving of the weight, this resultant center of gravity is changed and in consequence the position of the governor balls is changed. A hand crank, *H*, on the end of the screw, *S*, may be used to turn the screw after disengaging the clutch, *C*, from the gear, *G*.

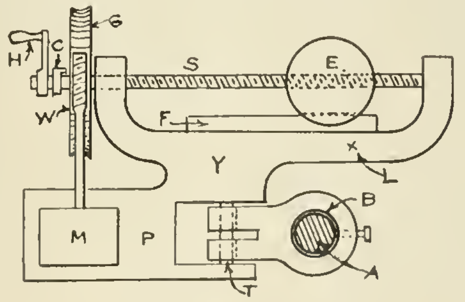

FIG. 7.—APPARATUS FOR CHANGING GOVERNOR LEVERAGE.

The boiler plant consists of six boilers of the well-known Babcock & Wilcox type, arranged in three batteries. Each boiler has three 36-in. drums, 23 ft. 3 in. long and 252 tubes 4 in. in diameter and 18 ft. long, having a total of 5,143 sq. ft. of heating surface. At 10 sq. ft. of heating surface per horse-power, each boiler has a normal rating of 514.3 horse-power. The boilers are operated with a steam pressure of 175 pounds, but are built for a working pressure of 200 pounds, and were tested with 300 pounds hydraulic pressure and found to be free from leaks.

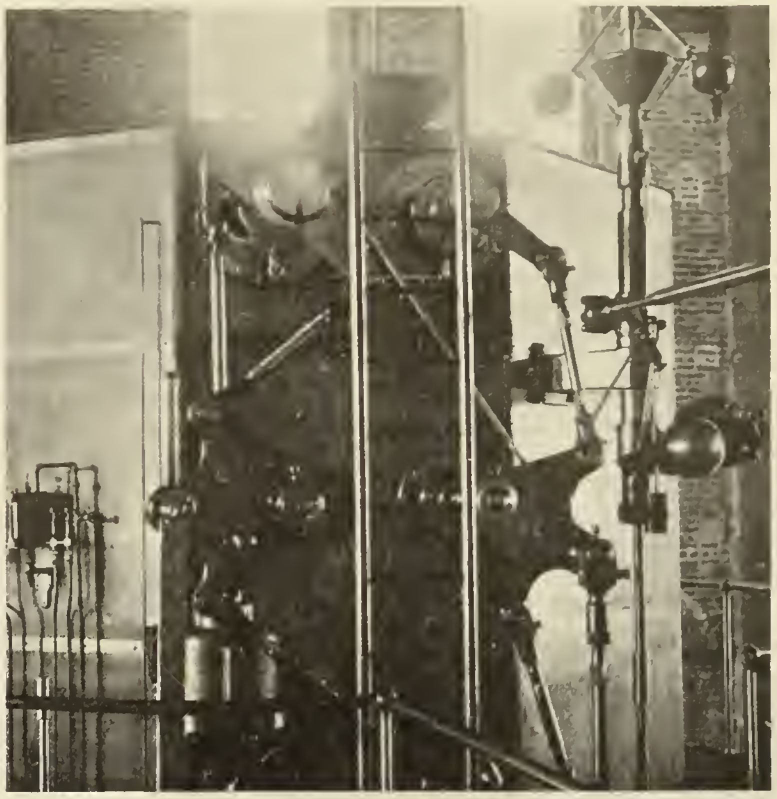

FIG. 6.—VIEW OF LOW-PRESSURE CYLINDER SHOWING SPEED-REGULATING DEVICE.

Each boiler is equipped with a Green traveling link grate containing 92 sq. ft. of effective grate surface, being 9 ft. wide and 10 ft. 2 in. long. The heating and grate surface of each boiler are, therefore, in the ratio of about 56 to 1. The grate is fed with coal by means of a hopper at the front of the boiler, under which the grate travels. The amount of coal burned is regulated by the speed at which the grate travels. Power for operating the grate travel is obtained through a rod operated from an eccentric on a line shaft, which is suspended from the basement ceiling, and runs the length of the boiler room floor. The line shaft is driven by a belt from either one of two 6-hp oscillating engines set on the basement floor between the ash pits.

Coal is shoveled from cars on a railroad switch into a storage pit on the outside of the boiler room, the boiler room wall forming one side of the storage pit. The floor of the storage pit slopes toward the boiler room wall at an angle of 45°, thus being sufficient slope to allow the coal to freely slide. From the storage pit coal is conveyed to the boilers by means of a coal and ash-handling apparatus manufactured and installed by the Heyl & Patterson Company.

This apparatus consists of a storage hopper, elevator and motor platform, all suspended from a bridge composed of structural steel members, securely braced and supported by four traction wheels. The track for the traction wheels are 23 ft. 9 in. apart, one running over the boilers and supported on girders resting on the front boiler columns, and the other running along the boiler room wall and supported by brackets on the steel building columns.

There are a number of bulkhead gates with sliding steel gates placed at intervals of a few feet in the boiler room basement wall, which, when opened, will allow the coal to slide from the storage pit into the boot of the elevator. The elevator has a lift of 48 ft.

and discharges coal into the storage hopper. The storage hopper discharges coal through a short chute into the hoppers of the Green grates. The elevator can deliver 60 tons of slack coal per hour to the storage hopper, which has a capacity of 10 tons. The bottom of the storage hopper is equipped with a cast-iron gate frame, supporting three sliding steel gates, by means of which the feed of the coal to the grate hoppers is regulated The hopper is also provided with a scales for weighing the coal.

The various parts of the apparatus are operated from the motor platform, where one attendant can look after the whole operation from opening any of the steel gates and drawing coal from the storage pit to depositing coal into any grate hopper.

The power for operating the apparatus is provided by a 10-hp, 500-volt, direct current motor, which transmits power by means of a belt to a main countershaft. From this main countershaft, the power for operating the elevator is transmitted by spur gear and roller chain drive to the head shaft of the elevator. The traversing mechanism is also taken from the countershaft and transmitted to the axles of the traction wheels by means of bevel gears provided with friction clutches.

As yet no special apparatus for handling the ashes has been installed, the coal-handling apparatus being used during periods of light load. The ashes are raked from the ash pits on to the basement floor and shoveled into the elevator boot, hoisted into the storage bin, from which they are dropped into barrows and wheeled out.

It was the original intention to install an independent apparatus for handling the ashes. This was to consist of a trolley bucket which would traverse the boiler room basement in front of the ash pit doors, collecting ashes from the ash pits and depositing them into a skip bucket, by means of which they were to be elevated and passed into a storage bin at the end of the boiler house, from which they were to be drawn into cars.

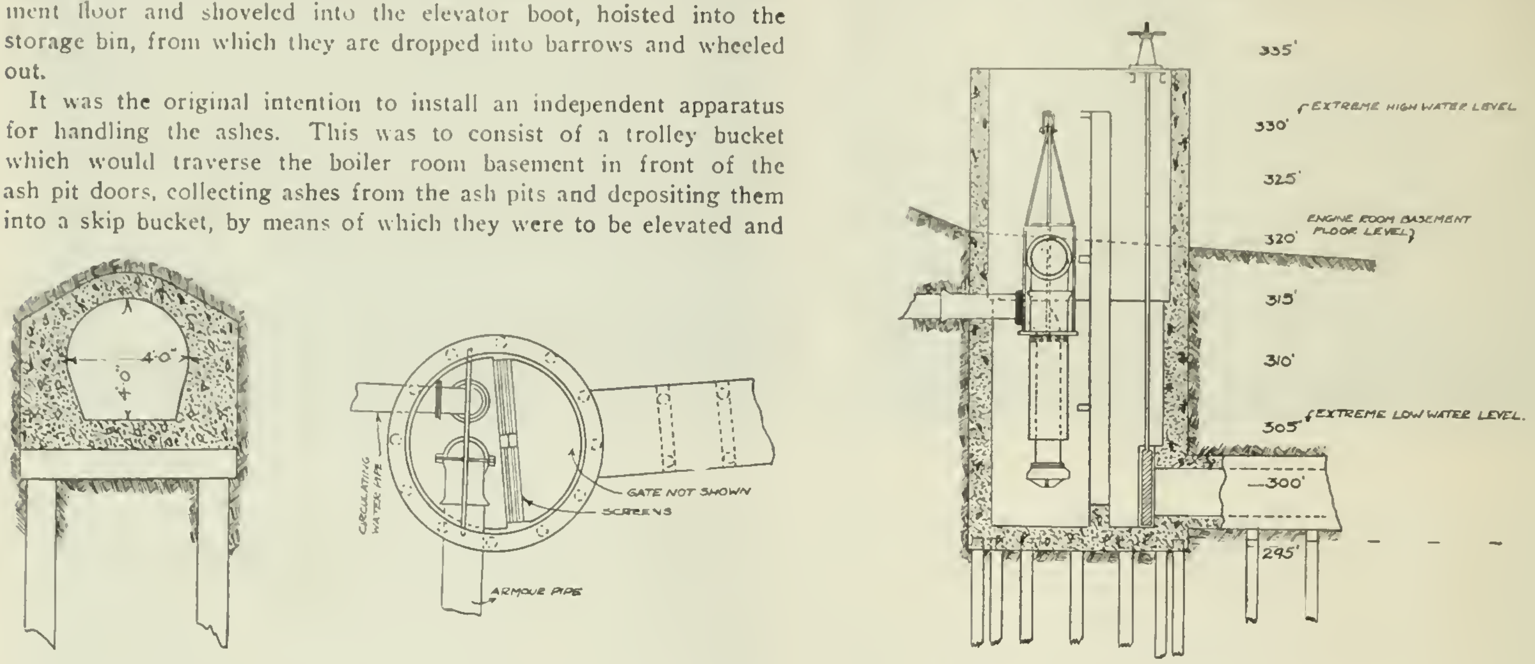

Fig. 8.—Diagrams of Concrete Tunnel and Suction Well.

AUXILIARY STEAM CONDENSER APPARATUS.

One Wheeler surface condenser takes care of the exhaust steam from both engines. It contains 8,000 sq. ft. of brass cooling surface, measured between the heads, and is capable of handling 80,000 pounds of exhaust steam per hour, this being the amount of the exhaust steam when both of the engines are working at 20 per cent. overload or thereabouts. Handling this amount of steam, it is guaranteed to maintain a vacuum of 26 in. with 5,100 gallons of circulating water per minute at a temperature of 70° F.; and a vacuum of 24 in. when the temperature of the circulating water is 85° F.

The feed water heater is a Webster "Star" vacuum feed water heater and purifier. It has a capacity for heating 80,000 pounds of water per hour from a temperature of 110° F. to temperature of 180° F. to 190° F. when supplied continuously with 6,000 pounds of exhaust steam per hour, and will condense this amount of steam under the stated conditions. The heater will be supplied with exhaust steam ordinarily from the feed water pumps, hot well pumps, stoker engines, air pumps and occasionally by the engine of the steam-driven exciter.

Water for condensing purposes flows from the Kaw River through a concrete tunnel into a concrete suction well, 15 ft. in diameter and 36 ft. 6 in. deep. The water is drawn from the suction well by means of the centrifugal pumps already described, is pumped through the condenser and discharged into an overflow well outside the building, which has a sewer connection to the river. (Considerable difficulty has been encountered in the building of the concrete tunnel owing to the quicksand, and the work is not completed at the time of this writing, the engines being operated on the free exhaust.)

Fig. 8 shows a plan and section of the concrete tunnel and the suction well. The extreme high and low water levels of the river are indicated, showing their elevations with reference to the engine room basement floor, where all the condensing apparatus is located The center of the suction well is 72 ft. 10 in. from the west wall of the building, and the tunnel extends out into the river a distance of 180 ft. 6 in. from the suction well.

The tunnel is supported every 5 ft. on timber caps, which rest on two piles one under each side wall of the tunnel. The portion of the tunnel extending out into the river has a rip-rap bed in addition to the piling foundation, and it is protected from the debris of the river on the upstream side by means of rip-rap and sheet piling Water enters the tunnel through an opening in the top, thus avoiding the mud of the bed of the river as much as possible. There is a platform extending from the suction well out over the river, from which logs or drift can be removed from around the end of the intake.

The suction well rests on 12 piles driven under the circular wall. It is divided into two compartments by a double set of screens, the tunnel opening being on one side of the screens and the suction pipes on the other. The double set of screens provides for one set to be raised and cleaned while the other set is down. There is also a gate at the tunnel opening which wedges tight against the water pressure on the tunnel side, and when closed provides for cleaning out the suction well. The suction well is connected to the circulating pumps by a 24-in. cast-iron bell and spigot pipe, which is provided with a foot valve on its bottom. The Armour Packing Company is also a joint user of the intake tunnel and suction well, being supplied through the 36-in. pipe shown in the figure.

By reference to the switchboard wiring in Fig. 10 it will be seen that each generator is connected to two oil-break switches controlled by non-automatic controlling switches on its panel. One oil switch makes connection between the generator and one of the station bus-bar sets and the other between the generator and the other station bus-bar set. These two sets of station bus-bars will be used for separate purposes, one set which is termed the Metropolitan bus-bars will be used for feeding the cables to the Metropolitan Street Railway Company's sub-stations, and the other set termed the Edison bus-bars will be used for feeding the cables to the lighting company's lighting and power sub-stations and for furnishing power normally to the apparatus hereafter described, in the station. However, the auxiliary apparatus may be connected to either or both sets of bus-bars through two sets of knife switches on the leads to the oil-break switches for each auxiliary machine. These knife switches also provide for breaking the connections between the oil-break switches and high-tension bus-bars in case of repairs to the oil-break switches.

Current for exciting the fields of the main generators and synchronous motors, described later, as well as for lighting the station, operating the oil-break switch motors and the auto-controlling switches, and for operating the engine governor controlling motors is furnished either from a 150-kw, 125-volt, direct-current generator, direct-connected to a 215-hp, three-phase, 25-cycle, 440-volt induction motor or from two Edison 60-kw, 125-volt bipolar generators belted one to each fly-wheel of an Armington & Sims high-speed engine.

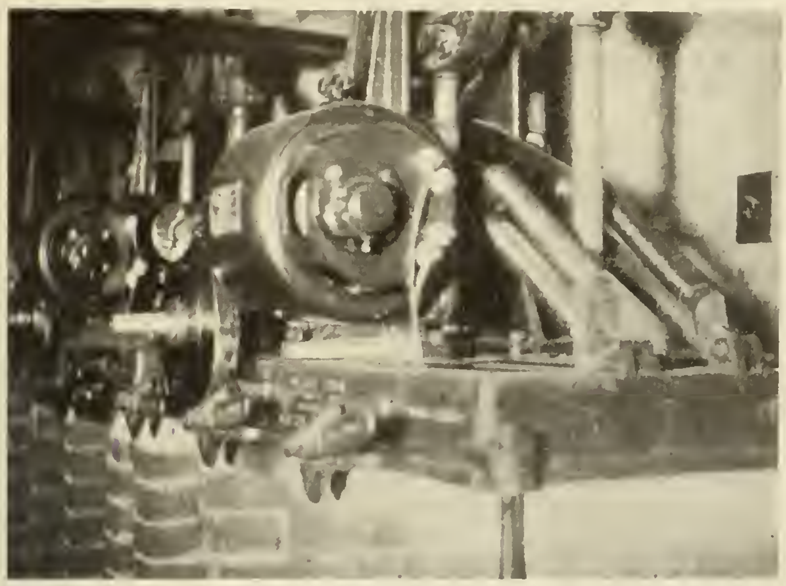

FIG. 9.—VIEW OF OIL SWITCHES.

It is almost needless to say that the steam-driven exciters will only be used for starting purposes, after a complete shut down or in case the motor-driven set should be disabled. The company had the Edison machines and the engine, so no expense except that of their installation was undergone to have steam-driven exciters. An interesting point about the control of these machines is that they are coupled electrically, rheostats are both operated simultaneously by the same hand wheel and a singly equipped panel answers for both. On the motor-driven set the induction motor is put in operation as follows, the connections being traced on the switchboard wiring plan: An auto-controlling switch is closed which causes the motor on the type H oil-break switch to close the circuit from the high-tension bus-bars to the high-tension side of three 75-kw, 6,600 to 460-volt oil-cooled transformers. Between these transformers and the motor is a starting compensator, operated by a crank on the motor panel. The circuit is protected from short circuits by a time limit relay, which closes an auxiliary circuit, which opens the auto-controlling switch. This causes in turn the opening of the H oil-break switch.

There are two 125-kw, three-phase, 25-cycle, 6,600-volt, synchronous motors, direct-connected one to each pair of circulating pumps. There are two sets of auxiliary bus-bars for the operation of these motors, starting and running bus-bars. Between these sets is placed the starting compensator, which is operated by a crank on one of the motor panels. There are two sets of oil-break switches for each motor, one set between the motor and starting bus-bars and the other between the motor and running bus-bars. These switches are operated by levers on the motor panels. An oil-break switch connects the station bus-bars to the motor running bus-bars. In starting a motor, the latter switch is closed, then the set of oil-break switches between the starting bus-bars and the motor, and then the compensator is thrown in, which closes the circuit to the motor. When the compensator switch is on the running position, the set of oil-break switches between the motor and the running bus-bars is closed. The compensator and starting switches will then be thrown off. The compensator may then be used to start up the other motor, if necessary, in an exactly similar manner. A time limit relay is placed on the circuit between the high-tension bus-bars and the oil-break switch. This relay opens the auto-controlling switch, which in turn causes the opening of the switch.

It may be stated here that the controlling switches for the oil-break switches have each a red and a green indicating lamp, one for indicating a closed and the other an open circuit, so that the attendant may see at a glance whether anything is wrong on those circuits closed by oil-break switches.

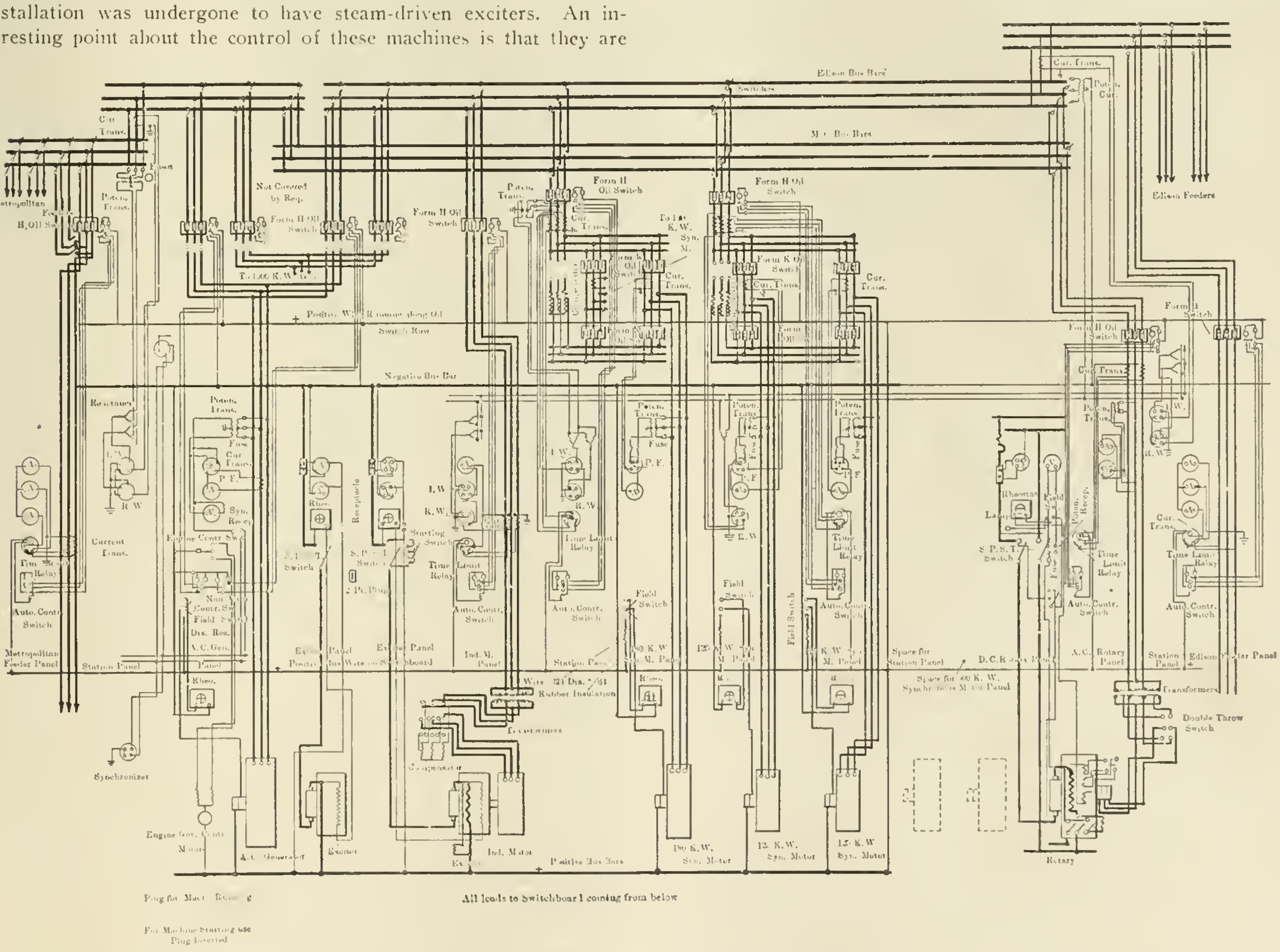

Fig. 10.—Diagram of Wiring for 6,600-Volt Switchboard.

There are in the main station four 4-circuit Brush arc dynamos, direct-connected in pairs to 180-kw, three-phase, 25-cycle, 6,600-volt synchronous motors. The dynamos will furnish power for the street lighting of Kansas City, Kan., on the present system. The switchboard connections of the motors are exactly similar to those of the 125-kw motors described above, using but one compensator and having but an oil-break switch, auto-controlling switch and time limit relay. There may be objection to having but one oil-break switch which in being opened by the protecting devices throws off both motors, though the short-circuit or overload may have occurred on but one of the motor sets. There is this much to say, however: Besides the expense of installing separate switches, which is considerable, the Brush arc dynamos will take care of any short circuit that may happen to occur in any of the lines. At any rate, for the arc service a momentary shut-down of one of the machines on account of the results of a short on the circuits of the other is not a serious matter, as the unaffected machine can be quickly started again.

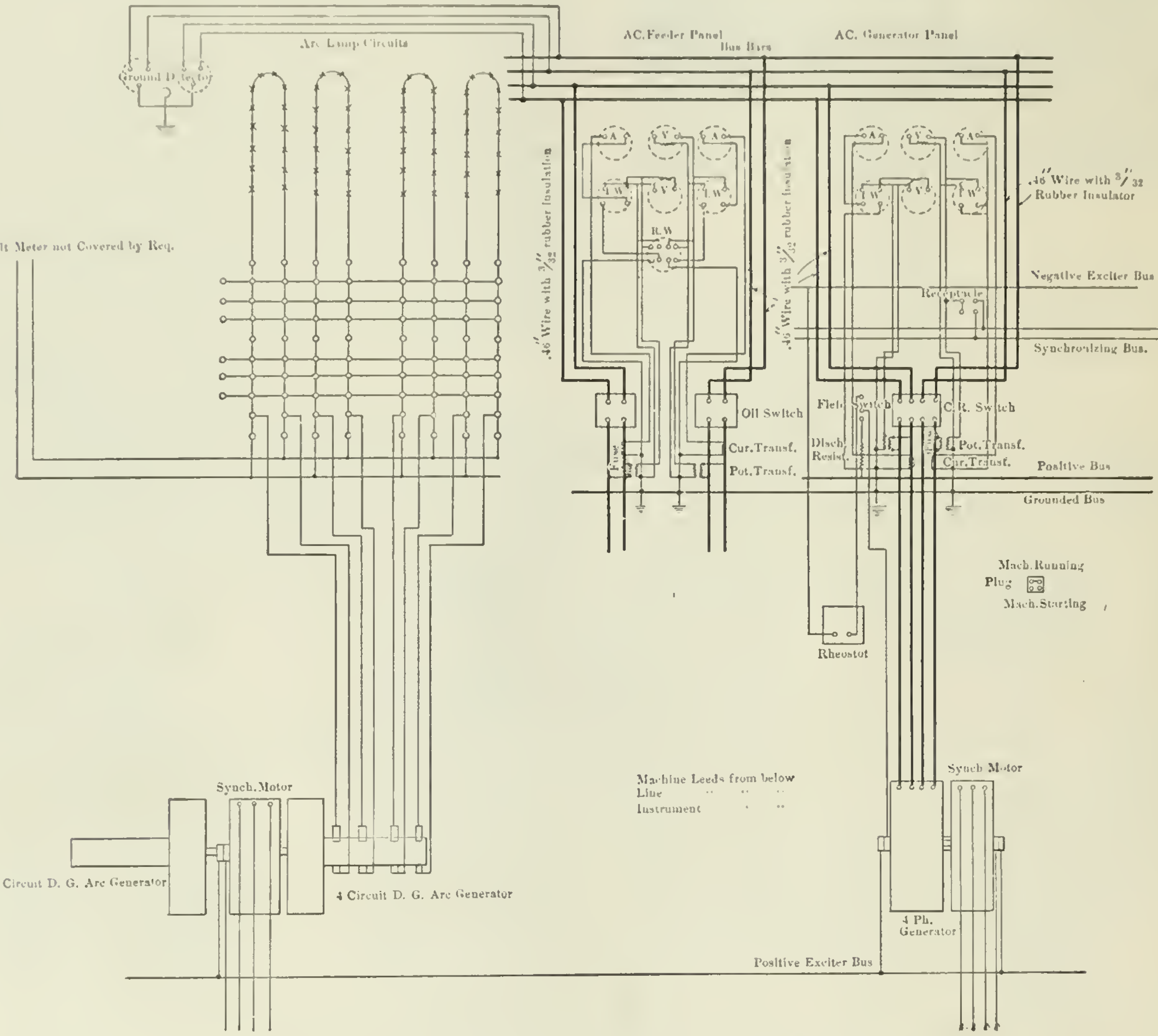

FIG. 11.—SWITCHBOARD WIRING FOR 2,300-VOLT AND ARC LIGHT BOARD.

A 500-kw, 600-volt, 25-cycle, three-phase rotary converter will be placed in the station to furnish power to some of the near-by factories and also to the crane motors, coal-hoist motors and sump pit motor in the station. The 500-volt building motors are operated at present from a railway circuit run into the building.

The rotary will receive power from the main generators through three 175-kw, 6,600 to 340-volt, air-blast transformers. It will be started ordinarily from the alternating-current side. The secondaries of the transformers are to be delta-connected, one lead going direct to the rotary, and the other two going to one side of a double-pole, double-throw switch connecting to the rotary. The other side of the switch will be connected to leads connecting to the secondaries of two of the transformers at their middle points. Thus it will be seen that one-half of the secondary voltage of the transformers can be thrown on the rotary for starting, and the full secondary voltage for running.

Provision will also be made for starting the rotary from the direct-current side on railway circuit by means of a starting switch. A Lincoln synchronizer will indicate when its alternating voltage is in phase with the station three-phase voltage. When this condition exists, an oil-break switch will be closed by means of an auto-controlling switch. The alternating current side of the rotary will be protected by a time limit relay, and the direct-current side by an ordinary railway feeder circuit-breaker.

There are also placed in the main station two 500-kw, two-phase, 60-cycle, 2,300-volt generators, direct-connected to 500-kw, three-phase, 25-cycle synchronous motors. These generators are used for incandescent service. The motors are connected to the switchboard in the same manner as the 180-kw and 125-kw motors described before, i. e., using one compensator and having but one oil-break switch, auto-controlling switch and time limit relay. The 2,300-volt board has one set of two-phase bus-bars. In the event of a protracted short circuit on a feeder both generators will be protected, as both their driving motors will be cut off from the source of power. Consequently but one oil-break switch is necessary.

As stated, the Metropolitan Street Railway Company is to be furnished with power for operating its rotary converter sub-stations. This power is sent out through lead-covered cables from the Metropolitan bus-bars. The lighting company's sub-stations will be fed through lead-covered cables from the Edison bus-bars. The latter sub-stations will have either motor generators to change the frequency to 60 cycles for incandescent lighting, and rotary converters for three-wire, 220 and 110-volt service or both.

All the transformers, bus-bars and oil switches in the main station are placed in the engine room basement under that part of engine room floor upon which the switchboard and auxiliary apparatus are placed. Each oil switch has dividing barriers of brick between the sets of terminals. The bus-bars are mounted on slate floors in brick compartments. All connections to transformers and to feeder circuits are made from "pot heads," i. e., brass bell-shaped ends on lead cables with insulated covers over the mouths in which are separate openings through which the wires pass.

Each generator panel is equipped with one ammeter registering the current in one of three leads, one voltmeter and one power factor indicator. The two non-automatic controlling switches for the type H oil-break break switches connecting the generator to either set of bus-bars, the engine governor controlling motor double throw switch, and the synchronizing plug are also placed on each panel. The field rheostat wheel is not on the panel, but is placed on a pedestal about 18 in. in front of the panel.

The exciter induction motor panel is equipped with an ammeter, indicating wattmeter and recording wattmeter. The time limit relay and auto-controlling switch and the crank for throwing compensator switch are on this panel.

The two exciter panels are equipped alike except that there is a starting switch on the motor-driven exciter panel for starting up from the direct-current end to overcome the inertia of starting, in case the starting compensator should be injured and cut out. A voltmeter, an ammeter field rheostat wheel, circuit-closing switch and potential plug constitutes the similar apparatus on each exciter panel.

The two 180-kw synchronous motor panels are similarly equipped. There is also a station panel for these motors. Each motor panel has an ammeter and power factor indicator, a field switch, field rheostat hand wheel and two levers for operating the two sets of oil-break switches. The station panel has an indicating wattmeter and a recording wattmeter, time limit relay, and two auto-controlling switches, only one of the latter being used at present, as there is but one oil-break switch in use.

The panels for the two 500-kw synchronous motors not yet shown in switchboard diagram will be of the same type and number as those for the 180-kw synchronous motors described above.

One of the two 125-kw synchronous motor panels has an ammeter, one recording wattmeter for both machines and a power factor indicator. The other panel has an ammeter, a power factor indicator and a time limit relay for the one oil-break switch of the pair. This panel also has the hand crank for operating the compensator. Both panels have field switches and field rheostat hand wheels, and two levers each for operating the two sets of type K oil switches for connecting each motor to the starting and running bus-bars respectively.

The rotary alternating-current panel will have an ammeter, voltmeter, besides a time limit relay, an auto-controlling switch and synchronizing plug and lamps. Synchronizing will be done by means of a Lincoln synchronizer. The rotary direct-current panel will have an ammeter and a voltmeter, the line switches, starting switches, field switch, potential plug, rheostat hand wheel and circuit-breaker.

The feeder panels are seven in number; four will be used by the Metropolitan Street Railway Company, placed at one end of the switchboard, and three to be used by the lighting company, placed at the other end. Each group of feeder panels has a station panel. The apparatus on each panel consists of the following except that the Metropolitan feeders will be in pairs on two oil-break switches; three ammeters, time limit relay and an auto-controlling switch controlling an oil-break switch. Each of the station panels are equipped with an indicating and a recording wattmeter. A Lincoln synchronizer is mounted on brackets on the Edison feeder end of the switchboard.

It will be noted that wattmeters are placed at points from which power is taken. There is no wattmeter measuring the total power of the plant. On each synchronous motor panel the power factor indicator enables the attendant to adjust his motor fields for the minimum input.

The 2,300-volt switchboard is placed at one end and at right angles to the 6,600-volt switchboard. It is made up of two generator and two feeder panels. Each generator panel has an ammeter, a voltmeter and an indicating wattmeter in each phase. A lever handle throws in a set of two-phase oil switches which connect the generator to the bus-bars. In addition there is a field switch and field rheostat handle and synchronizing plug.

Each feeder panel has a recording wattmeter which measures the power through both phases, besides an ammeter, voltmeter and indicating wattmeter in each phase. There are two levers to throw in the single-phase oil-break switches on each panel. Ground detectors for each phase are hung on brackets on one end of the switchboard past the arc panels.

A Lincoln synchronizer is hung on brackets at the other end. This instrument will be used to get the voltages of the two 2,300-volt generators in exact phase by manipulating the driving synchronous motor fields to secure that result, the relative position of the revolving field being changed by changing the field current. There are two panels which are continuous with the 2,300-volt board. These are equipped according to the usual standard type.

The Central Avenue Station was designed and laid out by Pierce, Richardson & Neiler, engineers, of Chicago, under their immediate supervision and that of their Mr. Richardson, the general manager of the Consolidated Lighting Company. Upon change of management of the company in June last, the work of installing and completing the plant was performed by Ford, Bacon & Davis, engineers of New York, under the direction of Mr. C. N. Black, the engineer in charge of their Kansas City office, and to whom the writers are greatly indebted for the means placed at their disposal for the minute study of the plant.

Electrical Transmission From Boston.

TIDEWATER at Boston marks the location of a 50,000-kw generating station that will presently supply energy to points 25 miles west and about 14 miles north and south of that city. The transmission system instituted for this purpose is an extension of the Boston Edison plants.

Up to this time the Edison Electric Illuminating Company, of Boston, has confined its service within the city limits, where its supply is exclusive with small exceptions. The large extension of the Edison system has been made possible by its purchase of the local electric lighting plants at Woburn, Somerville, Milton, Canton, Dedham, Needham, Newton, Natick and Framingham. The ten generating plants in these places will all be shut down, and the entire supply of enegry will be drawn from the new 50,000-kw. station at tidewater in South Boston.

To serve the area now supplied by the ten generating plants just named, six substations will be established, using five of the buildings now occupied as steam driven stations and building one new substation. The locations of these six substations and the names of the cities and towns supplied from each are as follows:

Location of substation.	Cities and Towns Supplied.
Newton	Newton and Watertown.
Somerville	Somerville and Arlington.
Woburn	Woburn, Stoneham and Winchester.
Dedham	Dedham, Canton, Needham and Westwood.
Natick	Natick, Framingham, Wellesley, Wayland, Ashland and Holliston.
Milton	Milton.

The new substation is to be built at Newton. From this list it will be seen that eighteen cities and towns are to be supplied from the six substations. The most distant portions of this territory are Ashland and Holliston, parts of which are fully 25 miles from the new generating station in South Boston. This station will contain generators that will develop three-phase curret of 60 cycles at 7,000 volts. Until the new station is ready for operation current for transmission to the substations already named will be obtained from the present South Boston plant, which operates three-phase and 60 cycles at 2,300 volts for distribution in Boston. This 2,300-volt current will be stepped up to 7,000 volts by raising transformers at the South Boston station for transmission to the substations pending completion of the new station with its 7,000-volt generators. In the location of substations for the wide area covered by the above eighteen cities and towns the idea has been to keep the number of these substations as small as is consistent with first-class service, and particularly good regulation.

The tranmission voltage of 7,000 was found to be sufficiently high to keep the loss in lines between the generating and substations down to 10 per cent. at times of maximum load with moderate costs of lines, and it was thought that a maximum loss as low as 10 per cent. was only warranted on the score of good regulations. Lines between the generating station at South Boston and the several substations are partly overhead and partly underground. As far as at present decided three main transmission lines will leave the South Boston station for the substations. One of these lines, 64,000 ft long, will pass to the Dedham substation, 35,000 ft of this length being underground and 29,000 ft overhead on poles. The underground portion consists of two cables, each containing three No. 4-0 conductors of copper. The overhead portion of this line consists of two circuits with three conductors each, two of these conductors being equivalent to 1-0 copper, 3-0 aluminum, and the third 2-0 copper. From the Dedham sub-station the transmission line continues a further distance of 55,000 ft. to the sub-station at Natick, which is 119,000 ft. from the plant at South Boston. Between the Dedham and Natick sub-stations the line will consist of three aluminum conductors 1-0 copper, equivalent, all overhead. The Natick sub-station is more distant than any of the others from the South Boston generating plant, being 22.5 miles by the line. From this sub-station the distribution lines will extend some six or seven miles further to Ashland and Holliston, so that the total length of the transmission to parts of these towns will be nearly 30 miles.

Another line connects the South Boston plant with the Somerville substation, a distance of 39,000 ft. Of this distance 18,000 ft. is covered by underground cables, and 21,000 ft. by overhead line. Two cables are used in this case, each containing three No. 4-0 copper conductors. The overhead line connecting with these cables consists of two circuits, and each circuit of three aluminum conductors of 4-0 copper equivalent. From the Somerville sub-station the transmission line continues a distance of 40,000 ft. to that at Woburn, which latter is 79,000 ft. by he line from the South Boston plant. Between the Somerville and Woburn sub-stations the line will consist of two circuits each with three aluminum conductors of 4-0 copper equivalent.

A third transmission line passes from the South Boston station to the Milton substation, a distance of 30,000 ft., 9,000 ft. of this distance being covered by underground cable and 21,000 ft. by overhead line. The underground portion of this line consists of one cable containing three conductors of No. 4-0 copper. The overhead section of the line contains three No. 1-0 copper conductors.

As may be noted above, all of the underground cable is made up of three No. 4-0 or 211,000 cm. copper conductors in a single casing. This cable is insulated entirely with paper. On each conductor the paper is 6-32 inch thick, and outside of the group of three conductors there is another layer of paper 6-32 inch thick. Outside of this second paper covering there is a casing 1-10 inch thick of lead. Spaces between the three conductors of each cable are filled with jute. All this cable is laid in Camp vitrified clay conduit of 3 inches nominal diameter. At junctions between the cables and overhead lines each cable is carried some feet up a pole, and where its conductors connect with the line wires tops are made for groups of lightning arresters. Each of these groups consists of three 2,500 volt arresters, giving a capacity of 7,500 volts, and the arresters are mounted in weather-proof housings on the poles. The large amount of underground work in this transmission is made necessary by the fact that the lines from the South Boston station must pass through the business sections of the city in order to reach the suburbs.

Cement used in laying the conduits was required to be freshly ground, of the best Roslindale grade, and to pass through a No. 50 sieve to the extent of 90 per cent. of its weight. Briquettes of neat cement 1-inch square in cross-section were required to have an ultimate tensile strength of sixty pounds after setting in water 24 hours, and of 100 pounds after setting in water for seven days. Concrete used on the conduits was composed of one part cement, two parts clean, sharp sand, and two parts screened gravel, or crushed stone, to be small enough to pass through a 1½-inch ring.

Before any concrete was laid spruce or pine side boards were placed in the ditch so as to be not less than 3 inches from the sides of the ducts when they should be in position. A concrete bed 4 inches thick was next laid on the bottom of the ditch, from one side board to the other. This bed of concrete was laid to line and grade, and properly rammed. After the tile ducts had been laid on this concrete bed a further layer of concrete at least 3 inches thick was placed at the sides and over the top of the ducts and well rammed. All ducts when laid were required to break joints and to be true to lines and grades. Every joint between ducts was plastered and the spaces between ducts filled with mortor, consisting of one part cement and one part sand.

A layer of kyanized or creosoted 2-inch plank was laid on the top of the conduit when finished. Each duct after it was completed was required to pass a mandrel of 2⅞ inches diameter. The brick walls of manholes were built on a layer of concrete 6 inches thick, and the outsides of these walls were plastered with hydraulic cement mortor consisting of one part cement and two parts sand. Mortor used to lay the brick walls of the manholes was of this same mixture. The bottom of each manhole was plastered and had its lowest point at the center. A layer of concrete 3 inches thick was laid over the iron manhole frame to a depth of 3 inches below the top of the brickwork. In cases where it was thought necessary each manhole was connected with the sewer, using a 6-inch pipe and a 6-inch 3/4 "S" trap, with strainer and cesspool of cast iron, complete for the purpose.

Poles used for the transmission lines were of live chestnut shaved, sawed square at both ends, and of the following dimensions:

Length feet.	Circumference at top, inches	Circumference 5 ft. from butt not less than inches.
35	25	42
40	25	44
45	25	50
50	25	57
55	25	63
60	25	69
65	25	75
70	25	82

On straight lines in earth or gravel, poles of the several lengths were set at the following depths:

Length, feet.	Depth, feet.	Length, feet.	Depth, feet.
35	5	55	7
40	5.5	60	7.5
45	6	65	8
50	6.5		

On curves all poles were set 6 inches deeper than here stated, and were given a certain amount of lean. Each hole for a pole was required to be 8 inches larger in diameter at the bottom than the butt of the pole to be placed therein. In filling about each pole one shovel and four iron tamps were required to be constantly in use, and large stones or bricks were not permitted to be used. Where the soil was too soft to tamp an artificial foundation for each pole was provided, and if the pole was located on a curve it was braced. Poles were so selected as to their lengths and locations that there might be no abrupt changes in the level of line wires. After its erection each pole was painted with two coats of raw linseed oil and white lead paint. Where necessary each pole was guyed with a cable consisting of seven No. 9 galvanized steel wires, and a strain insulator was placed in each guy cable at a distance of 6 ft. from its pole.

Galvanized iron steps were located on alternate sides of each pole in holes bored for the purpose at right angles to the cross-arms. These steps were spaced 18 inches on centres for poles of less than 63 inches circumference, and 12 inches on centers for poles of more than 63 inches circumference. Gains in the poles were painted with a coat of lead and raw linseed oil, and the cross-arms were placed in the gains before this point was dry.

All cross-arms were made of seasoned Norway pine, or long-leaf yellow pine, and were painted with two coats of white lead and raw linseed oil. Each cross-arm was fastened to the pole by two galvanized iron lag screens, each ⅝ inch by 8 inches, and fitted with washers. Two galvanized iron braces, each ¼ inch by 1½ inch in section, were used with each arm and fastened to it, and the pole by galvanized iron lag screens each ½ inch by 4 inches. Holes were bored for lag screws, and they were turned in, not driven in. All cross-arms were of standard six-pin size, with centres of pin holes 15 inches apart on each end of an arm. These cross-arms were located 30 inches apart on each pole, three arms per pole.

Locust pins, with steel cores, were used in all cross-arms. Each of these pins was 9½ inches long over all and 5½ inches long above the shoulder. The top end of each pin was cut with ten threads for a length of 2½ inches. At the top of each pin outside of the threads the diameter was ⅞ inch, and the depth of threads was about 3-32 inch. At the shoulder, just above the cross-arm, the pin diameter measured 1⅝ inches, just below the shoulder 1 7-16 inches, and at the lower end 1 5-16 inches. Each pin contained a steel core ⅜ inch in diameter, and extending from near the top to a point 2 inches below the shoulder. Pin holes were bored entirely through the cross-arms, and each pin was dipped in the lead paint before mentioned, and then driven into position. A ⅜-inch hole was bored through the cross arm and the center of each pin, and a ⅜-inch dowel of hardwood was driven entirely through the arm in this hole.

Glass insulators were mounted on these pins, each insulator having a double petticoat, a total height from top to lower edge of 5 inches and a diameter at its lower edge of 5½ inches. Line wires were tied to the sides of insulators. The copper and aluminum line wires were hung with sags that ranged from 12 to 24 inches on the regular spans of 125 ft. each. Line wires were tied to insulators by passing the tie wire around the insulators and then twisting each end of the tie four times around the line wire. All joints in solid line wires were made Western Union style, with four turns on each end and joints in copper lines were then soldered. Each joint was covered with two layers of rubber tape, and outside of this two layers of black friction tape. This joint was then painted with asphaltum paint.

The sizes of tie wires used with the several sizes of line wires were as follows:

Line wire No.	Tie wire No.
4	4
2	4
1-0	1
2-0	1
3-0	1-0

The ends of all tie wires were cut close to their line wires after being twisted about the latter.

All drops from line wires on a higher to those on lower arms were carried outside the ends of the higher arms by means of header cross-arms placed on the regular arms.

Lightning arresters are connected to each conductor cable outlets only at sub-stations. Each lightning arrester is grounded by a No. 1-0 copper wire run down the pole and twisted into a flat coil at the lower end. This coil is buried near the base of the pole at least 6 ft. under the surface of the ground. The No. 1-0 wire is insulated to a point 1 ft. below the surface of the ground, and below the insulation the wire and its coil are surrounded with broken coke.

The 7,000-volt overhead lines were so strung that all wires are 30 inches apart. Each pole carries three cross-arms and one wire of each three-phase circuit is strung on each of these arms. This arrangement of wires has been adopted to render it difficult to lodge a falling wire on other conductor on the two-line wires of the same circuit.

Distribution in the cities and towns supplied by this transmission system will be carried out with alternating current exclusively for lighting and stationary motors. Commercial lighting and stationary motors will be operated from three-phase circuits at 2,300 volts. Arc and incandescent street lamps will be operated with constant-current transformers in some cases, and with constant-current regulators in others. At Natick and at Woburn the present generating stations are delivering some 500-volt direct current for electric railways. When the transmission from South Boston is in operation these demands for railway current will be met by motor generators in the substations. The three-phase synchronous motors will draw current directly from the transmission line at 7,000 volts, thus avoiding the use of transformers. Arc dynamos will be done away with at all of the substations. Some of these stations already have constant-current transformers and regulators for arc and incandescent street lighting, but in other stations this class of equipment must be added. At each substation the 7,000-volt three-phase current from the transmission line will be transformed to 2,300 volts. Service transformers will reduce this pressure to 115 volts for lamps, so as to conform with the Boston practice, and make one voltage of lamps available for all renewals. Equipments for all of the sub-stations have not yet been decided on, but the following may be mentioned for some of them:

At Dedham three transformers of 250 kw. each, one 50-lamp constant-current transformer, and seven 7½-kw. regulators will be installed.

At Natick the new equipment will include three transformers of 200 kw. and three of 100 kw. each, four constant-current transformers for 50 lamps each, and six 7½-kw. and one 10-kw. regulators.

In the Somerville substation two transformers of 300 kw. each will be added.

All regulation of the distribution lines will be done at the substations; but in one or more instances, the 7,000-volt lines will be made a part of the distribution system, and will extend beyond a substation to a bank of stepdown transformers in another town. Thus the 7,000-volt lines will extend from the Natick substation to South Framingham, where a bank of transformers will reduce the voltage to 2,300 for the local service, but regulation of pressure for this service will be done at the Natick substation. In order to make regulation of this sort effective two 7,000-volt circuits will be strung between Natick and South Framingham, and one of these circuits will be devoted to street lighting while the other supplies commercial service.

Where two or more of the 7,000-volt circuits supply the bus-bars at a sub-station, each of these circuits is provided with automatic reverse current circuit breakers, so that a short circuit or ground connection on one of these circuits will not draw energy from the others through the substation switchboard. Time limit circuit-breakers will be provided at the several substations, and these breakers will be so set that short circuits on the more remote parts of the system will not interrupt the service on the parts nearer to the South Boston station. This result is reached by setting circuit breakers on more distant parts of the system so that they will open more quickly in case of a short circuit than the circuit breakers nearer the generating plant. The above described transmission system does not provide for electrical supply in Newton and Chelsea because the equipment that will be used to serve these cities has not been decided on.

The ten electric plants above named represent a large addition to the Boston Edison system in service area, connected load and earning capacity. Just how great the ultimate additions on this account may prove to be cannot now be stated, partly because many towns which now have no electric service lie close to the transmission lines, and may be expected to draw supplies from it at a future time. On June 30, 1902, the connected loads of the several electric plants were as follows:

Location of plant.	No. of arc lamps.	No. of incandescent lamps.	H.P. of motors.
Woburn	261	22,214	213½
Chelsea	330	17,062	447
Somerville	600	21,601	278
Milton	...	10,924	...
Canton	46	3,092	...
Dedham	36	7,212	...
Needham	...	3,047	1½
Newton	240	27,193	23½
Natick	23	7,869	20
Framingham	39	6,912	...

The foregoing figures do not include the connected loads of the municipal electric distributing plant in Wellesley for which energy has been purchased from the Natick plant. At Wellesley the municipal load was 597 incandescent lamps on the same date.

Combining these municipal loads with those before named it appears that the combined load on these ten plants amounted to 1,575 arc lamps, 124,676 incandescent lamps, and 1,396 horse-power in motors on June 30, 1902. Since that date this connected load has no doubt materially increased. For the year ending at the date just named the gross and net earnings of these ten stations from sales of electrical energy were as follows:

Location of plant.	Gross earnings.	Net earnings.
Woburn	$84,544.73	$37,731.38
Chelsea	70,841.00	11,918.77
Somerville	123,900.59	55,664.40
Milton	29,541.73	15,313.26
Canton	9,953.59	2,580.48
Dedham	24,028.29	8,906.31
Needham	7,932.68	772.26
Newton	79,458.86	12,549.62
Natick	37,553.32	6,289.86
Framingham	24,114.25	5,732.88

It may be expected that the economies resulting from the operation of the above loads by a single generating station will materially increase the ratios of net to gross earnings shown by above plants.

Steel Making by Electricity.

It is stated that Canadian capitalists have secured the Ruthenborg process of making steel by electricity, and in the near future will construct a mammoth electrolytic steel plant on the Welland River at Chippewa, using a large block of Canadian Niagara power. Dr. Haanel, Superintendent of Mines, recently returned to Ottawa from Lockport, N. Y., where he inspected the new process for the electrical treatment of magnetic iron ores. There are enormous beds of magnetic iron ore in Ontario and Quebec, which can be profitably utilized. There is, however, no fuel convenient to these deposits, but there are water powers from which almost unlimited electrical energy can be cheaply produced.

Rise of Efficiency in Electric Stations.

By Alton D. Adams.

EFFICIENCY of electric stations has made a marked advance during the past decade. To prove this proposition for stations in Massachusetts two classes of data are available, namely, the prices and incomes from sales of electrical energy on one hand and the capacities of lamps and motors supplied, with the weights and costs of fuel consumed on the other. Before 1896 figures for the cost of fuel in all the stations of the State are not available, but the costs of station operation in prior years give an indication of the relative costs of fuel. The truth of this last statement may be gathered from the fact that in the fiscal year of 1896 the cost of fuel for all stations under private ownership was 44 per cent. of their total cost of operation. For the year of 1890 the cost of operation at all of these stations was 39 per cent. of their income from sales of electrical energy, but for 1895 the corresponding per cent. declined to 35.

Energy incomes and costs of operation for all stations:

Year ending June 30.	Energy incomes	Costs of station operation.	Per cent operation costs to incomes.
1890	$1,908,394.00	$752,831.18	39
1891	2,432,869.15	1,014,242.88	41
1892	2,947,199.64	1,156,320.69	39
1893	3,427,576.84	1,376,946.15	40
1894	3,623,056.92	1,389,187.27	38
1895	3,794,060.41	1,358,689.83	35

From these figures it is hard to avoid the conclusion that the proportionate outlay for fuel declined rather than rose during the period. Beginning with 1896, the cost of fuel is separate from other items, and in that year this cost was 15.54 per cent. of the total energy income of all the private stations. The next three years each show a reduction of this per cent., and there was a slight rise to 14.18 in 1900. This corresponds to a reduction of 9 per cent. in the ratio of fuel cost to energy income during the period.

Energy incomes and costs of fuel:

Year ending June 30.	Total energy income.	Cost of fuel.	Per cent fuel cost to energy income.
1896	$4,148,681.71	$644,996.91	15.54
1897	4,467,146.60	693,479.59	15.52
1898	4,775,316.07	673,026.98	14.09
1899	5,046,412.75	702,925.20	13.92
1900	5,622,556.43	797,743.73	14.18

The two sets of figures just presented show a small decrease in the ratio of fuel cost to energy income during the decade under consideration. Assuming the cost of fuel per unit of heating capacity to have been constant during this period, the efficiency of electric stations must have risen slightly if prices were the same throughout. If average prices rose greatly, the general efficiency must have declined. If prices fell, the average efficiency advanced. At one of the largest inland stations of the State the average prices paid for coal in each year were: In 1892, $3.43; 1893, $4.14; 1894, $4.43; 1895, $4.07; 1896, $3.97; 1897, $4.29; 1898, $3.67; 1899, $3.75; 1900, $4.39 per ton. At a large station on tide water the prices were: 1895, $3.17; 1896, $3.35; 1897, $2.77; 1898, $3.13; 1899, $3.00.

Evidently these prices for soft coal, the principal fuel, did not cause the decline in ratio of fuel cost to energy income. Commercial prices per unit of energy sold by electric stations during the past decade cannot be accurately determined from the data at hand. It is possible, however, to show very clearly what the general movement of these prices has been during the period. One of the means by which a conclusion as to relative prices can be reached is found in a comparison of the total income from sales of electrical energy in each year with the dynamo capacities of electric stations in the same year. The table shows that for each kilowatt of dynamo capacity in electric stations of Massachusetts for the fiscal year of 1890, an income of $125.12 was received from sales of electrical energy during the year. For 1892 this income rose to $139.09, but since that year there has been a constant and rapid decline in its amount. This decline is not due to any falling off of the amount of energy sold, for the energy income of 1892 was only 52 per cent. of that of 1900. During the fiscal year of 1900 the energy income of electric stations per kilowatt of dynamo capacity was $81.51, or only 59 per cent. of the like income for 1892. Unless the conditions of electrical supply were much more adverse in 1900 than in 1892, this change of income seems to indicate a large reduction of prices. It may be suggested that the ratio of dynamo capacities to maximum loads has increased with the general improvement of electric stations, but it is at least equally true that average loads have gone up faster than maximum loads, due to the rise of electric motive power and the extension of day lighting in business houses. It can hardly be maintained that dynamo capacities have increased sufficiently, relative to the average load, to reduce the income per unit of capacity by 41 per cent. The only other conclusion is that of a reduction in price. The income figures thus far given are for both commercial and public lighting, but it can be shown that price reductions have taken place as to each sort of service. Beginning with the fiscal year of 1896, it is possible to divide the total energy income into the parts received for service to commercial arc lamps, commercial incandescent lamps, public arc lamps, public incandescent lamps and for electric power.

Energy incomes of electric stations per kilowatt of their total dynamo capacity:

Year ending June 30.	Kilowatts dynamo capacity.	Total energy income.	Total per kilowatt capacity.
1890	15,244	$1,908,394.00	$125.12
1891	18,593	2,432,869.15	130.84
1892	21,188	2,947,199.64	139.09
1893	26,953	3,427,576.84	127.16
1894	31,749	3,693,056.92	116.32
1895	33,256	3,794,060.41	114.08
1896	40,226	4,148,681.71	103.13
1897	45,461	4,467,146.60	98.26
1898	50,490	4,775,316.07	94.57
1899	63,020	5,046,412.75	80.07
1900	68,941	5,622,556.43	81.55

For the fiscal year of 1896, 11,100 public arc lamps were operated by electric stations at a total price of $1,170,627.73, or an average of $105.46 per lamp. The like average was less in each year thereafter, and in 1900 amounted to only $99.17 per lamp. This represents a reduction in price of 6 per cent.

Incomes and prices of public arc lamps:

Year ending June 30.	Number public arc lamps.	Income from public arc lamps.	Average price per lamp.
1896	11,100	$1,170,627.73	$105.46
1897	11,695	1,179,197.17	100.83
1898	12,104	1,247,708.61	103.08
1899	13,092	1,278,571.07	97.66
1900	13,462	1,335,103.02	99.17

Public incandescent lamps are a comparatively unimportant item, and the total income derived from them is only about one-fourth of the like income from public arc lamps.

Incomes and prices of public incandescent lamps:

Year ending June 30.	Public incandescent lamps.	Income from public incandescent lamps.	Income per lamp.
1896	13,307	$251,393.03	$18.89
1897	14,834	292,492.01	19.71
1898	15,632	319,671.36	20.45
1899	15,980	320,706.55	20.06
1900	17,611	336,593.11	19.11

Between 1896 and 1900 the income of electric stations per public incandescent lamp varied but little, having been $18.89 in the former year and $19.11 in the latter, an increase of 1 per cent.

Turning to commercial service, a much more rapid reduction of prices is notable than that found for public lamps. Commercial arc lamps numbered 7,614 in 1896 and the average income from each was $68.57. In 1900 there were 9,893 of these lamps and the average income per lamp was $53.81. The latter year thus shows a reduction as to the former of 21 per cent. in the average price per lamp in use.

Incomes from commercial arc lamps:

Year ending June 30.	Commercial arc lamps.	Income from commercial arc lamps.	Income per lamp.
1896	7,614	$522,105.08	$68.57
1897	7,834	575,834.23	73.50
1898	7,743	564,593.82	72.91
1899	8,161	529,459.80	64.87
1900	9,893	532,374.29	53.81

In this connection it may be noted that for the year of 1896 each public arc lamp yielded a revenue of 53 per cent. greater than the revenue from each commercial arc lamp, on an average. For 1900 the average revenue from each public arc was 84 per cent. greater than that from each commercial arc. Commercial income per connected incandescent lamp, like that per arc, shows a material decline between 1896 and 1900.

Incomes from commercial incandescent lamps:

Year ending June 30.	Commercial incandescent lamps.	Income from commercial incandescent lamps.	Income per lamp.
1896	535,072	$1,687,255.58	$3.15
1897	648,139	1,828,844.28	2.82
1898	743,266	2,006,414.96	2.69
1899	851,742	2,190,493.10	2.57
1900	973,579	2,580,019.28	2.64

Commercial incandescent lamps to the number of 535,072 yielded an average income of $3.15 each in 1896, and 973,579 of these lamps earned $2.64 each in 1900. These figures show a decline of 16 per cent. in the income per lamp for the period. Each public incandescent lamp yielded an average revenue 500 per cent. greater than each commercial incandescent lamp for the year of 1896, and for 1900 this per cent. rose to 624. Electric motors as well as lamps show a decided reduction of commercial income per unit of capacity during the period under consideration. For 1896 the rated capacity of motors supplied from electric stations was 13,930 hp, and the average income per horse-power from these motors was $37.13.

Incomes from electric motors:

Year ending June 30.	Horse power of all motors.	Income from electric power.	Income per horse power.
1896	13,930	$517,300.29	$37.13
1897	16,318	590,778.91	36.20
1898	18,930	636,927.32	33.64
1899	22,740	727,182.23	31.95
1900	27,133	838,466.73	30.90

In the year of 1900 electric service to motors of 27,133 aggregate horse-power yielded an average income of $30.90 per hp. The income per unit of connected capacity for electric motors was thus 17 per cent less in 1900 than in 1896. Public lighting as a whole during this period yielded a declining income per unit of energy capacity in the lamps supplied, because the fall of 6 per cent. in the average earnings per arc more than offsets the rise of 1 per cent. in the average earnings of each public incandescent lamp. This reduction of income per public lamp, and, in commercial service, a fall of 17 per cent. per horse-power of motors, 16 per cent. per incandescent lamp and 21 per cent. per arc lamp, in average yearly revenue, seem to point to lower prices for energy all along the line. Against such a conclusion it can only be urged that the average hours of service from each lamp and motor per year have decreased during the period. Just the reverse of this is probably true, however, as it is a matter of general observation that the tendency has been for the daily periods of service from street and private lamps and from motors to increase. It follows that prices have fallen at least as rapidly as the income per unit capacity in lamps and motors supplied. While the ratio of fuel cost to energy income has declined more than 9 per cent., the energy income per kilowatt capacity of dynamos in electric stations has grown smaller by 41 per cent., and like income per unit of capacity in connected lamps and motors has shrunk from 6 to 21 per cent. All this argues a substantial increase of efficiency. Results thus far relate to all of the electric lighting stations of the State under private ownership, and show merely the average result. As many stations may have failed to make material advances in efficiency, particularly in small places, it is probable that the best stations have done much better than just indicated. Massachusetts contains 33 cities. In three of these the electrical supply is derived from stations in other cities. Two cities operate public electric plants. Water power is used in connection with electric stations in three cities. Of the 25 remaining cities, 24 have only one electric lighting system each, and one, Boston, has several such systems. Two of the electrical systems at Boston and the single system in each of the other 24 cities are here considered to determine their changes of efficiency during the past decade. The first step in this direction is to find the yearly energy income at each city per ton of coal consumed by its electric lighting system. Coal is stated in long tons of 2,240 pounds each. Small amounts of coke have been used in some plants, and this coke is included with the coal on the basis of 2,000 to the ton. In instances where screenings have formed a part of the fuel, only 85 per cent. of their weight has been added to that of the coal. For each electrical system the income derived exclusively from sales of energy in each year has been divided by the corresponding number of tons of coal. Each electrical system is designated by the name of the city in which it is mainly located. A glance at the table shows great diversity of results; in some systems the income per ton of coal has remained nearly constant; in others it has largely increased, and in still others it has materially declined. Good examples of nearly constant incomes per ton of coal, looking at the entire period rather than at fluctuations in single years, are found in Lowell, Fall River, Lynn, Somerville, Newton, Waltham, Brockton, Northampton and Marlboro, a total of nine cities. In five cities there has been a decided decrease in the energy income per ton, namely in Pittsfield, Chelsea, North Adams, Beverly and Newburyport. Twelve plants, namely, the Brockton Edison, Boston Electric, Cambridge, Worcester, Salem, Woburn, Haverhill, New Bedford, Quincy, Gloucester, Malden and Fitchburg, have yielded a substantial gain in the income per ton. As a rule, the incomes per ton of coal for each system are consistent from year to year, and show only such changes as may readily be due to fluctuations in prices or to improvements of efficiency. There are, however, a few figures for incomes per ton that seem to be due to errors in the original reports as to the tons of coal burned in certain years. Incomes per ton that are probably incorrect are those at Lowell, Worcester and Malden in 1892, at Somerville, Haverhill and Newburyport in 1893, at Newton and Beverly in 1896, at Woburn and New Bedford in 1898, at Newburyport in 1897, and at Beverly and Newburyport in 1900. Reports for the weight of coal from 26 stations during nine years involve 234 separate quantities, and the eleven reports that appear incorrect constitute only 5.5 per cent. of the total. In general it may be fairly said that these figures as to incomes per ton of coal carry on their face evidences of truth, when considered with the known facts of electrical supply. It is of interest in this connection to know that the figures for fuel consumption are sworn to by the officers of electric corporations, as required by law, and a willful misstatement is perjury.

Energy incomes of electric stations in dollars per ton of coal burned:

Stations.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.
Boston, Edison	23.89	20.85	25.17	30.63	33.12	32.23	29.57	26.20	28.75
Boston, Electric	21.48	24.47	23.91	23.81	23.24	23.65	22.53	21.15	31.24
Lowell	32.83	22.39	24.07	20.44	24.14	24.50	17.16	21.22	21.90
Cambridge ...	18.22	21.16	21.60	21.82	19.81	19.55	21.77	22.36	24.59
Pittsfield	17.54	17.06	15.95	14.69	13.64	12.32	14.26	13.98	12.75
Fall River	29.61	34.02	33.16	32.02	32.77	28.57	27.27	27.16	29.00
Worcester	39.56	33.08	34.78	32.63	35.86	38.25	40.28	40.38	44.40
Somerville ...	19.34	37.27	23.17	19.57	22.76	21.83	23.07	22.57	22.07
Lynn	34.38	32.15	35.12	37.93	39.27	37.29	37.31	34.78	32.69
Salem	18.75	18.45	18.71	21.02	21.32	24.43	23.71	21.70	22.19
Brockton	22.92	20.87	18.57	16.01	20.28	18.74	18.29	18.43	19.61
Chelsea	25.20	22.17	20.10	18.55	18.23	16.37	15.04	17.09	17.32
Newton	15.27	11.13	13.51	14.67	90.61	13.39	15.46	14.26	16.66
Waltham	13.57	17.56	16.12	14.51	13.83	12.76	14.39	14.28	14.64
North Adams .	25.13	17.66	21.76	20.18	18.51	13.72	14.35	16.05	15.12
Woburn	....	13.37	14.39	12.28	12.82	11.60	8.36	11.43	18.62
Malden	28.77	18.43	26.37	22.82	24.31	22.84	24.88	24.53	25.45
Haverhill	18.26	51.10	28.35	23.77	25.32	24.71	27.57	26.21	30.61
New Bedford .	17.58	17.32	22.39	24.65	25.21	26.18	42.23	24.05	32.31
Fitchburg	26.93	24.99	31.00	25.14	23.68	24.17	25.34	28.46	29.81
Northampton .	19.51	24.04	20.63	19.38	17.92	20.08	20.45	20.71	18.46
Quincy	15.01	14.67	14.51	14.68	17.46	19.58	19.96	19.10	20.46
Gloucester	23.81	17.49	14.72	17.52	15.91	22.17	19.36	22.38	24.25
Beverly	30.88	32.09	34.98	33.26	42.94	15.53	15.57	16.97	36.07
Marlboro	26.12	26.68	23.38	21.37	21.67	21.69	22.32	22.05	24.63
Newburyport ..	30.26	36.71	27.75	23.49	24.54	6.38	21.67	23.44	33.10

Of the 26 electric lighting systems above considered, 9 are owned by gas companies, namely those at New Bedford, Lynn, Newton, Fitchburg, Chelsea, North Adams, Waltham, Beverly and Newburyport. The remaining 17 lighting systems are owned by purely electric corporations. Of these 9 gas companies that operate electric lighting systems, those at Chelsea, North Adams, Beverly and Newburyport, or 44 per cent. of their totals, show a decided decline of energy income per ton of coal during the decade. The gas companies at Lynn, Newton and Waltham, or 33 per cent. of the total, have held their income from electrical energy per ton of coal at a fairly constant figure. Two gas companies, those at New Bedford and Fitchburg, or 22 per cent. of those operating electrical systems, have made decided gains in their energy incomes per ton of coal. Of the 17 purely electric systems, the Boston Edison, Boston Electric, Cambridge, Worcester, Salem, Woburn, Haverhill, Quincy, Gloucester and Malden plants, or 58 per cent. of the total, have earned a rising income per ton of coal during the decade. The plants at Lowell, Fall River, Somerville, Brockton, Northampton and Marlboro, being 35 per cent. of those that are purely electric, have maintained a nearly constant energy income per ton. Only one purely electric plant, that of Pittsfield, representing 6 per cent. of the 17, has suffered a decided loss in energy income per ton. While 58 per cent. of the purely electric companies have gained in energy income per ton, only 22 per cent. of the gas companies have made similar gains. While 44 per cent. of the gas companies have lost in energy income per ton, only 6 per cent. of the electric companies have made a similar loss. These facts bring to mind the words of a very old book concerning a man who tries to serve two masters.

Omitting the figures above stated to be probably incorrect, the most notable changes in incomes per ton of coal between the years 1892 and 1900 are as follows: Comparing incomes in the latter with those in the former year, it appears that the Boston Electric system made a gain of 45, the Haverhill of 67 and the New Bedford of 83 per cent. per ton of coal. On the other hand, between 1892 and 1900, Pittsfield lost 27, Chelsea 31, North Adams 40 and Beverly, to 1899, 45 per cent of the energy income per ton for the earlier year. At first glance it may be thought that declining incomes per ton necessarily imply lower efficiencies, but this is not conclusive, for the influence of changes in prices has to be reckoned with. Unless prices have risen to a corresponding degree, increasing incomes per ton of coal certainly indicate higher efficiencies. In order to draw certain conclusions as to efficiencies in these 26 electrical systems, it is necessary to determine the movements of the prices they received for electrical energy during the period. It is alike impossible and unnecessary to find the actual prices paid for each class of service, but relative prices from year to year can be ascertained, and this is sufficient for present purposes. For each electrical system the income from sales of electrical energy and the total connected load are given yearly. If the energy income is derived in each case by the number representing the kilowatts of total connected load, the income per unit of connected load in each year is determined, and relative prices are approximately shown, from year to year. The connected load is made up of three items: arc lamps, incandescent lamps and motors. To obtain from these items the equivalent kilowatts of connected capacity, the number of arc lamps is multiplied by 0.4, the number of incandescent lamps by 0.06, and the horse-power of motors is taken to represent kilowatts, thus implying an efficiency of 74.6 on an average.

Figures thus obtained for these three kinds of loads are added to obtain the total kilowatts of connected capacity for each system yearly. It is not thought that these kilowatt figures are exact, but it seems that they are sufficiently accurate for present purposes, and that any errors they contain will not operate more strongly in one year than in another. The number representing total kilowatts of connected capacity for each station in any year is used to divide the energy income of the station in that year. These calculations have been carried out for the 26 electrical systems in the years 1892 and 1900. No doubt the general reduction of incomes per kilowatt capacity in connected lamps and motors is due in large part to the fact that the average yearly hours of service to parts of the apparatus have decreased.

Incomes of electrical systems per kilowatt capacity of connected lamps and motors:

System.	Income, 1892.	Income, 1900.
Boston Edison	$66.55	$48.54
Boston Electric	248.66	82.67
Lowell	140.39	43.66
Cambridge	204.00	52.52
Pittsfield	99.32	53.27
Fall River	250.10	76.23
Worcester	253.35	99.48
Somerville	162.23	75.66
Lynn	150.05	55.62
Salem	159.15	51.74
Brockton	73.81	54.27
Chelsea	104.62	51.86
Newton	130.46	50.52
Waltham	179.68	59.06
North Adams	201.09	37.87
Woburn	97.73	46.43
Malden	152.56	64.09
Haverhill	190.19	58.53
New Bedford	72.10	48.80
Fitchburg	162.71	71.84
Northampton	108.70	40.80
Quincy	146.40	49.60
Gloucester	171.45	52.13
Beverly	228.41	66.93
Marlboro	133.52	52.72
Newburyport	209.65	120.03

This decrease is largely due to the great additions of residence lighting. It seems quite certain, however, that varying portions of the reductions in incomes per unit of connected capacity are the result of lower prices. Figures for incomes of the Edison systems at Boston, Brockton and New Bedford support this view, as it seems very improbable that these low-pressure plants have taken on enough residence lighting to lower their incomes to the extent indicated. It is also to be noted that these three systems, which have made comparatively small extensions to residences, have lowered their incomes per connected kilowatt capacity less than any of the other plants. Between 1892 and 1900 the income per kilowatt of connected apparatus of the Boston Edison decreased 27, of the Brockton Edison 26, and that of the New Bedford Edison 32 per cent. Meantime the Boston Electric Company, selling in direct competition with the Edison Company, in the territory of the latter, reduced its income per kilowatt of capacity in connected apparatus 67 per cent. How much prices of electrical energy have been reduced in any particular city cannot be determined, because of the variable factor of residence lighting, but that they have been lowered to some extent in every case seems practically certain. With this result in view, it appears that electrical systems which have maintained a nearly constant income per ton of coal, must have increased in efficiency. Even plants where the income per ton has declined may have lost only through lower prices. In the larger number of purely electrical systems the energy income per ton of coal has persistently risen in the face of falling prices. The obvious conclusion is that a very substantial rise in efficiency has taken place during the decade.

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Expansion of Electrical Supply in Springfield, Mass.

ELECTRICAL supply in Springfield, Mass., which is mostly transmitted from two water-power stations on the Chicopee River, is expanding rapidly. This fact appears at once from the figures for the output in kilowatt-hours of the system. Taking the number of kilowatt-hours delivered by the Springfield system during the year ending June 30, 1901, as unity, the corresponding number for the year ending at like date in 1902 was 1.10 and in 1903, the present year, 1.23, thus showing an increase of 23 per cent. in two years. The importance of water power in this system, as well as the present rapid rise of its energy output, is shown by the fact that the kilowatt-hours developed by water power alone during the six months ending June 30, 1903, amounted to 45 per cent. of the entire electrical output from both steam and water power during the year ending on that date.

This increase of energy output has followed a rise in the connected loads of the system as follows:

LOADS, YEAR ENDING JUNE 30.

No. arc lamps.	No. incandescent lamps.	H.P.-motors.	Year.
1,285	41,124	902	1901
1,352	47,579	969½	1902
1,518	50,296	1,400	1903

The greatest gain has been made as to the motor load, for while the numbers of arc and incandescent lamps have each increased about 25 per cent. since 1901, the horse-power of connected motors has risen 55 per cent. This motor load is still on the increase, a contract having just been closed to supply an entire factory equipment of two-phase induction motors with an aggregate capacity of 800 horse-power.

During the year the old electric light station on the bank of the Connecticut River in the heart of the business section of Springfield has been entirely remodeled and is now a brick, tile and steel structure throughout. This building does duty as sub-station for the transmission from the water powers and also contains the auxiliary steam plant, which includes condensing engines of 1,650 aggregate horse-power with their connected generators. Besides the 800 kw added to the generating capacity of the water power stations last year a further increase of 600 kw will be made during the present summer at the Indian Orchard plant. At the steam plant in the sub-station just mentioned are four boilers of 215 hp and three of 300 hp each, all being of the vertical, Hazelton water tube type.

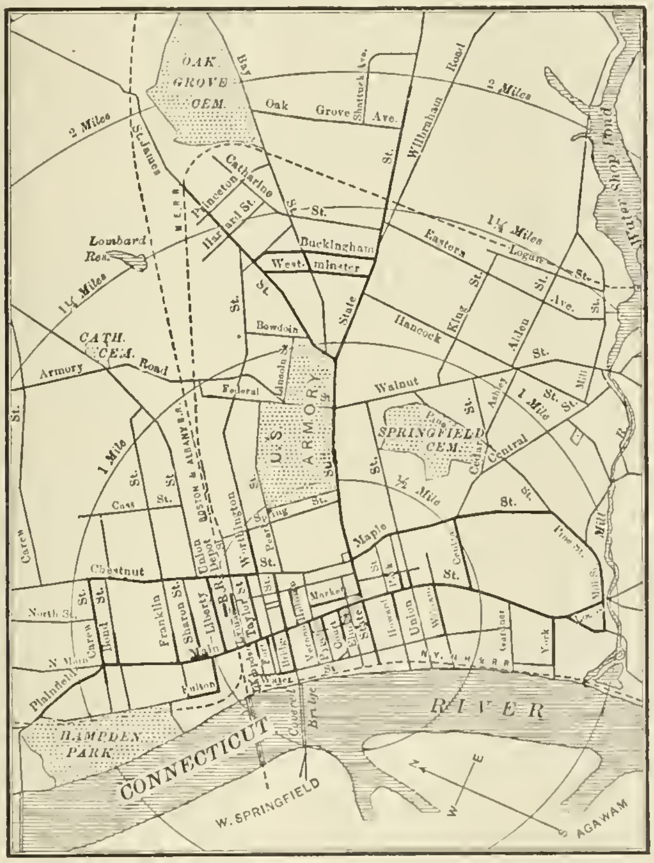
The most notable extension of the Sprinfigeld system during the past year, aside from the very large addition to its motor load, has been in the direction of underground conduits and cables. Though Springfield had a population of only 62,059 in 1900, standing ninth among the cities of the State in this respect, yet as to length of underground conduits and of electric light and power circuits therein it was surpassed by only Boston and Worcester, in 1902. On June

30 of that year the Springfield system included 58,830 ft. of underground conduit containing 303,461 ft. of cable. During the year ending June 30, 1903, there have been added to the Springfield underground system more feet of conduit ranging from 2 to 36 duct, than it had at the beginning, and in this conduit the length of cable installed amounts to 368,706 ft. This cable is all rubber-covered and leaded, and varies in size from No. 8 to 500,000 cm. Both single and duplex cables have been laid, the former for direct-current arc circuits of 10,000 volts, and the latter for two-phase alternating circuits of 2,500 and 6,000 volts respectively. The 6,000-volt cable forms a part of the transmission lines between the water power plants and the sub-station, and the 2,500-volt cable is used in the distribution system.

UNDERGROUND CABLES LAID DURING YEAR ENDING JUNE 30, 1903.

Length in feet.	Size of conductor in cable
13,350	Number 8
158,794	Number 6
94,206	Number 4
6,040	Number 2
206,858	Number 0
13,000	Number 00
852	Number 0000
16,606	500,000 c. m.

The single-conductor, 10,000-volt cable is insulated with rubber to a thickness of 7/32 in. and outside of this is a lead sheath 5/64 in. thick. The 6,000-volt duplex cables have a covering 8/32 in. thick of rubber on each conductor, and outside of this 3/32 in. of lead over all. In the 2,500-volt cable the thickness of rubber on each conductor is 7/64 in. and the lead sheath is 3/32 in. thick



MAP SHOWING UNDERGROUND DISTRIBUTING SYSTEM, SPRINGFIELD, MASS.

In connection with the lengths of underground conduit shown in the table, 188 manholes have been constructed. All conduits were laid with vitrified clay duct having 3-in. openings and in lengths of 18 in. In single-duct the 3-in. opening is circular and in multiple duct the openings are each 3 in. square in section.

All conduits were laid on a foundation of concrete 4 in. thick and then the 4-in. layer of concrete was extended over the sides and top of the conduit when completed. Ducts were so laid as to break end joints and with ¼ in. of cement mortar between the different layers. Portland cement was employed for both mortar and concrete, the proportions for mortar being one part cement and two parts sand. For concrete the mixture was one part cement, 3 parts sand and 5 parts broken stone. Broken stone in concrete for use about the conduits was all required to pass through a 1½-in. ring, and for manhole concrete through a 2½-in. ring. In laying multiple ducts a strip of burlap 6 in. wide was dipped in coal tar or neat Portland cement and placed about each end joint. Dowel pins were used at end joints of multiple ducts, the pins extending 3 in. into each duct. The trenches in which ducts were laid had a depth in each case such that the top of the layer of concrete over the completed conduit is 18 in. below the surface of the street. After the completion of the conduits a mandrel 12 in. long and 2⅞ in. in diameter was pulled through each duct.

UNDERGROUND CONDUITS LAID DURING YEAR ENDING JUNE 30, 1903.

Length in feet.	Number of ducts.	Length in feet.	Number of ducts.
9,792	1	124	15
3,101	2	5,485	16
962	3	244	18
9,742	4	6,290	20
18,451	6	690	21
105	7	910	24
310	8	260	25
7,478	9	45	36
4,930	12		
2,530	13		
277	14		

The 188 manholes before mentioned were constructed on concrete foundations 6 in. thick, and the sides of the manholes were 8-in. brick walls laid in cement mortar. Each manhole is provided with a cast-iron frame and cover at the top weighing about 1,000 pounds.

These facts relative to the growth of the system owned by the United Electric Light Company at Springfield have been collected through the courtesy of the manager, Mr. Walter L. Mulligan.

Isolated Plant vs. Central Stations Supply of Electricity. A Suggestion for Obtaining Estimates of Costs on a Competitive Basis.

By R. S. Hale.

The question of isolated plant vs. central station supply is one of perennial interest, and is one of which there seems to be no general solution. The operating engineer who is or who expects to be in charge of the heating boilers of a modern building is always sure that an isolated plant is the cheapest for the owner, and so are the salesmen of the machinery, and frequently the architect and consulting engineers, who are to lay out the plant are also in favor of putting in such an installation. On the other hand, the fact that so many large buildings take central station current shows that there are some business men who think the estimates of isolated plant cost are, to say the least, optimistic. Recently the question came up in regard to a building in which I was interested, and a conversation with one of the machinery salesmen suggested to me that the conflicting estimates on the one hand of the central station man, who is sure that electricity from an isolated plant really costs about 20 cents per kw-hour, and on the other hand the estimates of the engineer who is sure that he can run dynamos and engines with no extra labor and save so much coal by using the exhaust steam for heating that the total coal bill with a plant will be even less than for heating alone, could be compared in such a way as to disprove or verify one or the other by bringing them to a basis where they must be backed up by a definite proposal and contract.

The suggestion is that a company might be formed whose business it should be to install and run isolated plants. Such a company would go to the owner of a building and propose a contract as follows: The owner to let to the company space sufficient for the installation of boilers, engines, dynamos, etc., at an annual rental; the company to agree to supply heat, light and power from this plant to the owner of the building and to his tenants.

Such a contract would, of course, be by no means as simple as the contract that the central station man could offer, but the various clauses would involve no insuperable difficulty. In the first place, of course, it must be drawn for a long term of years, the length depending on the expected life of the plant to be installed. Thus, if an owner puts in his own plant he expects to run it for say 10 years and to pay interest and depreciation on it during this time, since after he has put in his own plant he cannot take it out except at a loss. He should, therefore, be willing to make an equally long contract with the isolated plant company.

The contract might very properly be made with a sliding price, depending on the price of coal. Thus, the price for steam heating might be fixed at 40 cents per square foot, and for electricity at 8 cents per kw hour on the basis of a price of coal of $4 per ton, with a provision that for every 10 per cent. increase in cost of coal, the price of heat and light should be increased 5 per cent., and vice versa. If the cost of coal should go down, the price of light and heat should be correspondingly decreased.

The contract should provide for a minimum annual payment, which would correspond to the amount the owner would have to allow for the interest, depreciation and care of the plant, which he would have to pay whether he used it or not, and there should also be an upper limit to the amount of light or heat that the owner of the building could require at any one time, this amount corresponding to the capacity of the plant.

In fact, a good lawyer assisted by a good engineer, could easily draw up a contract so that the owner of the building would have no more obligations and no more burdens than if he put in the plant himself. On the other hand, if the owner of the building would let space in his basement for such a company, the company could supply all the heat, light and power that the owner could get from his own plant at rates at least as low as the owner could make it for himself, and show a very good profit. To-day the owner of a building is usually willing to pay the central station 10 per cent. or 15 per cent. more for current than he figures he can make it for himself in a private plant, merely to save himself the trouble of running such a plant. An isolated plant company, on the other hand, could take all this trouble off the owner's hands while still saving to the owner this 10 per cent. or 15 per cent. difference in price, since the isolated plant company would have many sources of saving not open to the owner of the small plant. The isolated plant company would be able to buy all its coal, its oil and all supplies in quantity at a better rate than the independent plant. It would not have to keep such a large store of coal, since in case of shortage it could distribute what coal it could get evenly instead of having some of its plants overstocked and others without coal. Such a company would be able to put an ordinary engineer in charge of each plant, with a first-class man in general charge of several plants to look after the repairs and maintenance of them all, while the owner of a single small plant would have to pay proportionally more for a first-class engineer, who would have to spend a large portion of his time on work that might just as well be done by a cheaper man.

A company running several isolated plants would have sufficient data and experience to enable it to buy the best and most economical form of machinery, while several independent plants each run by the owner of the building who would not be an expert in that line, could not be run so economically.

When it is remembered that all these profits are in addition to the interest and depreciation figured in at the start on the plant, whether put in by the owner or the isolated plant company, it appears that a company engaged in running numerous isolated plants ought to show a tremendous return on the investment besides the ordinary interest and depreciation, and there should be a tremendous field for such companies not only in the large cities, but in the cities of the second class.

Central stations should welcome such a company, since if it be true, as they claim, that the cheapest way of supplying a modern large building is for it to use a plain low-pressure heating system from boilers in the basement for heating only, while buying light and power from the central station, then a company which undertook the whole supply of several large buildings would quickly become the best customer of the central station. On the other hand, if the central station cannot really compete with the isolated plant it had better learn the fact before it invests any more capital in plant and underground mains that will be useless when all current is supplied from isolated plants.

The fact, however, that such companies to run isolated plants have not been started, or at least have not been a permanent success in our cities, is pretty good evidence that the rosy estimates of 1 and 2 cents per kw-hour as the net cost of electricity from private plants are not correct.

Electric Sewage Pumping at Sydney, New South Wales.

For low level sewage pumping the Sydney, New South Wales, Water and Sewerage Board have gone in extensively for electrical driving. The first electrically-driven plant was put down at Double Bay, the "Shone" system of compressed air ejectors being used, the air compressors being driven by electric motors. The plant is practically in duplicate, there being two air compressors, each of the double acting duplex pattern, fitted with positive valve motion, making 200 r.p.m. when running at full speed, and having 11 inch cylinders and 18-inch stroke, and fitted with water sprays, cooling jackets, etc. An intermediate shaft is used, to which either or both compressors or motors can be attached by means of special couplings. The connecting rod of each compressor is attached to its respective separate crank shaft. The intermediate shaft runs at a speed of 100 r.p.m., and carries the necessary flywheels and spurwheels. The motors are two 25-hp. Parker make, with toothed core armatures, Eickmeyer winding, and are geared to the intermediate shaft by means of spurwheels and pinions.

The whole plant is designed to work automatically, starting and stopping according to the rise and fall of the air pressure, which in turn depends upon the quantity of work to be done. The principle adopted is the rising and falling of a piston actuating a hydraulic relay; the water is thus admitted into a starting or stopping cylinder, as the case may be, which in turn actuates a rack and pinion, the latter being directly connected to the electrical controller shaft. For the purpose of obtaining the necessary quick movements from contact to contact, the piston travel is so arranged that it is stopped by a die-plate after having reached the end of the predetermined portion of its strike. Having now made its corresponding contact in the controller, the controller spindle cannot again be moved by the traveling piston until the die-plate moves and allows it to travel to the next position, where it is again caught by the plate, with the result that each successive movement from one position of the controller to the next takes place rapidly and with certainty. The blowing out of the arc is accomplished by means of a small air-blast of compressed air, automatically turned on and off by means of a special valve situated in the foot of the controller itself and actuated by the controller spindle.

A set of 230 Epstein cells of 180-hour capacity has been provided as a safeguard against stoppages of the generators, and to provide for the supply of power during such times as the cable engines driving the generators are not running. This plant has been running for over a year now, and has proved so successful, not having required any special attention or repairs of any kind, that the Board decided to utilize electrical driving on an extensive scale, especially as they have been able to obtain power from the tramway power house on exceptionally favorable terms. In future extensions electrically-driven pumps will be used pumping the sewage direct.

The present operations, involving 21 pumping stations, extend along the shore of the harbor from Snails Bay, Balmain to Double Bay. A separate steam-driven plant serves the low lying portions of Marrickville. The largest station, serving as a head station from which all others will be controlled, will be situated alongside the Darling Harbor railway line, close to the Ultimo Power House. Electrically controlled mechanism will be used for indicating at the Pyrmont station the level of the sewage in the receiving wells at the other stations, as well as specially arranged telephonic communication designed so that the attendant in charge may hear the pumps and machinery working at any of the different stations and detect any irregularity in the working. A large subterranean chamber below the street level, which is hewn out of the solid rock, contains the pumping machinery and electric motors for dealing with the sewage from the low-lying portion of Pyrmont and Darling Harbor. Power is supplied here from the Ultimo Power House and distributed to the other pumping stations.

The outlying pumping stations are practically similar to the underground portions of the controlling stations and are of various sizes, according to the area of the district to be served by the station. Some of the stations are situated below the surface of the road, where no other suitable place could be found for it. These consist of a huge caisson built up of cast-iron plates. It is about 28 ft. by 20 ft. wide and 20 ft. high, weighing 80 tons. The interior is oval in shape, and the two ends of the oval are partitioned off by further iron plates, forming two receiving tanks for the sewage, the centre portion being reserved for the machinery. About half the stations are in hand and several are ready to receive the machinery. The pumps are being manufactured by the Clyde Engineering Company, of Sydney, the motors being supplied by the Westinghouse Company. The overhead material and mains are being supplied by Callenders and Henleys, and the construction work is in the hands of Messrs. Edge and Edge. The Brush Electrical Engineering Company will supply the switchboards and controlling mechanism. The total cost is estimated at about $500,000.

An Object Lesson in Telephone Receivers.—I.

By Arthur V. Abbott, C. E.

An analysis of the telephone receiver indicates that it may be viewed from three different standpoints. It may be considered magnetically, electrically or mechanically. There is no receiver now manufactured which is best from all of these various standpoints, but each one contains certain admirable features which make it superior for a particular purpose, and so the manager of a telephone plant must weigh the various advantages offered by each model and choose that which seems best suited for his particular service. Receivers for local battery exchanges must be utterly different electrically from those designed for common battery installations. Where many toll lines exist, and a large proportion of the business is long-distance work, a type of receiver entirely different in design, both electrically and magnetically, is desirable from that which is sufficient for the country village whose conversations are relatively of less importance and never traverse more than a mile or two of wire. Mechanically, the highest types of receiver are more expensive to construct, produce better results and last longer than the cheaper varieties. Naturally a small country exchange, whose subscribers cannot be reckoned by hundreds, can use a type of receiver which would not be tolerated by the city plant having tens of hundreds of subscribers.

Viewed from the standpoint of the magnetic circuit, receivers may be subdivided into four classes:

1st. Single-pole receivers.
2nd. Double-pole.
3d. Single-bar magnets.
4th. Laminated magnets.

Electrically, according to the design of switchboard into which receivers are to work, there are two divisions:

1st. Local battery receivers.
2nd. Common battery receivers.

Mechanically, it is possible to class receivers into two divisions, depending upon the method of assembling.

1st. Receivers in which the magnetic system and diaphragm are rigidly connected together, independently of the case, and

2nd. Those in which the case forms the supporting foundation for the entire mechanism. Under the two classes of this division there are two sub-classes, namely, (*a*) receivers with external cord connections, and (*b*) those with internal cord connections.

Now it is proposed to examine and describe a few of the more familiar types of receivers with the view of ascertaining the present status of the art of receiver manufacture. As comparisons under all circumstances are invidious, none will be drawn, though subsequently methods of testing, applicable to both transmitters and receivers, will be developed, whereby performance of either the receiver or transmitter may be tested and conclusions formd as to the type of service to which any particular instrument is best fitted. Manufacturers are constantly improving in the art of receiver building, and the receiver itself is so complex a machine that even with the most perfect system of interchangeable manufacturing it is difficult to produce two instruments that are exactly alike; nor has interchangeability in the building of receivers been carried to anything like perfection that is witnessed in watch works, the sewing machine factory or a gun shop; and so, while the models described may be taken to be fairly representative of the art of receiver building, it is quite certain that other examples from the same shop may differ considerably in many of their properties.

THE HAND RECEIVER OF THE AMERICAN TELEPHONE & TELEGRAPH CO.

The first models of the receiver manufactured by the American Bell were of the single-pole variety, shown in Fig. 7 (see page 687, Electrical World and Engineer, April 18, 1903). This design has been so universally supplanted by the bipolar type that the earliest form is merely of historic interest. The bipolar receiver is shown by dimension drawing and sectional photograph in Figs. 8 and 9 (page 687, Electrical World and Engineer). Further details appear in Figs. 32 and 33. The complete receiver, as it is usually met with in practice, is given in Fig. 32, while in Fig. 33 the instrument is dissected. The case is made of hard rubber and consists of three parts: the body, *A*, Fig. 33, the tail piece, *B*, and the diaphragm cap, *C*. The magnetic system shown at *D* consists of two rectangular bars 3¼ in. long, the outer corners of which are chamfered. The bars are .63 in. wide and .26 in. thick. At the rear end the bars are bolted together with a soft iron filling piece and iron bolt, while in the front the filling piece and bolt are of non-magnetic material. Between the bars a lead weight is cast, so that the receiver may be sure to hold the hook switch in proper position. At the front end the filling piece carries a screw thread whereby the entire magnetic system may be secured in the body of the case in which a similar thread is cut. The pole pieces are recessed between the front filling piece and the magnets and all clamped by a substantial bolt. The magnet bars are placed ½ in. apart and exercise a tractive effort of 1.13 pounds (588 grams). The sectional area is about .164 sq. in. (1.06 sq. cm.). This corresponds to a tractive effort of 550 grams per sq. cm., which would indicate a remenance of 4,200 gausses. The pole pieces are set ½ in. apart centers. They are .54 in. wide, .086 in. thick and 1.36 in. long, giving an area of .046 in. (.3 sq. cm.) so the pole flux would be 9,800 gausses. The coil spools are .09 in. long, .40 in. wide and .43 in. deep, made of brass, giving a winding volume of .06 sq. in. (.385 sq. cm.). The winding is No. 34 or 36 B. & S. silk-covered copper wire, for the common battery receivers, both coils being connected in series. The usual resistance is about 60 ohms, but receivers are wound as low as 20 ohms and as high as 75. For local battery stations the winding is one or two gauges finer and the resistance carried to about 100 ohms. The diaphragm is of ferrotype metal No. 31 B. W. G. .01 in. thick, 2.25 in. in diameter over all, with a free diameter of approximately 2 in. As a protection from moisture, the diaphragm is thoroughly varnished. The body of the case is faced presumably at right angles to the thread cut to hold the magnetic system, and the magnets screwed into the case till the pole pieces are from 1/64 to 3/64 of an in. away from the diaphragm. Upon the outside of the tail piece, *B*, a pair of binding posts are placed, to which leading-in wires of cotton-covered copper are soldered and extend alongside of the magnetic system through a fibre disk which is placed just beneath the pole pieces and are soldered to the ends of the line coils. Thus

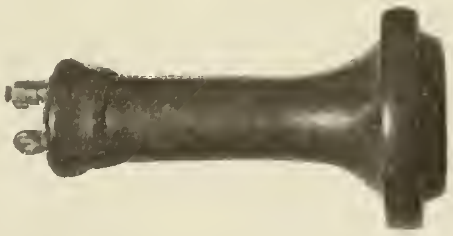


FIG. 32.—ASSEMBLED BELL RECEIVER (COMMON BATTERY TYPE).

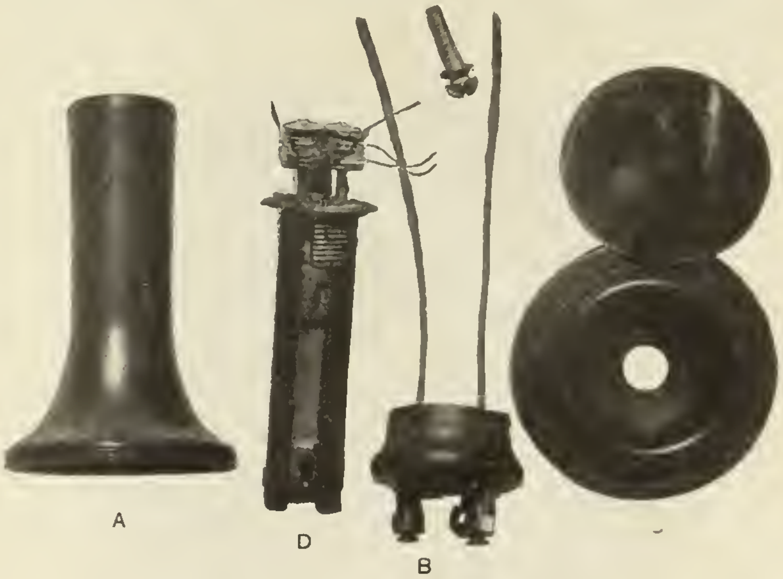


FIG. 33.—DISSECTED BELL RECEIVER.

it is impossible to take the receiver apart without unsoldering some of the electrical connections. The tail piece is secured in place by being slipped over the end of the case body and held by a screw that is tapped into the rear of the magnet. The mouth of the Bell receiver noticeably flares much more than most of the other models and the resonant cavity enclosing the diaphragm is considerably larger. Fig 34 is a phantom of the Bell receiver with the diaphragm removed The field is quite uniform and symmetrical, but not sufficiently intense to affect the iron filings over the entire area of the plate. Fig. 35 is a phantom with the diaphragm in place, from which it appears that the field is fully sufficient to saturate the diaphragm at least in the immediate neighborhood of the pole pieces. The diaphragm, as in most models, is secured between the cap and the case by a screw thread on the exterior of the case, consequently adjustability is attained only by loosening the tail piece screw, and moving the magnetic system in and out of the case by means of the screw thread which holds it in place.

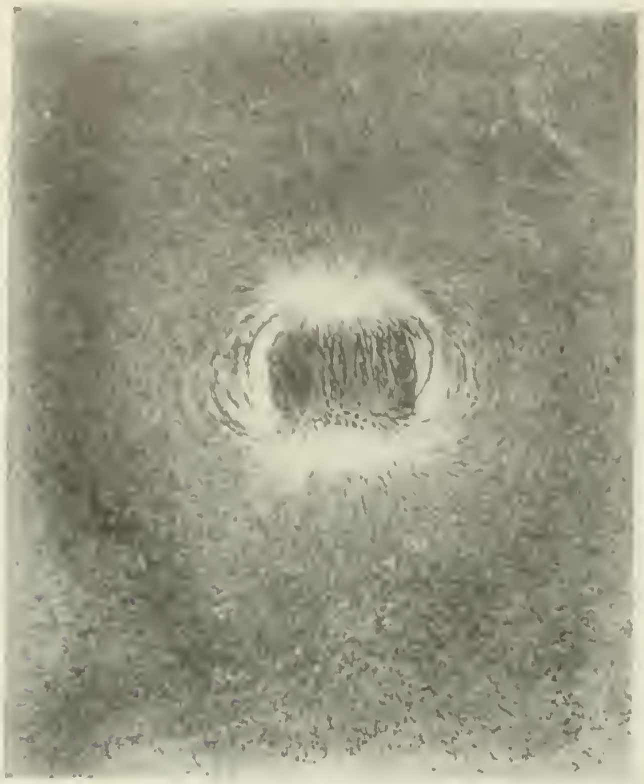


FIG. 34.—PHANTOM WITHOUT DIAPHRAGM. BELL RECEIVER.

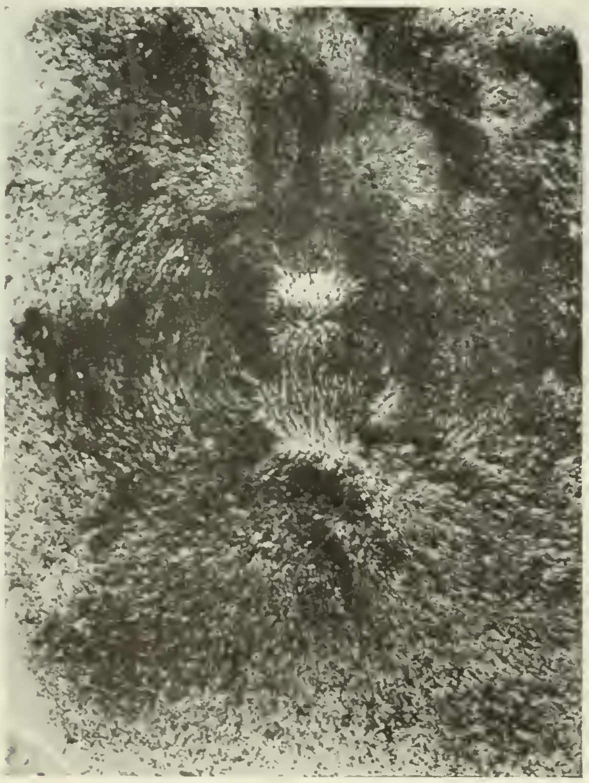


FIG. 35.—PHANTOM WITH DIAPHRAGM. BELL RECEIVER.

THE HEAD RECEIVER OF THE AMERICAN BELL.

When a receiver is in constant use it becomes burdensome to constantly hold it to the ear, and it is customary to build a very small and light instrument, which may be supported on the head by means of a band or cap, and thus adjusted to the proper place at the ear, leaving the hands free to follow other avocations. Such telephones are a necessity to switchboard operators. One of the models of this form of receiver manufactured by the American Bell is illustrated in Figs. 36 to 41, inclusive. The assembled receiver is shown in Fig. 36. In Fig. 37 the cap and diaphragm are removed, while in Fig. 38 the instrument is dissected. The receiver case consists of a light shell of pressed brass, about the size of a watch case, and so these instruments are frequently denominated "switch watch receivers." The case is about 2 in. in diameter and 11/16 in. deep. The edge of the brass case is chamfered to form a bearing for the diaphragm, and on the exterior is a screw thread engaging with the rubber diaphragm cap. The magnetic system consists of two bars of steel ⅛ in. thick, 7/16 in. wide, forged into circular segments as shown in Fig. 39. The laminated magnet thus formed is placed on the bottom of the brass case and secured thereto with one screw. To each end of the magnet a soft iron pole piece is attached which, as is seen in Fig. 38, extends inwardly towards the center of the magnet, and is there turned upwards at right angles. The pole pieces, .357 in. wide, .085 in. thick and ½ in. deep. Upon the pole pieces the line spools are placed made of brass .37 in. wide, .68 in. long, and .31 in. deep. The spools are usually wound with No. 38 wire to a resistance of about 60 ohms. Between the ends of the magnet a fibre block is screwed to the case, to which the terminals of the line coils are attached. The receiver cord is often made of

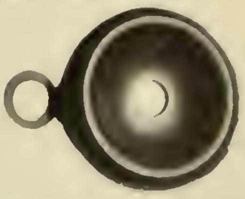


FIG. 36 HEAD RECEIVER ASSEMBLED.

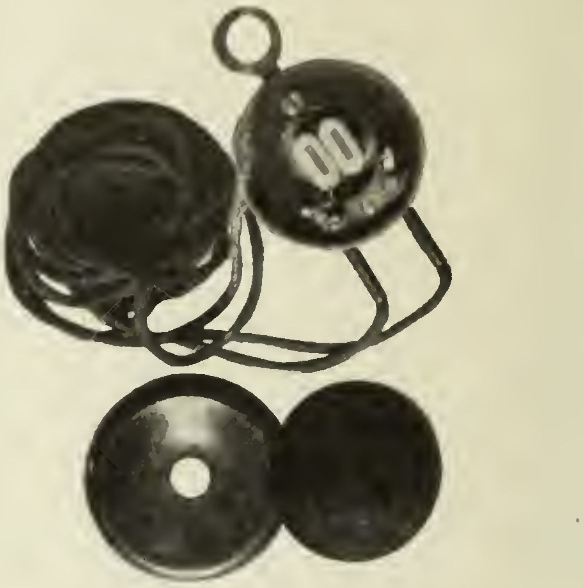


FIG. 37.—CAP AND DIAPHRAGM REMOVED.

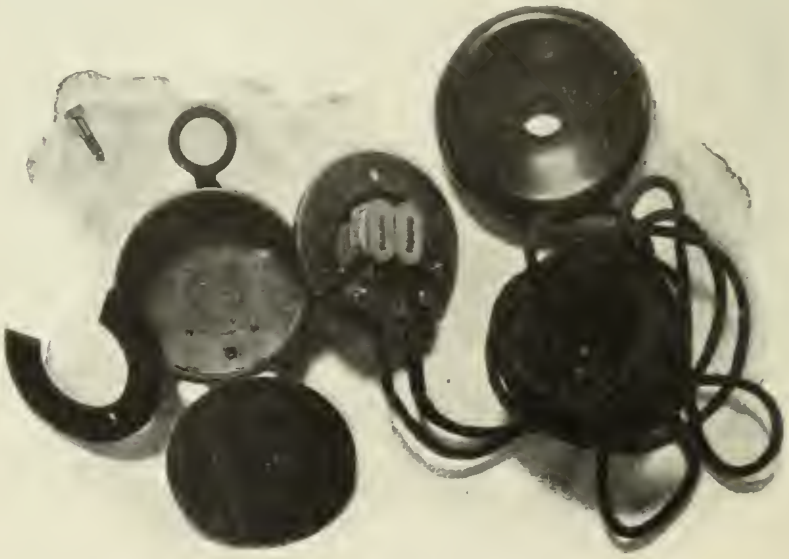


FIG. 38.—HEAD RECEIVER DISSECTED.

two strands, each of which carrying its appropriate tip that passes through a hole on the side of the case, and is clamped in the fibre block by means of two screws (Fig. 38) that connect the tips with the terminals of the line coil. The diaphragm is of ferrotype metal .01 in. thick, 2 in. in diameter over all, with a free diameter of 1.93 in.; the diaphragm is perfectly flat. The magnets of this receiver exercise a tractive effort of 1.313 pounds (477 grams). This corresponds to a tractive effort of 690 grams per sq. cm., and indicates a remenance of 3,500 gausses. The weight of the entire receiver is 5½ ounces and is not an uncomfortable burden even if constantly worn against the ear. Fig. 40 is a phantom of the magnetic system with the diaphragm removed, showing an evenly distributed though not very intense field. Fig. 41 is a phantom with the diaphragm in place. At first sight this phantom appears curiously, as there is distinct evidence of the magnetic field around the circumference of the case. A little consideration, however, shows that this is caused by leakage from the circumference of the circular magnets to the diaphragm, and thence through the diaphragm to the pole pieces in the center. Apparently the pole piece system is hardly sufficient for the magnetic flux impressed upon it, and possibly to augment this portion of the magnetic circuit might somewhat improve the efficiency of the receiver, but it is difficult in so small a space to secure a design which is desirable from all standpoints.

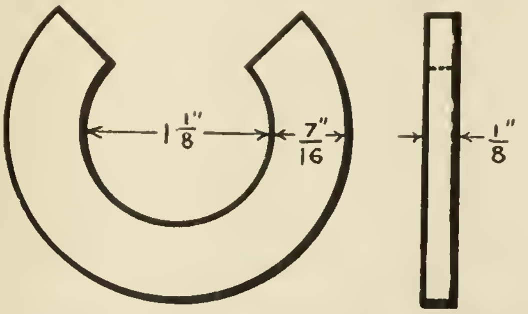


FIG. 39.—MAGNET OF HEAD RECEIVER.

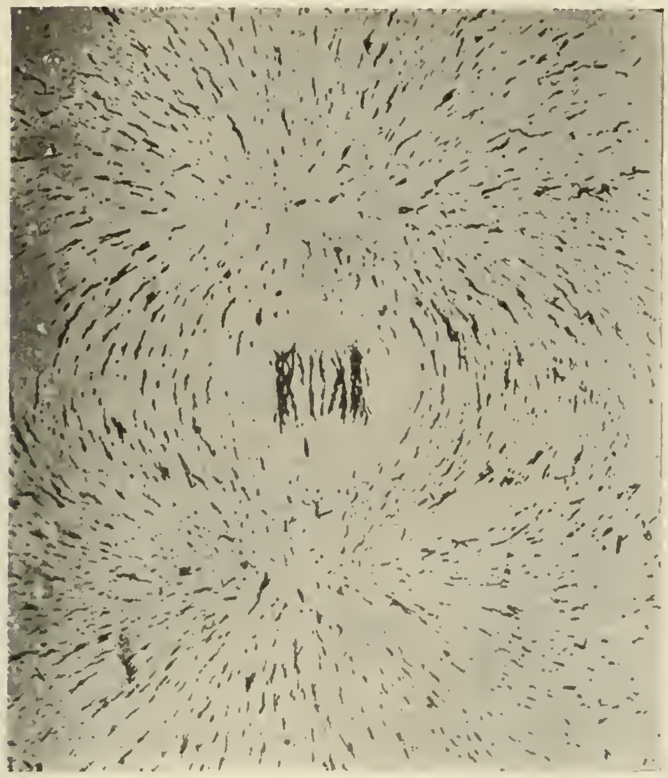


FIG. 40.—PHANTOM OF HEAD RECEIVER WITHOUT DIAPHRAGM.

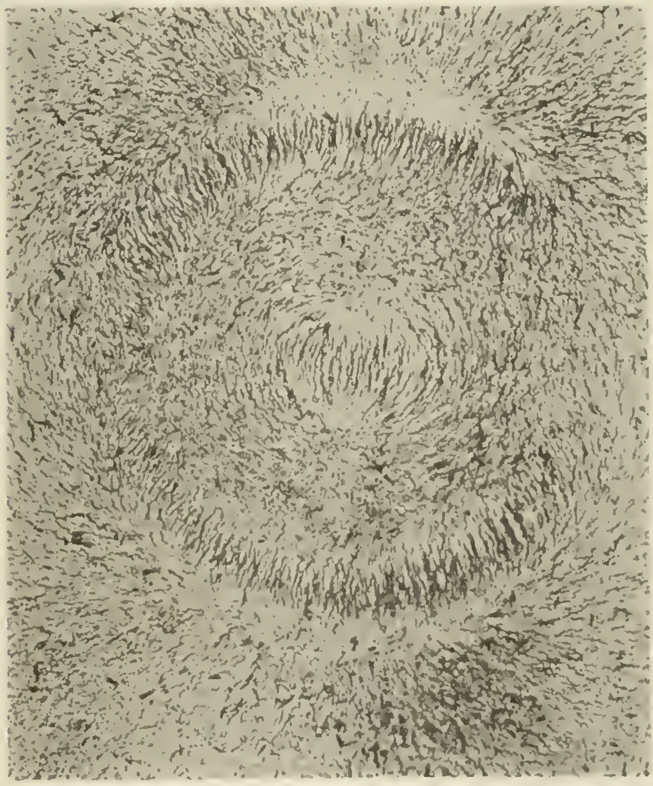


FIG. 41.—PHANTOM OF HEAD RECEIVER WITH DIAPHRAGM.

Traction Developments in Chicago.

Plans for the consolidation of the Union Traction, City Railway and other companies have recently been discussed in New York. A basis of one-city-one-fare is considered by the receivers to be the best foundation upon which to ask franchises of the city. Its details will probably be worked out by protective committees representing the North, West and other companies, together with a so-called voting trust, with power to act for the Union Traction Company. It is not believed that the one-city-one-fare arrangement would be a heavy burden upon the consolidated company, as it is thought that through travel between the various sides of the city will be comparatively light.

As an immediate result of the conference of the officials in New York, promises for better accommodations for Union Traction passengers are held out. General Manager Roach estimates that the cost of more cars and better facilities demanded by Judge Grosscup will be some $600,000. His estimates are as follows:

100 new double-truck, modern electric motor cars, capable of seating 65 persons each	$480,000
Replacing cables with electricity at the outlying ends of several cable lines	67,000

The general manager figures out that with this added electrical equipment and the new and commodious cars, he can increase the accommodations given the patrons of the road to a marked extent. He can relieve the cable loops in the down-town district of many cars they are now carrying by running them in over rails now seldom used, but at the same time make possible the use of more cars on these loops during the rush hours, by taking off the cable lines burdens in the way of long-haul cars they are now bearing in the outlying districts. It would be, of course, necessary to get the approval of the city, but it is not thought there will be any difficulty in this, in the face of the improvement in service the company expects to be able to show.

Improvements which will improve the capacity of the union loop by 35 per cent. and add greatly to the convenience of the traveling public, have been outlined to Commissioner Blocki. The improvements depend upon an extension permit for station platforms, to be sought from the city council. The companies promise to install moving stairways at State, Dearborn and La Salle Street Stations, and eliminate the grade crossings at Fifth Avenue and Van Buren Street, where the Metropolitan trains enter the loop. It is further planned to improve the station near Clark and Lake Streets, and to elevate the outer track from Madison Street and Wabash Avenue to Quincy Street and Fifth Avenue.

Modern Science Club.

On September 8 there will be a general discussion of the subject of electric elevators before the Modern Science Club, 125 South Elliott Street, Brooklyn, N. Y., and some short papers on the same theme are to be read. On September 22 Mr. J. A. Anderson will give a lecture on the Eastern Power Station of the Brooklyn Rapid Transit Company. Mr. R. Henderson is secretary of the club. A smoker is scheduled for September 15.

Reporting the Yacht Races by Wireless Telegraphy.

FIG. 1.—YACHT "CHETOLAH."

One of the most interesting features of the recent international yacht races between the *Reliance* and *Shamrock III.*, off Sandy Hook, for the America cup, has been the use of wireless telegraphy for reporting events "at the front." It will be remembered that efforts in this direction had been made at previous races, but the preparations on this occasion were upon a far more elaborate scale, and should have been attended with greatly improved results. But if there is one thing at present apparent, it is that in multitude of coherers there was dire confusion; while if all the statements made are true a great deal of the interference was outrageously malicious. So far as can be seen, present appliances or methods of tuning are not adequate to suppress or ignore interference of this character whether malicious or not, but statements made by Mr. Marconi and Mr. Edison indicate that both inventors will bend their energies jointly to overcome this difficulty.

So far as could be ascertained there were at least three systems busy during the races, the Marconi, the De Forest and the International or Gehring, the first-named being installed on the Associated Press boat, *Chetolah*, where ELECTRICAL WORLD AND ENGINEER had an opportunity to watch its working. To receive its dispatches, there were the existing stations at Babylon, Long Island, and Sagaponnack, Long Island, while a new station was put in operation at South Jamaica, L. I. The De Forest system was installed on the Lipton steam yacht, *Erin*, as recently described in these pages, and also on a tug, with a land station at Coney Island. The Gehring system was on a towed schooner, with a land station on the New Jersey Highlands. Possibly many other receiving stations were at work, and Professor Fessenden is understood to have had one at work successfully at Jersey City; but it is obviously impossible to know all who are "rubbering" wirelessly, whether from curiosity or from other motives.

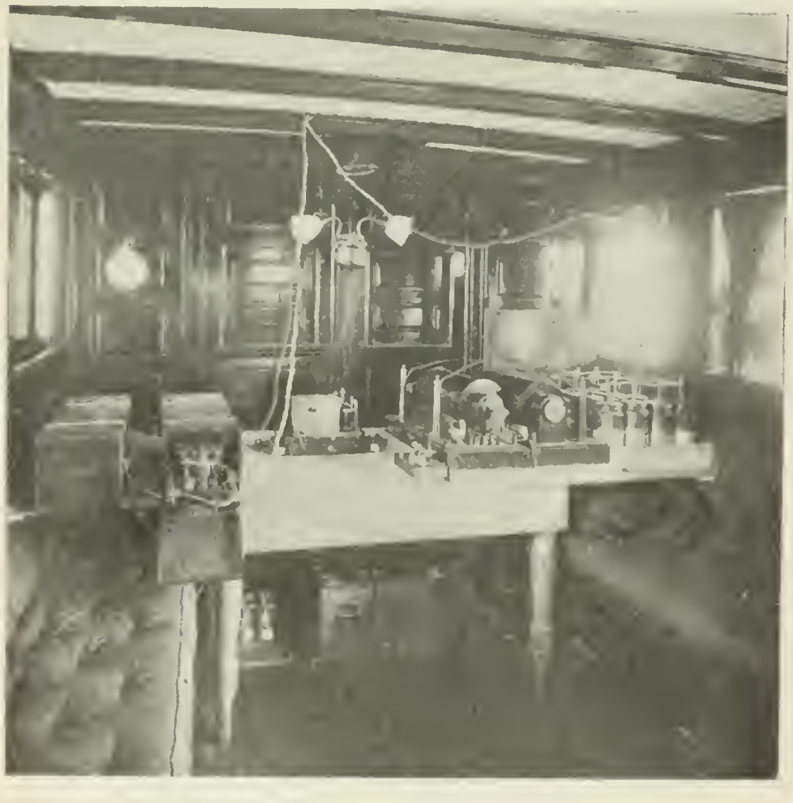


FIG. 2.—WIRELESS TELEGRAPH EQUIPMENT ON "CHETOLAH."

Views are shown herewith of the Marconi equipment on the *Chetolah*, operated by Mr. Newman. When seen on Thursday, August 27, the plant had been extended so that two "tunes" were available, the object being to overcome, if possible, the interference which had spoiled much of the good work done earlier, and which at the race just preceding had rendered reception almost out of the question. During Thursday, twenty Associated Press messages were sent from the open sea, the beat fifteen miles to windward taking the *Chetolah* between 30 and 40 miles from the land stations. Each message was sent three times on each tune, so that actually 120 messages were sent to shore. Once in a while the receiver was cut into circuit, when the tape record would indicate pretty clearly that some one in the vicinity was trying his best to "jam" the system by heavy current, or was interjecting meaningless matter, although the intelligence of a wireless company thus deliberately "fouling its own nest" would appear open to doubt. The results obtained, however, despite the interference were quite good as compared with some of the previous records, and Mr. Charles H. Boynton, the efficient superintendent of the Eastern Division of the Associated Press, who watched the situation with much interest, said: "Whether there was less interference on the part of the competing wireless telegraph companies to day, or whether the changes made by the Marconi Wireless Telegraph Company to overcome the interference which interrupted their service of the yacht race on Tuesday were successful, I am not in a position to positively say, but the result was certainly a great improvement. The officials of the Marconi company told us yesterday that they would utilize in to-day's race a change of system, which they hoped would permit them to send their messages through whatever interference they might meet, and this change, which naturally they do not care to make public, was operated to-day. Twenty bulletins were sent from the Associated Press yacht, *Chetolah*, and of these we received fourteen, though some were delayed in coming through. On the whole the service was fairly satisfactory, and kept us posted on the progress of the race."

As to the troubles of the earlier days, Mr. Bentley, vice-president of the Marconi Wireless Telegraph Company, has issued a formal statement in which he said: "The reason for the falling off in efficiency is this: While we have been able, by means of our improved apparatus, to cut out six of the seven competing stations, one high power land station has been able to disturb us. The proprietors of the high power station switched in more power, and from 9 o'clock in the morning until 5 o'clock in the evening incessantly kept the station key rattling out "A B C, A B C, A B C," except when varying this monotonous programme with meaningless phrases. On Thursday and Saturday of last week the erudition of the operator was more clearly disclosed by obscene expressions. On Saturday we received from the troublesome high power station a considerable part of 'The Wreck of the Hesperus.' During the races the *Chetolah*, with our apparatus aboard, was for the greater part of the time in hailing distance of the three boats carrying apparatus of the other companies. This we were prepared for, since the president of one of the companies had threatened to 'put us out of business.' This we knew he could not do with any apparatus he could put on a vessel. The threat of the individual referred to, made to a third person, can be verified by affidavit when required."

Telephony in Michigan.

The reports on file in the office of the State Auditor-General, at Lansing, Mich., of gross earnings for 1902 show that the 47 independent companies earned $532,126.80, while the Michigan Telephone Company, Bell system, earned $1,426,061.24. The independent companies paid in taxes about $15,000 and the Michigan company $45,000. The total value of the physical property of the independents, as shown by the report of the tax commission, is $1,000,000, and of the Michigan company $5,000,000. These are the figures prepared by Prof. M. E. Cooley in 1900. Since then the Michigan company has made improvements and extensions costing more than $1,000,000.

The location of the independent lines shows that they have very little bearing upon the business of Detroit. The principal one is the Citizens', of Grand Rapids, which owns exchanges in that city, Lansing and Battle Creek, in every one of which cities the Michigan company has larger exchanges, Grand Rapids and Detroit being connected by ten circuits. Port Huron, Mt. Clemens, Ann Arbor, Ypsilanti, Monroe, Wyandotte, Lapeer and Kalamazoo have only the Michigan company's system. Pontiac is the only important city near Detroit that has an independent exchange, but that city has over 700 Michigan telephones. Of the 47 independent companies, the Michigan company has contracts for exchange service with about 10, among which are Tecumseh, Marine City, the Moore system operating in the Thumb, Cheboygan, and the new system operating a toll line between Bay City and Alpena, and an extensive system at Cassopolis.

Recent Electrochemical Developments.

RECOVERING TIN FROM TIN SCRAPS.

Two patents were granted on August 25 for improvements in the method of recovering tin from tin scraps by electrolysis. Messrs. Martin Laernoes and John Dunn, of Streator, Ill., patent mechanical details of construction of a sheet-iron cathode for such processes, the object being to make the plate more durable and to facilitate the removal of the tin deposited on the plate.

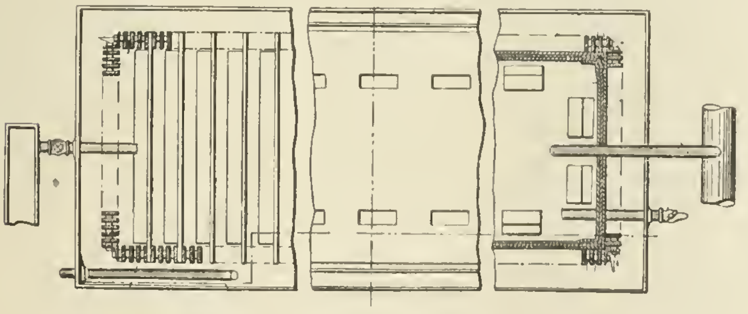
A new process for recovering the tin from scraps, patented by Mr. B. A. Bergman, of Ryfors, Sweden, involves two steps. The first step is the dissolution of the tin in caustic alkali. This is accomplished by making the basket, containing the tin scraps, one electrode in a cell, while finely divided copper oxide is the other electrode, caustic alkali being the electrolyte. This combination acts as primary battery, quite analogous to the Edison-Lelande cell, if tin is substituted for zincs. The process during discharge is the solution of tin to form stannate of the alkali and the reduction of copper oxide to copper. The electrical energy generated in this manner may be stored up in a storage battery. This is the first step, the result being the solution of tin in caustic alkali. The second step of the process consists in drawing off the solution and recovering the tin from it by well-known processes. The finely-divided reduced copper is re-oxidized by glowing in a current of air.

PRODUCTION OF CHLORIDES OF CARBON IN THE ELECTRIC FURNACE.

A patent granted to Dr. F. J. Marhalske, of Chicago, for producing chlorides of carbon in the electric furnace, describes a process of purely chemical nature, the electric furnace being used only for the production of the required high temperature. The charge consists of a mixture of broken coke, sodium chloride and silica sand. The chlorine combines with the carbon and the resulting carbon chloride is withdrawn and may be condensed. Various chlorides of carbon may be produced by varying the proportions of the ingredients of the charge.

DIAPHRAGM PROCESS FOR THE PRODUCTION OF CHLORINE AND CAUSTIC ALKALI.

Most of the larger paper and pulp mills have begun to install in recent years electrolytic plants, for the production of bleaching powder for their own use. All of them use diaphragm processes, but the construction of the cell is different in different plants. A patent for a new diaphragm cell was granted on August 25 to Mr. A. B. Larihar, of Oldtown, Me., the patent being assigned to the Penobscot Fibre Company, which has conducted a number of experiments with such processes in recent years.


APPARATUS FOR PRODUCTION OF CHLORINE AND CAUSTIC ALKALI.

The special feature of this new cell is the cathode, which is of peculiar construction. It consists of a grating forming a complete enclosure, constituting the side walls of the cell. This grating is in sections, forming the four sides of a parallelogram and secured together at the corners by posts of angle iron. The polygonal enclosure thus formed serves not merely as the cathode, but possesses sufficient rigidity to act as the wall of the cell, supporting itself and the diaphragm which is stretched upon it, and also the cover of the cell from which the anodes depend.

The grating which composes the cathode consists of a series of vertical bars or slats of soft steel. The slats are spaced uniformly apart, so that a lamellar cathode is formed which divides the solution into a great number of films which pass from the diaphragm out through the cathode into the receptacle which surrounds the cathode. The floor of the cell is formed of Portland cement. The diaphragm consists of asbestos paper, several thicknesses of which are placed around the walls of the cell so as to break joints with each other, each layer forming a lap-joint with itself. The anodes consist of a series of graphitized carbon slabs.

Brine is supplied to the interior of the cell, which represents the anodic compartment. The caustic soda solution escapes from the outside reservoir through an overflow pipe, which is adjustable, so that the surface level of the liquid in the outside reservoir may be changed at will. By maintaining the inside level (anode compartment) slightly above the outside level, it is possible to counteract the tendency of the O H ions to come over from the cathodic into the anodic compartment and there cause trouble. In this the inventor applies the old method used by Le Sueur in his early pioneer work.

In the adjoining diagram on the right end of the cell the cover and upper portion of diaphragm are removed. The left end is a horizontal section taken in the plane of the top of the tank, with the diaphragm omitted; the middle part has the cover on.

Electrically Operated Swing Bridge at Sydney, New South Wales.

An electrically-operated swing bridge is being installed at Sydney, New South Wales, to replace the present Pyrmont bridge. The existing bridge, which was opened for traffic in 1857, has very little head room, and has to be opened for anything larger than a rowboat. The new bridge is to have headway of 26 ft., which will allow a number of smaller vessels to pass under and materially reduce the number of times daily that the bridge has to be swung. The swing span of the new bridge will be 225 ft. long and 54 ft. wide, and will weigh 600 tons. The swing is of the ring-bearing type, and the whole weight—some 800 tons when swinging—is distributed by an arrangement of girders to 16 points on the drum, thus insuring an even load on 66 cast steel rollers upon which the span travels.

Two 50-hp. motors will be provided for operation, and it is estimated they will either open or close the bridge in sixty seconds. Both slewing and end-lift motors will be carried on a platform inside the drum, the former working, through a chain of gears, a vertical shaft, on the lower end of which is a cast steel pinion meshing with a cast steel rack secured to the top of a pivot pier, while the end lift will be effected by means of cones on horizontal shafts worked by a 35-hp. motor gearing to a longitudinal shaft running the whole length of the pier. The whole of the operations connected with the swing span and the gate on the side span will be controlled by one man from the controller house over the footpath of the centre of the swing span. The new swing will afford two clear fairways of 70 ft., as against the 57 ft. 6 in. and 35 ft. openings as at present.

Electric Railway Progress in Japan.

Mr. Fukutaro Yuhara and other gentlemen, who are backed by certain capitalists of Tokyo, have applied to the authorities for permission to construct an electric railway between Atami and Odawara with a capital of 500,000 yen. There seems to be little hope of the proposal being sanctioned by the authorities, unless an amalgamation is effected between the proposed company and the "Hand-pushed Car" Company, now carrying on business in the locality.

The application to the Metropolitan Police authorities of the Tokyo Electric Tramway Company for power to increase its passenger fares has been refused. The subject has naturally attracted a great deal of attention in Tokyo, and the decision of the authorities will no doubt give much satisfaction to the public.

With a view to making connection with the electric railways in Tokyo, the Keihin Electric Railway Company has, it is reported, decided to diminish the width of the gauge to 4 ft. 6 ins., against 4 ft. 8.5 ins., and has already applied to the authorities for permission to do so. It is also reported that the company intends to employ a number of large passenger cars, 44 ft. long.

International Association of Municipal Electricians.

The eighth annual convention of the International Association of Municipal Electricians was held at Atlantic City, N. J., September 2, 3 and 4. The attendance was large and indicates a steady growth in the organization. Members of the Association were present from all parts of the country, and a number of interesting papers were read and discussed.

The meeting was called to order Wednesday, September 2, in the large convention hall of the Hotel Rudolf, and the delegates welcomed to the city by Mayor Franklin P. Story, of Atlantic City. Suitable response was made, and the business of the convention was taken up.

Mr. Osborn H. Hatch, of Detroit, Mich., contributed a most interesting paper in which he urged that the municipal electrician should not only make a record of every official action, but also of conversations having relation to his duty. The paper includes a set of rules and regulations for the construction and maintenance of electrical wires, which might well serve as a substitute for many similar sets of rules perfunctorily prepared and now in use. A system is also sketched upon which to base city reports and another relating to details connected with new work and repairs and for keeping track of work. The paper includes a number of tables and diagrams explanatory of the text.

Mr. W. H. Thompson, of Richmond, Va., in a paper dwelt upon the importance of the fire alarm and police telegraph to municipalities. He shows how, with a proper fire alarm system, the losses caused by fire may be greatly reduced, and points out the benefit of a police patrol system to a community.

Mr. Henry W. Pope read an interesting paper entitled "The Economy of Time," in which he elaborated upon the importance of the telegraph and the telephone in modern life. As an instance of a new use of the telephone, he told of a case where a farmer arranged with the postmaster to open and read his important communications to him by telephone. This resulted in some official correspondence as to the propriety of the action of the postmaster, but the latter was tacitly sustained. Mr. Pope says that this practice has now gone into considerable use, and he considers that eventually some provision may be made for the regular transaction of business in this manner.

Referring to the time lost in sending to and from offices telegraph messages, he suggested the use of blank forms for the reception of the type-written message which would admit of being folded and sealed to show the address, eliminating the necessity of an envelope and the labor, time and expense involved in providing and addressing it; or an envelope with a space cut out of the face side and covered with transparent paper so that when the telegram was properly folded the address would be visible from inside the sealed receptacle.

In filing the telegram for transmission thus prepared, the sender should be asked to elect whether delivery should be by messenger or telephone, and this indicated by some character or symbol would be the authority for the distant office. Every business man, every business office or factory of any account in the United States has a telephone, and this will be true to a considerable extent with residences and farmers in the near future. As the public became apprised of the feature, the messenger would be gradually relegated to other fields of industry and the greatest element of delay eradicated.

There are other details, that of copying, for instance, that seem unnecessary in the days of typewriting. It would seem as if the original always accessible was sufficient, and that danger of trouble or loss from errors or omissions, which are limited to the tolls paid under most conditions, are insignificant in comparison with the benefits derived in the saving of time and labor.

Mr. Pope considers that the time is not far distant when the existing conditions with regard to the collection and delivery of telegrams, or even the more improved conditions suggested, in which the telephone is utilized, will be considered indirect and cumbersome to large commercial users of the telegraph—unable for one reason or another—expense principally—to avail themselves of the advantages of a private wire. The demand for a service that will fill many of the requirements of a private wire and reduce the time element still further will bring into use an automatic service which will be in entire control of the sender and receiver of communications, as is the case to-day with the long-distance telephone service, the company performing no part of the operating service in the actual transmission and reception of the message, except furnishing and maintaining the wire and apparatus.

The almost general use of the typewriter with its universal keyboard and its skilled attendant meets the operating problem, and it is easy to conceive, that with a simple operating or punching mechanism this employee is in training to become the operator of the future in punching, transmitting and translating type, or for the work of operating simple printing devices or any device possible of operation with a universal keyboard. The connection would be put up on order as is now done in a telephone transaction. The message having already been prepared by the stenographer or typewriter, is then transmitted through to the distant customer at the rate of hundreds of words per minute, and there translated by the customer's employee. The charge for this service, in which the company or its employees take no part, other than in providing the circuit, leasing and maintaining the apparatus and putting up the circuit on demand, would naturally be by the period of time occupied, which would seem a possibly cheaper method than the present telegram charge, in that the labor of operating is borne by the customer and the limit as to the number of words is practically removed.

All telegraphers understand why the Morse holds its own against all suggested automatic schemes. It is because of the delay intervening in preparing and translating. The automatic, as we understand it to-day, is a wire economizing device more than anything else. The scheme outlined eliminates, so far as the company is concerned, the time and inconvenience of preparation and delivery—the labor and stationery—of an ordinary telegraph transaction. Mr. Pope said he has often wondered why this sort of a system has not suggested itself as of sufficient importance to justify an experimental trial. It seems a perfectly feasible and practicable way to economize time and labor now that we have reached the era of copper wire and high type of construction.

Mr. Pope advocated the installation of private branch exchanges with ample trunking facilities where the telephone is largely used. Interior service between stations is free and unrestricted. The chief officer is within speaking distance of every department or subordinate, it being no more trouble to open up a conversation than to put on a hat, and the time usually occupied and the inconvenience experienced in running to and fro—from one department to another—is saved. Some corporations go so far in the broadening of this system as to provide telephones for their clerks, maintaining that the convenience and time saved justifies the expense, which at best is nominal after the exchange is once established. Such an exchange is a clearing house and information bureau for all citizens having business with city departments, the operator under your own jurisdiction being able to direct and distribute inquiries to the proper department.

It does not follow that the installation of a private branch exchange involves increased telephone expense. Oftentimes a considerable saving can be effected by the elimination of high-priced direct exchange connections and passing such service through the private exchange. Such an exchange operated by one's own employees could handle fire and police calls originating through telephone channels with absolute reliability and promptitude. With direct trunk wires, for emergency purposes only, from each city exchange to this private branch exchange, it must be obvious that the field of operation and protection would be enormously increased and extended.

Many of the manufacturers of electrical apparatus and supplies were present, or had their representatives on the scene.

Frederick Pearce, of New York, who has not missed a convention of this body since its inception, was present and greeted his friends.

Mr. J. Jones, Jr., of J. Jones & Son, New York, was most assiduous in his attention to all visitors, and talked persuasively of the merits of his various lines.

The American Circular Loom Company was ably represented by Thomas H. Bibber, of Boston.

The Okonite Company sent Romaine Mace, of the New York office, to represent its interests.

The Gordon Battery Company, New York, had in attendance Mr. Banks, of the New York office, who had just returned from a successful Western trip. The Gordon battery, he reports, continues to grow in favor everywhere.

The Saratoga Convention of the American Street Railway Association.

In accordance with the programme, the twenty-second annual convention of the American Street Railway Association was held this week at Saratoga Springs, N. Y., and it was still in active progress when this issue of Electrical World and Engineer went to press. At the same time the Street Railway Accountants of America held their seventh annual convention and the promising American Railway Mechanical and Electrical Association, formed last year, held its first annual meeting. It is needless to say that the call of the great parent association and its subordinate bodies was responded to very generally, with the happy result of a gathering fully equal to any of the past in size and importance.

Many members arrived early and by Wednesday the various hotels were overflowing with the street railway contingent arriving from all parts of the country, and the badges were much in evidence, not only at the Grand Union headquarters, but on the piazzas of Congress Hall opposite, in the parlors of the United States or the corridors of the Kensington. Lively, animated throngs were to be seen everywhere of those whose names are prominently associated with the industry of such marvelous electrical growth and with the allied enterprises from which it draws materials and supplies.

By a fortunate inspiration, the Association, instead of bunching the exhibitors into frowsy bedrooms and fusty basements, had taken title in their behalf to the broad stretches of turf and adjacent balconies; and there the exhibitors had set up their booths, giving the impression of an outdoor fete. It may indeed be questioned whether the exhibits at a street railway convention were ever grouped before in such a picturesque fashion. Some of the booths, too, were quite ornate and elaborate, but others were decidedly of the camping-out kind, which but for the providential turn of the weather might have resulted very disastrously and pneumonically for the al fresco show men. Elsewhere in this issue further reference is made to the individual displays, it being intended here merely to record the general nature and effect of the exhibit side of the convention. The pretty daylight scene was, if anything, outdone by the night views, when brilliant electrical signs were lit up and when the spray of the big fountain showed up in prismatic colors under the dazzling beams of the searchlight.

The first of the conventions to assemble was that of the American Railway Mechanical and Electrical Association, which gathered in one of the cosy "club" rooms in the wings, and which, by the largeness of the early attendance as well as the earnestness and enthusiasm of the delegates, showed how active is the interest in this body, the right "A. R. M.," as it is already facetiously called, of the old parent body, these being some of the initials in its long name. The meeting was called to order by President Farmer, who delivered an excellent practical address, in which he put the membership at 85, and indicated how large is the field of possible usefulness. The paper first taken up was that of Mr. C. F. Baker, of the Boston elevated system, dealing with the "Care and Maintenance of Car Bodies," he being superintendent of shops and machinery of the road. As a matter of fact, this extremely practical and sensible paper dealt largely with car painting, which was freely discussed by the members, but it soon drifted into the other and larger subject of car wiring and insulation, to the consideration of which a number contributed in a long and able exchange of views and data, among the speakers being Messrs. Libby, Lindall and Ballard, of Boston; E. W. Olds, of Milwaukee, and Alfred Green, of Rochester.

Mr. Lindall said that he had been much impressed with the agitation over the late sad disaster in the Paris Underground, and had himself for some time past given great attention to the fire-proofing of cars on the Boston "L." The motors' ends were encased in asbestos and sheet iron, and the question of improved car wiring had also been dealt with, from the conduit standpoint. Mr. Green took a decided objection to asbestos, which he claimed only nursed and retained the heat from the adjoining sheet iron, until it caused fire. That was his experience, and he believed a good air space to be better. Mr. Farmer told how there had been trouble on their plow car cables until he cased them in lead pipe, with similar taps; and for four years they had been free of any serious trouble at all. Mr. Wright, of Providence, stated that on account of the breaking of solid wires to heaters, etc., they had put in stranded wire, with very beneficial results. In the treatment of cables, they brought out all taps above the floors, and used porcelain or clay tubing for the points of passage, as well as porcelain knobs, instead of cleating. His aim had been to get rid of rubber insulation around the connecting points, stripping the insulation well back and often using asbestos sleeves instead. The rubber insulation was often dangerous in carrying fire. He had recently been over the subject of car wiring with one of the representatives of the New England Insurance Exchange, and had found in that quarter a decided inclination to insist on metal conduit work for all car wiring, virtually making it uniform with house wiring in material and methods.

Mr. W. Pestell, of Worcester, made further inquiries of members as to car cables, and a variety of data and details were given, showing a marked tendency to improvement in this important item, as well as in regard to the leads to motors, etc. Mr. Ballard, of Boston, discussing the subject of rubber insulation again, stated that they had got some splendid results with okonite and Washburn & Moen rubber leads, which it had been impossible to set on fire, even by applying a torch to the rubber; and they used this on all leads to motors, resistance boxes, etc. The discussion then branched out and was continued to such a length that at last the members had to adjourn reluctantly for lunch.

At the afternoon meeting a paper on "Improvements in Street Car Motors" was read by Mr. E. W. Olds, superintendent of Rolling Stock of the Milwaukee Electric Railway & Light Company.

Mr. Olds pointed out in what respects the present street car motors admit of improvement. One of these is greater accessibility for repairs. Nearly all motors as now designed are arranged to open at the bottom, while in repairing double-truck equipments it has been found more satisfactory to lift the car body from the truck, thus making it possible to do all of the repair work from the top. Gears should be made with wider faces than at present and the quality of steel should be better. The life of the present gears is from 18 to 24 months and the pinions from 12 to 18 months; Mr. Olds considers that these figures should be increased 100 per cent. The gear case should be so constructed as to stand abuse better, and the improvement might consist in casting the case as a part of the lower half of the motor frame, thus doing away with bolts and giving the gears absolute protection. Armature bearings should be made longer and larger, with linings that may be easily removed and either rebabbitted or renewed. The bearings should be designed to use only oil, to be fed through wool waste or wicks placed in wells below the bearings. The average life of bearing linings in Milwaukee is at present about six months, which he considers should be increased to not less than one year.

Mr. Olds considers that the contact between commutators and carbon brushes should certainly be improved, which can be done by making the commutator bars longer and deeper, thus giving better contact for the brushes and longer life. The present carbon brushes are not always reliable, and a better connection should be made between the carbon brushes and the brush holders. A weak point of present motors is the insulation of the magnet wire used for fields and armature coils, and he considers that some covering should be devised that will not carbonize. The article concludes with details of motors designed by the Milwaukee Electric Railway & Light Company, which embody some of the special features above suggested.

This admirable paper was discussed by Messrs. Mundy, Baker, Farmer, Green, Libby, Annable, of Grand Rapids, and others, and covered various topics. There was a general survey of details of motor construction, insulation, fields, etc., and a good deal of attention was paid to the pressing on and off of car wheels and gears. Particular attention was also paid to Mr. Olds' remarks on the question of gears, and the relative advantages of solid gears over split gears. The drift seemed to be altogether in the direction of the use of solid gears.

An elaborate paper by Mr. H. H. Adams, superintendent of shops of the United Railways & Electric Company, of Baltimore, Md., was then read in the regretted absence of the author, on the subject of "Shop Kinks." The illustrations of methods and processes that accompanied the paper were on exhibition in the convention room.

Mr. Adams described various conveniences that have been devised for use in the repair shops of his company. Among these is a compressed air sand blast, which is used for frosting glass and for making illuminated signs. Another is a device for cutting dashers for headlights, by means of which a dasher of No. 12 soft steel can be cut for a 10-in. head light in about eight minutes. An arrangement is described for unloading cars from railroad flats.

With this, the cost of which does not exceed $100, the average time in unloading 110 open cars on trucks with a gang of six men was ten minutes. Other conveniences are an armature cart and a trolley pole straightener. A method is described for reinsulating fields, full details of the various operations being given. It is stated that in nine months 281 fields have been successfully reinsulated by this method with No. 1 wire, no trouble having been experienced with any. An induction test for armature short-circuits is described. An old Baxter motor field is suspended and supplied with alternating current. The armature to be tested is placed in the magnetic circuit of this field and revolved slowly. A light piece of sheet metal is held at the top of the armature, and if there are any short circuits they will be easily determined by the vibration of the tell-tale piece, which can readily be felt by the hand. Two devices are described for use in making armature coils.

A point that was discussed, following the Adams paper, was the reinsulating of machines or wire, especially fields. Mr. Green, of Rochester, stated that they had been reinsulating wire for seven years. The boy who ran the machine for doing it got $1.38 a day of nine hours; and every field was wound under a job order. Some members stated that reinsulation of all types of motor fields had not been found feasible. Mr. Mundy, of St. Louis, said that with six men they got eight fields per day on the basis on which they worked. He approved of the method recommended by Mr. Adams of testing by transformer, as the least carelessness of the coil makers or armature winders was detected at once, and saved the expense of putting an imperfect motor together. Mr. Ballard, of the Boston Elevated, said that they tested newly wound armatures up to 2,000 volts, and on old work they ran up to 800 or 1,000. Mr. Mundy said he used a frequency of 25 cycles, which gave him every test they wanted. In regard to winding coils for heaters, Mr. Ballard said that in repairing heaters it was necessary to wind long coils of wire, and in place of winding them on a mandrel, the wire is fed through a fine hole into the interior of a die containing several screw threads, which is revolved in a lathe; and the coil of wire is fed out as long as desired. Another neat little "kink" was mentioned by Mr. Lindall, of Boston, in regard to moving motor trucks. They had a large lift which takes the trucks from underneath the car on the upper floor, and takes them to the machine shops. They had to move the trucks from the lift or elevator 25 or 30 ft., and at one time had ropes and tackle and hauled the trucks around, until one day one of the men suggested that the trucks might be made to move themselves. So they took one of the car rheostats, put it on the wall, connected a feed line to it, and ran out a flexible lead to the truck, starting the connections. The truck then simply walked off by itself, as it were, and a great deal was saved in the way of pushing and hauling. Mr. Pestell also mentioned a neat scheme of regrinding engineers' air brake valves. He used a little motor with a fine wheel on it, mounted on the post of a lathe. The valve seat was then put in the lathe and revolved, and this motor attachment was run right across its face, finishing it up in two or three minutes. They had a hardened steel head for grinding the disc, and a small hole to take the stud on the face of the disc, putting in ground glass and oil between the two faces, facing off the disc in a very short time. This whole session was very interesting, as showing what a wealth of practical and useful information the members could draw upon in discussion.

At the opening of the Mechanical Association on Wednesday morning the paper of Mr. Alfred Green, master mechanic of the Rochester, N. Y., Railway Company, was read on "Car Shop Practice," accompanied by a number of sketches and photographs.

Mr. Alfred Green, Master Mechanic of the Rochester Railway Company, Rochester, N. Y., gave an account of the organization of the repair shops of his company, and described some of the conveniences with which it has been specially fitted. Among these are an air crane and pit with electric elevator, an armature holder for babbitting, a panel bender heated by gas, a band saw brazer, etc. The paper also describes in detail the latest type of car used in Rochester.

In the discussion, Mr. Mundy, of St. Louis, said he had installed a motor-driven mechanical hoist, which from the time the car entered the shop until it was in the air ready to let the truck run out, required only one minute. But with a four-motor car they had at least 16 leads to disconnect. These took a pretty good man at least two minutes or more than to hoist the car. He was therefore looking for a quick system of lead disconnection, but neither the General Electric Company nor the Westinghouse had been able to help him out. This opened up a discussion on connectors, which led again to one on the propriety of taking the trucks out and so getting an examination of them. As to inspection, it seemed to be the opinion that the mile basis was better than that of time. Mr. Lane said he gave cars a general overhauling and inspection after 20,000 miles, besides inspecting them underneath thoroughly every day or every other day. As to coil testing machines, it was stated by Mr. Baker, of Boston, that they had ten or twelve of them, and they had had no trouble in educating men to use them. After further discussion o methods and times of inspection, the conversation turned on the adoption of motor-driven machinery and tools in the car shops, and Mr. Pestell reported that they had subdivided to some extent in using separate motors for different departments, and he believed that while this was an advantage it was not policy to make individual drive for different tools, except large ones. The general practice appeared to be dividing machinery up in groups and driving with separate shafts with motors. It depended somewhat upon whether it was wood-working or iron working machinery.

A paper was then read by Mr. W. O. Mundy, master mechanic of the St. Louis Transit system, on the "Type M Control," which dealt at some length with the details and operation of the Type M system of control of the General Electric Company. It is stated that while this system is of necessity more complicated than an ordinary series-parallel controller, it has advantages that give it a field aside from train use. For example, as nearly all of the weight can be placed under the car body, the platforms have much less to carry and more room is made for passengers; moreover, the motorman has a much smaller handle to operate and as there is so much less work to do he should do it more carefully. The ease of handling has caused a number of electric locomotives to be equipped with this apparatus.

This interesting paper was followed by a discussion as to results with the controller by those who had used it, and as to the poin at which a system should stop at the series parallel or go on and adopt the new train control. The question also came in of the greater cost. Mr. Olds spoke of its satisfactory use on 25 of the single interurban Milwaukee cars, where it had been very satisfactory, and Mr. Beeler, of the Denver Tramway, mentioned its use on one or two of their freight cars, with coal trailers. Mr. Mundy remarked that he did not intend to depreciate the drum controller in his paper, and it was best for some service; but there were some conditions under which the train control of cars must be more satisfactory than that of the smaller controller. The meeting then adjourned to examine the exhibits in the afternoon, leaving one paper for later consideration.

The twenty-second annual convention of the American Street Railway Association began on Wednesday at 2 P. M. in the Grand Union ballroom. In the absence of President Hutchins, of Detroit, in Europe, Mr. W. Caryl Ely, of Buffalo, first vice-president, called the convention to order and presented State Senator Edgar T. Brackett, of Saratoga Springs, who welcomed the body on behalf of the municipality. After this a letter of regret was read from President Hutchins stating that to his regret ill health would detain him in Europe until the middle of September. Mr. Ely then made the annual address.

After quoting from the recent Census Office report on electric railway statistics, President Ely said that the stupendous figures represent the investments of many thousands of people and relate to the intimate concerns and the daily life of millions of people. They are, therefore, the legitimate subject alike of popular and governmental interest and inquiry, and correct data and information concerning them are matters of the very highest importance. He was pleased to be able to state that the methods of keeping the records and accounts of this class of transportation companies are improving from year to year, and that it is rare to find an instance where the fullest and freest information is withheld from even the most casual inquiry. Service of great value has been rendered in this department of street railroad work by the Street Railway Accountants' Association of America. The classification of construction accounts and operating expense accounts which has finally been settled upon by this association was adopted by the United States Census Bureau in gathering statistics for its census of electric railways, and a representative of the Census Bureau has prepared a paper on the subject, which is to be read in the accountants' convention now being held here. This classification has been officially adopted by the State Railroad Commissions of New York, Massachusetts, Connecticut and Maine, and is about to be adopted by the commission of the State of Pennsylvania. The association's form of monthly and annual report has also been approved and adopted by the National Association of Railroad Commissioners. The standard classification and forms of report have been approved by the leading bankers and financiers of the country. It is quite common at the present time for a banking firm examining properties with a view of purchasing to require the accounts to be changed in accordance with the forms of the Accountants' Association. It has already been adopted by many of the most progressive electric railways and by a larger number of companies than any other one system of accounting. Exact and precise uniformity in forms of classification and report are highly desirable, and the sooner it is attained, the better it will be for the stability and value of electric railway investments, and it would seem that the system which has been worked out by our Accountants' Association and adopted by such high governmental authorities, and which has received the approval of the financial and banking community, ought to be speedily adopted by all. The members of the Executive Committee join in urging upon members the desirability of immediate affiliation with the Accountants' Association, and the speedy adoption of its forms of classification and report.

The work of the various State Railroad Commissions has come to be of the highest value, not only in this regard, but in its bearing upon the actual operations of railroads in States where such commissions exist.

It is a singular fact that these, which at the beginning were so vigorously combated by railroad managers, almost without exception have come to be regarded as almost indispensable and of the highest benefit and advantage to the very corporations which are subject to their control and regulation.

Another striking development of the year has been the tendency displayed toward consolidation of the street railway properties in the smaller cities, together with the electric and gas lighting service; in fact, this tendency has been so marked during the last year that in spite of the large number of new street railway corporations that have been formed in the last 12 months the actual number of operating systems has been only slightly increased. The value of the properties, however, has been growing constantly and the general average increase in gross receipts for 1902 over 1901 was 9 per cent. The largest individual consolidation was that of the properties of the North Jersey Street Railway Companies and allied lines in the Public Service Corporation of New Jersey. Other notable consolidations were those at Augusta, Mobile, New Orleans, Kingston, Oakland and Norfolk and Newport News.

At the last annual meeting, it will be remembered, a very interesting paper was read upon the steam turbine. The investigation of this important subject has been continued during the last twelve months, and a further contribution is promised for this meeting, which it is hoped will embody the record of the advancement during the last year. Already plans have been prepared and actual work has been begun upon the installation of several large power stations in which this class of apparatus is to be installed. The most important of this character for street railway service thus far announced is that of the new station of the Union Traction Company of Philadelphia, where an installation of ten 5000 K. W. engines is contemplated.

A year ago considerable interest was awakened among street railway men, particularly those interested in interurban electric railroading, in the possibility of developing a single-phase motor for railway service. It was, of course, understood that such a motor would not be adaptable for city service, but many promises were held out to those who were interested in the development of long interurban lines. During the last twelve months assurances have been given that progress was being made, but up to the present time no reliable information has been available, and the electric railway engineers are still dependent upon the direct current motor for interurban as well as city work.

Mr. Ely supplemented this address with some further ones on association policy and on the status of the electric railway in the eyes of the community it served. He even suggested the possibility of a permanent place of meeting with a settled business-like method of defraying expenses, and no reliance upon the good nature and generosity of local companies for free entertainment.

Secretary Penington read the report of the secretary and treasurer, which showed that twenty companies had joined the association since the last meeting; that five members had withdrawn, mainly on account of consolidation; membership on August 24th was 206 companies. The financial transactions during the year were as follows: Balance in bank October 1, 1902, $9,948.03; receipts, $7,677.28; total, $17,625.31. Expenditures during the year $7,286.62, leaving a balance of $10,338.69.

Following the secretary's report the Chair announced the following gentlemen as the members of the committee on nominations to nominate officers and select a place for the next meeting: Messrs. Laflin, of Worcester; Goodrich, of Hartford; Sloan, of Chicago; Stanley, of Detroit; Henry, of St. Louis.

A discussion arose over the compensation paid or proposed by the Government for mail service, and after the proposal of the appointment of a committee of three to take up the subject, Mr. Grant was asked to formulate a resolution to that effect. The meeting then adjourned until Thursday morning.

The Street Railway Accountants' Association began its sessions on Wednesday also, the principal item of the proceedings being a paper on "Freight and Express Accounts," by Mr. Irwin Fullerton, general auditor of the Detroit United Railway.

On Wednesday evening a trip was given the delegates and exhibitors to the Saratoga Casino by the Hudson Valley Railway Company, where an entertainment was provided.

CONVENTION NOTES.

It has already been mentioned that the standard feature of every annual street railway convention—the exhibits—was this year characterized by an element of distinct novelty, and that in picturesque camp meeting style the various displays were grouped on and around the great lawn that occupies the court of the Grand Union Hotel.

The display made of machinery, trucks, tools, motors, etc., was quite large and fine. We describe below a number of the exhibits, and shall publish further data of the kind next week in regard to a number of important displays not now brought to notice, owing to the fact that the convention did not begin until Wednesday, when this issue of Electrical World and Engineer went to press.

Mr. G. M. Gest, the conduit contractor and designer, of New York, was able to leave a good deal of the inquiries and new business in the hands of his Cincinnati representative, Mr. W. T. Jackson, who has already formed a wide acquaintance in the electrical field.

Stanley Electric Manufacturing Company occupied a large and handsome booth on the lawn, and rather took the convention by surprise with the exhibit of railway apparatus and material. There was shown a complete car truck for two motors, each of 48 hp, governed by the new and ingenious Stanley S. K. C. No. 2 car controller, in which a number of features of simplification and economy have been introduced. The controller was also open to full inspection, as well as a 35-hp motor, with the fields and armature exposed to inspection. There was also a new trolley base, with which the pole could be lowered almost to a perfect parallel plane with the car roof allowing very low arches and bridges or tunnels to be cleared. The exhibit was in charge of Messrs. S. T. Dodd, electrical engineer, and M. C. Canfield, F. W. Garrett, H. R. Wilson, G. Robb and W. R. Hamlin.

General Electric Company had a handsomely decorated booth at the centre of the lawn, but did not attempt to make any display of apparatus, reserving its energies for the special excursion which it gave on Thursday, taking the train in the afternoon to its big works at Schenectady, and there providing lunch, as well as opening up all the departments for inspection, including that devoted to the Curtis steam turbine, now a theme of universal comment. At Saratoga the General Electric Company was represented, among others, by Messrs. J. R. Lovejoy, general manager, railway department; W. J. Clark, manager foreign department; J. G. Barry, assistant manager railway department; C. C. Peirce, Boston; J. J. Mahony, New York; E. H. Mullin, publicity department; F. H. Gale, Schenectady; T. P. Bailey, Chicago; F. T. Barbour, San Francisco; Geo. D. Rosenthal, St. Louis; J. C. Kalisch, Buffalo; W. B. Potter, chief engineer railway department.

Standard Underground Cable Company had an attractive display of cable samples in parlor 238 at the Grand Union. Their staff was out in force, being represented by Messrs. C. J. Marsh and Kimball, of the New York office; T. E. Hughes, of Philadelphia;

J. L. Pietzer, Chicago, S I. Colby, Boston, and F J McBride, of Pittsburg

Electric Railway Equipment Company, of Chicago, represented by P H. Harten, superintendent of factory, and Elmer P Morris, as well as by Messrs Knott and Morris, Jr, had a very fine exhibit of railway line material, motor starters, car rheostats, etc. The exhibit included a very interesting wire grooving machine, making about a .4 inch groove in the trolley service wire, for the clips. There were also shown a number of single and double trolley poles, as well as simple lighting poles as in use in Cincinnati and New York. The exhibit included some 50 different styles of overhead brackets, and a variety of other line material. The rheostats and motor starters were those of the Magneto Electric Company, of Amsterdam, and were remarkably compact for their capacity.

Albert & J. M. Anderson Manufacturing Company, of Boston, had a most interesting and effective booth display of their electric railway switches, including a group of antiquated historical line supplies that made one realize how far and how swiftly the art has traveled. Perhaps the feature was their new section insulator made in both galvanized malleable iron or strong bronze metal. The terminals that hold the trolley wire at either end may be detached from the central body and renewed without removing the body itself from the line. The renewable strip is lignum vitæ, with auxiliary terminals, and there are several other features making for endurance and efficiency as well as flexibility. Another exhibit was that of Aetna and Hecla line material, including the big dead end strain insulators used in Brooklyn; also third-rail supports, globe insulators, etc. On a large board were also mounted a number of quick break and heavy current switches, one of them taking up to 3,000 amperes. The exhibit was in charge of Messrs. J. R. Eckman, Boston; Ernst Waltman, New York, and Mr. Sanville, of Philadelphia.

Electrical World and Engineer was represented by Messrs. J. M. Wakeman, president; T. C. Martin, editor; J. R. Cravath, Chicago, and had booth space adjoining all the convention meeting rooms, from which copies of the journal were distributed during the meeting.

Rossiter-MacGovern Company had a large space on the lawn fitted up with a booth and replete with electrical apparatus, and occupied also one of the cottages in the annex, where a hospitable welcome was extended to all comers. A number of motors were shown, open for inspection, as well as armature and field coils, and commutators, including one of 750 kw., just finished for the Brooklyn Rapid Transit system. The exhibit was directed by Mr. McGovern, whose staff comprised Messrs. R. J. Randolph, J. A. Peirce, C. J. Macdonald, J. W. Archer and several other efficient men. A neat pamphlet of Rossiter-McGovern plants was distributed and was in great demand.

Pittsburg Reduction Company had a spacious double-barreled booth on the lawn, a conspicuous feature being a Waterbury Machine Company's wire drawing machine driven by a 10-hp General Electric motor drawing aluminum wire from ¼ to 3-32 inch, in seven passes, and in commercial practice from ⅜ to 3-32. A large variety of aluminum wire and bus-bar plate was shown, including samples of the wire, of which 1¼ million pounds have been sold to the Standard Electric Company, of California, and two million pounds to the allied Bay Counties Company; also samples of the wire for the New Milford Power Company; 200,000 pounds and 300,000 pounds for the Hamilton Cataract Company, thus giving a graphic idea of the extending use of this specialty. The company was represented by Messrs. A. V. Davis, general manager; A. K. Laurie, general sales agent; W. Hoopes, electrical engineer; S. K. Colby, New York; J. A. Rutherford and C. Harris, Cleveland; J. H. Finney, Washington; E. H. Noyes, Chicago; W. R. Darby, New York.

Bullock Electric Manufacturing Company, of Cincinnati, had the largest electrical exhibit at the convention, in their booth, it being one of five rotaries for the Scioto Valley Railway Company's power plant at Columbus, Ohio. It is a handsome machine, receiving three-phase current and delivering 400 kw. direct current at 600 volts. It is six-pole, about 9 ft. high, and slightly over 10 ft. square at base. The order for these includes three 1,000-kw., three-phase generators, as well as step-up and step-down transformers. The exhibit was in charge of Messrs. R. T. Lozier, general sales agent; G. B. Foster, W. S. Arnold, A. E. Foote and C. Van Deventer.

Electric Storage Battery Company made a comprehensive booth exhibit, the ample walls of which were lined with photographs of railway, lighting and isolated "chloride" plants A very interesting map was shown, indicating by numerous rings every place in the United States where batteries had been installed—leaving out but two States, North Dakota and Idaho. There were also exhibits of two large railway cells complete; two cells of 2 F type in glass jars, and some exide cells. The exhibit was in charge of Messrs. C. Blizard, general sales manager; Albert Taylor, W. G. Gay, G. H. Atkin, F. J. Stone and W. R Proudfoot.

Bryan Marsh Company were represented by Mr. Guy V. Williams and Mr. J. P. Williams, who made no exhibit, but answered many inquiries in regard to Imperial lamps, inner globes, etc.

Mr. F W. Darlington, consulting engineer of Philadelphia, was present in connection with his electric railway work as well as in behalf of the Darlington Electric Fountain Company's interests.

H. W. Johns-Manville Company, of Hartford, Conn., had what was considered the most artistic booth on the grounds, handsomely draped in red, with the Stars and Stripes caught up in an eagle's beak; a red canopy and massive columns made to resemble closely the famous Sachs "Noark" fuses. Of these fuses there was a complete exhibit up to 600 ampere capacity, the concern now making them up to 1,000 amperes on 220 and 500 volts. A most interesting display was also made of "Transite," their new insulating material for car work, adopted for the New York underground, and affording a most desirable protection for the motor circuits under the car. An exhibit was also made of the Johns electric car heaters, and of the electro-therm. There was also a display of car fuse boxes, underground boxes, high-potential strain insulators, etc., for trolley work, etc., standing a voltage up to 5,000. Among those present on behalf of the concern were Messrs. E. B. Hatch, president of the Johns Pratt Company; J. W. Perry, sales manager; J. Sachs, electrical engineer; J. E. Meek, J. Humphries and H. M Voorhis.

Westinghouse Electric and Manufacturing Company had an excellent space on the lawn, well decorated and also occupied one of the large private cottages at the side, where it showed a brilliant electrical sign surrounded by flags. A notable feature of the Westinghouse exhibit was the new system of multiple unit control, which has of late attracted so much attention. As is known, in this electro-pneumatic train control system, the actuating mechanism is not directly connected to the main source of current, but has a separate, independent battery supply, so that the controlling mechanism can be worked while the main current is cut off, so that it is possible to reverse the motors and use them to produce a braking effect when needed. The contact devices are actuated by pistons operated by compressed air working against spring pressure. The turret was shown in operation with a complete motor equipped truck for the Interborough Road of New York City. The cottage exhibit included car controllers and other apparatus and material. The company was represented by Messrs. A. Hartwell, L. M. Aspinwall, N. W. Storer, K. F. Elers, of Pittsburg; J. B. Ingersoll, E. W. T. Gray, D E. Drake, W. S. Rugg, C. Townley, J. L. Crouse, F. B. H. Paine, New York City; J. R. Gordon, Atlanta; T. P. Gaylord, E. Dryer, C. W. Regester, Chicago; R. S. Brown, D. E. Manson, M. H. Merrill, E. D. Mills, Boston; C. A. Bragg, Philadelphia; W. W. Lovell, Cleveland; P. T. Brady, G. W. Pulver and S. B. Storer, Syracuse, N. Y. There were also large contingents from the Westinghouse Traction Brake Company, and the Westinghouse Air Brake Company, while Mr. W. M. Probasco was the efficient representative of the publication bureau of all the Westinghouse companies.

The Speer Carbon Company, of St. Marys, Pa., had a neat little exhibit in the hotel corridor, in charge of President Speer himself, including their well-known car motor carbon brushes, and other standard specialties.

"Habirshaw" wire and cable interests were well taken care of, Dr. W. M. Habirshaw, of the India Rubber & Gutta Percha Insulating Company, being present as well as Mr. J. B. Olsen, who has already made such an enviable record as the general sales manager.

"Okonite" was adequately represented by Mr. George T. Manson, of the New York office.

National Carbon Company, of Cleveland, at the hands of Mr. N. C. Cotabish, sales manager, and Mr. R. K. Mickey, enjoyed good representation, its booth space being well filled with samples of all its well-known carbon specialties in the car line, as well as with its well-known Columbia dry cells for automobile purposes and ignition work in general. These gentlemen also had literature on the subject for distribution.

J. G. White & Co., of New York, were represented by President J. G. White.

Mr. C. O. Mailloux, the well-known consulting engineer, who has of late gone heavily into electric railway work and enterprise, was present, with his associate, Mr. W. C. Gotshall.

Dearborn Drug & Chemical Works, of Chicago, had a space under the veranda which they employed as a reception room and for handing out ingenious souvenirs. They were represented by Messrs. R. F. Carr, vice-president and general manager; W. B. McVicker, second vice-president and Eastern manager, and Mr. G. W. Spear, of Chicago.

Mr. C. J. Harrington made himself thoroughly at home—and his friends—at Cottage E in the annex, and hung his signs bravely on the outer wall. With him were associated Messrs. J. E. Laughran, F. B. Jacobs and R. Taylor, and Mr. F. D. Masterson, for the Chase-Shawmut Company, of Boston

Mr. Fred. Locke, of Victor, N. Y., associated with Archbold-Brady Co., of Syracuse, had a most striking and effective display of his celebrated high-tension porcelain insulators. A separate dark room had been fitted up, containing the high-potential transformer of Prof. Smith, of Worcester Polytechnic, as described recently in these columns. It is capable of giving a potential of 175,000 volts and with it over 100,000 was thrown on groups of porcelain and glass insulators to show how they could stand up under the enormous strain. Mr. Locke was himself present and was gratified at the astonished expressions from visitors in regard to the resisting powers of his porcelain insulators. A variety of the insulators were also shown in the Archbold-Brady space, as well as Locke glass insulators; and the space was at night beautifully lit up by several types of Nernst lamps, for which the Syracuse firm are agents.

Ohio Brass Company had displayed a great deal of taste and thought in fitting up its booth on the lawn, and had converted it into a very pretty floral bower, worthy of some carnival. At the same time the decorations served rather to set off than to conceal the admirable exhibit of trolley line specialties with which the company's name is so prominently connected. The company was represented by Messrs. C. K. King, secretary; G. A. Mead, chief engineer; N. M. Garland and J. C. Warren, Jr., New York; F. H. Jameson, Mansfield, O.; A. L. Wilkinsburg, general sales agent, and Burt Gellathy, Pittsburg.

Gold Car Heating and Lighting Company had a large booth space in which were shown a variety of types of their well-known car heaters, etc., and as usual President Gold and General Manager Ward were present to meet hosts of friends and make new customers.

National Electric Company, of Milwaukee, had a most tasteful booth, with a Christensen motor-driven air compressor car outfit as an attractive feature. Under its new name the company is making an active and successful bid for street railway orders, and in its cottage annex showed photographs of the large generators which it is now building. At the cottage was also to be seen a small motor-driven model of an air compressor for cars. The company was represented by Messrs. F. C. Randall, general sales manager; J. H. Denton, J. T. Cunningham, J. F. Dixon, J. S. Hamlin, S. I. Wales and J. J. Nef, while the electrical department was specially represented by C. G. Burton, W. L. Waters, W. J. Richardson, C. D. Knight and J. E. Eldred.

Benjamin Electric Manufacturing Company, of New York City, had a booth tastefully decorated with their specialties, which were shown by Mr. Basil G. Kodjbanoff, manager of the Eastern and export departments. This concern is making wireless clusters, which consist essentially of an insulating base of porcelain, two one-piece contact plates attached thereto. These serve as terminals to all the lamps in the cluster, and each is provided with a binding screw; and the other part is a removable casing of brass or aluminum supported by porcelain rings or bushings of special design. Obviously the cost of installation is very much reduced for ceiling and pendant lights, and the cluster is made thoroughly durable as well as compact and handsome. For series work the contact plates are made in sections so as to serve two adjacent lamps, the inner and outer plates, overlapping each other, thus giving series connection without wiring. In the exhibit were shown the styles adopted by the Interborough Company, of New York, for all cars, a series two-light cluster, as well as the five-light series clusters used by the New York Metropolitan in its car barns. Another example illustrated the application to window lighting where economy of space was an object.

A Marconi Interview.

The *Wall Street Journal* of Monday, August 31, prints an interview with Mr. William Marconi in which the inventor gives some information concerning his future plans and other matters. He says his experiments with wireless telegraphy have demonstrated that it is possible for him to establish commercial communication between America and Europe without employing the high towers used in his former demonstrations. He is not certain that he will be able to dispense with towers altogether, but can definitely promise that in less than three months the stations of his companies will be open for the reception of commercial business and that the height of the towers heretofore used may be materially reduced. He has determined certain facts with relation to wave lengths which will reduce the amount of power required for transatlantic communications nearly 50 per cent. His experience has taught him that all interference with wireless communications may be eliminated with the exception of malicious interference. That is to say, that it does not seem possible, in the light of present knowledge, by scientific means to prevent a malicious person from employing an amount of power not only unnecessary for legitimate purposes, but absolutely useless for the transaction of bona fide business, which will prevent the successful operation of an opposing wireless station. This is equally true of any system of telegraph. For instance, in the course of some of his experiments at Poldhu, the power employed was sufficient to disable the instruments in the postal telegraph station 18 miles away, so that they were useless for 24 hours. Upon learning this he abandoned all experiments upon this line in fear of an injunction and has not resumed them.

It is possible to permanently disable all telegraph systems by the same means. He could take a building next door to a telegraph office and, without any visible or tangible evidence, absolutely obstruct the operation of all lines leading from that office. Legal enactment will in time provide adequate protection for the operation of wireless telegraphy, just as it has provided penalties for the theft of electric currents. It is an open question now if present laws are not sufficient to prevent malicious interference. Marconi explained that by malicious interference he meant the use of high power discharges into the atmosphere, which were unnecessary to accomplish successful transmission of messages, and which, in fact, defeated the efforts of the person using them to accomplish successful transmission of intelligence. He thought that possibly laws would be enacted in time determining by legal limit the sphere of influence of wireless stations, thus guaranteeing them against successful attempts at wilful interference. He has determined positively that by the attunement principle it is possible for many wireless instruments to be operated and many messages dispatched simultaneously without becoming tangled in the least.

On the subject of the Berlin conference on wireless, Signor Marconi said one of the delegates is here with him, the Marquis Solari. The proceedings are to be made public on the 1st of September. Although he has a transcript of the transactions, he was not at liberty to speak in reference to the subject, but added that with Italy and England represented, the Marconi system has nothing to fear. He said there was no truth in the statement published that a consolidation of the Marconi and German interests was in contemplation. He had met the Kaiser in Rome, had discussed wireless with him, but there had been no consideration of the question of consolidation. The inventor will leave New York at once for Glace Bay, Cape Breton, for the purpose of installing his new inventions. He will return from there to South Wellfleet. He has placed a three months' limit on the interval before opening commercial communication with Europe, but those closest to him are confident it will be accomplished in less time. After his return to England he expects to so arrange his time as to visit America once a month in order to exercise a proper supervision over affairs on both sides.

Telephonic Nursemaid.

It is mentioned by a Western newspaper as an actual occurrence that a farmer's wife in the locality, wishing to visit a neighbor, pulled the baby's crib up in front of the telephone, opened the receiver, and told central if the baby began to cry to call her up at the neighbor's. This simplification of maternal duties may have an important bearing on the "race suicide" question.

CURRENT NEWS AND NOTES.

OHIO ELECTRIC LIGHT ASSOCIATION.—The ninth annual convention of the Ohio Electric Light Association will be held at the Hotel Chittenden, Columbus, Ohio, October 13, 14 and 15 next. This association ranks high as to the quality of the papers read at its meetings, the discussions thereon and the technical ability and enterprise of its members.

"INVENTOR OF THE COMPASS."—A little to the south of Vesuvius, on the Gulf of Salerno, lies the town of Amalfi, whose inhabitants have recently been celebrating the sixth centenary of Flavio Gioja, the inventor, so say the Amalfians, of the mariner's compass. They have found the man and fixed the date; it was Gioja, and about 1302 or 1303. There are people who doubt that there ever was such a person as Gioja, and many who incline to the opinion that the mariner's compass was doing good service many centuries before his date.

WIRELESS TELEGRAPH CONFERENCE.—Gen. A. W. Greely, Chief of the Signal Service of the United States Army, who has been in Berlin as one of the American representatives at the International Wireless Telegraph Conference, arrived last week from Europe. He would not talk of the work done by the conference in regard to an international code or otherwise, as it had been agreed that nothing would be given out pending the report of the various delegates to their respective Governments. "There were eight nations represented," said Gen. Greely, "and we were all treated with the greatest courtesy. I may mention that the first of the foreign delegations to call on the American representative was that from Spain."

TELEPHONE POLICE SIGNAL SYSTEM.—After a sharply contested competition extending over several years, the City of Cleveland has contracted for a police signal system employing the telephone instead of telegraphic apparatus. The system is that of the Municipal Signal Company, of Chicago, the apparatus being supplied by the International Telephone Company of the same city. The first installation was made in Chicago in 1899, and it has been in use in St. Paul for several years. The system was used at the Pan-American Exposition, and will be installed at the St. Louis Fair for police service. The action at Cleveland in connection with the recent adoption in New York of a telephone police service, points to a general change in the methods of police signaling service.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—The thirteenth annual convention of the American Electro-Therapeutic Association will be held at the Hotel Windsor, Atlantic City, N. J., September 22, 23 and 24. Among the papers to be read are the following: "Currents of High Frequency, Apparatus and Therapeutic Uses," by F. G. DuBose; "The Use of Electricity in the Treatment of Diseases of the Heart," by S. Cohn; "Electricity in the Treatment of Diseases of the Stomach," by H. H. Roberts; "A Plea for Electro-Therapeutics Proper," by W. J. Herdman. Many other papers of special interest to the members and the profession in general are down on the programme. Dr. Clarence E. Skinner, New Haven, Conn., is secretary of the Association.

TELEGRAPHS AND TELEPHONES.—From the Statistical Year Book of the German Empire, Mr. Simon W. Hanauer, United States Deputy Consul-General at Frankfort, quotes the following: "In 1900 Germany had 24,471 telegraph offices, with 36,000 instruments in operation; Great Britain, 11,512 offices and 38,000 instruments, and the United States, 22,954 offices and 81,000 instruments. The number of telegraphic dispatches transmitted in 1900 was: Great Britain, 92,000,000; United States, 63,000,000; France, 50,000,000; Germany, 46,000,000. In Germany there were 2,411 cities or towns having public municipal telephone systems, with 305,795 connections. France had 1,199 public telephone plants with 72,480 connections." The telegraph figures as to the United States are decidedly incomplete.

WORLD'S FAIR HISTORICAL EXHIBIT.—The Board of Directors of the American Institute of Electrical Engineers has appointed a committee to arrange an exhibit showing the evolution of the prominent elements which are the basis of electrical engineering. Any person possessing or knowing of the whereabouts of interesting historical electrical machines or appliances, will render the committee a great service by communicating with the chairman, or one of the members at once. The exhibit will be given a prominent place in the Electricity Building, where the Institute will also maintain headquarters. The members of the committee are: Mr. T. C. Martin, chairman, 114 Liberty Street, New York; Mr. W. J. Hammer, Havemeyer Building, New York; Mr. J. S. Anthony, 44 Broad Street, New York; Mr. Henry Noel Potter, 510 West Twenty-third Street, New York; Mr. Cloyd Marshall, Electrical Department, World's Fair, St. Louis, Mo.

EAST PITTSBURG TECHNICAL NIGHT SCHOOL.—A Technical Night School will be conducted in the Casino Buildings, East Pittsburg, Pa., by Mr. Henri F. Chadwick, formerly one of the faculty of Tufts College and of Armour Institute, the courses of which are particularly arranged for clerks, mechanics and apprentices employed in the various Westinghouse works. The school term will extend from September 1 to June 1. Three courses will be taught, namely, mechanical-electrical engineering, mechanical-steam engineering and shop practice, each extending over two years. There will also be special courses in mathematics and a preparatory course in this branch. The teaching will be supplemented by lectures by experts on engineering subjects. Instruction books will be supplied free to students, and a diploma granted at the end of a course if all examinations have been passed satisfactorily. Five scholarships will be offered to those who obtain the highest rank in the courses. The fees are $3 for entrance and $2 monthly.

REPORT ON PARIS DISASTER.—The Paris Municipal Committee investigating the recent tunnel disaster on the Metropolitan Railroad, has drawn up a report, which has been approved by the Prefecture, indicating the reforms which should be immediately made in the underground railroad system of Paris. The principal proposals are that the present system of a motor at each end of the train should be suppressed; the motors must be capable of isolation from the train; in case of the slightest fire, the train must be stopped, and the motor isolated; telephones and speaking tubes must be provided at reasonable intervals along the line; the number of employees at the stations must be increased; the platforms must be cleared of every obstruction and lighted by an electric current, independent of the currents supplying the traction or the lighting of the tunnels; and numerous lamps must be placed to indicate the direction of the exit. The report says that it is proposed to insist later on the use of incombustible rolling stock, and the construction of refuges in the tunnel walls.

THE CONVENTION OF EDISON ILLUMINATING COMPANIES.—The Association of Edison Illuminating Companies will hold its next convention on September 8, 9 and 10, at the Frontenac, Thousand Island, St. Lawrence River, N. Y. Following is a list of the papers to be read at the convention: "Commercial Experience with Nernst and Meridian Lamps, by Mr. W. B. Thompson, Detroit, Mich.; "Purchased Electric Power in Factories," by Mr. E. W. Lloyd, Chicago, Ill.; "Operating Features of High Tension Power Stations," by Mr. W. F. Wells, New York, N. Y.; "Position of Steam Turbines in Central Station Operation," by Mr. August Kreusi, Schenectady, N. Y.; "Overhead Pole Line Construction and Operation," by Messrs. A. H. Manwaring and J. T. Hutchings, Philadelphia, Pa.; "Comparison of European and American Engineering Practice," by Mr. Charles Schwartz, Chicago, Ill.; "Profitable Advertising," by Mr. W. H. Johnson, Philadelphia, Pa.; "The Central Station and the Isolated Plant," by Mr. Douglass Burnett, New York, N. Y.; "Depreciation in Electric Light Plants: How Estimated and Applied," by Mr. H. M. Edwards, New York, N. Y.; "Selection and Installation of High-Tension Switching Apparatus," by Mr. Leonard L. Elden, Boston, Mass.; "Illumination," by Mr. C. P. Steinmetz, Schenectady, N. Y.; "Results Obtained with Steam Turbines in Milan, Italy," by Mr. Guido Semenza, Milan, Italy; "The Development of Summer Lighting," by Mr. E. A. Leslie, Brooklyn, N. Y.; "Notes on Commercial Features of European Lighting Practice," by Mr. Arthur Williams, New York, N. Y.

HELIUM FROM RADIUM.—Sir William Ramsey recently made the announcement that some experiments appeared to show that there is a production of helium—a rare constituent of the atmosphere—continuously from radium.

WIRELESS MIXED METAPHORS.—The wireless telegraph station which has been established at the Brooklyn Navy Yard was placed in working order last week, and it immediately got into communication with trolley cars in various parts of Brooklyn every time the cars "lost their trolley." Signals from the station at the yard and from the DeForest wireless station at Coney Island got to crossing each other, and as neither had the slightest idea what the other was talking about the Navy Yard got about as much wireless news from Coney Island as Coney Island got got from the Navy Yard. Attempts were made by the operators at the station at the yard to get into communication with one of the warships in the waters near the eastern end of Long Island, but these were unsuccessful. The Slaby-Arco system is used at the Navy Yard, with a flag pole antenna 180 feet high.

ELECTRICITY IN SPAIN.—According to the Boletin de la Cámera Oficial de Comercio de Cadiz, the following statistics show the number of gas works and electric plants in Spain and the amount of taxes collected thereon in the year 1901, the latest year for which statistics have been published: During the year 1901 there were 79 gas works in operation in Spain. The production of gas was 136,853,231 cubic meters, which yielded a tax of 2,048,342 pesetas ($395,330). The electrical plants in operation numbered 961, of which 266 were in the province of Barcelona. The provinces of Huelva and Orense had but two each. The annual production in kilowatt-hours reached the figure of 42,248,657, which yielded a tax of 1,955,302 pesetas ($377,383). Taxes from the manufacture of calcium, 27,834 pesetas ($5,372); customs duties collected on imported calcium, 154 pesetas ($30); taxes from the Basque provinces, 105,180 pesetas ($20,300). Total taxes collected on gas, electricity and calcium, 4,136,812 pesetas ($798,404).

THE GEM KUNZITE.—A new and unusually phosphorescent gem has been discovered by Dr. George F. Kunz, President of the New York Mineralogical Club and a gem expert, after whom it has been named by authorities. Near Pala, California, crystals of the new gem as large as a man's hand were found. The tint is described by Dr. Kunz as "rosy lilac." When cut and mounted in a certain way one of these crystals yields a gem of unusual beauty. The discovery is of more than ordinary interest because nothing similar to the new gem has ever been seen by gem experts or jewelers before. In the course of the tests by Dr. Charles Baskerville the Kunzite crystals were subjected to the action of ultra-violet light without showing any evidence of fluorescence or phosphorescence, and is was not until it was subjected to the bombardment of X-rays of very high penetration that it became at all fluorescent. On its removal to a dark chamber it exhibited a persistent white luminosity never before observed in its class of minerals.

RADIUM AND THE CREATOR.—Mr. Julian Hawthorne has the following in a recent article in the *Booklovers' Magazine* "And, if radium does undermine the time-honored theory of the conservation of energy, it is an intimation of things which are precious to philosophy, if not to practical life. The conservation of energy shuts us up in a box, into which nothing new can enter, from which nothing can escape. Among other things which are thus shut out, or in, is the Creator Himself. But the Creator is infinite; how can He be enclosed or excluded? The destruction of the conservation of energy theory would discredit that other great creed of the last century—the alleged truth of evolution. Man would not have been evolved, through interminable continuous processes, from the protoplasmic cell; but each successive order in nature would be distinctly created, without continuity. There would be some—and that the characteristic—thing or principle in each step of the series which had not been in the series up to that time. And the Creator, consequently, would be relieved from the present charge of having set a machine going in the beginning which has been running ever since without His interference, leaving Him to amuse Himself otherwise or not at all, and He would be shown in a state of constant and infinite activity." What bosh the magazines admit!

LETTERS TO THE EDITORS.

The Metric System.

To the Editors of Electrical World and Engineer:

Sirs:—I have just noticed for the first time a statement in your issue of August 15 that the "press agent of the metric opposition" stated recently before the Furniture Association of America that "in France, the country in which the system originated, it is in practical disuse."

As I made an address on this subject before this association at its recent meeting, I conclude that your courteous words refer to me. Inasmuch as I made no such statement, nor anything comparable with it, I trust you will allow me to correct the mistake under which you labor.

By the way, why do you ignore the statement made in Mr. Colle's recent letter that electrical units are not metric? Outside the ranks of pure scientists, the chief support for the metric system is found among electrical engineers, and the "metric" character of their units is the stock in trade of their arguments. Do you not know that you cannot afford to ignore the challenge of Mr. Colles?

New York. F. A. Halsey.

[We regret that in quoting verbatim a newspaper statement we unwittingly did an injustice to Mr. Halsey. The statement that electrical units are not metric was not ignored, though we confess it was disposed of rather summarily; to discuss seriously such a statement in the columns of an electrical journal would imply a very poor opinion of the intelligence of its readers.—Eds.]

To the Editors of Electrical World and Engineer:

Sirs.—The communication of Mr. J. G. Vogel in your issue of August 15, relative to the metric system, would have remained unanswered, as it contains absolutely nothing new, nothing which has not been said a hundred times, and answered as many, and the citation from Arthur Schopenhauer, which I made in my former communication, has remained and will ever remain as true as the day it was written; but one remark of Mr. Vogel's is, to say the least, interesting.

The funny part of it all is, that the try-it-on-the-dog proposition—meaning a Government dose of metric system—is now fathered upon me, and I am pronounced "hard-hearted" for such a cruel idea. Alas! much as I would like to have originated so fitting a phrase, I dare not appropriate thus publicly the words of the enemy. Permit me, then, sir, to inform you that this is no *bon-mot* of mine, but the very words of the Hon. J. H. Southard, chairman of the Committee on Coinage, Weights and Measures, of the House of Representatives, and of his spontaneous utterance, in his explanation or extenuation of his own measure, given on the floor of the Convention Hall of the American Society of Mechanical Engineers at their annual meeting last December! Mr. Southard's idea of this bill, in other words, was not at all a part of a well-defined and decided course which was to cause the general use of the metric system—that, in the face of the wall of evidence with which he was confronted, he could not maintain—but a mere trivial tinkering, like the child's "poke it and see what it'll do" before some strange insect. Sir, I most thoroughly agree with you as to the hard-heartedness of this proposition; will you not, then, unite with me in opposing it?

And permit me to say further that if there appears to be animus on our side, it is not directed against the metric system *per se*, which, to be sure, many of us disapprove, but is the reflection of a just indignation against the insinuating and semi-subterranean schemes by which it has been promoted, and which are more reminiscent of the machinations of certain religious societies to get possession of governments in the eighteenth century than of *progress* in the twentieth; the cult having charge of this propaganda, whose headquarters appear to be a body calling itself the American Metrological Society, having no less a means in view, to accomplish their end, than *the taking away of our constitutional liberties and the substitution of the autocratic methods of Europe.* Yes, gentlemen, that is the plan. Now let those who think they want metric system at that point of the bayonet sit down and medicate a while on these things and then tell me if they still think the game worth the candle.

And now, Messieurs the Editors, may I suggest, in my most dulcet tones, the propriety and even desirability of such of your readers as may have an opinion to express, or suggestions to make, on this rather vexed question—making a little investigation into "the state of the art" first—just to avoid some unnecessary repetition and insure some advance in the discussion; and perhaps I may even go so far as to recommend the paper of Mr. F. A. Halsey, December, 1902 (published by the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York), as one containing a good many things worth knowing.

George W. Colles.

Montreal, Canada.

[The metric question in its present aspect is a practical one, which can be neither forwarded nor retarded by discussions of an academic or personal controversial nature. Setting aside the matter of the intrinsic merit of the metric and English systems, the fact remains that the latter is a handicap to our foreign trade, and to study and research in the great engineering and scientific literature of the Continent. Since there is no possibility that the countries now using the metric system will ever discard it for the English system, the practical question is whether as a great commercial nation and one which owes so much of its industrial prosperity to the teachings of science, we shall continue to suffer this handicap. It now seems to be a matter of but a few years when Great Britain, by pressure from her colonies and her commercial interests, will be led to adopt the metric system. We thus have the alternative of anticipating such action or later being constrained by the situation thereby created of supinely following the lead of our principal competitor in the markets of the world.—Eds.].

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Winding of Magnet Coils.—Zischeck.—A mathematical article, in which the author deduces a formula for the calculation of the depth of the winding of magnet coils with a given amperage and a given resistance of the wire, for square, round and elliptical cross-section of the magnet. Several examples are calculated. The formulas are long but simple. The author claims the following advantages for the formulas 1. They permit of seeing whether the space assumed for the winding is sufficient without requiring the dimensions of the wire to be known. 2. From the calculated depth of winding, the dimensions of the wire can be quickly and exactly determined in a simple manner, and the laborious trials are done away with. 3. The equations can be used for every form of cross-section of the magnets, if the necessary coefficients are calculated according to formulas given in the article.—*Zeit. f. Elek.*, August 9.

Transformer of 1,000 Kw.—An illustrated description of a recent Oerlikon construction of a transformer of the oil-insulated type with artificial cooling. The apparatus is built for 1,000 kw at 3,000 volts primary and 27,000 volts secondary potential at 50 cycles. It contains three iron cores, each of which carries a high and low-pressure winding, separated by an insulating layer of 10 mm. thickness. One high-pressure coil contains 35 coils, each consisting of 26 windings of bare copper strip of 1 × 13 mm. cross-section. The low-pressure winding has 18 coils, of 10 windings of copper band of 2.5 × 33 mm. cross-section. The high-potential coils are star-connected, the low-pressure coils in triangle. The current strength at normal load is 21.5 amp. in the high-potential and 110 amp. in the low-potential coils. Data as to the iron losses at 52 cycles, the fall of potential, the testing for overload, efficiency calculation, etc., are given in the article.—*Zeit. f. Elek.*, July 26.

REFERENCES.

Universal Forming Machine for Armature Coils.—Robinson.—An illustrated description of a recently-designed machine for forming armature coils for different sizes of armatures. The mechanism and the mode of operation are described in detail.—*Am. Mach.*, August 20.

Lights and Lighting.

REFERENCE.

Hot-Wire Enclosed Arc Lamp.—Tomlinson-Lee.—A short article with diagrammatic illustration of the Foster lamp, in which a thermo-expansive strip is used for the control of the striking and feeding mechanism. It is stated that very little more than the internal resistance of the lamp and mechanism, about 2 ohms, is needed on direct current. Its apparent indifference to circuit conditions is claimed as the most remarkable characteristic of this lamp. A pair of lamps adjusted to burn on a 220-volt, direct-current circuit was switched over to a 220-volt, 50-cycle, alternating-current, without the arc breaking.—Lond. *Elec. Rev.*, July 31.

Power.

The Storage Battery in Mining.—Huber.—A long, illustrated article. The author thinks that it is very surprising that up to now so few mines have installed storage battery plants, as the faculty of the storage battery to equalize the load on the power plant is particularly valuable in mining on account of the intermittent working of the machines. He attributes this state of affairs to the ignorance of the interested parties as to the advantages of a storage battery. After briefly noting these advantages, the author gives a description of a plant at a silver mine, with illustrations of some of the machinery and the storage battery plant. The latter consists of 275 elements, with a capacity of 370 amp.-hours, a maximal charging current of 226 amp., and a maximal discharge current of 370 amp. Three dynamos furnished current for the whole mining plant, being kept running day and night, and their current varied from one instant to the other between 10 and 100 amp., according to the demands made upon them for power. After the storage battery was installed, there were used only 2 of the 3 dynamos in the forenoon, 1 in the afternoon and none at night. Diagrams are given showing the distribution of the load before and after the installation of the storage battery plant. For the size of the battery to be installed for such purposes, the author offers the following considerations: 1. The battery must be capable of taking up all sudden rushes of current; that is, on sudden interruption of the consumption of current to take all of the current generated by the dynamos connected in parallel, and in the next instance, when the power-consuming machines begin to work again, to furnish the excess of power needed above that generated by the dynamos. 2. The battery must be capable in case of a break in the machinery or another disturbance in the generation of current, to furnish the whole power needed for a certain predetermined time; it has to have, therefore, of a certain capacity. If these two points are sufficiently considered, the following advantages accrue from the installation: *a.* The boiler and engine plant which has to be provided, becomes about 50 per cent. smaller and, therefore, cheaper; the saving thus effected will generally pay for the storage battery. *b.* The cost of production is considerably less, as not only the steam consumption is reduced to a minimum by suitably distributing the load on engines and boilers, but also the necessity of running them during the night is obviated. *c.* The safety of working is greater, for not only an overload on the machines is prevented, but in case of breakage or accident the power can be furnished by the battery. A detailed example is calculated for a hoisting engine at a coal mine, with a maximum effect of 621 hp. It is calculated that with electric drive and a buffer storage battery, only a 250-hp gas motor will be required to furnish all the power needed, which is now provided by a 621-hp steam engine. —*Glueckauf*, August 8.

Forty-Thousand-Volt Power Transmission.—Guarini.—A note on a 15,000-hp installation in the Alps between Italy and the Tyrol, to be built by the Oerlikon Company. The tension at the terminals of the three-phase generators will be 9,000 volts, with a frequency of 42. The plant is said to be interesting as the first in Europe to make use of a tension of 40,000 volts as well as of transformers of a capacity exceeding 2,000 kw.—*Scien. Amer.*, August 8.

Gas Producers for Poor Gas.—Dupuy.—An illustrated description of the Pierson system, with tests showing a consumption of fuel of about 1,073 grams per kw-hour. The author concludes that the ease of running three gas producers, their low cost of maintenance and the possibility of using cheap coal in them, are such that a considerable development in this line may be foreseen in their application to small and medium motive power.—*L'Eclairage Elec.*, August 8.

Critical Speed of Steam Turbines.—Zurnedden.—An article in which the author calls attention to the necessity for high speeds to secure economy in steam turbines, and points out that in these high speeds the centrifugal forces which enter are of a hitherto unknown magnitude. It is seldom, if ever, possible to bring the center of gravity of the rotating part to the center of the shaft with mathematical exactness even with the most careful balancing. The resulting centrifugal force tends to bend the shaft, and this bending increases with the speed and the eccentricity of the center of gravity. He shows that this condition does not become dangerous until a so-called critical speed is reached, and he deduces this speed in terms of the bending of the shaft. The methods of balancing the rotor are given.—*St. R'y Jour.*, August 15.

REFERENCES.

The Electric Motor for Small Industries.—Loewit.—A popular article reviewing the advantages of the motor for this purpose and giving some calculations of the cost of installation and power.—*Der Elektrotechniker*, July 31.

New Shirt Factory Driven by Electricity.—An illustrated description. Power is furnished by steam to a high-speed enclosed compound engine, coupled directly to a compound-wound multipolar dynamo for 220 volts at full load. Separate mains for lighting and power are run from the main switchboard to distributing boards on each floor.—Lond. *Elec. Rev.*, July 31.

The Diesel Engine.—Ade Clark.—A paper read before the recent meeting of the English Institution of Mechanical Engineers. In the introduction the author describes the principles of construction and the development of the Diesel engine, after which he gives a description illustrated by cuts and diagrams, of an 80 brake-hp engine. The paper is especially valuable for the detailed account which it contains, of a number of tests made on Diesel engines of 35, 80 and 160-hp, and a table giving the total cost in power production for the Diesel engine, the gas engine and the high-speed compound condensing engine.—Lond. *Eng'ing*, July 31, August 7; abstracted in Lond. *Elec.*, August 7.

Liquid Fuel.—Hubbard.—An article covering in a general way the subject of liquid fuel. The author enumerates the various advantages of oil as fuel, and describes different burners for the same. —*Amer. Elec.*, August.

Internal Separators for Steam Boilers.—Strohm.—An illustrated article describing several devices for drying the steam before it passes from the boiler and without reducing its temperature. It is claimed to be more economical than separating the same moisture outside the boiler and returning it by auxiliary apparatus.—*Amer. Elec.*, August.

TRACTION.

Electric Traction with Single-Phase Motors.—A description of a test made recently on a trolley line in Milan of a single-phase motor, constructed by Dr. G. Finzi, of Milan. The latter is one of the directors of the manufacturing firm of Brioschi, Finzi & Co. He took a direct-current motor of the enclosed marine type, with a completely laminated magnet circuit, with removable pole-pieces. This method of construction gives a magnetic circuit of the highest permeability and also enables the field coils to be wound on a standard former and then slipped on the poles. In order to adapt the motor to alternating currents, the only important changes made were, first, to insulate each stamping of the armature and field more carefully than usual; and, second, to make longitudinal slots across the pole faces, so as to minimize the transverse flux due to the armature reaction as completely as possible. There are no subsidiary windings on the commutator connecting bars; at most these differ from those of the direct-current machine only by being made of high-resistance material. It is stated that the sparking is practically eliminated by these arrangements, so that it never exceeds that usually observed at the commutators of traction motors. The Edison Company, of Milan, co-operated in having the motor tested on a practical scale by fixing it on a car where it replaced a 27-hp motor. The direct-current supply was cut off for several hours, and the traction system was fed from a special alternator at 570 volts and 18 cycles. The runs were continued for several nights, the car, which weighed 9 tons, covering over 200 km. The speed occasionally reached 30 miles an hour, while the starting on a gradient of 1 in 40 was accomplished as easily as with direct current. A diagram of the wattmeter record for one section is given in the article. The equipment for alternating currents does not require controlling resistances, which are replaced by a variable-ratio transformer, for starting the motor and regulating the speed. In the actual test there were 5 notches on the controller, adjusting the voltage on the motor between 80 and 160, the primary of the transformer being wound for 570 volts. The abolition of starting resistances with the single-phase motor is stated to get rid of one of the great causes of energy loss with continuous-current working. The more frequent the stops and starts, the more noticeable does this comparative saving become. In ordinary tramway traffic Dr. Finzi is said to have found from actual wattmeter observations that the single-phase system affords a reduction of over 25 per cent. in the energy required per car. There would be in addition a considerably increased efficiency due to the more numerous transformations necessary for the direct-current supply. The equipment for single-phase working is somewhat heavier, but inclusive of the motor, controller and variable-ratio transformer, it is not more than 10 per cent. in excess of the weight of the direct-current apparatus, which is negligible in comparison with the weight of the complete outfit and the car itself. The demonstration of the practicability of the alternating-series motor is said to have apparently been highly satisfactory. Details of the behavior of the motor, its net efficiency, power factor and rise in temperature, are not yet available.—Lond. *Elec.*, August 14.

Suspension Railroad Barmen-Elberfeld.—Koepke, Goering and von Borries.—A long abstract of a report made on the operation of this railway, repeatedly noted in Digest, after a little more than two years of continuous running. The advantages of the monorail suspension system are set forth at length. The second part deals with the observations made during the operation of the line, as to easy running, security of operation, noise, etc. All the wheels of a train were originally made driving wheels by being geared to a common motor placed between the two wheels of a truck. There was a certain loss of power in this arrangement, however, and, therefore, only one wheel of each truck has been used as driving wheel. Under these conditions the consumption of current for 15.2 km. with 24 stops, at a speed of 30 km. per hour, the car weighing 14.6 tons, was 6.375 kw-hours per car km., and 28.8 watt-hours per ton-km. Under similar conditions on ordinary roads, 35 to 40 watt-hours per ton-km. are assumed; the suspension road, therefore, has given an economy of 18 to 28 per cent., despite numerous curves of 90 meters radius. In the future each wheel will have its motor, and a still larger economy is expected. The third part is devoted to a comparison of the Langen system of monorail suspension railroads with other monorail constructions, and to the advantages of a suspension road for high speeds.—*L'Eclairage Elec.*, August 8.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Switching Transmission Circuits.—Adams.—An article in which the author reviews the conditions leading to the construction of oil switches and discusses their advantages and general arrangement. He states that the safety and reliability of operation at voltages of 5,000 or more require that each element of the equipment be so isolated as well as insulated from every other element that the failure or even destruction of one element will not seriously endanger the others, and, therefore, the cables from each generator to its switch should be laid in a brick or concrete conduit, which contains no other cables. The brick or stone compartment for each phase should be so substantial that the contacts of that phase may arc to destruction without injury to the contacts of another phase. Feeders passing away from the bus-bars should also be laid in separate fire-proof conduits; the folly of grouping a large number of feeders transmitting great powers was shown by the accident at Niagara Falls last spring. The switchboard connections are then considered by the author.—*Elec. Rev.*, August 22.

REFERENCE.

Safety Devices.—A profusely illustrated didactic article describing various electrical safety devices beginning with the simplest form of fuse. Enclosed fuses, fuse circuits, cut outs, main line cut-outs, branch blocks and their connections, together with single and double-pole circuit-breakers, are dealt with.—*Amer. Elec.*, August

Wires, Wiring and Conduits.

Alternating Current Wiring.—Poole.—An article with a number of tables on alternating current wiring. The author gives various formulas for calculating the drop and size of wire for inductive and non-inductive loads. The tables are very complete, giving power factors, inductance factors, resistance of copper wires calculated from parallel wires, each 1,000 ft. long, reactance of copper wires, energy drop in per cent. for low potential, single-phase, two-phase and three-phase circuits, and ratio of reactance to resistance, which applies to circuits having any number of phases, provided the wires are arranged symmetrically so as to balance the mutual inductance.—*Amer. Elec.*, August.

REFERENCE.

Conduit Construction.—An illustrated article giving a description of the building of a very extensive underground conduit system for the Cincinnati Gas & Electric Light Company. Two hundred miles of conduit were laid, in runs varying from 1 to 150 ducts. The operations are described in detail.—*Eng'ing News*, August 20.

Electro-Physics and Magnetism.

Deflection of the Positive Rays in the Electromagnetic Field.—Stark.—The author endeavors to explain the fact, found by Wien, that positively-charged canal rays are deflected to different degrees by a transverse field, which may be electric or magnetic. A bundle of canal rays is spread out in the form of a band or spectrum. Three possible explanations have been suggested, the first being that the most strongly deflected rays had a smaller velocity. Wien, however, showed that the most strongly deflected rays already had the maximum velocity. The second explanation is based upon a difference in the masses of the particles, a variable number of neutral atoms having attached themselves to the positive ion. In that case maxima and minima should have appeared in the deflection band, which have not been observed. The third explanation accounts for the phenomenon by the hypothesis that the electric charge of the different rays is different. The assumption has then to be made that the negative electron possesses only a part of the charge of the ion. Then the molecules might get a different charge by taking a different number of electrons. In that case the mass of the negative electron would have to be taken as being proportionally smaller and the negative electron would have to be imagined as still much smaller than it had been regarded up to now. This assumption seems to be confirmed by a recent observation of Becquerel, that the positive rays of radium are deflected by the magnet when they are traveling through a space filled with a gas, and that this deflection is the smaller the farther they have to travel in the gas. This explanation, however, would strike at the root of the electron theory, as it conflicts with the idea of the constancy of the elementary quantity of electricity, as it appears from electric measurements and from the electromagnetic radiation theory, it having furthermore been shown that the charge of the negative electron is identical with that of the positive electrolytic hydrogen ion. The author then gives another explanation, assuming the charge of the negative electron to be constant and equal to 3.1×10 to the $^{-10\text{th}}$ power E. S. units, and the charge of the positive electron equal to this or a simple mutiple of it. He assumes that neutral molecules or atoms under the same conditions can assume a ray-like character in the same way as positively and negatively-charged particles, if they possess a very great velocity and traverse a gas in a straight line for a certain distance, and in striking certain bodies bring them to luminiscence. These neutral molecular rays, formed by transformation from the positive ion rays either by impact or by neutralization through taking on a negative electron, do not suffer deflection in the electromagnetic field. They, however, continue the motion of the positive rays, from which they were generated, and travel in the direction of the tangent, which is drawn to the deflection curve at the point where the transformation takes place. As positive rays are thus transformed into neutral rays at all points of the deflection curve, and makes an impression on the sensitive photographic film, a continuous absorption band is produced. The author thinks that this explanation does not conflict with any experimental result obtained up to the present time.—*Phys. Zeit.*, August 1.

Fluorescence of Crystals Under the Rontgen Rays.—Strutt.—An account of some experiments by the author to determine the question whether the Rontgen rays are polarized or not. Blondlot a few months ago concluded that they were, but it has since appeared that he was misled by the presence of a new kind of refrangible rays from the tube, which are capable of brightening a minute electric spark. The author, reasoning from the fact that fluorescent crystals of magnesium platinocyanide light up with a different color, according to whether the plane of polarization of the incident light is perpendicular or parallel to the optical axis, thought that there might be a possibility that some such difference might appear, when the crystal was fluorescing under the influence of the Rontgen rays. Röntgen rays from a focus tube were allowed to fall normally on the prism faces of large crystals of the above salt, but the fluorescence was not found to depend on the angle between the optical axis of the crystal and the cathode stream in the tube. The experiment, therefore, points against the polarization of the Rontgen rays. A number of other fluorescent crystals, including various platinocyanides, apophyllite, calcite, feldspar and scheelite, were tried, but they did not exhibit any difference of fluorescence, depending on which face was exposed to the rays, or on the orientation of the face. Experiments on calcium tungstate were also tried. Natural or artificial crystallized calcium tungstate is brightly fluorescent under the rays, but the amorphous precipitated calcium tungstate is scarcely at all so. The amorphous variety was subjected to a prolonged boiling with water, for four days, and it was found on comparing it with some unboiled material of the same lot, that it had become much more fluorescent under the influence of the rays than the unboiled portion, though less so than natural crystallized scheelite.—*Phil. Mag.*, August.

Energy of Cathode and Canal Rays.—Leininger.—An investigation undertaken to determine the ratio of the quantities of electricity carried by the cathode and the canal rays to the generating-current strength. The apparatus used consisted of a tube, which carried a brass ring closely fitting the wall of the tube, and having soldered to it a wire mesh. The rays were caught on an aluminum disk, the distance of which could be varied. The experiments were carried out in rarefied air, pure hydrogen and oxygen. The results are plotted and given in tabular form. The determination of the ratio of the cathode and canal rays to the current strength by which they are generated, has shown "that the quantity of electricity of the rays is directly a part of the generating current." This percentage increases rapidly with increasing evacuation, and it must be concluded from its high value at very low pressures that at these pressures the current is nearly all used up for the production of cathode and canal rays. The values for cathode and canal rays appear a little different, but it may be stated with a high degree of probability that after fully considering absorption, etc., these values are equal, and that consequently the appearance of the cathode and canal rays is nothing else than a splitting up into positive and negative ions, which fly away from the electrodes in opposite direction and take their charges from the current. The difference in absorbability is probably connected with the different velocities and rises of the particles, which form the cathode and canal rays.—*Phys. Zeit.*, August 1.

Electro-Chemistry and Batteries.

Electrochemical Equivalent of Silver.—Pellat and Leduc.—A paper presented before the French Academy of Sciences. The authors have made a redetermination of the electrochemical equivalent of silver, using a hemispherical silver disk with 300 sq. cm. surface as cathode. The electrolyte was a neutral silver nitrate solution, and the anode was composed of pure electrolytic silver, separated from the cathode by a muslin diaphragm. The experiments lasted two or three hours and the current was furnished by a battery of storage cells. The current was measured by an absolute electrodynamometer. Three experiments gave an average value of the electrochemical equivalent of silver as 0.011195. The authors think that the total error could not be greater than ½ thousandth. They, therefore, consider it certain that the amount of silver deposited by a coulomb is comprised between 1.119 and 1.120 mgs., confirming results obtained by Potier and Pellat, and Paterson and Guthe, as against lower values obtained by Richards, Collin and Heimrod.—*Comptes Rendues*, Tome 136, p. 1649; abstracted in *L'Eclairage Electrique*, August 8.

Electric Resistance Furnace.—FROELICH.—A short paper, read before the recent Congress of Chemistry in Berlin, describing in a general way the result of the author's investigations to find a material to be used for forming the walls of electric resistance furnaces. This material must have a high melting point, must be chemically indifferent and must have a high electric resistance. It must also permit being made in different shapes, so that the furnace walls can be built up of a number of units. He has found a series of chemical compounds, the names of which are not disclosed, which satisfy these conditions, and the electric resistance of which is mostly much higher than of carbon. Conducting plates are formed from these materials by means of the electric arc, which in connection with suitable electrodes, form the heating units, from which the resistance furnace is constructed. These heating bodies are decomposed little if at all by direct currents.—*Zeit. f. Elektrochem.*, August 6.

Electrometallurgy of Zinc.—SALGUES.—An abstract of a paper read before the Société des Ingenieurs Civils de France. The author describes a process for treating zinc ore in the electric furnace. Oxydized and sulphuretted zinc minerals, with a suitable addition of fluxing materials, are melted and brought to reaction either among themselves or with carbon, iron, etc. There results a slag practically free from zinc, which is tapped off, and metallic zinc, which is also tapped off or volatilizes, according to the conditions of working. With cold minerals, of 40 per cent. of zinc, in furnaces of 100 kw, the production is nearly 5 kgs. per kw-day.—*L'Industrie Elec.*, July 25.

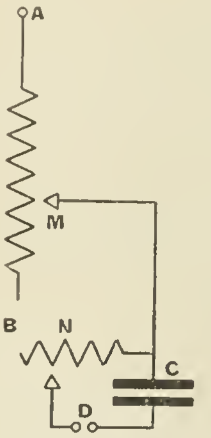
REFERENCE.

Electrolysis of Water.—An article describing the Garuti process for the industrial electrolysis of water. The process depends on the utilization of a perforated metallic diaphragm, which does not act as intermediary electrode as long as the voltage between the poles does not go above 3 volts. The apparatus is illustrated. An improved oxyhydrogen blowpipe is also described.—*Revue de l'Electricite*, July 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

On the Theory of the Quadrant Electrometer.—WALKER.—The author mathematically examines the theory of the symmetrical quadrant electrometer. Hopkinson pointed out that the usual formula given by Maxwell was imperfect, and gave an empirical formula which closely represented his experiments. The author found that Hopkinson's formula can be readily explained, as well as his general result, namely that the sensibility of the electrometer rises to a maximum as the potential of the needle is raised, and that any further increase in the potential of the needle reduces the sensibility. After a lengthy mathematical exposition he concludes that the investigation may be held to show that the air-gap as usually found in an electrometer is quite sufficient to account for the observed fact that there is a maximum sensibility depending on the potential of the needle. The conclusion is that the ordinary formula would be more nearly obeyed with a small air-gap. Diminishing the air-gap raises the potential of maximum sensibility, and the author also thinks it possible that higher sensibility will be attained thereby. With regard to Ayrton and Sumpner's results with the White electrometer bipolar suspension, the author explains the apparent conflict. They found a maximum at about 1,200 volts, but after falling a little the sensibility curve rises as the potential of the needle increases. They showed most satisfactorily that the effect is due to lack of symmetry, particularly of the guard tube. The author states that it is not, however, clear that this effect is the same as that obtained by Hopkinson. In his experiments the maximum occurred at about 800 volts, and thereafter the sensibility went on decreasing much more rapidly than in Ayrton and Sumpner's experiments. Hopkinson's instrument was also more sensitive. The author thinks that their experiments apply only to an extremely unsymmetrical instrument of comparatively low sensibility, and that the maximum considered in his paper is beyond the range of their instrument.—*Phil. Mag.*, August.

Resonance Coils.—MIZUNO.—The first part of an illustrated article. He describes some experiments which he carried out with an arrangement in which the two long parallel wires, used in Lecher's system, for the production of stationary electric waves, were replaced by two coils. He obtained much stronger effects, as the self-inductances of the wires are less than those of the coils and the capacities of the Leyden jars used must be reduced in order to get resonance, and, therefore, the electrical energy of the system becomes less. The author states that the well-known Tesla experiments can be easily performed by means of the coils, the method being much simpler than the Tesla apparatus, as it requires no separate primary or awkward oil insulation. The author then describes a way of producing the first odd harmonic of the fundamental vibration. He has also measured the variation of potential along the coil by means of a point-plate spark micrometer, the lengths of the sparks drawn being proportional to the maximum values of the potential at the corresponding parts of the coil. A curve is obtained by plotting the number of turns of the coil as abscissas and the spark lengths as ordinates; this shows that the potential which produces the spark does not vanish anywhere, that the vibration is not sinusoidal, and that the space-rate of variation of potential is rather slow in the neighborhood of the free end. By means of this method the author has also investigated the change of potential at the free end of the coil due to change in the length of the coil. The experiment was conducted with the arrangement shown in the adjoining figure. A coil, *A B*, was connected at *M* with a Leyden jar circuit. The self-inductance is adjusted by means of a movable contact, until the part, *A M*, of the coil is in resonance with the condenser circuit, *C D N*. The maximum spark length at the free end, *A*, was then observed. The contact piece, *M*, was then moved up and down the coil from the above position for resonance, so as to change the total length of the coil, and the corresponding maximum spark lengths were observed. The curve plotted from the values thus found shows that the rates of diminution of the spark lengths on both sides of the maximum point are somewhat unsymmetrical. Above the critical point the spark length decreases more rapidly than below the point.—Lond. *Elec.*, August 7.



RESONANCE COILS.

Measurement of Self-Induction Coefficients and Condensers.—BRION.—The author gives a method of comparisons based upon the use of an alternating current and a telephone. The apparatus is illustrated in the adjoining figure. *A B* is the measuring wire, *L n* and *L x* the known and the unknown self-induction, *C D* and *F G* two adjustable resistances, free from capacity and induction, *D F* an auxiliary measuring wire, and *T* the telephone. Two points are connected on the measuring wires; for instance, *P* and *E*, which will generally show a difference of potential. *P* is then moved, until a minimum is reached, after which *E* is moved to the minimum; *P* is then moved again to a minimum and so on, until a simultaneous minimum is reached on both wires. A graphic solution of the problem is given by the author. The method is also applicable to condensers, as is shown by the author by a graphical solution for that case. If a condenser is to be compared by this method with a normal condenser, the dielectric hysteresis of which is assumed as being very small and the ohmic resistance as infinitely great, a resistance has to be connected in parallel to the normal condenser, which has to be so regulated that the sound disappears in the telephone.—*Elek. Zeit.*, August 1.

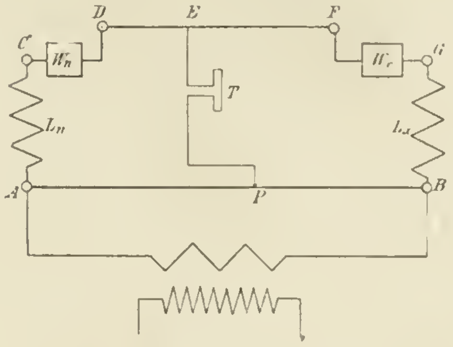


DIAGRAM OF CONNECTIONS FOR MEASUREMENTS.

REFERENCE.

Power Measurement on Alternating-Current Circuits.—WILLIAMSON.—The author first discusses the power conditions met with in alternating circuits and then the power measurements on single, two and three-phase circuits.—*Elec. Rev.*, August 15, 22.

Telegraphy, Telephony and Signals.

Intercommunicating Telephone Systems.—O'Brien.—Another article in the series, the Couch & Seeley automatic intercommunicating telephone system, being described. In this system, as in the majority of systems for similar purposes, the automatic switch constitutes the distinctive feature. The switches are constructed so as to be mounted in the interior of the instrument, and they form an integral part of both the wall and desk sets. The switch consists of a number of strips of jacks mounted on a metal frame fastened to the interior of the instrument. Each jack strip contains five jacks, and in consequence the switches are readily constructed in any desired multiple of five. The lines from the various instruments are connected to the corresponding line terminals in the switch, the arrangement and number of terminals and the style of jack used depending upon the method of wiring. Sectional views of the switches are given, together with diagrams for connecting up the various stations.—*Amer. Elec.*, August.

REFERENCES.

Telephone Engineering.—Dommerque.—An illustrated article dealing with the stringing of outdoor wires. The author describes adjustable reels, the different joints, splices, sleeve connections and methods of dead-ending and transposing with regular and pole transpositions. —*Amer. Elec.*, August.

Wireless Telegraphy Communication Between Martinique and Guadaloupe.—Guarini.—A popular illustrated article, giving a diagram of the electrical arrangement of one of the stations. The system used is the Ferrié, and it has been installed by the inventor.—*La Nature*, August 8.

MISCELLANEOUS.

Electrification of the Brain.—Leduc.—A summary of the facts known concerning the action of electric currents upon the brain, with additional information concerning the electric production of sleep. According to Von Ziemssen, the brain substance is the best conductor in the human body, being about 3,000 times more conducting than muscle. That electricity has not been more frequently used in the treatment of brain disease is largely due to an exaggerated notion concerning the dangers involved. Generally speaking, a continuous current passing from one ear to the other produces dizziness, the objects appearing as if mounted on a wheel turning around, so that the top seems to pass from the anode to the cathode side. Currents from back to front appear to be innocuous and even beneficial. Thus a current brought up to 5 milliamp. in five minutes and kept at that strength for another five minutes, with electrodes on forehead and neck, increased the muscular power by 6 or 7 per cent., as measured on the ergograph. The best arrangement for the production of sleep is a current of 4 milliamp. at 30 volts, interrupted 100 times per second for nine-tenths of the period of interruption. The author has tried it on himself. The faculty of speech disappears first, then the motor faculties. Respiration and pulse are unaffected within the limits stated, but their temporary or final stoppage may be brought about by increasing the current. Short of that, awakening is instantaneous and the resulting feeling is one of refreshment.—*Arch. d'Elec. Med.*, July; abstracted in Lond. *Elec.*, August 7.

New Books.

Reflexions sur la Puissance Motrice du Feu et Sur les Machines propres a developper cette Puissance. By Sadi Carnot. Paris: A. Hermann. 116 pages.

This appears to be a photolithographic reproduction of the celebrated pamphlet that has made Sadi Carnot famous as the founder of the scientific theory of the heat-engine. The physical ideas presented are slightly different from those now in vogue, but the arithmetic and logic are as invincible to-day as they were when formulated by this remarkable scientist. The treatise is worked out in the metric system of units and the illustrations are substantially the same as those illustrating text-books on the theory of the simple heat-engines. It is interesting to observe that Carnot virtually took the absolute zero of temperature at — 267° C., instead of the modern assumed value of — 273° C. A dedicatory letter by Senator H. Carnot, the author's brother, written to the Academy of Sciences in 1878, and a sample page of the author's manuscript, end the little volume.

Infortuni Sul Lavoro. Mezzi Tecnici per Prevenirli. Manuali Hoepli. By E. Magrini. Milan: Ulrico Hoepli. 215 pages, 258 illustrations. Price, 3 lire.

This little volume analyzes the various dangers to life and person presented by the operation of ordinary forms of machinery and trade processes. The various constructions and means for avoiding such accidents are also discussed. Only a few pages (225-232) in Chapter XI on "Electrical Machines," relate to electrical accidents. The ordinary rules of constructing machinery and switchboards to insure the safety of workmen and operatives are described. The treatment in case of severe accidental electric shock, is also outlined according to the suggestions of D'Arsonval. The book fills an important place in the literature of sociological mechanics and industry, but is not of much direct interest to electricians, or to those engaged in electrical industries.

Kalender für Elektrochemiker. Sowie Technische Chemiker und Physiker, 1903. By D. A. Neuberger. 583 pages. Beilage zum Kalender fur Elektrochemiker sowie Technische Chemiker u. Physiker. 448 pages. Berlin: M. Krayn. Price, 4 marks.

This is an excellent electrochemical pocketbook drawn up with great care and covering a wide range of subjects. The first 82 pages contain a calendar with the regular saints days for the year. The next chapters relate to electrical measurements, with various useful table of constants and data. The second division contains 120 pages and relates to chemistry, and contains tables of constants such as atomic weights, solubility and analysis methods. The third division relates to electrochemistry and covers 300 pages. It contains a very large and useful collection of electrochemical data in tabular form clearly expressed. The Appendix has tables in mathematics, physics, heat, optics, mechanics, magnetics, machinery, fuels and various other matters of technical interest, including patent rules, and electric fire insurance rules. The Appendix is of thus greater importance to German than to American electrochemists.

Pratique des Essais des Machines Electriques. By Emile Duquesne and Ulysse Rouviere. Paris: Ch. Béranger. 362 pages, 223 illustrations. Price, 15 francs. 1903, price 15 francs, 362 pages.

The purpose of this useful book is to supply to the electrical engineer the outlines of test for any well-known type of dynamo-electric machine. The first chapter describes testing apparatus. Chapter II deals with laboratory tests. Chapter III treats of the methods of testing direct-current dynamos for the various properties usually regarded as significant. Chapter IV similarly treats tests of continuous-current motors. Chapter V describes the various tests of street railway motors. Chapter VI relates to the measurement of power transformation. Chapter VII deals with the testing of alternators. Chapter VIII, IX, X and XI deal with the testing of synchronous motors, converters, induction motors and transformers, respectively.

In an appendix are inserted the rules of testing and standardization adopted provisionally by the German Association of Electrical engineers at the Dresden Congress of June, 1901. The book will be very serviceable to electrical engineers.

La Traction Electrique. Tramways, Locomotives et Metropolitains Electriques. Par Paul Dupuy. Paris: C. Naud. 495 pages, 264 illustrations. Price, 12 francs.

This work discusses broadly the subject of electric traction, taking up roadbed construction, electric locomotives, street railway cars and traction in mines, and has also chapters devoted to electric traction of canal boats.

The first chapter, which introduces the subject, is devoted to general traction considerations both electrical and mechanical; the development of electric traction in different countries, both with reference to rail construction and storage battery work; and a classification of the different traction systems.

The second chapter is given to a theoretical study of the traction problem and particularly to that of different coefficients. The traction effort and the power necessary for traction is taken up and supplemented with formulas pertaining to these functions, and formulas are given for practical cases. The influence of curves and the formulas pertaining thereto are discussed, and the additional tractional effort due to grades is given some space, together with practical examples. A few paragraphs are devoted to the coefficients of traction and adhesion; the calculation of the traction effort and the power in a general case for a known profile is given, together with the mean traction effort obtained over different lines of railway. This is followed by a calculation of the power necessary in central station for a line of known and possible traffic conditions, after which a part is devoted to the determination of the power of the motors for the cars and the necessary energy for planning grades and for acceleration, and the possible economies of power by a proper manipulation of the car is gone into at some length. The practical operative conditions on several lines of tramways supplement these discussions, and finally there is a list of the necessary information for a preliminary survey and the study of a proposed electric railway. This completes what is called the first part of the book.

The second part of the book is more of a descriptive nature and deals of central station material and rolling stock, and the characteristics and practical performance of machinery. The chapter on generators can hardly be called descriptive of the best modern practices, as much space is devoted to the description and performance of types, particularly belted machinery, which is now almost obsolete, at least in new railway installations. The following chapter is devoted to the discussion of various methods of construction for the permanent way. Here again considerable space is given to methods of construction which are rarely used in American practice, having had their period of trial and failure. Some interesting methods and tests on electrolytic phenomena are, however, of interest.

In the third chapter overhead construction is discussed and the work described and material illustrated is somewhat better, though hardly of the most modern character. Further on in the chapter electric railway conduit construction of various types is given consideration, and the chapter closes with a dissertation on sectional conductor systems. Chapter IV is devoted to rolling stock, and the machines illustrated contain, to say the least, a great number of "old-timers." The work includes numerous controller diagrams. The trucks given as examples are mostly of the four-wheel type, and the modern double truck is given but little space in the discussion. Following these are descriptions of various kinds of car bodies and overhead trolleys and means of heating cars, and then comes an interesting section on the application of alternating currents to electric railway construction. It discusses, in detail, however, only the systems of Ferraris and Arno.

Chapter V is a commercial chapter, dealing with the prices of materials, and while subject to the general criticism that must be made on all such compilations, it must not be forgotten that every contribution of this kind is of value even though it be seriously limited by conditions. The next chapter is the storage battery street railway work. It does not discuss the storage battery itself, but gives some practical examples of storage battery traction and systems of connection and manipulation.

The third part is devoted to financial considerations with reference to street railways, discussing gross earnings, possible cost of maintenance, cost per car kilometre, etc., and is supplemented with a large table of data on this subject and a list of French lines in course of construction. The following chapter is devoted to electric locomotives on roads at high speed and gives theoretical calculations and practical examples. It would hardly be a French work without a discussion of the Heilman locomotive, which is given considerable space. The fifth part of the work deals with traction machines for drawing canal boats and various traction applications in mines and systems of electric telpherage, the latter not covering the latest developments.

The appendix, although short, gives considerable data on subjects which are more modern, and materially improves the work. In conclusion, it may be said that the mathematical and theoretical part of the work is very good. The practical data, however, are not as modern as they might be, and the book is a better treatise of what has been done than a modern reference book.

Jahrbuch der Elektrochemie. Berichte uber die Fortschritte des Jahres 1901. By Dr. W. Nernst and Dr. W. Borchers. Halle a.S.: Wilhelm Knapp. 725 pages, 226 illustrations. Price, 24 marks.

The present volume is the eighth annual issue of this well and favorably known publication. The former issues were edited by Professors. Nernst and Borchers, but the present one has for an editor Dr. H. Danneel, with the assistance of Askenasy, Borchers, Elbs, Harms, Von Kuegelgen and Mugdan. The volume, as in former years, is divided into two parts, the first dealing with scientific electrochemistry and the second with applied electrochemistry The part on scientific chemistry covers 372 pages and gives the usual very complete review of the work done in the various branches during the period covered. The subjects represented are as follows: Apparatus and methods, theories, conductivity and condition of solutions, galvanic elements, polarization and electrolysis, electroanalysis, Becquerel rays and conductivity of gases, each subject with its various subdivisions. A review of the most important books which have appeared during 1901 is also included.

The part of the book on applied electrochemistry covers the ground in the same thorough and exhaustive manner as in former years. The advances and projects in the construction of galvanic elements and storage batteries are recorded. The chapter on metalloids and anorganic products includes among others hydrogen, oxygen, ozone, the haloids, graphite, carbon bisulphide, calcium and other carbides, silicides, etc., the work done in the production of alkali and bleach by electrolysis, etc. The section on electroplating has been cut short, for the reason that the periodical and patent literature on the subject has grown to be very voluminous. The electrolysis of organic compounds is treated fully and in a very able manner. As in former volumes, one section is devoted to electromagnetic ore dressing and separation. The last pages deal with electric furnace methods and diaphragms.

This series of volumes is a valuable addition to a library of electrical literature and will be found to be very useful as a digest of the literature, both to the engineer and to the student. The present volume seems to maintain the standard established by the previous ones. The reviewer, however, cannot help deprecating the tendency, always manifest even in the earlier volumes, but perhaps more pronounced in this volume, of passing adverse judgment upon books and investigations, which do not lay sufficient emphasis on or push into the foreground, the dissociation theory and other theoretical considerations promulgated by a certain group of German scientists. For instance, to say, as the writer of the review of the valuable "Lehrbuch der Anorganischen Chemie," by H. Erdmann, says, that "the book is totally unfit for the electrochemist, who cannot dispense with the dissociation theory and the law of mass action," is, in our opinion, going too far, and the judgment is certainly not shared by the German chemical public, as is shown by the rapid appearance of new editions of this work.

Schedule for Continuous-Current Dynamo Design. By Prof. S. P. Thompson. New York: Spon & Chamberlain.

This schedule, which is extracted from Prof. Thompson's book on dynamo design, consists of five sheets printed on heavy writing paper. The first sheet has blank spaces for the general description of a machine and a table for the commercial test entries. The next two sheets contain a blank tabulation for all the data of every element of a dynamo, and also a section for entries in tests for armature reaction. Sheet 4 is a schedule of calculations for the winding of field magnets; and on sheet 5 are a table for temperature tests and one for weights and cost.

BOOKS RECEIVED.

Kurzes Lehrnbuch der Electrotechnik. By Adolf Thomalen. Berlin: Julius Springer. 515 pages, 277 illustrations. Price, 12 marks.

Telegraphic Signals, Vocabularies, etc. By James Nicholson. London: Whittaker & Company. 63 pages. Price, 5 shillings.

Das Elektrische Kabel. By Dr. C. Baur. Berlin: Julius Springer. 327 pages, 72 illustrations. Price, 8 marks.

Das Elektrische Licht. Und Die Elektrische Heizung. By Dr. Alfred Ritter v. Urbanitzky. Leipzig: A. Hartleben. 226 pages, 103 illustrations. Price, 4 marks.

Die Telegraphie Ohne Draht. By Augusto Righi and Bernhard Dessau. Braunschweig: Friedrich Vieweg & Son. 478 pages, 258 illustrations. Price, 13 marks.

Students' Guide to Submarine Cable Testing. By H. K. C. Fisher and J. C. H. Darby. Third (enlarged) Edition. New York: D. Van Nostrand Company. 230 pages. Price, $2.50.

Elektrischer Maschiner und Apparate. Von Dr. F. Niethammer. Berlin: R. Oldenbourg. 192 pages, 237 illustrations. Price, 8 marks.

Continuous-Current Dynamos and Motors and their Control. By W. R. Kelsey, B. Sc. New York: D. Van Nostrand Company 440 pages, 225 illustrations. Price, $2.50

MODERN STEAM BOILER, THE PRACTICAL PHYSICS OF. By Frederick J. Rowan. With a preface by Prof. R. H. Thurston. 638 pages, 414 illustrations. Price, $7.50.

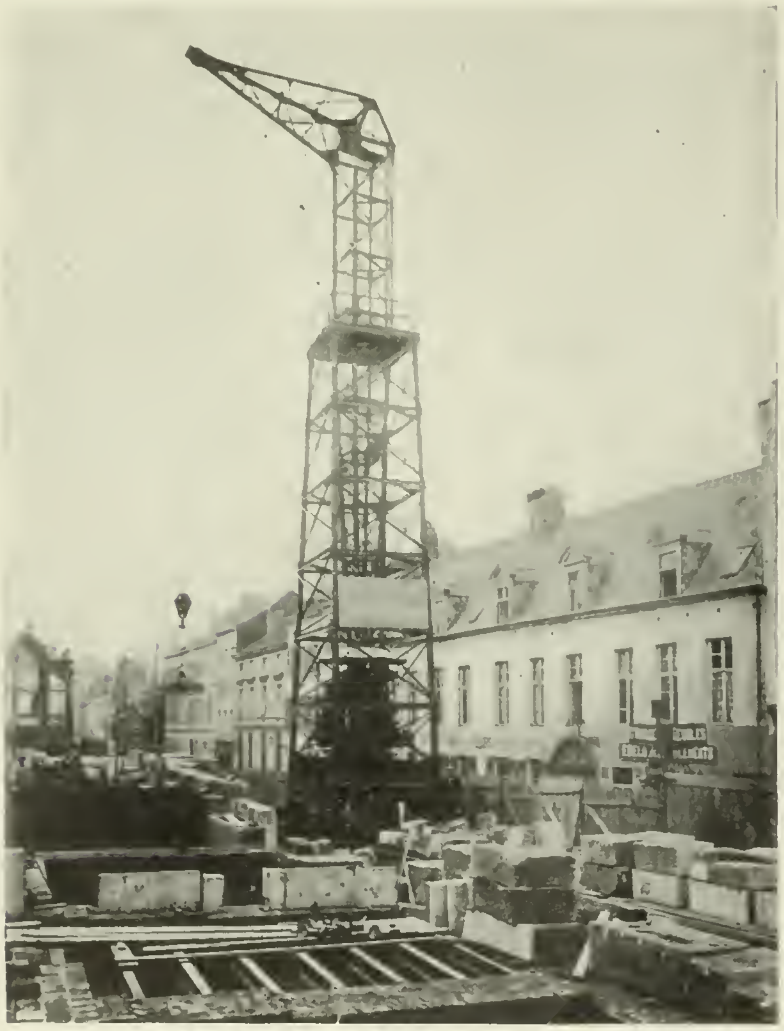
TOOLS AND MACHINES. By Charles Barnard. New York: Silver, Burdett & Company. 164 pages, illustrated. Price, $1.50.

THE METALLURGY OF ZINC AND CADMIUM. By Walter Renton Ingalls. New York: *The Engineering and Mining Journal.* 701 pages, 404 illustrations. Price, $6.00.

Electric Crane for Erecting Large Buildings.

By C. Bender.

A large armory under erection in a city in Belgium is being constructed with the aid of an interesting electrical hoisting crane. The crane, which is 80 ft. high, and provided with a movable jib of 20 ft. length, runs on a track of rails of 650 ft. long along the front of the building, the gauge being 11.5 ft. It is used for conveying the blocks of stone from the cars on which they arrive, to the place of the building where they are to be used. The crane rests on a car body with wheels so designed that blocks of stone may be stored between the rails without preventing the operation of the crane. The crane is provided with three motors, one for raising and lowering the load, the second for moving the whole crane on the rails and the third for turning the crane.



ELECTRIC CRANE FOR ERECTING LARGE BUILDINGS.

A problem to be solved in the design of the crane was to assure its stability under the most trying conditions in spite of the relatively small gauge of the track; moreover the crane had to be designed to resist the greatest wind velocities, and able to run up and down a grade of three per cent. The speed of lifting with the maximum load of 10 tons is 10 ft. and the speed of traction on the rails 50 ft. All operations of the crane are governed by a universal controller. The entire weight of the crane is 110,000 pounds.

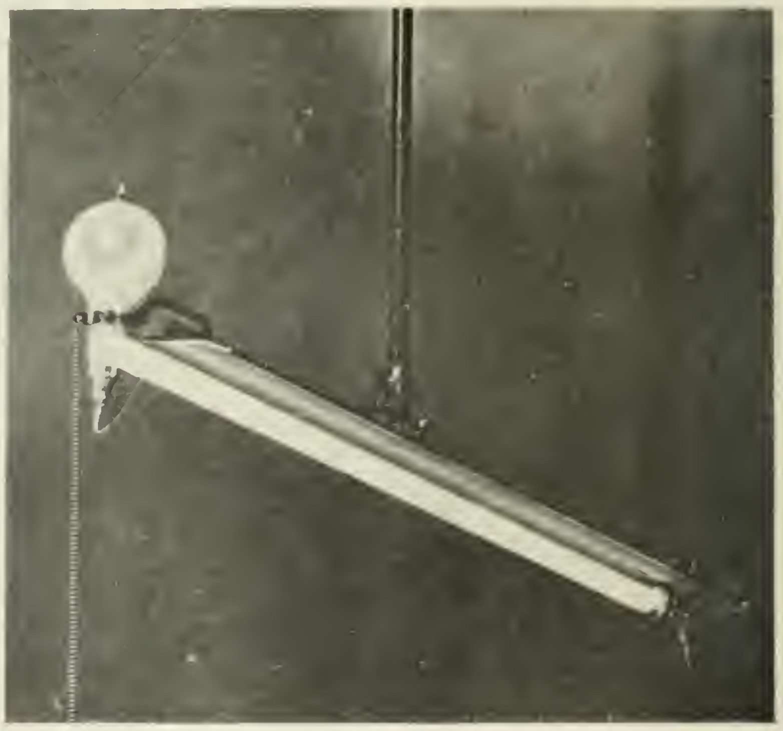
The crane is the first of its kind that has been constructed and it is expected that this type will soon find extended use in the erection of large buildings, and especially on docks. It is, without any doubt, one of the quickest and cheapest apparatus for such purposes. To appreciate this it is sufficient to estimate what scaffolding would cost for a building 650 ft. long and 80 ft. high, for it is evident that such a crane replaces not only the scaffolding, but includes at the same time the lifting apparatus. It will be found that it is cheaper and quicker than any other kind of provision for the same purpose. The experiments with this crane have given such excellent results that another crane of the same type, but 115 ft. high, is to be built for a similar purpose. The manufacturer is the Gesellschaft fur Elektrische Industrie, Karlsruhe, Baden.

Improvement in Cooper Hewitt Vapor Lamp.

A notable improvement has recently been added to the Cooper Hewitt vapor lamp, consisting of a new method of starting. Up to now the lamps put into commercial use were started by a high potential kick from an inductance coil. A special quick break switch under oil was used to make and break a circuit across the coil, the discharge of which passed through the lamp, breaking down the initial reluctance to starting.

The new process of starting, which is due to Mr. S. E. Flechtner, one of the engineers of the Cooper Hewitt Electric Company, is known as the "Tilting" method, and is somewhat similar to that employed by Arons and other early investigators, in that an absolute connection is established between the two electrodes of the lamp by means of the fluid of the electrodes themselves. These former lamps had two mercury electrodes in the same plane and were started by being turned sideways, so that the two pools of mercury came into contact. On being returned to the original position the contact was broken and the conduction through the vapor established.

In the Hewitt lamp, however, the electrodes are placed one above the other and a connection is established by first tipping the lamp so that there is an excess of mercury in the normal upper electrode and then allowing this mercury to flow, by gravity, in a stream down the length of the tube. This stream momentarily establishes a metallic connection between the electrodes and then breaks, usually at the bottom, where it ends in a spray. The lamp lights across the break, the luminous area rapidly extending up the tube as the stream falls away. The liquid mercury has the property of stringing out into a long, fine, continuous stream, and lamps over four feet long have been lit in this manner, using no more mercury than is required for their normal operation. It is usual, however, to use lamps about two feet long to operate on 55 or 60 volts. This is the type of lamp illustrated in the cut.



NEW FORM OF VAPOR LAMP.

At the upper end is the condensing and regulating chamber, which is one of the distinctive features of the Hewitt lamp. The lamp is supported by two asbestos-lined clamps to a metal tube, through which run the wires to the two terminals. The rod is pivoted in the center and has a weight at the lower end, so that the lamp normally hangs as shown. A chain is provided for pulling the upper electrode down and thus furnishing it with a surplus of mercury. On releasing the chain the lamp returns automatically to its normal position, the stream is formed and the conduction through the vapor established. A spring and cushion at the pivot prevent any jar. An adjustable reflector is strapped to the supporting rod.

To operate on 110-120 volts, the lamps are connected two in series. If it is intended to light both lamps simultaneously they are mounted in one frame and tilted together. With an apparatus of this kind, a simple rheostat and choke coil for steadying resistance are all that is required. When the lamps are to be lighted independently, each is furnished with a resistance having in shunt across the vapor lamp another resistance which is automatically cut out when the lamp is started. Two 40-volt, 1.5-amp. incandescent lamps are used as the shunt, so that being first turned on by an ordinary switch the operation of tilting the vapor lamp may be readily accomplished in an otherwise dark place. They also serve as pilot lamps to show when the switch is left closed and the vapor lamps unlit.

Besides the lamp illustrated, the company is manufacturing two other types of "Tilting" lamps. Both are mounted in double holders and are intended to be lit simultaneously. One set consumes but 1.3 amp. and is intended for retouching lantern slide work, etc., while the others are the regular three-ampere lamps and are arranged for all sorts of photographic and printing work.

In spite of the falsification of colors produced by the light, the lamp is finding much favor as an illuminant for offices where close application is required. The company has recently installed vapor lamps for lighting the composing room of the *New York Evening Post* and the train dispatcher's office of the Pennsylvania Railroad, at Jersey City.

Use of Electric Commercial Automobiles.

SIGN FOR AUTOMOBILE CHARGING STATIONS.

In spite of whatever ideas may exist to the contrary, the use of electric commercial automobiles appears to have extended greatly during the past year; and the reports of firms employing them are on the whole very satisfactory. Under this head, Electrical World and Engineer has recently been in receipt of a number of interesting communications, which are presented in abstract below, and which have been sent to use directly by the parties concerned.

One of the most interesting letters to electrical readers perhaps is that of the Edison Electric Illuminating Company, of Boston. Mr. W. H. Atkins, general superintendent, writes us as follows:

We have only had a five-ton truck two weeks in our service, and we have not had time to go into the operating cost. We have ordered and will have in service within the next four weeks a five-ton truck, a three-ton truck, an emergency wagon for underground emergency work, and a trimmers' wagon for trimming arc lamps and two superintendent's service wagons. We propose to increase this number after a few months' trial of our present equipment. We feel that they will be a success and the truck we have now in use is showing good results.

I suppose you know that the Boston Edison Company is trying to promote the sale of electric vehicles by establishing charging plants on its lines throughout Greater Boston, and has published booklets showing various charging stations within a radius of 25 miles of the city. The company is also about to publish a new book of charging stations in New England.

We have instituted an enamel iron sign for these charging plants, which we hope will be universally adopted throughout New England, and will be known in time as well as the Bell Telephone Company's sign is to-day. I enclose you photographs giving an idea of the sign and a book of advance information giving an idea of the business we are trying to promote.

Mr. Lewis A. Platt, president and manager of the Platt Bros. & Co., Waterbury, Conn., writes: "(1) We have used one three-ton truck, electric, since last August, 1902. (2) It carries an average of 6,000 pounds 15 miles daily. (3) It is too early to determine with certainty the cost compared with other methods of transportation, but the indications are that under ordinary conditions the electric truck is the more expensive. (4) The electric truck is much more convenient than those drawn by horses in many ways. We have not fully decided whether this convenience is more than offset by the apparent increase in the cost of maintenance or not. With our present experience we should hesitate to purchase another machine for additional work, although we believe the defects would not be so apparent with a number of machines as with a single one, provided that they were built with interchangeable parts."

The Germania Roofing Company, of New York City, have had an encouraging experience, and say: "We have one automobile truck in use since June, 1902, and one automobile truck in use since January, 1903. The former will carry 4 tons 25 miles on one charge and very often covers a radius of 30 or more miles in one day, while the latter will carry 2 tons a radius of 40 miles, and has made several trips to East Mt. Vernon from our works on one ordinary charge and in less than 5 hours. The cost of maintenance seems to be that of renewing rear tires, pinions and batteries. In general we believe that $400 per annum would keep each vehicle in first-class condition almost indefinitely, and charging, storage and general care about $500 per annum, total $1,100 maintenance, charging, storing, insurance and interest on the investment would cover everything in our opinion except the wages of the operator. It is our intention eventually to use electric vehicles in the place of horses altogether."

Cluett, Peabody & Co., of New York City, send us the subjoined data: "We are operating only one large truck. It has been in use steadily for a little more than eight months, and has given very good satisfaction. It runs daily from our salesrooms on Nineteenth Street down town to the Battery, and up town to One Hundred and Twenty-fifth Street, covering both the East and West Sides, and makes from 100 to 125 deliveries a day. The cost of the service, including the investment and the depreciation of the value of the truck because of wear, does not exceed the amount it originally cost us to do the same work with horses and wagons. As soon as we have completed our first year's use of the vehicle we shall be able to give you actual figures, showing the comparative cost between the two methods."

Kent-Costikyan, Persian rug importers in New York, say: "We have recently purchased an automobile truck, but have had it so short a time that we prefer not to make any positive statements yet, but that it appears in every particular to be satisfactory. It has shown a capacity to do a great deal more work than was accomplished by our horse truck, and if, after further trial, it continues to give as much satisfaction as now we shall probably purchase others."

A special form of service or duty is that required by the New York Railway & Steamship Time Table Company, whose Mr. J. E. Wyman writes as follows of the results of about three months' practical use: "We are much pleased with the results from the working of our auto car, which has attracted so much attention, not only in New York, where it is used, but all over the country. The car was designed by myself and built by the Vehicle Equipment Company, in Brooklyn. It is built most substantially, the bed being constructed of steel with sufficient strength that with flange wheels substituted it could be placed on a railroad track in a regular train and do its share of the work.

"During the two months' service the cost for repairs have been less than ten dollars, that being mostly for broken jars in the battery and the wearing out of two small pinions on the end of the motor shaft.

"It is my personal opinion that the question of motor trucks has been solved. I believe that it is perfectly practical now, but of course will continue to be improved, especially in the batteries, for all time to come."

Saks & Co., a dry goods house in New York City, with widespread retail trade, have had the following experience: "1st. We are using at present twelve (12) electric autmobiles. 2nd. We have no means of compiling the exact amount of work performed by each wagon, but would state that in our opinion they are doing work somewhat in excess of what could be done with a horse and wagon. 3rd. The cost is now, exclusive of repairs, $35 per wagon a month, for stabling and current (4th). The replacements and repairs amount to $20 a month per wagon (5th). We feel that the success of an automobile delivery system depends to a great extent upon the care which the wagons receive. If in charge of the proper people, an automobile delivery service can be made a success, but not otherwise." In like manner, the Hard Manufacturing Company, of Buffalo, write us: "We have one electrical truck in use and consider that it does as much as two or three ordinary wagons. The actual cost to run it, it is rather hard to determine, as we have our own charging plant and run the engine anyway. We should think it would compare quite favorably, however, with the cost of a single wagon. As to our general feeling on the subject of the success or failure of this electric vehicle, the enormous increase in the number used testifies to their efficiency. Thirteen are about to be used here by one of the express companies."

A batch of electrical and mechanical concerns reporting may next be considered. Mr. G. C. Allen, superintendent of construction of the New York Telephone Company, whose truck we illustrated and described not long ago, says: "We have but one automobile and that your issue of March 28, this year, fully described. The automobile is primarily used to pull underground cables into the subway, thus substituting power for manual labor, and it is in this use that we effect a very large saving in the cost of laying cables. The vehicle is maintained, under contract, by the people of whom we purchased it, and I am, therefore, not able to furnish you with the various cost items. We figure that the total cost per year to us, including interest on investment, depreciation and maintenance, but not including the operator, is about $1,000. It has been in use since the first of the year and has given satisfactory service." The next letter is that from the hardware concern of Hammacher, Schlemmer & Co., of New York City, as follows: "We have one three-ton truck making an average of 25 miles per day with one charge. The actual cost for eight months' service is an average of $37.50 per month. This truck we have used since September, 1902, and up to the present writing feel that it is a good addition to our equipment. Although making an average run of 25 miles per day, it has required comparatively little repairing, and we have found it serviceable in stormy weather. It requires of course good care, but when proper attention is given it, our experience is that little trouble will arise. We have used horses exclusively up to the time this truck was purchased and apparently the truck will be as cheap as the horse, but we have not used it long enough yet to determine this feature definitely." The third letter of this class is from the well-known house of Niles-Bement-Pond Company, who speak of experience in handling machine tools in New York City. Mr. Walter Y. Clark, vice-president, writes us as follows: "We have had one 6-ton electric truck for about eight months, and we hardly feel competent yet to compare the results, so far as expenses are concerned, with horse-drawn vehicles. There is no doubt that the electric truck gets about the city more rapidly and hence does more work. The cost of restoring the batteries is approximate to that of feeding a pair of horses. The depreciation of battery and tires is quite rapid, and this expense of renewal is considerable; whether more or not in the long run than with horses may be questioned, although our experience is rather unfortunate in this respect. We find, as probably others have, that the tires are short-lived and very costly, ours costing $90 apiece. Probably in a city that was reasonably well paved this would not be so great an element of cost. Especially with a heavy truck our very rough streets are particularly hard on tires.

"Except for this vulnerable point, we would unhesitatingly predict a very large use for these trucks in the near future. They are rapid, noiseless, and take up very much less space than horses, which is an advantage in getting about in crowded streets, on docks, etc., and also for storage purposes, to say nothing of the advantage of their cleanliness to the city at large."

In the same category of well-informed mechanical concerns may be put Sackett & Wilhelms Lithographing Company, of Brooklyn, who remark: "We would state that we have three electric vehicles, two of which are heavy delivery wagons of four tons' capacity, and a combination passenger and parcel delivery wagon. So far our large wagons have moved large amounts of material and were especially valuable in our recent moving, from New York to Brooklyn. We are handling most of our deliveries now with the electrics. So far we have been unable to determine the actual cost of the service. We have our own generating system and our facilities for charging are especially favorable; our current does not cost more than three cents per kilowatt hour. We feel that one of the great drawbacks to the use of this class of truck is the replacement of gears and batteries and the high charge for such replacement. Besides this, the initial investment is high and consequently the interest and depreciation charges are also high.

"It would seem that improvements can be made in the gearing to exclude the dirt by applying a suitable gear case. Our general feeling as to the success of this class of vehicle is that providing the repair bills can be kept down and with power taken from one's own plant, there seems to be no other reason why electric trucks shall not prove a desirable investment."

The Hall Safe Company has made a practice for some time past, as already noted in these pages, of handling safes in New York City, in electric vehicles, hauling them to and from the spot, and hoisting them in and out of buildings by auxiliary motor. They say: "We have had a truck in service for nearly two years. It has been satisfactory to us in every way. We find that the greatest advantage to us is the ability of the wagon to do hoisting with its own power. It can do hoisting work four to five times quicker than we can do the same by hand, and can make about two to three times as many deliveries as a double-team truck. The cost of maintenance is from $18 to $25 per month for electricity and wear and tear of about $1 per day. We are in every way well pleased with this vehicle and think that for any business in which there is both hauling and hoisting, such as ours, that it is a great saving and convenience."

On the other hand, the experience of Mr. Henry Heide, the confectionery manufacturer, is not quite so satisfactory, for he remarks: "I cannot say as much in favor of my automobiles as I would like to. It would be all right if there was not so much difficulty with repairs, which adds considerably to the expense as well as preventing as free use as we would like to make of it. I only have one electric truck and this does about as much as a double and a single truck. Whether the cost is any more or less, I cannot quite state as yet, because the truck is only in operation about nine months. My general feeling on the subject is that before electrical vehicles for business purposes are entirely satisfactory, considerable improvements must be made, particularly in regard to the storage battery. One of my objects in investing in my truck was to make the far-off deliveries, such as East New York, etc., in order to save the horses during the hot weather. In making these trips, however, I find that we run out of electricity occasionally before we reach home." Another point of view, again, is that furnished by Montgomery, Ward & Co., the famous "mail order" people, of Chicago: "We have to say that we have but one electric truck in commission at present, although we have several more ordered, undelivered. The one we have had in use during the past three weeks has so far proven very satisfactory, the work that it does being all that we could expect. It handles almost double the amount of freight that a team-draw truck can do in a given length of time, and at less expense for maintenance. We find, however, some objection to it among the teamsters and the Teamsters' Union, of Chicago, who seem prejudiced against an innovation of this nature, but we believe that within a short time, by diplomatic conduct, this prejudice will be done away with and machines electrically equipped will prove successful and extensively used in this and other cities of the West."

John B. Ellison & Sons, of Philadelphia, writes: "We are using one electric wagon, for delivery of packages from our New York store, and the amount of work done by it is considerable, as it covers practically the whole business section of the city, each day. The actual cost we find to be about the same as we formerly paid for hauling by means of horse and wagon. We are very well satisfied with the work that our electric wagon is doing, as it covers more ground in less time than by our former method of delivering." Goldenberg Brothers & Co., importers, New York City, say: "We have two electric delivery wagons, which we use daily from 8 A. M. to 6 P. M., almost continually. As to the probable or actual cost of the service we can give you no definite information at present, as we have not had them long enough to give any accurate estimate. We feel thoroughly satisfied with the service we are getting from them, and they are a success as far as our use of them up to the present has demonstrated." In this connection, C. C. Shayne, the furrier, of New York City, says that the electric truck bought last November is very satisfactory and that they can do more work with it than with a wagon and team of horses.

A batch of brewers may next be considered. The Isaac Leisy

Brewing Company, of Cleveland, say: "We have been using our electric truck since February daily, making from two to three trips per day. Since it has been running we had no repair bills to pay. The capacity of the truck is 5 tons, and we can recommend the electric truck as giving entire satisfaction." The Christian Feigenspan lager concern, of Newark, N. J., write: "Our experiment has hardly been of sufficient duration to give us an idea of the practicability of the machine. So far as making deliveries in good time and covering distances is concerned, everything has been satisfactory. We have, however, experienced more or less tire trouble and some minor difficulties with our batteries in the line of breaking bands and defective cells. We are keeping very close watch of what our machine is doing, and, no doubt, in the course of several months, we will be able to get a better idea of the cost of repairs, etc., in order that we can make comparison between horses and the electric truck as regards expense of maintenance, etc., at which time we will be pleased to give you the result of our experiment."

A concern that has experimented a good deal in the truck line is the Moxie Nerve Food Company, of New England, from whose New York office we have the following data: "Our experience with electric trucks and wagons has not been very great. We have used during the last few years several steam machines of different makes with varied success, but on the whole they have not been satisfactory. We have found that there is something out of repair with them about all the time, and it requires a regular engineer to take charge of them. We have only one electric wagon. This wagon has been in constont use with us for over a year and has been used for various purposes, but usually to transport goods to our various stations, located in Harlem, Newark, Brooklyn and Mt. Vernon, and at the present time we are making two trips daily to One Hundred and Twenty-fifth Street, Harlem, and two trips to our Brooklyn station daily, loaded both ways. During our busy season last summer we used to use this wagon 16 or 18 hours a day and during the entire time it has only been laid up two days for repairs, which was for cleaning the battery. This is excepting an accident which occurred to the machine last season when it was run into by an electric car. The cost of maintenance so far has been very small, barring this accident. We should say that the cost of all the repairs so far had not exceeded $50. Up to the present time the machine has not required new batteries or tires, which of course will bring up the cost of maintenance considerably. We are not in a position to state at the present time just what it would cost for maintenance for an entire year.

"This class of vehicle has been entirely satisfactory to us and we shall probably install several more of them in the near future. One reason why these vehicles appeal to us in particular in this kind of a business is that when the weather is the hottest we are the busiest and have to cover our routes more often than any other time. It does not matter how hot the weather is, the electric wagon is ready to go and it can be pushed to its utmost capacity, as the weather does not affect it as it does horses."

Two letters reach us from Pittsburg. One is from the Ohio & Pittsburg Milk Company, which says: "We have one electric delivery wagon, which has capacity of 1,500 pounds. We consider that it does the work of what three single wagons would do. We have no idea of what the cost for operating it is as we have not yet had it long enough to give the average cost of expense on it. We think very much of the wagon and would certainly get more of them immediately if we were located in a level city. Our machine does all the work that is claimed for it, but these hills in this town are an awful strain on it; besides the streets are paved too rough for fast speed. For a city like yours we think they are just the thing." The other letter from Pittsburg is that of the Seely Manufacturing Company, who deal in and supply automobiles, and have a Westinghouse charging plant with a capacity of eight vehicles on charge at once. They say: "We have at present in use in Pittsburg three electric delivery wagons and one electric truck. One of the delivery wagons and the truck are at present doing as much work as any three teams, but the other two electric delivery wagons are smaller ones, and do not do as much work. In the former two instances, the expense of operating the carriage is practically nothing except the salary of the operator, which is about $60 a month, as both companies make their own power, and therefore their expense of charging is reduced to a minimum. We can only see one future for this class of vehicle, and that is a successful one."

It will be seen from the above voluntary testimonials that the electric truck situation is far more cheering and hopeful than many of our readers have been inclined to believe, and that the attitude of the purchasing public toward them is thoroughly cordial.

Improvement in Searchlights.

The accompanying illustrations show searchlights with a new and improved device for spreading or converging the light at will by means of dispersion lenses. The lenses are mounted in two light brass semi-circles, as shown in Fig. 1. These semi-circles are pivoted so that they may be rotated through an angle of 90°, or a quarter circle. The two small handles shown on the top of the cylinder are for turning the lenses. When placed in the first position the lenses present a surface only one-half inch thick to the rays of light. This small amount of surface detracts nothing from the brilliancy of the light which emerges in a solid straight beam. By turning the handles through an arc of a circle of 90°, the lenses are swung around as

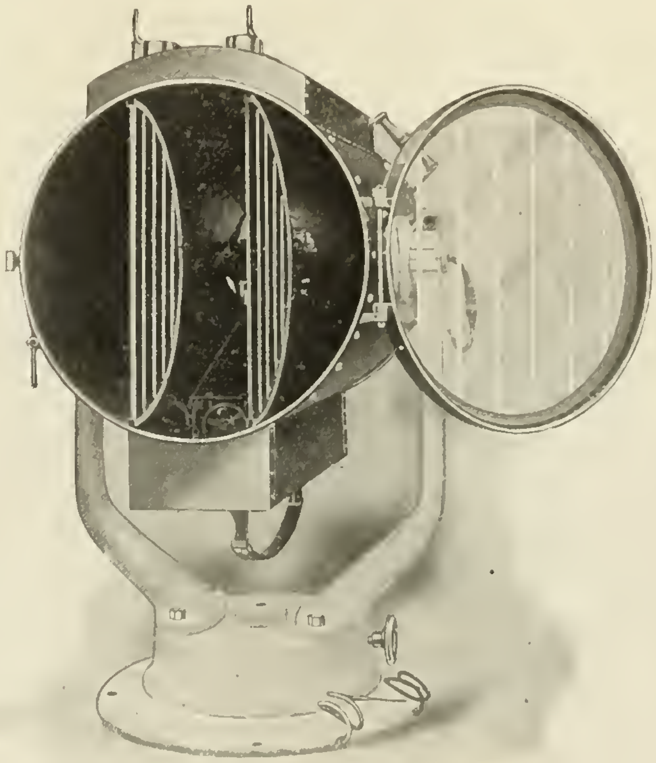


FIG. 1.—SEARCHLIGHT.

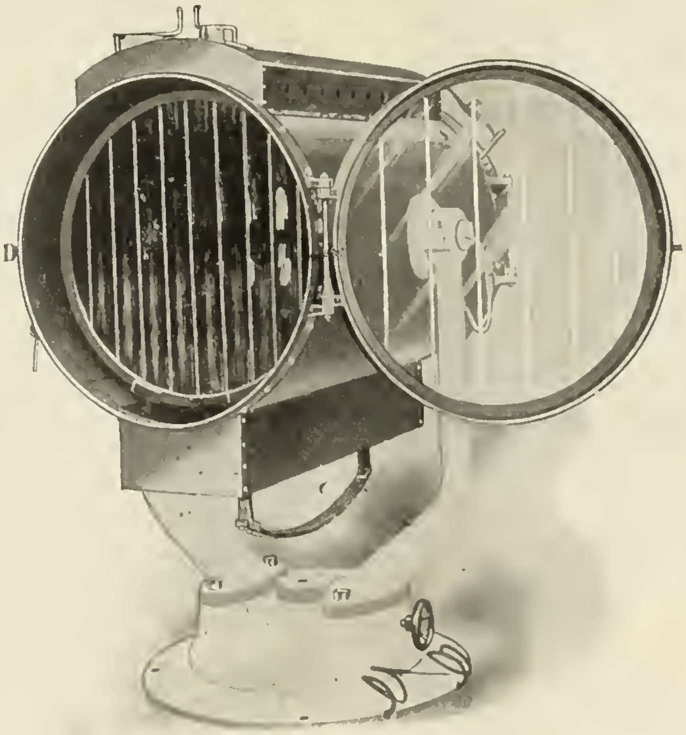


FIG. 2.—SEARCHLIGHT.

shown in Fig. 2. All the light has to now pass through the lenses, and it is spread out according to the curvature of the lenses.

It might be added that the dispersion lenses are permanently mounted in the searchlight cylinder, and trimming, cleaning, etc., are readily accomplished without removing them. The door containing the plane glass is left in position and not removed at all. In the illustrations the glass door has been purposely swung back to show the interior of the searchlight.

These searchlights are made by the Carlisle & Finch Company, Cincinnati, Ohio.

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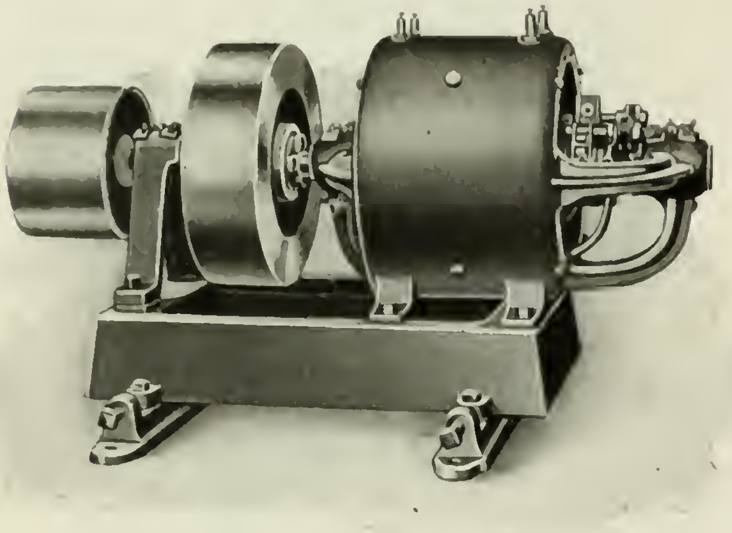
Gas Engine Type Dynamos.

The most exacting service required of a gas engine is in driving an electric dynamo. The explosive nature of the discharge tends to make an unevenness in the power, showing itself in a flickering of the light. A solution of this condition is offered in the dynamo illustrated herewith, which is manufactured by the Hobart Electric Manufacturing Company, of Troy, N. Y. In it the weight is applied where most effective, and the fly-wheel is sufficiently heavy to carry over the irregularities of any gas engine. A fly-wheel of this size requires the additional support of a third bearing. The manufacturers state that hundreds of these dynamos are now in constant service with a great variety of gas engines under widely varying conditions, but up to the present no engine has been found, however, impulsive or irregular in its speed, that will not give a light when connected with the dynamo free from the annoying fluctuations which affect the sight and nerves.



GAS ENGINE TYPE DYNAMO.

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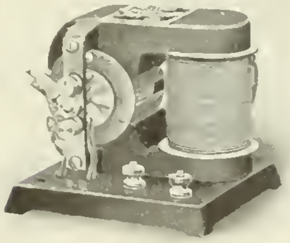
Power Motor.

The accompanying illustration shows a power motor manufactured by Messrs. J. Jones & Son, 64 Cortlandt Street, New York City. In its design it follows the lines of machines for use on electric lighting circuits. With a set of dry batteries it supplies an outfit for the operation of sewing machines. Among other uses to which it may be applied are the driving of models, jewelers' lathes, dental drills, phonographs, etc. In design and mechanical construction it is stated to be in every respect equal to larger power machines. The fact that it is adapted for use in connection with a dry battery is a strong recommendation for its application to many domestic purposes.



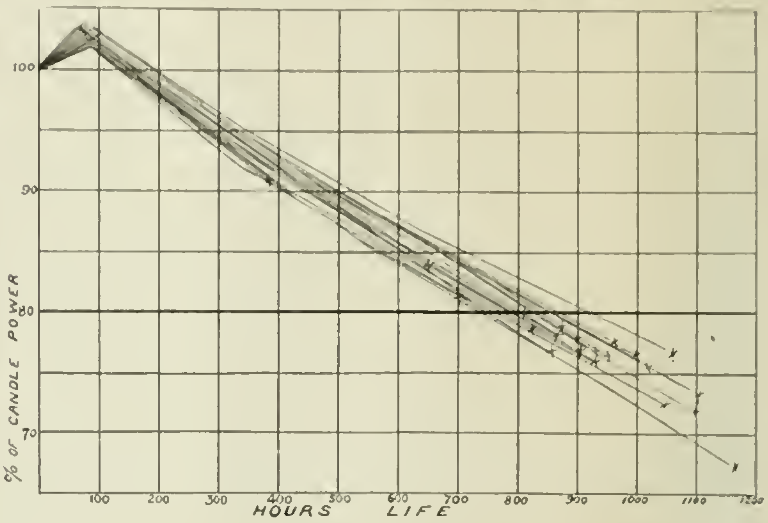
POWER MOTOR.

An Improvement in Incandescent Lamps.

From the beginning of incandescent lighting a point in economy of the incandescent lamp to which considerable attention has been given is that relating to the decline of candle power and current efficiency with the life of the lamp. As far back as ten or more years ago it was pointed out that after a lamp has reached a certain age it is economy to "smash it" and substitute a new lamp. This conclusion followed from the fact that aside from the reduced illumination, the cost per unit of light increased largely beyond a certain life.

In most of the large central stations the policy has been adopted of removing lamps when they have declined to 80 per cent. of the initial rated candle-power. As lamps may continue to burn at still further reduced candle-power and still less efficiency for hundreds of hours beyond this point, it will be seen that to carry out this method properly involves either photometric measurements of lamps in service—which is impracticable—or keeping a life record of all such lamps.

The Bryan-Marsh Company announces that as the result of a study of the characteristics of incandescent lamps affecting their life, it has been enabled to develop a lamp which exhibits the remarkable and important property of burning out when it has declined approximately 20 per cent. in candle-power. The accompanying curve was constructed from a test of 16-cp. 3.5-watt lamps of this type, the actual average efficiency being about 3.41 watts per candle-power. It will be noted that the burning out appears to occur a little below the 80 per cent. line, but this is obviously better than having a sharper decline in candle-power during the early period of life, and then holding on to a burning out point which in most lamps is not reached until the candle-power has declined to from 60 to 70 per cent. of the initial rated candle-power. The candle-power curve shows that the average hours in which the Bryan-Marsh lamp reached 80 per cent. were 813, while the average hours to the point of burn-out were 914. While the lamps thus lived 100 hours beyond their useful life, this is a great advantage over lamps which, while not having a longer life, during that life drop from 30 to 40 per cent. of their initial candle-power before burning out.

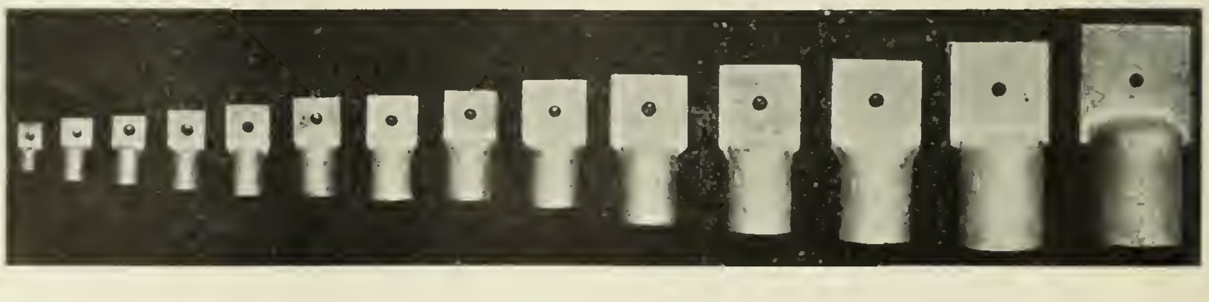


CANDLE-POWER CURVES.

◆

Cast Copper for Castings for Electrical Apparatus.

The many places where copper castings for electrical apparatus can not only be used to much better advantage than rolled copper from the point of mechanical construction, durability and economy, but furthermore, are absolutely necessary, will readily occur to the electrical engineer. In the past, the great objection to such castings has been their decreased conductivity as compared with rolled copper. As everywhere else, the great desideratum has been the



COPPER CASTINGS.

use of a composition such that all electrical losses would be reduced to a minimum. This is particularly true where large currents are handled, as is realized by all who use electrical devices; and the best is none too good both from the point of economy and perfect operation.

The J. Lang Electric Company, Chicago, announces that after many years of research and experimental work, it has succeeded in perfecting a process by which copper can be cast and yet retain its solidity and electrical conductivity. In fact, it is said that with castings made according to the company's process the conductivity is one-third to one-half greater than with any others produced on a commercial scale. The castings are perfectly solid, and can be made of any size or shape. The company is also making use of these in its entire line of switches, table-boards and other devices manufactured by it.

Cleaning Boilers.

One of the methods of cleaning boiler tubes is to rap the tube so as to give it a frequent but not severe vibration, in such a manner that the more brittle and non-elastic scale formation is shaken off, without any strain being sustained by the tube.

The General Specialty Company, 70 Carroll Street, Buffalo, N. Y., has devised a machine for boiler cleaning purposes in which the motive power is applied in the most direct manner, thus insuring the greatest speed of piston. The double-acting knocker rod is firmly secured to the former, and the travel of the knocker rod is so limited that though it is capable of exerting a sufficiently hard enough blow on the tupbe, it cannot puncture it or injure it; because even though the tube were not present to stop the motion of the rod, it would not travel beyond the point where the walls of the tube would be. This construction makes it possible to safely operate the machine at boiler pressure, thus obviating the necessity of using a separate steam gauge, or a reducing valve to lower the pressure.

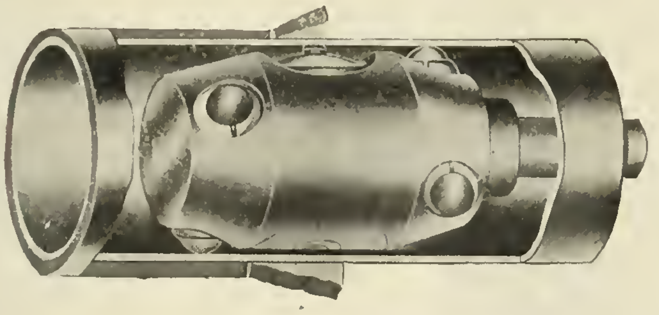


FIG. 1.—BOILER TUBE CLEANER.

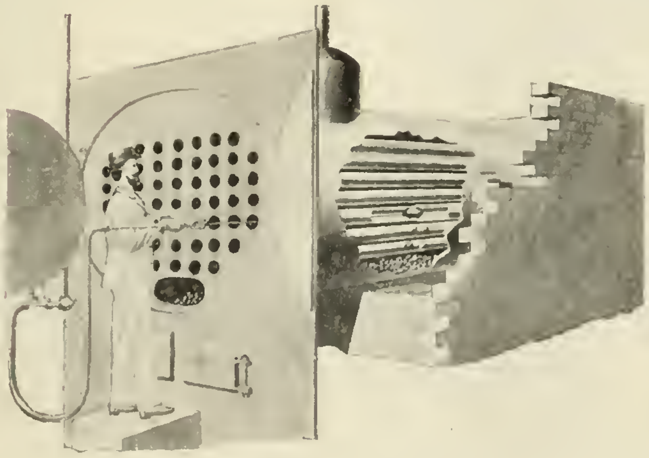


FIG. 2.—BOILER TUBE CLEANER.

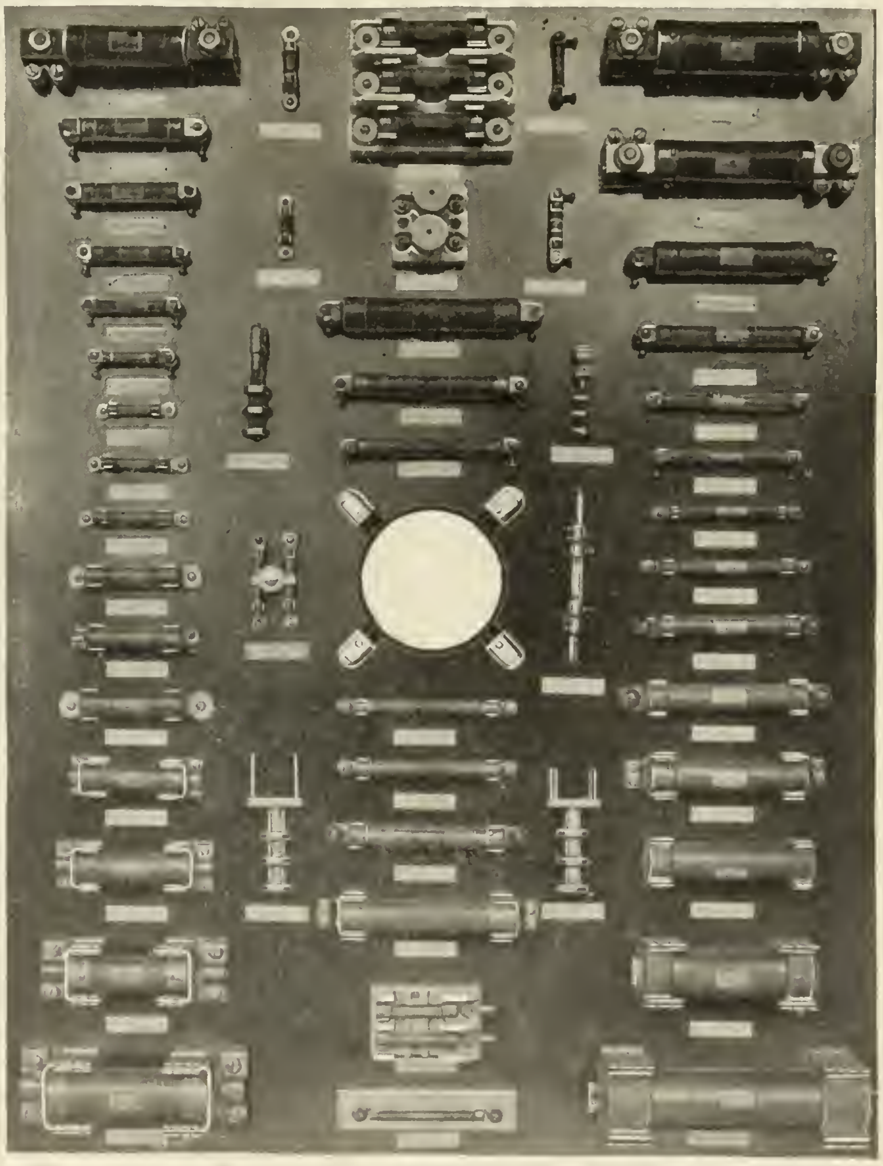
For obvious reasons, the body of the machine must be made considerably smaller than the inside diameter of the tube, and this, in connection with the rest of the construction, necessitates some means for accurately maintaining the machine in the axis of the tube. This is accomplished by two sets of centering lugs, one ahead and one back of the piston, which are forced out against the inner surface of the tube by steam pressure.

The undue heating of the tube operated on is further avoided by so using the steam that it is expanded to such a point before exhausting into the tube that its temperature is only a very little above the atmosphere.

An actual test of this machine has shown a speed of 3,000 strokes and upward per minute, according to the pressure used—nor was the temperature of the tube at the end of thirty minutes raised so much but what it could be easily handled without gloves.

Enclosed Fuse Protective Devices.

No recent development in electrical construction devices has met with more rapid advancement and success than the so-called enclosed fuse, which is to-day supplanting nearly all forms of open fuse protective devices. Actual commercial exploitation was begun but a few years ago, yet at present the variety of styles and types of enclosed fuse protective devices is surprisingly extensive and covers almost every branch of electrical service. This is indicated by the illustration herewith, which shows some of the different types and styles of "Noark" enclosed fuses and cut-outs, which type is made by the H. W. Johns-Manville Co. It is also of interest to note the large ampere sizes to which these fuses have been developed on the various voltages in common use. Recent tests made of "Noark" fuses on a 4,000-amp.-hour storage battery at 250 volts have demonstrated the entire efficacy of fuses whose normal carrying capacity was 400 amp. at 250 volts (100,000 watts). These fuses were short-circuited dead on the terminals of the battery and operated absolutely without smoke, flash or any demonstration whatever, yet indicating upon the exterior of the tube their interior condition. Larger sizes are now being developed, and it is expected that they will be furnished up to 1,000 amp. in the near future. As a circuit-rupturing performance, the opening of the enclosed fuse capable of carrying 500 or 600 amp. at 250 volts absolutely without any external demonstration or explosion whatever, and without in any way affecting the integrity of the tube or external structure, is certainly noteworthy.

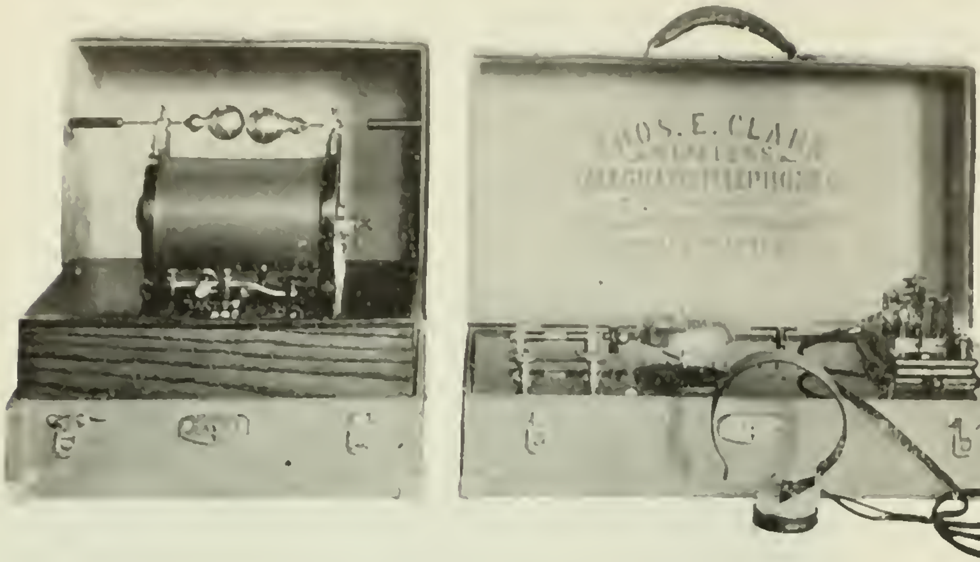


ENCLOSED FUSE PROTECTIVE DEVICES.

Wireless Telegraph Instruments.

By Auckland Stirling.

The accompanying illustrations show a set of wireless telegraph instruments made by the Thomas E. Clark Wireless Telegraph Company, of Detroit, Mich. Fig. 1 is a transmitting instrument consisting of a transmitting transformer, dry batteries, telegraph key and adjustable spheres or spark gap. As will be seen, the parts are tastefully arranged and are mounted on a piano-finished, hardwood base. All the unsightly parts and electrical connections are concealed, the spark-gap, sphere, coil proper and key being only exposed to view. The dry batteries supplying the energy to the coil or transformer, are located in the lower part of the case.



FIGS. 1 AND 2.—WIRELESS TELEGRAPH APPARATUS.

The transmitting coil is of the Clark high-frequency transforming type, with primary and secondary, the insulating material being of the highest grade. The core is so constructed as to prevent the usual loss through eddy currents. The condensers are especially well insulated. The vibrator, seen at the end, is fastened securely to the coil head, and is supplied with heavy platinum contacts; it is so constructed that the adjustment, once made, is constant.

The coil is mounted on hard-rubber brackets with polished heads. The secondaries terminate at the tops of the head ends. The telegraph key is connected in the battery circuit, and when used by the operator in transmitting messages in the Morse Code of dots and dashes, it excites the primary of the coil or transformer, thereby causing rapid current alternations in the secondary, which give rise to discharges at the sphere gap. The spheres are mounted on pillars of polished insulating material. The secondary of the coil is connected, as well as the aerial capacity, with a ground on a gas or water pipe. The aerial wire is otherwise insulated from the ground by means of a bamboo fish pole, a hammock or wire cord suspended by means of brass hooks holding the bamboo.

The receiving instrument (Fig. 2) is made up of the following parts, mounted on an oak removable base: An adjustable Clark sealed coherer with a neat receiving stand or clip, which supports the coherer and acts as connecting or disconnecting switch as well; a special wound split core relay of the Clark type, with automatic tapper; and condenser and shunt coils. The batteries for the receiving and tapper circuit as well as the shunt coils, condensers and tapper, are all concealed in the case underneath the shelf panel; the relay head band receiver attachment, gong, coherer and binding posts for aerial and ground connections, together with circuit switches, being the only parts visible.

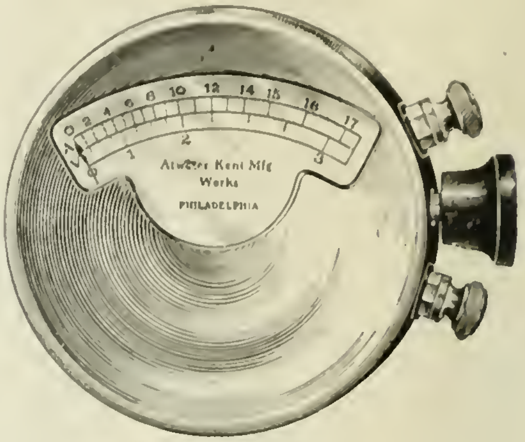
Both instruments may be transported as easily as a dress suit case, being very compactly enclosed in a drab color case. A tape-writing device can be used instead of the microphonic receiver if desired; with some practice, however, messages can be received faster with the latter.

◆

Pocket Volt Ammeter.

There has been a good demand for a small, accurate moderate-priced ammeter and voltmeter for testing batteries, especially in the case of electric ignition of gasoline engines. To meet this demand, the Atwater Kent Manufacturing Works, 120 North Sixth Street, Philadelphia, have brought out a combination instrument which is designed and calibrated especially for testing each cell separately. The ampere scale reads to 20 and the voltage scale to 5. The voltage test is made by placing the two pliable leads furnished with each instrument, on the terminals of the battery, and the amperage test is obtained by simply pressing the button on the instrument, without changing the leads.

The needle is light and delicately pivoted, and is as nearly dead beat as is possible to make a small accurate instrument. But two seconds are required to bring the needle to rest. The instrument is of particular service for use with gasoline automobiles and launches, as it shows exactly the condition of the battery. It is substantially constructed on scientific principles and on the workmanship no pains have been spared.



POCKET AMMETER.

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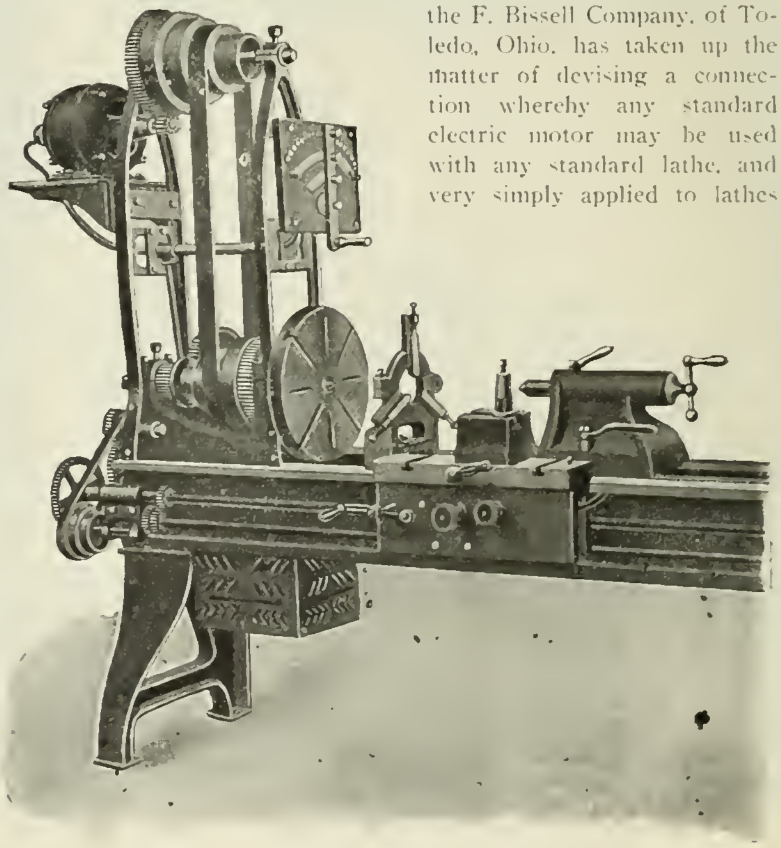
Motors for Driving Standard Machine Tools.

In the discussion of the direct-connection of electric motors to individual machine tools, it is usually taken for granted that the machine tool will be adapted for such connection; in other words, that the usual design of tools will be sufficiently departed from to fit them for operation by electric motors. It is interesting to note that the F. Bissell Company, of Toledo, Ohio, has taken up the matter of devising a connection whereby any standard electric motor may be used with any standard lathe, and very simply applied to lathes already in use and driven by belting. The accompanying illustration shows a lathe thus fitted. By this method the manifold advantages of the electric drive may be secured without the expense of purchasing and installing a new lathe.



MOTOR ADAPTED TO LATHE.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Dullness characterized the stock market throughout the week and the volume of transactions was at a low level. The public is holding off and large professional operators were inactive. The market was devoid of feature, though further declines were noted in industrial specialties. The interior is beginning to call for funds with which to move the crops and considerable foreign money was loaned. The United States Steel stocks were rather heavy though not active, and there was quite a little manipulation in Amalgamated Copper, which to some extent reflected the strength of copper stocks in the London market. The downward movement of tractions was checked, and there was a firmer tendency. Brooklyn Rapid Transit made a net gain of 1¾ points, closing at 45¾, which was a fraction below the highest point of the week. Metropolitan Street Railway closed with a gain of ¾ of a point, at 114, this being ½ point below the highest figure of the week. There was little business done in General Electric, but it was on an advancing market, the closing price being 164, which was also the highest of the week, and a net gain of 2 points. Western Union closed at 83¾, ¼ of a point higher than the closing quotation of last week. Following are the closing quotations of September 1:

NEW YORK.

	Aug. 25	Sept. 1		Aug. 25	Sept. 1
American Tel. & Cable	79	79	General Electric	162	163
American Tel. & Tel	.	133	Hudson River Tel	..	..
American Dist. Tel	25	23	Metropolitan St. Ry	112¾	114¼
Brooklyn Rapid Transit	45⅜	45½	N. E. Elec. Veh. Trns	..	..
Commercial Cable	..	..	N. Y. & N. J. Tel	..	..
Electric Boat	15	11	Marconi Tel	..	3
Electric Boat pfd	40	40	Western Union Tel	84⅛	83¼
Electric Lead Reduction	1¼	1¼	Westinghouse com	165	164
Electric Vehicle	6	6	Westinghouse pfd	170	170
Electric Vehicle pfd	9	8			

BOSTON.

	Aug. 25	Sept. 1		Aug. 25	Sept. 1
American Tel. & Tel	134	133	Western Tel. & Tel. pfd	80	82
Cumberland Telephone	..	..	Mexican Telephone	1¼	1¼
Edison Elec. Illum	.	..	New England Telephone	123	123
General Electric	162½	.	Mass. Elec. Ry	21½	21⅛
Western Tel. & Tel	13	13	Mass. Elec. Ry. pfd	79	80

PHILADELPHIA.

	Aug. 25	Sept. 1		Aug. 25	Sept. 1
American Railways	..	..	Phila. Traction	95½	95½
Elec. Storage Battery	57	56½	Phila. Electric	6¾	6⅜
Elec. Storage Battery pfd	57	56⅛	Phila. Rapid Trans	..	..
Elec. Co. of America	8⅛	8¾			

CHICAGO.

	Aug. 25	Sept. 1		Aug. 25	Sept. 1
Central Union Tel	..	..	National Carbon pfd	95	88
Chicago Edison	.	..	Metropolitan Elev. com	..	..
Chicago City Ry	165	165	Union Traction	5	4
Chicago Tel. Co	123	.	Union Traction pfd	30	..
National Carbon	26	20			

BROOKLYN RAPID TRANSIT.—The published statement of Brooklyn Heights earnings shows a surplus equal to 1.67 per cent on Brooklyn Rapid Transit stock. This is not, however, a true presentation of the results for the year on Brooklyn Rapid Transit stock since certain items, notably the interest on Brooklyn Rapid Transit bonds, are not shown in the report of the operating company, but everything considered it is not improbable that the full pamphlet report of the Rapid Transit Company will show results about as good as those indicated by that of the Heights Company. The most notable feature in the statement is the increase of $832,000 in gross earnings being a growth of 7.2 per cent over the preceding year. Operating expenses figure 61.1 per cent of gross, but when the property becomes thoroughly modernized it is not too much to expect that this should be reduced to 50 per cent. Such a rate for operating last year would have meant a surplus larger by $1,374,919 than that actually shown or an additional 3 per cent on Brooklyn Rapid Transit stock.

BELL TELEPHONE FINANCES.—Some interesting figures have been made on American Telephone & Telegraph finances. At $50 per subscriber, the Bell companies will this year earn about $70,000,000 gross and $19,000,000 net. The direct net earnings of the American Telephone & Telegraph Company, from its long-distance service this year will probably be $2,000,000. Adding one-half the net earnings of the sub-companies, $9,500,000, the result is $11,500,000 net earnings of the parent company. This is equivalent to 10 per cent on the $109,685,000 stock eligible to dividends this year, and to 8 per cent. on the $131,628,200 stock issued. The money expended for new construction will probably yield about 10 per cent. In 1902 construction expenditures by the Bell companies were $37,336,000. The output of instruments was 624,714, and the number of new subscribers was 257,336. At $50 per subscriber, the gross earnings from new construction would be $12,866,000, and net earnings (29 per cent. of gross) $3,730,000, or about 10 per cent. of the amount spent for construction.

ELECTRIC BOAT.—The directors of the Electric Boat Company have declared the first dividend on the company's preferred stock, an event which had been long looked forward to by many of the stockholders. The dividend is a quarterly one, and amounts to 2 per cent, being payable October 1. A director of the company stated that the dividend for a full year has been set aside in bank so that there may be no question of a continuation of these quarterly payments for a twelvemonth at least. The company is said to be doing a very satisfactory business with various European governments, which have purchased a considerable number of the submarine boats manufactured by the company, and it is from this source that the Electric Boat Company derives its principal profit.

INTERURBAN STREET RAILWAY.—It is reported that the financial departments of the constituent companies of the Interurban Street Railway are to be consolidated under the general direction of a comptroller, an office recently created, and that C. N. Duffy, secretary and auditor of the Chicago City Railway Company, has been selected to fill the new office.

WESTERN TROLLEY ROADS PROSPEROUS.—It is stated that all of the trolley lines throughout Ohio, Indiana and Michigan will show phenomenal earnings for August. Six of these interurbans will show over 30 per cent. increase when compared with last year and 20 when compared with July of this year. One line shows an increase of 50 per cent.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade conditions appeared to be somewhat irregular, due to the backwardness of crops in some sections, damage reports from others and uncertainty as to the monetary outlook. The best reports as to corn crop results came from the Southwest. Insect damage in Texas has given a less satisfactory turn to cotton crop reports, which are, however, still better than last year's. Fall trade in favorably-situated sections compares well with that of a year ago. There are still complaints of car congestion. In the iron trade some uncertainty is still noticeable, although there is a somewhat better feeling in the trade, and it is thought that prices have reached the lowest level. Trade reports from St. Louis, Kansas City and most Southern points are highly satisfactory as regards fall trade in dry goods, shoes, hardware and lumber. At Chicago business is better and more buyers from Kansas, Nebraska and Iowa are in the city. The lumber trade is picking up somewhat. Railway gross earnings for the first three weeks of August will exceed those of 1902 by about 12 per cent. The business failures for the week ending August 27, as reported by *Bradstreet's*, numbered 142, against 166 the week previous and 140 the corresponding week last year. In copper there were signs of weakening on the part of certain members of the latest bull movement. It is said that official figures are being cut from ⅛c. to ⅜c., according to grade and other conditions, and that consumers are still buying from hand to mouth. The closing official quotations are as follows: Lake, 13¾c. to 13⅞c.; electrolytic, 13⅝c. to 13¾c.; casting stock, 13⅜c. to 13½c.

NIAGARA FALLS POWER.—The Niagara Falls Park & River Railway Company, in Victoria Park, Niagara Falls, Ont., is greatly increasing its output of power for railway purposes. For some years past, two big generators in this power house have been run to supply power for the customers of the Canadian Niagara Power Company. On July 1 the leases for these machines expired, and since that time they have been removed, and are being replaced by new machines of much greater capacity. New dynamos for railway purposes will also be installed.

BALL ENGINE ORDERS.—Dravo, Doyle & Co., Pittsburg representatives of the Ball Engine Company, Erie, Pa., have recently received an order from the National Tube Works, Pennsylvania Department, for a 700-hp horizontal cross-compound Corliss engine, direct-connected to an alternator. The Birmingham Water Works, of Birmingham, Ala., are about to install two 100-hp. direct-connected engines furnished them by the Ball Engine Company.

THE GOLDY-McLEAN COMPANY, 120 Liberty Street, New York, which concern acts as export sales manager for a number of American manufacturers of electrical equipment, supplies, etc., is about to send a representative to the Hawaiian Islands, China and Japan, the Philippine Islands, Australia and India, with a view to opening agencies in those parts of the world.

AUGUST FAILURES. R. G. Dun & Co. report 812 commercial failures in the United States in August, involving a total indebtedness of $10,877,782. In the corresponding month last year there were 840 failures, but the liabilities were only $8,068,525. An interesting feature of the report deals with manufacturing failures. In August of this year these numbered 241, and involved $7,748,085, as against 213 last year, involving $2,762,180. In other commercial lines the losses were below those of August, 1902. In trading there were 544 defaults, with aggregate liabilities of $2,046,352, compared with 580 in August last year to the amount of $3,333,158. Of banks and other fiduciary institutions, eight suspended this year, with liabilities of $871,075, and last year four similar defaults involved $1,108,750. The analysis shows, therefore, that in manufacturing industries alone were the losses more severe than in the corresponding month last year. All the excess over the losses in August, 1902, was caused by a few large failures in iron and machinery. The total losses in August were larger than in the corresponding month of any other year since 1896, but the excess occurred in manufacturing only.

THE MEXICAN LIGHT & POWER COMPANY, LIMITED, of which James Ross, of Toronto, is president, and F. S. Pearson is vice-president and chief consulting engineer, reference as to whose project to transmit electric energy from its huge plant now under construction at Necaxa, State of Pueblo, to Mexico City and neighborhood, a distance of some 90 miles, has appeared from time to time in these columns, has just decided to generate power at the same plant for transmission to El Oro and Tlalpujalma for the purpose of operating the several extensive mines in those regions. No details regarding the quantity of power to be called into requisition are yet available, but it is understood that they will be completed within the next week or so, and that the company's engineers will soon be on the field making surveys for the new transmission line, which will be more than 100 miles in length.

STROWGER TELEPHONE EXCHANGES.—The Automatic Electric Company, of Chicago, reports that its installing forces are now engaged in equipping the following plants with Strowger automatic telephone apparatus: Citizens' Telephone Company, Grand Rapids, Mich., 5,000 stations; Northeastern Telephone Company, Portland, Me., 2,500 stations; St. Marys Telephone Company, St. Marys, Ohio, 500 stations; Cleburne Telephone Company, Cleburne, Texas, 640 stations; Southern Telephone Construction Company, Columbus, Ga., 700 stations; University of Illinois, Urbana, 50 stations; University of Chicago, 50 stations; Armour Packing Company, St. Louis, Mo., 45 stations; Union Telephone Company, Limited, Woodstock, New Brunswick, Canada, 110 stations. All of these will be in operation in a few weeks.

CROCKER-WHEELER ORDERS.—The National Malleable Castings Company, of Chicago, has recently purchased a 300-kw generator of Crocker-Wheeler make for direct-connection to a Buckeye horizontal cross-compound engine. This new set will be used to replace four direct-connected units of foreign manufacture. The Malleable Castings Company has about 300 hp in Crocker-Wheeler motors for factory equipment. The Oliver Typewriter Company, of Woodstock, Ill., is adopting electricity for power. It has just placed a contract with the Crocker-Wheeler Company for a 130-kw generator and a large number of motors. Charles L. Brown, of Chicago, has been retained as consulting engineer for the installation of the equipment.

PROPOSED EXTENSIVE CONVERSION OF CHILIAN RAILWAY.—The Chilian Government Railway authorities are seriously considering the question of taking advantage of abundant water power by converting large sections of the steam railways in that part of the world into electricity. It is proposed to change the line running from Santiago, the capital of the Republic to Talca, located about 150 miles south. W. R. Grace & Co., 1 Hanover Square, New York, look after the interests of the General Electric Company, on the west coast of South America, while the business of the Westinghouse people is taken care of by J. K. Robinson.

INCANDESCENT LAMP FACTORY FOR MEXICO.—A factory is to be built in Mexico City which will be devoted to the manufacture of incandescent lamps in Mexico City. It will be the first plant of its description in the southern republic. A company has been organized in Mexico for the purpose of carrying on the enterprise. Its capital is $100,000. A. Chaillet, some time technical manager of the Shelby (Ohio) Electric Company, is primarily interested in the company. The initial capacity of the plant will be 1,000 lamps daily. Besides catering to Mexican trades, it is intended to make a bid for export business.

H. T. PAISTE CO.—The recent purchase of a pottery by the H. T. Paiste Co., of Philadelphia, together with the expansion of our electrical supply business, has necessitated the active services in the home office of the secretary, E. A. Jenkins. He has heretofore had charge of the Western office and warehouse, with headquarters at 190 South Desplaines Street, Chicago. The company has secured the valuable services of Mr. James Wolff, Western sales manager of the New York Insulated Wire Company, who will conduct the Paiste Western business at the same address in connection with his present well known wire agency.

"SOO" POWER CANAL.—The engineer's figures name $35,000 as the actual cost of the repairs to the Michigan Superior power canal, at Sault Ste. Marie, and $45,000 as the cost of additional construction. At the time the leak occurred, months ago, exaggerated rumors had it that the cost would run high in the hundred thousands of dollars. The canal is stated to now be about in readiness for turning on the water again, whenever the management shall see fit. The Union Carbide, which under its contract is the biggest customer of the company for power, is expected to be ready for operation about October 1.

ISOLATED TURBINE EQUIPMENT.—The first isolated steam turbine equipment in Chicago has been started up in the packing plant of Schwartzchild & Sulzberger, the installation consisting of a De Laval turbine and a Northern twin generator. A test made was eminently satisfactory and promises much as being a satisfactory example of the practicability of steam turbine practice. The equipment will probably carry a 24-hour load, including the Sunday load. The day load will be shared with a generator unit driven by a reciprocal engine. The turbine equipment has a capacity of 200 kw at 900 r.p.m.

MACHINE TOOLS WANTED.—The Thomas E. Clark Wireless Telegraph & Telephone Company, of Detroit, Mich., has been doing so large a business it is compelled to enlarge its manufacturing plant, and it is now in the market for the necessary tools for making wireless apparatus. The plant required includes wood working machinery, brass working machinery, monitor and automatic lathes, etc. Mr. T. E. Clark, the president, has been in New York the past week on business connected with this increase of capacity, and speaks very hopefully as to the demand for wireless apparatus.

A MEXICAN TELEPHONE SYSTEM.—An extensive telephone system is to be constructed and operated by American interests in the City of Guaymas, Hermosillo and other cities located in the State of Sonora, Mexico. The Sonora Telephone Company has been organized under the laws of Arizona for the purpose of carrying out the project. L. W. Mix, Edward Titcomb, W. E. Bristol and C. C. Kingsley, all of Nogales, and F. E. Monteverde, of Hermosillo, are the principal parties interested in the undertaking. The company has power to operate elsewhere in Mexico if desired.

ANOTHER BIG MEXICAN HYDRAULIC PLANT.—A project is on foot to build another large hydraulic plant in the State of Jalisco, Mexico, for the purpose of generating electric energy for various purposes. The concession has been granted by the Mexican Government to Facundo Perez, of Mexico City. The franchise permits of the utilization of 10,000 liters of water per second from the Santiago River. The concessionaire is also authorized to build telegraph and telephone lines in the same State.

WIRE, SWITCHES, ETC., FOR JAPAN.—Francis A. Cundill, of 90-96 Wall Street, who represents the American buying interests of the British electrical engineering and contracting firm of L. J. Healing & Company, Yokohama, received orders by last mail for insulated copper wire, switches, etc., for shipment to the Far East. The wire will be supplied by the National India Rubber Company, of Bristol, R. I. The switches will come from the Perkins Electric Switch Manufacturing Company.

EQUIPMENT FOR SANYO RAILWAY, JAPAN.—The Sanyo Railway Company, through the Japanese house of Mitsui & Co., New York, has awarded an order to the General Electric Company for the 250-kw, alternating-current, three-phase, 60-cycle generator, for which American and European bids were called recently.

GERMAN LIGHTING EQUIPMENT FOR PEKIN PALACE.—F. C. Jenkins, an Englishman, but long domiciled in Germany, has secured the contract for the entire electric lighting plant to be installed in the Pekin Palace, China. The equipment will be of alternating-current type.

THE PLUNGER ELEVATOR COMPANY has just closed a contract through its New York sales agent, Mr. W. L. Lawton, 17 Battery Place, for ten elevators for the new factory building of Eaton, Cole & Burnham Co., of Bridgeport, Conn.

SOME C & C CONTRACTS.—The C & C Electric Company reports receipt of a large number of contracts, principally for large sized generators and motors, from various parts of the country. The Brooklyn Cooperage Company has ordered a 75-kw, also a 60-kw. C & C generator for direct connection to 110-hp and 90-hp engines, to be built by the Ames Iron Works, Oswego, N. Y. The order also calls for three C & C motors, aggregating 100-hp capacity. The equipment will be used for both light and power. The Otsego Hotel Company, which is to build a large hotel in Jackson, Mich., has requisitioned for two 50-kw. generators for direct connection to 12 in. by 12 in. Ames engines. This outfit will be used for lighting purposes. Colonel H. A. Dupont, of Wilmington, Del., has ordered a 225-kw. belted generator for lighting and power use in a new Chicago factory building. The Reeves Engine Company, of Trenton, N. J., has sent in an order for a 75-kw. generator for direct connection to one of its own engines. This outfit will be installed in the Trenton Fire Clay & Porcelain Works for light and power purposes. The Miller Lock Company, of Frankford, Pa., has ordered a 50-kw. belted generator and a 40-hp motor for light and power use. The Rogers Locomotive Works, Paterson, N. J., have just sent in the third order for a 150-kw. direct connected generator to be used for power purposes. Seven motors, varying from 7.5 hp to 50-hp capacity each, have been ordered for installation in the new Hotel Belmont, Forty-second Street and Park Avenue, New York. They will be used for driving, heating and ventilating, the apparatus being furnished by Howard & Morse and the B. F. Sturtevant Co. The Continental Mills, at Lewiston, Me., will be equipped with four C & C belted generators of 55-kw capacity each, for light and power use. The Illinois Sewing Machine Company, of Rockford, Ill., has ordered a 150-kw. generator, which will be driven by a 225-hp engine of Corliss type manufactured at the Murray Iron Works, of Burlington, Ia. This equipment will be used for both light and power. The Salisbury Light, Heat & Power Company, of Salisbury, Md., has ordered a 100-kw. belted dynamo for installation in an extension to its plant.

AMERICANS TO BUILD ELECTRIC RAILWAY ACROSS NICARAGUA.—An American syndicate has been formed for the purpose of building an electric railway system right across Nicaragua, Central America. Pittsburgers are primarily interested in the project. T. M. Latimer, president of the Lindmore Land Company, and the Anglo-American Potteries Company, of Pittsburg, is the chief party concerned in the enterprise. Others largely interested are Isham Sedgwick, of the United Coffee Company, and C. T. Manning, who is the Nicaraguan representative of R. G. Dun & Co. The Nicaraguan steam railroad, which was built about a year ago by British capitalists, and is now owned and operated by the Nicaraguan Government, will be acquired by the syndicate. The line runs from Port of Corinto on the Pacific Ocean to Granada on the Lake of Nicaragua via Chinandega. Its length is 161 miles. The road will be electrically converted, and is to be operated in connection with a new electric road, which will join the existing one at Managua and extend to the Atlantic Ocean, having terminals at Monkey Point and Perlas. The third-rail system will be employed. The present Nicaragua road is narrow gauge. It will be standardized as well as the new line. The length of the system will be about 500 miles. The power house will be constructed at Matagalpa, where there is an abundance of water power available. The new system will be constructed, it is anticipated, at the rate of about 100 miles per annum, so that it will take about 5 years to complete. Each section will be placed in service as soon as finished. Branch lines are proposed to be built so as to connect with roads in Honduras and Costa Rica.

CARS FOR PERU, BRAZIL AND PORTO RICO.—The John Stephenson Company, of Elizabeth, N. J., and the Peckham Manufacturing Company, New York, have just secured another contract for car bodies and trucks for use on the electric traction system now being built under the supervision of A. W. McLimont on behalf of the General Electric Company, between Lima and Callao. The present contract calls for four ten-bench open cars. The trucks will be of the four-wheel type. The G. E. motors will be of 35-hp capacity each. The Tijuca Electric Railway Company, Brazil, has ordered two Peckham trucks to be fitted with G. E. motors of 38 hp each. The company is increasing its rolling stock. The car bodies will be built in Brazil. No additional power house equipment will be purchased at present. The San Juan Light & Transit Company, which is controlled by the electrical engineering and contracting firm of J. G. White & Co., has requisitioned for three pairs of Peckham maximum trucks, equipped with G. E. motors of 50-hp capacity each, for use on its electric traction system at San Juan, Porto Rico.

THE PLATTE RIVER CANAL POWER TRANSMISSION PROJECT IN NEBRASKA.—Messrs. J. F. Kelly, T. W. Kloman and C. B. Vance, of New York City; W. J. C. Kenyon, general manager, and W. S. King, chief engineer, of the South Omaha Stock Yards Company; L. D. Richards, of Fremont, and H. E. Babcock, of Columbus, have been going over the plans and routes of the power transmission project for the development of electric power from the Platte River, for transmission to Omaha and intervening points. Two separate schemes are under consideration, the site of one being near Fremont, Neb., and the other near Columbus, Neb. It is understood that capitalists interested in the packing house industries have taken up the project and the John F. Kelly Engineering Company, of New York City, has been called upon to go over the plans already drawn up by the local engineers and to decide upon the more feasible of the two and make careful estimates of the costs. Upon the decision of the experts will depend the selection of the route and the practicability of the scheme determined. Should the experts report favorably on either proposition, it is said there will be no trouble in securing funds to finance the deal. Local parties estimate the probable cost as about $3,000,000.

VARIOUS EQUIPMENTS FOR PHILADELPHIA.—The electrical engineering and contracting firm of Keller, Pike & Co., Philadelphia, Pa., has just placed an order for the lighting equipment to be installed in the University of Pennsylvania gymnasium, Philadelphia. It will consist of two 50-kw. C & C dynamos, direct connected to 75-hp Harrisburg engines. Francis Brothers & Jellett, general electrical contractors, of Philadelphia, have placed orders for the generators to be installed in the new Mint, Realty Building and the Majestic Building, Philadelphia. Two 75-kw. C & C machines will be put in the former building, and two 75-kw. and one 50-kw. generators will go in the Majestic. The Hotel Vendig is to have a 50-kw. C & C generator direct connected to a Harrisburg engine of standard type and 12 in. by 11 in. dimensions.

HARRISBURG ENGINE ORDERS.—Mackenzie, Quarrier & Ferguson, 120 Liberty Street, New York, which concern represents the Harrisburg Foundry & Machine Works, has secured a contract from the Domestic Sewing Machine Company, of Newark, N. J., for a 150-hp Harrisburg standard engine for direct connection to a 100-kw. Westinghouse generator. The equipment is intended for lighting purposes. The Rogers Locomotive Works, of Paterson, N. J., have ordered a 225-hp engine for direct connection to a 150-kw. generator of C & C build. The West Point Naval Academy has requisitioned for a 75-hp Ideal engine, to be direct connected for lighting use to a Westinghouse generator. The Harrisburg people have now over 60 engines of various sizes under construction at their works.

TRANSMISSION IN OHIO.—The Noblesville Hydraulic Company, Noblesville, Ind., has awarded the contract to the Leffler Wheel Company, of Springfield, Ohio, for six 50-in. turbine wheels for $14,500; and to the National Electric Company, of New York, for the generators and dynamos for $18,500. The company is constructing an electric light and power plant a few miles north of the city and proposes operating it by water power from White River. It is estimated that each turbine wheel will generate 350 hp, thus furnishing over 2,000 hp for transmission to the city. A dam 17 ft. high is nearing completion.

ELECTRICAL EQUIPMENT FOR OHIO QUARRIES.—An extensive electrical equipment is to be installed for the purpose of operating all the machinery, etc., at the Ohio Quarries Company's quarries at North Amherst, O. Two 200-kw. generators have been ordered from the C & C Electric Company for direct connection to 300-hp. engines to be built by A. L. Ide & Sons, Springfield, Ill. A 35-hp C & C motor-dynamo set has been ordered, also three 60-hp C & C motors and a similar number of 12-hp machines will be installed.

EQUIPMENT FOR NEW B. & O. SHOPS.—The new shops of the Baltimore & Ohio Railroad, now under construction at Greenwood, Pa., are to be electrically equipped. The contract for the boilers—1,000 hp in four units of 250-hp each—has been given to Thayer & Co., 39-41 Cortlandt Street, New York. They will be built by the Aultman & Taylor Machinery Company, of Mansfield, O.

ELECTRIC HOISTS FOR HAMBURG-AMERICAN DOCKS—Several electrically operated hoisting equipments are to be installed in the new American docks, Hoboken, N. J. So far six hoists have been ordered from the Consolidated Iron Works, Hoboken. They will be operated by C & C motors of 35-hp capacity each.

TWO HUNDRED CARS FOR B. R. T.—The Brooklyn Rapid Transit Company has just ordered 200 special M. C. B. trucks from the Peckham Manufacturing Company, 26 Cortlandt Street, New York, for elevated service. They will be equipped with Westinghouse motors.

THE IRON CITY ENGINEERING COMPANY, Pittsburg, Pa., has secured a contract for the entire electrical equipment, including pole line work, for the town of Rockwood, Pa.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electrochemical Society. Secretary, C. J. Reed, 909 Chestnut Street, Philadelphia, Pa. Next meeting Niagara Falls, N. Y., Sept. 17, 18 and 19, 1903.

American Electro-Therapeutic Association. Secretary, Dr. C. R. Skinner, New Haven, Conn. Next meeting, Atlantic City, N. J., September 22, 23 and 24, 1903.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York.

American Order of Steam Engineers. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa.

American Railway Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Ave., Detroit, Mich.

American Street Railway Association. Secretary, T. C. Pennington, 2020 State Street, Chicago.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa. Next meeting, Thousand Islands, N. Y., September 8, 9 and 10, 1903.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, Indianapolis, Ind., June 15, 1904.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., 1904.

Engine Builders' Association of the United States. Secretary, F. P. Ide, Springfield, Ill. Next meeting, December, 1903. Date and place to be announced later.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, Ill., December 8, 9 and 10, 1903.

Iowa Telephone Association. Secretary, C. C. Deering, Des Moines, Ia. Annual meeting, Des Moines, March 8, 1904.

Magnetic Club, New York, N. Y. Secretary, R. J. Murphy, 195 Broadway, New York City. Annual meeting, Second Thursday in January; meetings, April, June and November.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting St. Louis, Mo., September 14, 15 and 16, 1904.

New England Street Railway Club. Secretary, J. H. Neal, Boston, Mass. Meetings, Fourth Thursday of each month, July and August excepted.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

National Electric Light Association. Secretary, Ernest H. Davis, Williamsport, Pa. Next meeting, Boston, Mass., May or June, 1904.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, Milwaukee, Wis., Jan. 20, 1904.

Ohio Electric Light Association. Secretary, J. H. Perkins, Youngstown, Ohio. Next meeting, Columbus, Ohio, October 13, 14 and 15, 1903.

Old Time Telegraphers' & Historical Association and Society of United States Military Corps. Secretary, John Brant, 195 Broadway, New York. Next meeting, Milwaukee, Wis., September 23, 24 and 25, 1903.

Pennsylvania Street Railway Association. Secretary, Charles H. Smith, Lebanon, Pa. Next meeting, Williamsport, Pa., September 23, 1903.

Southern Indiana Telephone Association. Secretary, E. W. Pichardt, Huntingburg, Ind.

Southwestern Electrical Association. Secretary, G. W. Cooper, Oklahoma City, Okla. First Semi-Annual meeting, Oklahoma City, October 9 and 10, 1903.

Southwestern Gas, Electric & Street Railway Association. Secretary, Frank E. Scovill, Austin, Texas.

Street Railway Accountants' Association of America. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

Street Railway Association of the State of New York. Secretary, Henry A. Robinson, 621 Broadway, New York. Next meeting, Syracuse, N. Y., October 6 and 7, 1903.

The Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

United Electrical Contractors' Association of New York State. Secretary, William J. Davis, Ithaca, N. Y. Next meeting, New York City, January, 1904.

General News.

THE TELEPHONE.

HUNTSVILLE, ALA.—The Huntsville & Guntersville Telephone Company will build a 16-mile extension. The American Telephone Company will also build an extension to New Market.

WOODLAND, CAL.—A new telephone line is to be built from Winters which will connect with the farmers' lines at Madison, Woodland and Sacramento and private lines at Arbuckle and Colusa.

DOVER, DEL.—A charter has been granted to the William Ebbitts Electric Company, with a capital stock of $150,000, to own telephone lines and telephone appliances and other devices. The company is from Cleveland, Ohio.

ATHENS, GA.—The Adams Telephone system of Stewart County, Ga., has extended to Columbus.

DUBLIN, GA.—The Dublin telephone exchange and the long distance telephone lines, including the lines to Sandersville, Wrightsville, Tennille and Kittrell, the line to Adrian and the line to Macon and Dexter have been purchased by the Dublin Telephone Company, which is composed principally of Messrs. Malcom D. Jones, of Macon, and F. F. Scarborough, of Dublin.

SAVANNAH, GA.—A charter has been applied for the Southern Long Distance Telegraph & Telephone Company. The application states that the purposes of the new company are to build and operate telegraph and telephone lines within the State of Georgia, and the proposed capital stock is placed at $100,000, with privilege of increasing to $1,000,000. The incorporators are J. H. Estill, W. A. Bisbee, Herman Myers, H. P. Smart, J. Paulsen, Leopold Adler, W. W. Gordon, Jr., and John Flannery.

MOWEAGUE, ILL.—Harry Odell and A. C. Doty have purchased the Odell telephone plant as equal partners, Oscar Odell retiring from the business.

SHELBYVILLE, ILL.—The Queen City & Shelby County Mutual Telephone Company has been formed, capital $10,000. Incorporators: J. F. Ulmer, S. A. Richardson, J. H. Thomas.

WAUKEGAN, ILL.—Mr. Chauncey G. Hellick is preparing plans for a fireproof telephone exchange to be built at Waukegan for the Chicago Telephone Company. It will cost $20,000.

FREEPORT, ILL.—The New Telephone Company announces the completion of a line from Freeport to Lena, connecting with the Pearl City independent lines and various towns on that system.

BRADFORD, ILL.—The Milo & Bradford Telephone Company has increased its capital stock from $5,000 to $20,000. The increase was voted at a special meeting of the stockholders, for the purpose of expansion.

GALESBURG, ILL.—The Ideal telephone exchange, which was completed less than two years ago, has grown and now operates nearly 50 miles of wires. There are now 135 shares of stock and the same number of subscribers.

MONMOUTH, ILL.—The annual meeting of the Monmouth Telephone Company has been held and by the report the receipts for the past year were shown to be $10,833.74, and the expenditures within this amount. Among the items of expenses is one of $3,306.34, for the extension of the system.

FOWLERTON, IND.—The Bell Telephone Company is putting in a new switchboard here.

PLEASANT LAKE, IND.—The Farmers' Telephone Company is putting up a metallic line from Angola to this place, also to Hamilton.

FORT WAYNE, IND.—The National Telephone Company, of which the Home Company of this city is a part, is building a new copper line that will give through connection from Fort Wayne to Indianapolis.

INDIANAPOLIS, IND.—The Fisher Telephone Company, of Hamilton County, has been incorporated for $5,000. The directors are T. A. Fisher, Thomas A. Beaver, J. A. Noury, N. G. Manship and A. C. Harrison.

INDIANAPOLIS, IND.—The Swayzee Co-operative Telephone Company has been formed, capital stock $6,000, by Eugene T. Ireland, Harrison Mark, Z. Hambler, Clement I. Goble, Rue P. Henley, William H. Ammon and C. C. Pence.

LOGANSPORT, IND.—The Home Telephone Company and the Case County Telephone Construction Company have effected a reorganization of the company, which is now composed solely of Logansport men. The Fort Wayne parties have sold their interests. The capital stock has been increased to $350,000.

CHICKASHA, I. T.—The new telephone system inaugurated by the Topeka & El Reno Telephone Company has commenced operations. Since this company purchased the local exchange it has expended over $5,000 in overhauling and changing and the system has been practically renewed throughout.

OGDEN, IA.—The town has voted to grant a franchise for a telephone exchange.

TORONTO, IA.—The Clarence Telephone Company will build a line southwest from here.

MUSCATINE, IA.—The Muscatine Telephone Company has been formed. Capital $1,200.

OTLEY, IA.—The Otley Telephone Company has been incorporated with a capital of $5,000.

BURLINGTON, IA.—The Modern Telephone Company, of Burlington, has incorporated; capital $300,000.

DES MOINES, IA.—The Butler County Telephone Company has been incorporated with $10,000 capital.

DES MOINES, IA.—The West Liberty Telephone Company has increased its capital from $10,000 to $25,000.

RUTHVEN, IA.—The Ruthven Telephone Exchange Company has been incorporated with $20,000 capital stock.

OTTUMWA, IA. The Iowa Telephone Company has a site for the erection of a modern central exchange building.

CHARTER OAK, IA.—The Crawford County Telephone Company will establish a first-class local and long distance system.

DES MOINES, IA. The Mutual Telephone Company will arrange to expend $100,000 to $150,000 in improvements to its system.

ALGONA, IA. The Burt Telephone Company has recently added three short rural lines to its system. Its patrons now number 149.

DES MOINES, IA. From West Point, the German-American Telephone Company will build lines to Lowell, Montrose and Fort Madison.

SHELBY, IA.—Amended articles of the Shelby Independent Telephone Company have been filed, increasing the stock from $10,000 to $25,000.

WATERLOO, IA. The council has granted the desired franchise for the Iowa Telephone Company which will proceed to rebuild its local system.

MUSCATINE, IA. Plans have been prepared by H. W. Zeidler, architect, for a building for the Iowa Telephone Company, which will cost $6,000.

DAVENPORT, IA. The capital of the New Independent Telephone Company has been increased to $150,000. Extensive improvements will be made and the line may be extended to St. Louis.

IOWA CITY, IA.—Manager A. J. Presson, of the Johnson County Telephone Company, is interested in a $500,000 transaction. The money must be secured by the Cedar Valley Telephone Company for the prosecution of various improvements, to be contemplated by the big organization.

DODGE CITY, KAN.—The Dodge City Telephone Company is extending its line.

ATCHISON, KAN.—Theodore Gary has purchased a controlling interest in the exchange at Atchison, Kan. The Atchison exchange has 1100 telephones now in use. The company, of which Mr. Gary is president, will spend $25,000 in improving and extending the service within the next four months.

COVINGTON, KY. Bids have been advertised for the sale of a franchise for the construction of a telephone and messenger system in the city of Covington, the franchise to run for twenty years.

FRANKFORT, KY.—The Independence Telephone Company, of Kenton County, with $5,000 capital, has filed incorporation articles with the Secretary of State. John M. Chambers, W. T. Loomis, Alvin Perry, C. M. Perry and John L. Vest are the incorporators.

PORTLAND, ME.—The Cumberland Telephone Company has been organized at Portland for operating telephones and telegraph lines; capital stock $50,000; paid in, $500. President, M. H. Kelley, Saco, Me.; treasurer, Alex Speirs, Westbrook, Me.

SWAN'S ISLAND, ME.—The Swan's Island Telephone & Telegraph Company has been formed for constructing and operating telephone and telegraph lines. Capital $5,000, of which $350 is paid in. President, W. B. Lindsay; treasurer, A. C. Smith. Directors: W. B. Lindsay, Carlisle, Pa.; A. C. Smith, Swan's Island; H. W. Joyce, I. W. Stinson, L. E. Joyce and H. W. Small, of Swan's Island, Me.

PORTLAND, ME.—The United States government is to connect all of its forts by telephone and work has been commenced on the system which will be an extensive one, as well as a very expensive piece of work. Fort Leavitt, on Cushing's island, Fort Preble, at South Portland, Fort Williams, at Portland Head, and Fort McKinley, on Great Diamond island, will be joined by private wires, having no connection whatever with the New England Telephone & Telegraph Company's system which has just been installed on Peaks and Great Diamond islands.

ELKTON, MD.—The Diamond State Telephone Company has built a line from Port Deposit to Conowingo. It will connect with the lines of Harford and Lancaster counties.

CAMDEN, MICH.—The Camden Telephone Company has started its exchange with a large number of local and rural subscribers. Lines are being built in every direction and will soon connect the northern towns of this county with the Ohio and Indiana lines.

SCHOOLCRAFT, MICH.—The stockholders of the Schoolcraft Telephone Company, at a meeting held for the purpose of perfecting the organization, elected a board of directors as follows: C. C. Duncan, John Gilchrist, B. J. Munn, W. R. Blodgett, F. M. Smith, C. W. Krum and R. E. Burney.

PARK RAPIDS, MINN.—The Union Telephone Company will build an exchange here.

DAYTON, MINN.—The Northwestern Telephone Company will build a line from here to Itasca and connect with Anoka.

NORTHFIELD, MINN.—The American Telephone & Telegraph Company has been permitted to run its lines into the city.

MORGAN, MINN.—The Redwood County Rural Telephone Company will build a line north connecting with the Franklin line.

VALLEY CITY, MINN.—A new telephone exchange with forty subscribers has been installed here by Ora Beeman. Connection is made with the Northwestern long distance service.

FOLEY, MINN.—The Maple Leaf Telephone Company has been granted a franchise for a local exchange. It will connect with the Northwestern long distance line running from St. Cloud to Foley.

RAPIDAN, MINN.—A meeting of several of the farmers of Rapidan has been held for the purpose of forming a local telephone company to connect with the Northwestern line of this city. C. A. Cheney was elected president, Wm. Jamieson, treasurer, and Chas. Johnson, secretary.

BUTTE, MONT. The Rocky Mountain Bell Telephone Company has completed the purchase of the lines and exchanges of the Montana & Wyoming Telephone Company in Wyoming, extending from Cody to Meeteetse and Basin. Negotiations are on for the purchase of lines in Montana embracing Red Lodge and Billings points. The new lines of the Bell people will enable one to talk from Butte or Salt Lake to Cheyenne and Denver.

FREMONT, NEB.—The Nebraska Telephone Company will spend about $10,000 in improving its plant at Fremont. It will put in a board with 1,000 drops, among the new improvements.

NORFOLK, NEB.—The Elkhorn Valley Telephone Company has filed articles of incorporation, the principal place of business being at Norfolk. The incorporators are I. S. Mahan, G. B. Christoph, and G. A. Luikhart. The capital stock is $100,000.

LINCOLN, NEB.—Articles of incorporation of the Virginia Telephone Company, Gage County, have been filed at Lincoln by the incorporators, Messrs. John A. Dobbs, William Holm, W. H. Stambaugh, Joel Dobbs, W. J. Kiser, Joseph Mangus and J. A. Erickson. The capital stock is given as $4,000.

VERDIGREE, NEB. Mr. Emil Shiem, president; Mr. J. B. Bates, vice-president, and Mr. B. Stevenson, secretary and treasurer, are the officers of the Verdigree Telephone Company, which has been organized, with a capital of $1,000, for operating a telephone line between Verdigree, Armstrong and Pischelville, Neb.

FREMONT, NEB.—On the morning of August 17 linemen of the Nebraska Telephone Company (the Bell company) cut the wires connecting the Farmers' and the Hooper exchanges. This action of the Nebraska Company was taken to enforce its contract with the Farmers' system, which prohibits the latter from connecting with exchanges other than those of the Bell company. Four wires running southwest from Hooper were cut.

OMAHA, NEB.—The York County Independent Telephone Company has connected lines with the Filmore County Independent Company, and also with the independent lines at Beaver Crossing, Milford and Friend, Neb. The local independent company at York has also built east to Utica, where it expects to connect with independent lines giving connection with Lincoln. North it has built into Stromsburg, where it is connected with the local independent company, and in a short time will have connection as far East as South Omaha.

TRENTON, N. J.—At an expense of nearly $50,000 the Fire Committee of Common Council is placing the wires of Trenton's police and fire-alarm system in underground conduits, hoping thereby to overcome frequent interruption to the service by reason of storms and other unfavorable conditions.

HAMMONTON, N. J. The officials of the Interstate Telephone Company are securing the right of way through Hammonton to erect their trunk lines from Atlantic City to this place, where they will connect with the Eastern Telephone Company, which will rebuild from Camden to this point. The former company has secured from the Board of Freeholders of Atlantic County a franchise to build lines throughout Atlantic County, while the Eastern Company has similar privilege through Camden County. This will give long distance telephone service between Atlantic City and Philadelphia, in opposition to the Bell Company.

SYRACUSE, N. Y.—The Syracuse Telephone Company is considering the expenditure of $300,000 in the improvement of its system in this city.

MILFORD, N. Y.—The Westville Telephone Company has been incorporated with a capital stock of $1,000, to build and operate a line from this village to South Valley. Directors: Frank Green, J. M. Cady, E. B. Coats and others.

SODUS, N. Y. The Empire State Telephone Company has decided to develop its system in this section. For the benefit of Rochester, Williamson, Sodus and Wolcott patrons a direct line of two copper wires is being installed. Williamson will be connected with the summer resort at Sodus Bay by two wires, and several wires will be run from Clyde to North Rose and then west and south to Palmyra. Another line of wires will run to North Rose from Clyde and then east to Wolcott.

AMITYVILLE, N. Y.—Articles incorporating the Suffolk County Telephone Company have been filed to carry on operations in the County of Suffolk, its lines extending along Main or the South Country road, from Amityville on the west to Montauk on the east, connecting all the intermediate villages on the south side of Long Island. The capital stock is $3,500, and the directors for the first year are H. Clay Losee, Walter H. Jaycox, Fremont Hammond and Joseph T. Losee, of Patchogue; Ralph C. Greene, of Sayville, and Morris F. Tyler, of East Patchogue.

CLINTON, N. C. The Clinton & Garland Telephone Company has been chartered.

EDMORE, N. D.—The Northwestern Telephone Company is busy putting a system and exchange in Edmore.

WAPAKONETA, OHIO.—The St. Marys Telephone Company will install an automatic telephone system in its new plant.

CLEVELAND, OHIO.—The Telephone Directory Company, capital $10,000, has been formed by W. H. H. Gorham, H. C. Brainerd, C. S. Bentley, F. L. Wait and C. H. Taylor.

CLYDE, OHIO.—The Farmers Telephone Company has been formed, capital $10,000, by F. S. Bronson, Fred Hutchison, Samuel Decker, S. F. Royer, D. H. Good and C. C. Wright.

SPRINGFIELD, OHIO.—Superintendent Gunn announces that the entire Appleyard system of traction lines is to be equipped with a Bell telephone system. The exchange will be located in this city.

JOHNSTOWN, OHIO.—The Johnstown & Croton Telephone Company with headquarters at Johnstown, Licking County, has filed a certificate with the secretary of state, increasing its capital stock from $30,000 to $50,000. Frank L. Beam is the president and Dwight E. Sapp is secretary of the company.

WAPAKONETA, OHIO.—The Buckland Telephone Company has been organized with the following officers and directors: President, H. D. Bowsher; secretary, T. B. Bowsher; vice-president, Dr. R. W. Sharp. Directors: Beecher Graham, John Edman, G. W. [illegible], S. A. Brookhart, Clarence Lathrop and Charles E. Bowsher.

OTTAWA, ONT.—The Bell Telephone Company has submitted to the city of Hamilton, Ont., a proposition for the exclusive franchise for the next five years, which will likely be accepted. The company's proposal is to pay the city $[illegible] a year, give the city [illegible] telephones at a cost of $25 each, and look after the police call system. The rate for private telephones will be $30 a year unlimited, and $15 for a measured service.

WYOMING, PA.—The franchises and all privileges of the Wyoming Telephone Company have been bought by J. Wood Platt.

LANGFORD, S. D.—The local telephone exchange will extend rural lines through the county.

ESTELLINE, S. D.—The Estelline Telephone Company has been incorporated with a capital of $10,000.

EGAN, S. D.—The Farmers' Egan Telephone Company has been incorporated with a capital stock of $10,000.

DELL RAPIDS, S. D.—The Dell Rapids Telephone Company is selling $5,000 worth of stock and will build rural lines.

LEAD, S. D.—The Nebraska Telephone Company, owner of the Black Hills system of telephones, has been granted a franchise by the city council of Lead to establish a central office, and is preparing to install a $25,000 plant here.

MEMPHIS, TENN.—The Mutual Telephone Company, has been formed and domiciled at Walnut Grove, capital stock, $100,000. The object of this company is to build a line from Forest to Carthage.

CHATTANOOGA, TENN.—It is announced that the Cumberland Telephone Company will soon begin the use of its wires for telegraph service between Chattanooga and Asheville, N. C. This, it is said, is done in order to compete with the Western Union Telegraph Company for the Chattanooga-Asheville business.

CHATTANOOGA, TENN.—The Hamilton Telephone Company is a new organization at Chattanooga growing out of the report that the Cumberland Telephone Company would raise its rates. The new concern has been granted a franchise by both branches of the City Council and the franchise referred to the proper committees. It is stipulated that rates shall not exceed $24 for residences and $36 for business houses. The rates which it is said the Cumberland Company will put into operation, are $30 and $48.

GAINESVILLE, TEX.—The People's Home Telephone Company has been incorporated with a capital stock of $250,000. Directors: F. B. McElroy and others.

OGDEN, UTAH.—The Utah Independent Home Telephone Company will erect a two-story telephone exchange. This is one of the preliminary steps to the installation of the new system.

SALT LAKE CITY, UTAH.—The Utah Independent Telephone Company has a large force of men at work on its underground conduits and placing poles in various parts of the city. The company has also taken out a building permit for the construction of a telephone building, which will cost $45,000. This will put a quietus on the report that the company was not securing a franchise in good faith.

RICHMOND, VA.—The corporation commission has granted a charter to the Mecklenberg Telephone Company, of Mecklenberg County, capital $250 to $5,000. The incorporators are W. H. Elam, Jr., C. F. Currin, J. O. D. Gohlson, F. W. Currin, W. A. Elam, R. F. Elam, S. W. Sand and J. D. Elam.

ROBERTS, WIS.—A telephone company has been formed to install a local exchange. R. C. Andrus is secretary.

LA CROSSE, WIS.—The La Crosse Telephone Company expects to install from 500 to 1,000 farmers' telephones in this county.

MILWAUKEE, WIS.—The Interstate Telephone Company has been incorporated with a capital stock of $4,000. J. A. Hull is agent.

UNION GROVE, WIS.—The North Cape Telephone Company has a gang of men extending its line into the Scotch settlement and Ives' Grove.

KNAPP, WIS.—The Knapp Telephone Company has been incorporated with a capital stock of $5,000. Directors: C. A. Silkworth and others.

ASHLAND, WIS.—The Bayfield County Telephone Company has been incorporated with a capital stock of $30,000. Directors: C. F. Latimer and others.

RIVER FALLS, WIS.—The St. Croix Valley Telephone Company has been formed, capital stock $1,200. Incorporators: J. L. Chapman, J. A. Chinnock, J. Bailey.

BORRE, WIS.—The Borre Mills Telephone Company has been incorporated, capital stock $30,000. Incorporators: George D. Sprain, W. C. Miller, August Nuttleman and others.

MADISON, WIS.—The Eau Claire County Telephone Company has been incorporated, capital stock $5,000, divided into 100 shares of $50 each. Incorporators: C. A. Silkworth, J. J. Osborn and Marshall Cousins.

MILWAUKEE, WIS.—The Stoughton Independent Telephone Company has been formed, capital stock $45,000, divided into 2,250 shares of $20 each. Incorporators: Robert R. Freeman, Clarence S. Pierce and William G. Whitehead.

READSTOWN, WIS.—The Readstown Telephone Company is making numerous improvements to its line. The company is at work on the extension to De Soto and as soon as that is completed will run its line to Sylvan, put a branch up the Harrison Hollow and a double wire to Brookville.

ELECTRIC LIGHT AND POWER.

HARRISBURG, ARK.—The Board of Alderman has granted G. I. Garvey a franchise for an electric light plant.

TUSCALOOSA, ALA.—The plant of the Tuscaloosa Light & Power Company was recently destroyed by the explosion of a 100-hp boiler. The loss is estimated at $[illegible],000.

SAN FRANCISCO, CAL.—The California Power & Development Company of Central California, has been incorporated, with a capital of $[illegible],000,000. Directors: K. H. Plate, of San Jose; L. Meyer, of Lincoln; J. I. [illegible], of Oakland, and others.

SAN LUIS OBISPO, CAL.—The San Luis Gas & Electric Company will expend about $100,000 in improvements to include new building, engine, boilers, generator, transformers and new gas plant complete. W. I. Boardman, 530 Market Street, San Francisco, is president.

SAN FRANCISCO, CAL.—The Owens River Water & Power Company is planning the construction of an electric power transmission system between its plant and Tonopah, Nev., a distance of 90 miles. A meeting of the stockholders will be held on October 12 to vote on a proposed bond issue of $2,500,000.

ARVADA, COLO.—Wm. Rawlins is president of a company organized to construct an electric light plant and street car system.

BLUERIDGE, GA.—It is reported that the Blueridge Electric Light & Power Company will purchase additional machinery. H. P. Mackey is secretary.

STERLING, ILL.—Robt. Miller, engineer of the Sterling Gas & Electric Light Company has completed plans and specifications for the new electric light station to be erected on the site of the old plant, to cost about $50,000. The plans and specifications for the new hydraulic plant have also been completed.

NEW HAVEN, IND.—The Council is figuring on the cost of an electric light plant.

RIVERSIDE, IND.—The Town Council has granted the Muncie Electric Light Company, of Muncie, an electric light franchise.

RICHMOND, IND.—The Light, Heat & Power Company will make an addition to its plant, to cost $40,000. J. W. Roney is general manager.

MUNCIE, IND.—The Union Trust Company, of Indianapolis, has acknowledged the release of a $60,000 mortgage held on the property of the Muncie Electric Light, Heat & Power Company. The amount has been paid in full.

VINCENNES, IND.—Smiley M. Chambers, who is heading a syndicate of Eastern and Indianapolis capitalists for the promotion and construction of an electric road from Vincennes to Jasper, has purchased the Vincennes electric light and gas plants.

FT. WAYNE, IND.—The Common Council is obtaining estimates on a station to furnish current for 600 to 800 arc lights and 35,000 to 50,000 incandescent lamps. No engineer has been retained. City Clerk A. M. Schmidt can furnish further information.

CRAWFORDSVILLE, IND.—The City Council has elected an electric light board to take charge of the municipal electric light plant. This step is taken to avoid, if possible, further financial loss. The previous management of the electric light plant by the city has been disappointing. The report for July gave the grand total expenses as $2,081.17 and the grand total receipts as $1,918.43, leaving a deficit of $163.28. The cost of the 143 street lights for the month was $878.28, or $6.14 each. This is at the rate of $73.70 per year.

INDIAN ORCHARD, MASS.—The United Electric Light Company is to build an extension to its plant at Indian Orchard.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company has petitioned the Gas & Electric Light Commissioners for authority to issue $140,000 bonds to build a dam, head gates, canal, power house, etc.

OCATLAN, MEX.—An electric light and power plant is to be established here.

TEZUITLAN, MEX.—It is stated that the electric power plant of the Tezuitlan Copper Company at this place is to be enlarged. The plant now has two units of a total of 666 horse power and it is proposed to install another unit to increase the capacity to 1,000 horse power. The power is generated by a waterfall obtained by the construction of 3,600 feet of ditch.

ADRIAN, MICH.—The Citizens' Electric Light, Power Company, capital $100,000, has been formed at Adrian, to take over the old company.

FLINT, MICH.—The Flint Light & Power Company has organized here by electing officers. D. G. Wright, of Philadelphia, Pa., is president, and Arthur G. Bishop, of this city, secretary and treasurer. The new company takes over the plant of the People's Electric Light Company. Eastern capitalists are interested in the new corporation, and the capital stock of the old organization will be increased to $150,000.

GLENWOOD, MINN.—The Glenwood Mill & Electric Company has been formed to consolidate the mill and light plants. The light plant will be rebuilt.

SOUTH STILLWATER, MINN.—Bids are being received for an electric light plant and water works, according to plans prepared by J. J. Flather, engineer, Minneapolis, Minn. Mr. Fred Kroeger is the village recorder.

SENATOBIA, MISS.—Harper Johnson, Mayor, writes that bids for material for an electric light plant are wanted at once. The probable cost of the plant is $6,000.

MARSHALL, MO.—The City of Marshall has bought the Marshall waterworks for $40,000. New city waterworks and an electric light plant will be built.

DILLON, MONT.—Articles have been filed by the Greater Electric Company to construct electric light and power lines and telegraph and telephone lines at Dillon; capital $40,000. A. F. Graeter and Wm. Roe, of Dillon, and Jos. Shineberger, of Redrock, are trustees.

VIRGINIA CITY, NEB.—Electric power is to be placed in the mines at Bodie, Nev., by Capt. Warren Loose, of Salt Lake. The plant will be installed on Rush Creek, and will generate 30,000 horse power.

LINCOLN, NEB.—As the result of an action taken by the City Council gas will be substituted for electric light in many of the city streets, with the exception of a few of the most important streets, where the electric lights will be retained. The change from electric light to gas is the result of an agitation on the part of some who were dissatisfied with the electric lighting service. The gas and electric light plants are both owned by the same company. A storm of protest from the citizens has been aroused by what those most interested consider a step backward.

NIAGARA FALLS, N. Y.—The Buffalo & Niagara Falls Electric Light & Power Company has secured the contract for furnishing 400 electric arc lights of 2,000 cp. each at $65 per year all night and every night.

ALBANY, N. Y.—The Granville Electric & Gas Company, of Granville, Washington County, has been incorporated; capital, $150,000. Directors: F. T. Pember and E. R. Norton, Granville; N. T. Drake, Sandy Hill.

GENEVA, N. Y.—It is stated that a syndicate is being formed in Geneva for the purpose of combining the electric lighting plants of Geneva, Waterloo, Seneca Falls, Clyde, Lyons, Newark and Palmyra. It is believed the capital will be about $1,000,000.

HOOSICK FALLS, N. Y.—The Hoosac River Electric Light & Power Company has been incorporated with a capital of $50,000, to operate in Schaghticoke, Valley Falls, Johnsonville, Eagle Bridge, Hoosick, Hoosick Falls, Cambridge, Green Island, Waterford, Albany, Cohoes, Rensselaer, Troy, Waterford and the towns of Schaghticoke, Pittstown, Hoosick, White Creek, Cambridge, Jackson, Easton, Greenwich and Petersburg. Directors: Le Grand C. Tibbitts and George M. Bovie, of Hoosick, and Sayre McLeod, of Troy.

PICTOU, N. S.—F. Mackaracher, Town Clerk, writes that plans are being prepared by R. S. Kelsch, of Montreal, Que., for an electric light plant, to cost about $18,000.

NELSONVILLE, OHIO.—The citizens have voted to issue electric light bonds.

SANDUSKY, OHIO.—It is reported that the Sandusky Gas & Electric Company will expend about $100,000 in improvements.

SHERODSVILLE, OHIO.—The Sherodsville Electric Light Company, of Sherodsville, has been incorporated with a capital of $10,000.

YOUNGSTOWN, OHIO.—The Board of Public Service has been authorized to receive proposals on 250 incandescent lamps for lighting the city. A ten years' contract will be placed.

HILLSBORO, OHIO.—The present city lighting contract expired September 1, and proposals will be received for furnishing light. Several new people are desirous of securing the franchise and contract.

COLUMBUS, OHIO.—The lighting committee of the Board of Public Service has found that the plans laid out for the new municipal lighting plant will not be adequate for the requirements, and it is proposed to install another boiler, engine and generator.

HUBBARD, OHIO.—An electrical engineer employed by the council estimates that the electric light plant can be rebuilt for $4,000. The Youngstown & Sharon Street Railway Company has submitted a proposition to furnish lignt for the village. The matter will be settled in the near future.

OTTAWA, ONT.—Representatives of over a dozen municipalities in the province of Ontario recently met in Toronto in the interests of the scheme for the transmission of electric power from Niagara Falls to various municipalities. A commission was appointed to investigate the matter for the benefit of the municipalities interested, with the view to deciding on the desirability of undertaking such an enterprise, and also the probable cost. Electrical and financial experts will assist the commission.

OTTAWA, ONT.—A number of Montreal, Toronto and Halifax interests, through Mr. Q. E. Warwick, general manager of the street railway of the City of Mexico, have purchased the Pueblo Light & Power Company. The company, which at present supplies power to the city of Pueblo, about 72 miles from Mexico, was held by Mexican interests, and has an exclusive franchise from the government of Mexico. Like the Mexican Light & Power Company, a new corporation has secured from the Dominion government a charter with wide powers, as the Mexican government signified its willingness to give it the same rights as it would receive from the Dominion The capital of the Pueblo Company is authorized at $3,000,000, and Montreal is designated as the chief place of business. The incorporators are E. M. Edgar, L. L. Edgar, L. S. Colwell, John Pinder and Albert E. Warwick, all of Montreal.

SEASIDE, ORE.—The City Council has granted E. M. Crawford, of Portland, a franchise for an electric light plant.

WESTON, ORE.—The Weston Electric Light & Power Company is to construct an electric plant to cost about $90,000. The power plant will be located about 3 miles above Bingham Springs.

SHENANDOAH, PA.—A charter has been granted to the Peoples Electric Light, Heat & Power Company.

REDLION, PA.—George R. Heisey, of Marietta, and others, have purchased the plant for the Redlion Electric Light Company, and will make improvements.

JOHNSTOWN, PA.—The contract for furnishing 250 arc lamps for a period of five years, has been awarded to the Johnstown Electric Light Company of Johnstown, at $40 per lamp per year, 500 watts each.

PAWTUCKET, R. I.—The J. & P. Coates Thread Company has decided to abandon its power plant, throw out all its mammoth engines and boilers and enter into a contract with the Pawtucket Electric Company for a continuous service of 5,000 horse power for 20 years. To supply this power the electric company will build a new power plant provided it can secure a 20-year exclusive franchise from the city. The electric company joins with the Pawtucket Gas and Providence Telephone companies in requesting such franchises, under provisions of the State law, which admits of a municipal tax of three per cent. The new electric plant will cost $500,000, and with other projected extensions will ultimately develop into a million-dollar plant. The franchise plan involves a contract for lighting the city for 20 years. The Coates Thread Company is ready to contract with the Thomson-Houston Company for electrical machinery to transmit the power.

BISHOPVILLE, S. C.—An electric light plant, costing $10,000, will be built here.

ROCK HILL, S. C.—It is reported that the Catawba Electric Company, which is developing an immense water power near here, contemplates transmitting power to Charlotte, N. C., to be sold for manufacturing purposes.

CHERAW, S. C.—Contracts for the electric light plant have been awarded as follows: For construction, to the Standard Electric Company of Charlotte, N. C., $5,000, and for engines and boilers, to Gibbs & Company, Columbia, S. C., $1,772.

ANDERSON, S. C.—A syndicate has purchased a 6,600-hp water fall near Anderson and will develop the same electrically. J. J. Fretwell is among those interested. Some of the stockholders of the Anderson Water, Light & Power Company are interested in the new enterprise.

TRENTON, TENN.—The town of Trenton has defeated a bond proposition to purchase the local electric lighting plant.

BROWNSVILLE, TEX.—John W. Maxcy, of Houston, has secured a franchise from the city for water works, electric light plant and telephones.

PILOT POINT, TEX.—The Pilot Point Light & Power Company has been incorporated with a capital stock of $30,000. The incorporators are G. E. Light, A. H. Gee, F. W. Hayden and A. P. Crosgrove.

RICHMOND, VA.—The Merchants' Co-operative Light & Power Company will construct an electric light and power plant, at a cost of $500,000. Franchise has not as yet been secured.

RICHMOND, VA.—The Virginia Passenger & Power Company is reported to be concluding negotiations for the purchase of riparian rights for 30 miles on both sides of Appomattox River above Petersburg and the establishment of a power plant to generate 10,000-hp of electrical energy.

NORTON, VA.—The Cumberland Transportation Light & Power Company, of Norton, has been incorporated with a capital of $50,000 by Henry M. Smyth, R. W. Dickenson and others. The company will begin at once building an interurban electric railway from Norton to Tom's Creek via Wise, Glamorgan, Esserville and Dorchester to Norton, and from Norton via Big Stone Gap, Imboden, Blackwood, Osaka, Stonega and Minersville, connecting mining plants in Southwestern Virginia. Each of the towns will also have electric lights. The principal office will be at Norton.

IRON RIVER, WIS.—It is reported that the Iron River Water, Light & Power Company will construct a dam 36 feet high and 160 feet long to develop electric power.

THE ELECTRIC RAILWAY.

PETALUMA, CAL.—Bids will be received up to 7 o'clock p. m., Sept. 8, for a franchise to operate an electric railway on certain streets and highways within Petaluma as applied for by Burke Corbet.

SAN FRANCISCO, CAL.—The North Shore Railroad Company has opened its new third-rail road between Sausalito and Mill Valley, Cal. This is the first third-rail road in California. The interior of the cars is lighted by arc lights and the platforms by incandescents. The road will be extended to San Rafael within a month. Aluminum feeders are laid close to the third-rail, the working current being of 550 volts stepped down from the 40,000-volt current of the Bay Counties transmission. There is a reserve steam plant and a storage battery plant. The Babcock & Wilcox steam boilers are oil fired.

NEW LONDON, CONN.—The incorporators of the Groton & Stonington Street Railway Company have voted to accept the charter recently granted by the General Assembly. The capital stock of the company is fixed at $600,000, and the proposed road will run from New London through Groton, Mystic and Stonington to the Rhode Island boundary at Westerly. The company will organize soon.

SPRINGFIELD, ILL.—The Kewanee Short Line Electric Railroad, Kewanee, Ill., has been incorporated with a capital of $15,000. Incorporators and first board of directors are W. V. Eddy, F. H. Davis, H. S. White, A. P. Eddy, A. C. Scott, all of Kewanee.

GALESBURG, ILL.—Articles of incorporation have been filed of the Galesburg, Monmouth & Rock Island Railway, beginning at Galesburg, extending through Monmouth and terminating in Davenport, Ia. The capital stock is $100,000. George F. Duncan and Edward Woodman, of Portland, Me.; W. B. McKinley, J. E. Johnston and Charles Zilly, of Champaign, Ill., are the directors.

ROCKPORT, IND.—The right of way for the Evansville, Boonville & Rockport Electric Railroad has been secured from Boonville to within 6 miles of Evansville, and the right of way for the entire line between Boonville and Evansville will be secured within a short time. J. F. Britton and E. C. Henning, having charge of that work, are pushing it as rapidly as possible. Further than Boonville nothing definite has been determined upon as to the extension of the line.

SIOUX CITY, IA.—The South Sioux City, Homer & Southern Railway, a newly projected road, will run a distance of 15 miles from South Sioux City to Homer, Neb. Much of the material for the construction of the line has already been bought by the company, and work will soon begin. It is thought that eventually the line will be extended to Decatur and Tekamah.

BURLINGTON, IA.—Articles of incorporation for the Burlington Interurban Railway Company have been filed here. The capital stock is $200,000.

The officers are Carl Leopold, president; J. W. Copeland, vice-president, Charles Blunt, second vice-president; Conley Anthknecht, treasurer, and J. W. Topping, secretary. The new line will be built from Burlington to Keosauqua.

TOPEKA, KAN.—The Topeka, Lawrence and Kansas City Electric Railway has applied for a charter. The capital stock is fixed at $1,000,000. Mr. T. S. Salathiel is the promoter. The road is to be 75 miles in length.

MADISONVILLE, KY.—The Madisonville Traction Company has filed articles of incorporation, with headquarters at Louisville. It is reported that a [illegible]-mile line will be built between Madisonville and Nortonville in Hopkins County.

PLYMOUTH, MASS.—The following officers have just been elected by the Plymouth & Sandwich Street Railway Company for the coming year: Horace B. Taylor and Eben Kimball, of Boston, J. Everett Cornish, of Philadelphia, Thomas Arnold and William B. Arnold, of North Abington, and Walter L. Boyden and John H. Marshall, of Plymouth. The board has organized with H. B. Taylor as president, J. E. Cornish as vice-president, and Walter L. Boyden as secretary and treasurer.

NILES, MICH.—The South Bend-Niles Interurban Line of the South Bend & Southern Michigan Railway Company is now in operation. The South Bend & Southern Company is a consolidation of the South Bend Northern Railway Company and the South Bend & Southern Michigan Railway Company. The former extends from South Bend to the Michigan state line, and the latter extends from the Michigan state line to St. Joseph, Mich. The construction of the line between South Bend and Niles completes the first division of the proposed line between South Bend and St. Joseph, Mich.

MANKATO, MINN. M. G. Willard and others contemplate forming a company to build an electric railway to St. Clair.

KANSAS CITY, MO.—The Metropolitan Street Railway Company has let the contract for altering the Eighth Street tunnel through the west bluff to the General Construction Company, of this city. The contract price for the work is about $200,000. The grade in the tunnel will be lowered from 8.8 per cent. to 5.3 per cent. In doing this the tunnel will be extended eastward several hundred feet. It is expected that the work of altering the tunnel will take about four months.

MARYVILLE, MO. A certificate of incorporation has been issued to the Maryville & St. Joseph Electric Railway Company, of Maryville. The company is capitalized at $700,000. The proposed road will be 70 miles in length and will run from Parnell, in Nodaway County, to St. Joseph, in Buchanan County. The incorporators are Richard Kuchs, Richard M. Bradbury, Stephen H. Kemp, Clarence E. Bartlette, Adolphe Lippman, Charles C. Donnell, John W. Thompson, all of Maryville.

OMAHA, NEB. It is reported the Armour Company will build a high-speed electric trolley line connecting its packing plants at Sioux City, Omaha, St. Joseph and Kansas City, and build spurs to Atchison, Kan.; Lincoln, Neb., and Des Moines, Ia. It is stated that preliminary surveys have been secretly made, and that eventually the line will be extended to the Chicago stockyards. Both freight and passenger traffic are said to be contemplated.

CAMDEN, N. J. The General Traction Company has been incorporated with a capital stock of $1,000,000. The object is to operate electric street railways. The incorporators are W. W. Benson and Charles G. Willis, of Philadelphia, and George A. Aldrich, of Audubon.

SANTA FE, N. MEX. At a meeting of the stockholders of the Capital Light & Power Company the following directors were elected: James G. Halapleus, Toledo; A. R. Gibson, J. P. Conner, Antoyno Winsor and H. E. Gibson, Santa Fe. The directors elected the following officers: A. R. Gibson, president; J. P. Conner, vice-president; H. E. Gibson, secretary; Antoyno Winsor, treasurer, and Jas. G. Halapleus, general manager. The company will build a large power plant on the Pecos and an electric railway between Santa Fe and Las Vegas.

SCHENECTADY, N. Y.—It is said that the Schenectady Railway Company has practically decided to extend its lines from Albany to Schodack Landing, passing through Brookview and Castleton.

NEW YORK, N. Y.—The Pennsylvania Railroad Company is building a power house for the Atlantic Avenue-Jamaica branch of the Long Island Railroad. This branch is now operated by steam power, which is to be displaced by electric power. It is stated that sooner or later many of the other short-haul lines will be operated in the same way. This, however, is a matter for future determination.

MANSFIELD, OHIO. The Mansfield Railway, Light & Power Company has placed orders for about $125,000 of new material for improving city lines.

EAST LIVERPOOL, OHIO.—L. W. Healey, of the United Power Company, has surveyors at work on a route for an electric railway from Wellsville to Steubenville.

TOLEDO, OHIO.—The capital stock of the Toledo & Michigan Electric Railway is to be increased from $450,000 to $4,500,000, to extend the line from Adrian to Coldwater, a distance of 60 miles.

CLEVELAND, OHIO.—Frank DeHass Robinson, who built the cable system in Cleveland and sold out to Senator Mark Hanna, has announced that he is at the head of the Cleveland Traction Company, and that as soon as the fight between Mayor Tom L. Johnson and the Cleveland Electric Railway Company is settled he will re-enter the field and offer a straight three-cent cash fare or ten tickets for twenty-five cents. He proposes to sell his stock to the "common people."

PORTLAND, ORE.—Efforts are being made to induce the City & Suburban Railway Company to extend its Montavilla line to Fairview and Troutdale.

ASTORIA, ORE. E. M. Ormen, an electrical engineer of Cincinnati, Ohio, has been making an examination of the country between Astoria and Seaside in the interest of the projected electric railway to connect the two towns. Local reports say he represents the Oregon Railway & Navigation Company.

DALLAS, TEX.—The Council has granted a franchise to Robert McCart, A. T. Byers, M. Sanguinett, C. S. Mitchell, Stuart Harrison and associates for the construction of a street railway to Arlington Heights.

DOYLESTOWN, PA.—Rights of way for the extension of the Philadelphia & Easton Railway's line from Tohickon Park to Bedminster, 4 miles, have been secured, and the directors expect to let the contract within a few weeks. The extension will cost about $50,000.

HAZLETON, PA.—The Hazleton, Weatherly & Mauch Chunk Railway Company has decided to begin a survey for its proposed line between Nesquehoning, Tamaqua, Broad Mountain, Hudsondale, Weatherly, Beaver Meadow and Hazleton. The route is 17 miles long. Charles Walters, of Wilkesbarre, J. M. Stauffer, of Beaver Meadow, and Ira N. Barnes, of Weatherly, are interested.

WALNUTPORT, PA.—The Heimbach Railroad Company has been incorporated to build a line fourteen miles long in Northampton County, capital stock, $140,000. Jay S. Moyer, of Bethlehem, is president of the company, and the directors are Frank Jacobs, Allentown, A. N. Brown, H. A. Thompson, John H. Fuenfstueck, Bethlehem; H. J. Weaver, S. Bethlehem; George H. Kressler, West Bethlehem.

FAIRHAVEN, WASH. The County Commissioners have granted the Whatcom-Skagit Interurban Railway Company a franchise over a specified route in Whatcom County. The company plans to build 26 miles of road in the county.

LEGAL.

WESTERN UNION AND PENNSYLVANIA. In the United States Circuit Court at Wilmington, Del., on Aug. 21 Judge Bradford issued an order temporarily restraining the Philadelphia, Baltimore & Washington Railroad Company, the Delaware Railroad Company and the Delaware, Maryland & Virginia Railroad Company from interfering with the property of the Western Union Telegraph Company on the right of way of these railroad companies. The order of Judge Bradford will remain in force until the question has been finally decided by the United States Supreme Court, or until the local court makes a further order.

INJURY TO CUSTOMERS FOR LIGHT.—In the suit of Lawrence and the Denver Consolidated Electric Company the Supreme Court of Colorado has decided that the complaint against an electric light company for injuries stated a good cause of action for negligence when it alleged that defendant was in the exclusive control of a plant for generation and distribution of electricity, that it supplied with electricity the residence where plaintiff lived, and that by reason of its failure to keep and maintain its plant and appurtenances in a safe condition, and to inspect them, plaintiff was, without fault or negligence on his part, seriously burned and permanently injured, by receiving a severe and terrific charge of electricity while attempting to turn on an electric light. The court also held that while a corporation furnishing electric light to others for private gain may not be regarded as an insurer, it owes its patrons the duty to protect them from injury by exercising the highest skill, most consumate care and caution, and utmost diligence and foresight in the construcable, consistent with the practical operation of its plant.

THE AUTOMOBILE.

CLEVELAND AUTOMOBILE CLUB. The Fall race meet of the Cleveland Automobile Club will be held on September 4 and 5.

RHODE ISLAND AUTOMOBILE MEET.—The third annual race meet of the Rhode Island Automobile Club will be held at Narragansett Park, Providence, September 19.

RECEIVER FOR AUTOMOBILE COMPANY.—L. J. Hammond has been appointed receiver for the General Automobile & Manufacturing Company of Cleveland, Ohio, upon application of the W. M. Pattison Supply Company.

IMPORTED AUTOMOBILES.—The business of importing automobiles is unusually active nowadays. Recently eighteen automobiles arrived at the Appraiser's Stores in New York where there is at present a large stock of the machines. In the last three weeks thirty automobiles have been passed, with an aggregate value of about $150,000.

NEW INDUSTRIAL COMPANIES.

THE NIAGARA SAFETY TROLLEY GUARD COMPANY of Niagara Falls has been incorporated; capital $50,000. Directors: Edward McDonnell, Morris Cohn, Jr., Frederick Charmann, Niagara Falls.

THE NATIONAL ELECTRIC CONTRACTING AND CONSTRUCTING COMPANY has been incorporated at Camden, N. J., to manufacture and sell electrical appliances, etc.; capital, $100,000. Incorporators: Frederick G. Warrell, Harry Thwaite, William L. Horner and Albert E. Warrell.

THE INDIANA ELECTRICAL COMPANY, of Crawfordsville, Ind., has been incorporated, with a capital stock of $30,000, all paid up. The company succeeds to the business of the Irwin Electric Company, the latter being absorbed by the new enterprise. The present factory will be enlarged for the purpose of buying and selling electrical machinery, appliances and supplies. The company will make and market dynamos, transformers, lamps and all kinds of electrical apparatus. The officers of the new corporation are: President, W. F. Hulet; vice-president, H. W. Ornbaun; secretary, G. B. Luckett; general manager, O. C. Irwin.

PERSONAL.

MR. W. MARCONI arrived last week on the Cunarder *Lucania*, which was in wireless communication all the way over with ship and shore

MR. GEORGE BULLOCK, president of the Bullock Electric Manufacturing Company of Cincinnati, Ohio, is now in New York on a few days' visit.

MR. G. WILBUR HUBLEY, superintendent and electrical engineer of the Louisville, Ky., Lighting Company, made a brief visit to New York City and the East last week.

MR. E. W. GOLDSCHMIDT, New York district manager of the Bullock Electric Manufacturing Company, is back at his desk again after a month's absence owing to indisposition.

MR. W. J. CLARK, manager of the foreign department in Europe of the General Electric Company, has arrived in this country in time for the street railway convention at Saratoga.

MR. E. B. LE MARE, as holder of the Gartside scholarship of Owens College, Manchester, England, will pass a year in the United States in post-graduate work in electrochemistry.

SIR W. H. PREECE, who was recently reported seriously ill with pneumonia, is, we learn by cable, in better health. We hope soon to be able to announce his complete recovery.

MR. DAVID HALL has resigned his position as chief engineer of the Milwaukee Electric Company to accept a position in the engineering department of the Bullock Elec. Mfg. Company.

MR. GEORGE C. EWING has been appointed New England representative of the Cooper Hewitt Electric Company, of New York City, to handle the Hewitt mercury vapor lamp in that territory.

MR. DOUGLASS BURNETT, of the electrical engineering staff of the New York Edison Company, was married in Brooklyn, N. Y., on Saturday, August 29, to Miss Jane Elting Young. The happy pair are now on their honeymoon.

MR. HENRY C. MEYER, JR., M. E., New York, has been retained to design and superintend the construction of a central heating and lighting station to be erected at West Point, N. Y., as part of the extended improvements to be made at the United States Military Academy.

MR. F. Z. MAGUIRE, who is well known in the field of electrical finance and promotion here and abroad has been elected vice-president of the De Forest Wireless Telegraph Company. Mr. Maguire was at one time secretary to Prof. Alexander Graham Bell and was later associated with Mr. Edison.

MR. T. F. MANVILLE, president of the H. W. Johns-Manville Company, and family have returned from a two months' trip abroad, visiting London, Paris, Berlin and other places on the Continent. Mr. Manville was largely interested in numerous important tests of the efficiency of pipe-coverings conducted by the English Government, and feels confident of closing some large contracts as a result.

MR. J. S. FEARON, of Fearon, Daniel & Company, of China, arrived in New York this week from the Far East. Some substantial contracts for various electrical equipment will be placed as a result of his visit to the States. Mr. Fearon's firm purchases electrical supplies, etc., for the Shanghai Municipal Council lighting system which provides electric light in the foreign settlement of that Chinese city.

MR. H. H. ROBINSON, the active and efficient general manager of the United States Telephone Company, at Cleveland, O., has now been appointed general manager of the Illinois Telephone & Telegraph Company, of Chicago, whose automatic exchange and subway system were fully described in these pages not long ago. His resignation took effect September 1, and he assumes his new duties at once.

MR. THOMAS A. EDISON, it is stated, has been giving some attention of late to the cure of cancer caused by Röntgen-ray and radium burns. His theory is that cancers that begin on the surface can be cured by the introduction of fresh blood from a healthy subject into the blood of the person affected. Mr. Edison believes that the idea is entirely tenable and having pointed out a way he will let the surgeons and scientific physiologists work out the problem.

MR. C. T. MANNING, who is primarily interested in the American syndicate which proposes to build a 500-mile electric railway across Nicaragua, has left New York for that Central American country. Mr. Manning, who is R. G. Dun & Company's representative in Nicaragua, is understood to have completed financial arrangements which permit of the syndicate acquiring the existing Nicaraguan Government steam road, 161 miles long, which is to be electrically converted.

MR. HENRY HINE, president of the Guanajuato Electric Light & Power Company, which concern is about to start operations on the second longest power transmission plant in this hemisphere, has left New York for Colorado Springs en route for Mexico. The Guanajuato plant will begin to generate current early next month. The transmission line will exceed 100 miles in length. The voltage will be 60,000. The energy will be utilized mainly for the purpose of operating several of the mines in the Guanajuato district, one of the richest mining regions in the Southern Republic.

MR. EMILE BERLINER, of Washington, well known as the inventor of the telephone transmitter bearing his name, the gramophone, and other important inventions, announces he has devised an aeroplane which has successfully maintained itself in flight. Over thirty years ago he took up the idea of the aeroplane, and urged that by means of the compression of air in front of the slanting sails and a motor to push the machine forward it was possible to sustain weight in the air and for man to fly. Eighteen years ago he made a large model embodying his ideas, but it failed to work. Since Prof. Langley began his recent aeroplane experiments Mr. Berliner has again taken up the old study of his youth, and has been flying out on one of the suburban roads on an aeroplane built on the buzzard plan

EDUCATIONAL.

ARTISANS ELECTRICAL INSTRUCTIONS. The General Society of Mechanics and Tradesmen of the City of New York, 20 West 44th Street, offers free evening instruction in physics preparatory to special work in electricity, in which the principles of electricity are taught, including the laws of electric currents and electrical measurement. The school offers a very complete course in mechanical drawing.

Trade Notes.

THE COUNTRY FAIR held under the auspices of the Cortelyou Club, in Brooklyn, will be decorated with Norbitt temporary decorative sockets, as made by the Crouse-Hinds Electric Company.

CARNIVAL DECORATIONS. At the Business Men's Carnival to be held at Paterson, N. J., the Norbitt temporary decorative sockets, of the Crouse-Hinds Company, F. M. Hawkins, New York agent, are to be freely used.

PITTSBURGH TRANSFORMER COMPANY, Pittsburgh, Pa., issues for September a very pretty little calendar, with a girl's head on it. It calls attention to its apparatus, requesting trial of it, and invites inquiry as to its merits and qualities.

REMOVAL.—The New York office of the Plunger Elevator Company on Sept. 1 moved from 156 Fifth Avenue to Room 509 Whitehall Building, No. 17 Battery Place. This move was occasioned by the demand for increased office space and by the desirability of a down-town office location.

KNIFE SWITCHES.—Pass & Seymour, Inc., have added a complete line of knife switches to their already extensive list of "P. & S." specialties. Following their established custom, they will make nothing but absolutely the best at reasonable prices. A handsome catalogue illustrates and describes the new switch.

THE ELECTRIC APPLIANCE COMPANY, Chicago, selling agents for Gutmann wattmeters insist that this wattmeter catalogue is an acknowledgement reference book on meters, and that it contains valuable information of a general character that should be read by every one operating meters. This catalogue will be mailed free of expense upon request.

TESTING BUREAU EQUIPMENT.—A spectro-photometer with brace prism, a Matthews integrating photometer, a Matthews arc lamp photometer, and a special device for the photometry of shades, reflectors, etc., are among the recent additions to the photometric equipment of the laboratory of the Lamp Testing Bureau, whose temporary quarters are at No. 14 Jay Street, New York City. This increase of facilities enables the Lamp Testing Bureau to undertake a great variety of photometric determinations.

LIGHTING IN A NEW YORK CHURCH. Simplicity, the keynote of the decorations in the Second Church of Christ, Scientist, in New York City, is obtained in a great measure by the method of illumination. The incandescent lamps being concealed in mouldings and cornices, the effect produced is both mysterious and beautiful. The auditorium has a seating capacity of 1400 and no shadows being caused by this mode of lighting, every portion of the room is thoroughly lighted with a soft glow. This church is lighted by I. P. Frink, 551 Pearl St., New York, with his system of reflectors for concealed lighting.

SELECTIVE SIGNALLING APPARATUS. The Swedish-American Telephone Company reports that the selective signalling apparatus that it recently put on the market is meeting with universal favor. The simplicity of the device makes it doubly attractive to buyers and those interested in this class of apparatus. The complication of springs, triggers and mysteriously wound coils is obviated, insuring the user satisfactory service and the operator a low cost of maintenance. Telephone buyers and those interested are requested to communicate with this concern for full and complete information.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, is preparing to enlarge its business by increasing its capital stock from $300,000 to $1,000,000. It is stated that the company will be re-organized and that a number of New York capitalists will be interested in it. Howard K. Gilman, president of the company, is to retire, but will retain an interest in the company and be a director. It is not known who is to succeed him as president. The new organization will take effect September 1. It is understood that Roger Scudder is to become an active participant in the affairs of the company. Mr. Gilman, it is said, is now organizing a construction company of which he will be president.

LAMP TESTING BUREAU.—More than two years ago the Lamp Testing Bureau, incorporated under the laws of the State of New York, began business as inspectors and testers of incandescent lamps. Its first customers were electric lighting and railway companies, manufacturers and purchasers of incandescent lamps. Its business was a success from the start and now embraces a grand total of over 10,000,000 lamps purchased by its customers and submitted by the manufacturers for inspection and test. In addition to lamp testing, the company has equipped a temporary laboratory at No. 14 Jay Street, New York City, for making electrical tests and calibrations of instruments, apparatus, materials and supplies, and has been able to a very great extent to fill the existing demands for services in this field. The growing demand for tests has taxed the present facilities of the company to such a degree that it is now found necessary to increase its equipment immediately more than one hundred per cent. To meet all the requirements a suitable building of heavy fireproof construction at 80th Street and the East River, New York City, has been secured, where its laboratory facilities will be greatly enlarged, its scope extended and its resources developed to meet any probable demands. The whole will form one of the most complete electrical laboratories that has ever offered its services for commercial testing. The company feels confident that by maintaining a skilled technical staff and assistants, together with a completely equipped laboratory, the value of its services will receive wider recognition. The company will welcome suggestions as to ways of increasing its public usefulness.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 25, 1903

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

12,149. APPARATUS FOR SELECTIVE ELECTRIC SIGNALING, John S. Stone, Boston, Mass. App. filed Dec. 2, 1902. A reissue of patent 714,831.

736,672. TELEPHONE, John A. Barrett, Louis A. Falk and Herbert L. Shreeve, Boston, Mass. App. filed Dec. 8, 1902. (See page 390.)

736,928. ELECTRIC MOTOR AND GENERATOR; Arthur Le R. Boden and George F. Krause, Indianapolis, Ind. App. filed Oct. 25, 1901. Details.

736,931. AUTOMATIC PRINTING TELEGRAPH, Charles L. Buckingham, New York, and Emil Germann, Brooklyn, N. Y. App. filed Feb. 1, 1900. The invention includes primarily a secondary relay which actuates the press magnet for all transmissions except the space transmission.

736,936. INSTRUMENT FOR TEACHING AND PRACTICE OF TELEGRAPHY, Charles F. Chinnock, Brooklyn, N. Y. App. filed April 27, 1901. The operator can turn a wheel which carries on its edge projections to actuate a circuit closer in accordance with Morse characters, the projections being grouped and a letter applied to each group.

736,942. TROLLEY POLE BASE; Albert D. Crossley, South Norwalk, Conn. App. filed March 4, 1903. An arrangement of contact plates upon the pole base.

736,950. INCANDESCENT ELECTRIC LAMP; James W. Forster, Chicago, Ill. App. filed April 17, 1901. The glass portion of the lamp is made in two parts, one of which is attached to the base and is of heavier material than the other, the latter inclosing the vacuum chamber, the object being to minimize the loss due to breakage.

736,966. ELECTRIC ARC LAMP; Haydn T. Harrison, London, Eng. App. filed June 27, 1902. The lower electrode is attached to a float resting on a body of mercury and inclosed within a solenoid.

736,975. AUTOMATIC ELECTRIC SAFETY SIGNAL; William W. Keener, Chesterfield, Ind. App. filed March 13, 1903. Details.

737,010. SELF-WINDING ELECTRIC CLOCK; Henry Rempe, Danville, Pa. App. filed Nov. 12, 1902. Details.

737,027. INSULATOR; William G. Rutledge, Brown Valley, Minn. App. filed Sept. 8, 1902. An insulator having a slotted top, the slot making a quarter turn and ending in a number of grooves, so that the insulator can be used on either a horizontal or vertical surface.

737,053. ELECTRIC RAILWAY SIGNAL; Henry A. Ammann and Albert D. Campbell, Spokane, Wash. App. filed March 9, 1903. Details of a device for attachment to the trolley wire and actuated to close a signal circuit by the passing trolley wheel.

737,072. WIRELESS TELEGRAPHY; Charles G. Burke, New York, N. Y. App. filed Sept. 21, 1901. A system for automatically transmitting and receiving in which the transmitting key is actuated through the agency of perforated tape which contains openings of uniform size variously spaced; the receiving apparatus includes a pen normally tracing a continuous line which is lifted at each impulse to divide the line up into dots and dashes corresponding with the spaces between the dots on the transmitter tape.

737,094. CONTROLLING SYSTEM FOR RAILWAY SIGNALS; George Gibbs, New York, N. Y. App. filed May 22, 1902. A supplemental device in which any of the signals can be held at danger by manually operated devices, notwithstanding that the automatic devices would ordinarily clear the signals; this is used where occasion requires.

737,107. ELECTRIC CIRCUIT CLOSER; Conrad Hubert, Spuyten Duyvil, N. Y. App. filed June 19, 1902. A circuit closer for bull's eye lamps in which a light pressure will close the circuit only as long as the pressure is applied, while a heavy pressure will lock the device in its closed position to hold the circuit closed indefinitely.

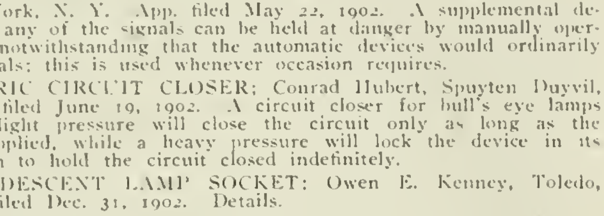
737,114. INCANDESCENT LAMP SOCKET; Owen E. Kenney, Toledo, Ohio. App. filed Dec. 31, 1902. Details.

737,162. APPARATUS FOR ELECTROPLATING SMALL METALLIC ARTICLES; John F. Shelton, Fort Worth, Texas. App. filed Sept. 16, 1901. The small articles are placed in a revolving perforated wooden cylinder.

737,170. APPARATUS FOR SELECTIVE ELECTRIC SIGNALING; John S. Stone, Cambridge, Mass. App. filed Aug. 2, 1902. A metallically-continuous elevated conductor serially connected with a plurality of closed resonance circuits each attuned to a different frequency.

737,173. LIGHTNING PROTECTOR; Jason D. Timmerman, Stone Mills, N. Y. App. filed May 14, 1903. A frame work is erected over a building and lightning rods supported upon it.

737,192. DYNAMO ELECTRIC MACHINE; Harry M. Acly, Pittsfield, Mass. App. filed Jan. 31, 1903. An arrangement of lugs and clamps whereby the coils are supported in position and can be readily removed and replaced.



737,254.—Fuse.

737,203. AUTOMATIC PRINTING TELEGRAPH; Charles L. Buckingham, N. Y. App. filed Feb. 1, 1900. An alphabet or code in which the letters are each formed by a definite number of transmitted impulses, while the figures are each formed of a different definite number, the character of the letters or figures being determined by prolonging some one or more of the impulses.

737,210. ELECTRIC STOP MECHANISM; Samuel G. Colt, Pittsfield, Mass. App. filed Sept. 23, 1901. A motor geared to a gate valve is provided with an automatic clutch which disconnects the motor when the valve is either fully closed or fully open.

737,227. ELECTRIC HEATER; William S. Hadaway, Jr., East Orange, N. J. App. filed Sept. 7, 1901. A peculiar form of flatiron having an electric heater inside in combination with a stand upon which the iron may be placed either in a position to close the circuit to the heater or leave it open.

737,237. SPEED GEAR FOR MOTORS; Albert B. Holson, Chicago, Ill. App. filed Jan. 6, 1902. The speed is varied by simply locking different concentrically disposed annular racks with the driving pinions of the motor.

737,242. TELEPHONIC APPARATUS, Miller Reese Hutchison, Upper Montclair, N. J. App. filed April 11, 1902. (See page 390.)

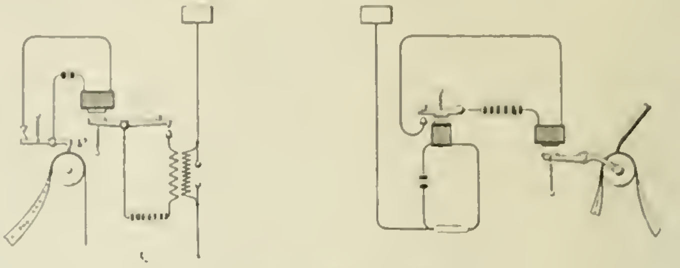
737,251. ELECTRIC MOTOR; Harry Landenberger, St. Louis, Mo. App. filed July 26, 1902. An armature ring has closed in heads from which project hubs, one of which serves as a pulley and the other as a carrier for commutator segments.

737,254. FUSE, William J. Lloyd, Pittsfield, Mass. App. filed Sept. 9, 1902. The terminals of a fusible strip are immersed in oil only the middle portion being exposed.

737,255. ELECTRICAL MEASURING INSTRUMENT, William J. Lloyd, Pittsfield, Mass. App. filed Feb. 10, 1903. The sensitive coil is mounted in a spherical chamber formed by the windings of a fixed coil which affords an intense and uniform field for all positions of the movable coil.

737,265. ELECTRIC BRAKE; Frank C. Newell, Wilkinsburg, Pa. App. filed Dec. 31, 1902. An automatic reversing switch which will always set up the proper combination of circuits for braking when the car is moving in either direction.

737,280. SAFETY FUSE; Joseph Sachs, Hartford, Conn. App. filed Feb. 19, 1900. The indicator usually fixed to the outside of the tube containing the fuse is arranged partially inside and partially outside of the wall of the tube.



737,072.—Wireless Telegraphy.

737,281. SAFETY FUSE; Joseph Sachs, Hartford, Conn. App. filed May 23, 1901. The indicator wire is arranged wholly inside of the tube, but a cord attached to it extends through an opening in the wall of the tube where it can be grasped or observed.

737,282. SAFETY FUSE; Joseph Sachs, Hartford, Conn. App. filed Jan. 13, 1902. A permanent casing serving as a holder for a fuse tube and adapted to be used with many different tubes.

737,283. FUSE BLOCK; Joseph Sachs, Hartford, Conn. App. filed May 6, 1902. The block contains grooves for main wires and clips to receive fuse tubes which will be held at right angles to the wires and in a different plane.

737,284. SAFETY FUSE; Joseph Sachs, Hartford, Conn. App. filed Sept. 29, 1902. The fuse tube is divided into a number of chambers through which the fusible strip is led in a zig-zag direction, thus making a short tube accommodate a long strip.

737,285. BATTERY ELEMENT; Charles B. Schoenmehl, Waterbury, Conn., App. filed May 19, 1902. A battery element, comprising a solidified and hardened flat depolarized plate, broadest through its top edge.

737,286. GALVANIC BATTERY; Charles B. Schoenmehl, Waterbury, Conn. App. filed May 1, 1903. A battery element comprising an annular solidified copper oxide depolarizer.

737,303. ELECTRICAL MEASURING INSTRUMENT; Thomas W. Varley, New York, N. Y. App. filed Dec. 26, 1902. The casing is pivotally mounted so that if the needle shows any deflection due to external magnetism, the casing can be shifted to compensate for it.

737,310. INCANDESCENT LAMP SOCKET; Joseph L. Yost and Owen E. Kenney, Toledo, Ohio. App. filed June 12, 1903. Details.

737,315. ELECTRIC ARC LAMP; Malcolm H. Baker, East Liberty, Pa. App. filed June 28, 1902. An improvement in the Bremer lamp in which an electro-magnet is used to withdraw a striker or igniter from the electrodes at the moment the current is turned on, the operation of the magnet being retarded to prevent a repetition of the action before the arc is actually established.

737,342. ELECTRIC ARC LAMP; Tito L. Carbone, Grunewald, Berlin, Ger. App. filed Dec. 30, 1902. The arc is surrounded by an iron ring placed in a magnetic circuit which thereby steadies the light.

737,343. ELECTRIC ARC LAMP; Tito L. Carbone, Grunewald, Berlin, Ger. App. filed Feb. 7, 1903. Details.

737,345. TELEPHONE TEST INSTRUMENT; Henry George Chalkey, New York, N. Y. App. filed June 19, 1902. (See page 390.)

737,349. SNAP SWITCH OPERATING MECHANISM; Charles A. Clark, Hartford, Conn. App. filed July 23, 1902. Details.

737,353. CONNECTING HOOK FOR ELECTROTYPERS; Jesse W. Cornelius and John Niemer, Cincinnati, Ohio. App. filed July 5, 1902. The bottom part of the hook switch which supports the plate in the bath is encased in lead or an alloy of lead, tin and antimony, to prevent its being attacked by the solution.

737,359. ELECTRIC ADVERTISING DEVICE; Jonathan C. Carrah and Russell A. Willson, Helena, Mont. App. filed June 23, 1902. The lamps are mounted on the spokes of a wheel and rotated by a motor while the circuits are variously operated.

737,368. ELECTRIC SAFETY FUSE OR CUT OUT; Louis W. Downes, Providence, R. I. App. filed June 2, 1900. The indicator wire on the outside of the tubes has attached to it a composition or a label which changes its appearance and gives an unmistakable indication of the destruction of the main fuse.

737,369. ELECTRIC FUSE OR CUT OUT; Louis W. Downes, Providence, R. I. App. filed Feb. 2, 1903. A modification of the preceding patent.

737,460. MEANS FOR STARTING ELECTROLYTIC OR NERNST LAMPS; Eustace Oxley, Brooklyn, N. Y. App. filed July 2, 1901. The circuit in which the heaters of a number of lamps are connected, is closed by a hand switch which is thereafter opened by a mechanical device after the lapse of a certain interval sufficiently long to bring the burners to a conductive condition.

737,491. REEL ATTACHMENT FOR MINE LOCOMOTIVES; Kenneth Rushton, Philadelphia, Pa. App. filed May 28, 1902. A friction gear connects the reel with the axle and can be thrown in when desired to reel up the cable carried by the locomotive.

737,553. ELECTRIC MOTOR; August K. Braun, New York, N. Y. App. filed July 3, 1903. Details.

737,554. ELECTROLYTIC APPARATUS; Linus P. Burrows, Washington, D. C. App. filed Jan. 22, 1902. The apparatus consists of a dissolving vessel, containing the anode, one or several filters, and a depositing vessel, containing the cathode. A stream of liquid is passed from the dissolving vessel into the filter and from the filter into the depositing vessel.

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THE STREET RAILWAY MEETING.

Last week we devoted considerable space to the street railway convention at Saratoga, and this week are able to report the closing exercises, which included a good deal of matter of general interest. Now that the industry is so thoroughly electrified, many or most of its broad topics are those which receive attention from engineers in other branches of the art, and anything from telephones to turbines appears pertinent to the trolley. We think our general readers will thus find some valuable data in the Emmet paper on steam turbines and the subsequent discussion. The encouraging remarks on the turbine in practice, from so competent and conservative an engineer as Mr. Mailloux, must have great weight on coming development in power stations.

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THE TELEGRAPHIC STATUS.

The wireless telegraph situation comes in for so much discussion, it rather crowds the older telegraph interests to the wall, as far as popular consideration is concerned. As a matter of fact, public interest in commercial telegraphy does not appear to be very great, and the reason may be the lack of anything sensational, either in its finances, its technique or its general development. For its great advances, wireless telegraphy has little to thank the earlier art and those who control it, and hence wire telegraphy is thought of as a thing apart. The time may come and perhaps is not far distant, when in view of the frequent interruptions of their lines, the telegraph companies may adopt a wireless system as an adjunct to be used in emergencies. This would be a sensible and progressive thing to do, but meantime the telegraph companies damn the wireless with faint praise—and possibly under their breath with what is not praise. Leaving aside the wireless, there are no great improvements visible in telegraphic technique, such as the adoption of "machine" or automatic methods; although doubtless there are sundry minor betterments which are too small to impress the public fancy, but which in the aggregate count a good deal for efficiency and economy. This may help to explain the encouraging report just issued by the Western Union for the September quarter, which shows a net revenue of $2,400,000, or $150,000 better than last year, and $700,000 better than the same quarter of 1900. To say the least, this is creditable, if the upkeep of the system has not suffered in doing it; and there is nothing to indicate that. It means apparently better executive and financial management, for we all recognize that there is little expansion in telegraphic income, whatever may be the explanation. Moreover, the surplus shown by the Western Union of $8,600,000 in 1900 has risen to $13,916,000, and the sturdy old "industrial" has gone right along paying its dividends all the while.

It so happens that just as these Western Union figures are available, some detail data comes to hand of the British telegraphs, as will be seen by other pages in this issue. On the face of the returns, the telegraph business in Great Britain in the hands of the government would appear to be growing more quickly than here; but if this be actually so, it is due to the cultivation of traffic at a losing rate. Now, it is not a peculiarly difficult trick to sell goods for less than they are worth; nor is it unusual that such a process should result in deficits. The British system does not make ends meet. It pays no dividend to the State on the investment, but calls all the time for more money. An explanation of the deficit is readily found in the fact that by means of very cheap press rates the Postmaster-

General makes the newspapers a present of at least $1,500,000 annually, and there are no signs that anybody will stop this leak, as they would in a merely commercial enterprise. But outside of that, the want of flexibility or growth in the business is seen again in the amount of traffic. Although the year 1902-3 was a banner period, the number of inland telegrams was only 75,883,000, and the total number, including foreign, was 92,471,000. This would seem to figure out somewhere around two messages per capita per year, or possibly just a little better than in the United States, where on the other hand the use of the telephone is far greater than in Great Britain. It strikes us that after all the telegraph falls short of its possibilities when barely two messages a year per head are all that the public can get out of it, directly, leaving out of consideration press dispatches. The great future question for telegraphy is, what can be done to make the two messages ten, and if something can be done, why it is not done. Not less than 160 trolley rides a year suffice for each American citizen, and we are strong enough believers in the telegraph to imagine that there must be ways and means of getting every good American to use the telegraph 6 or 16 times a year, as well.

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An Abuse of Hospitality.

At the recent meeting of the American Street Railway Association one of the prominent members in commenting on the fact that no invitation has been extended to the Association for its next meeting, intimated in rather plain terms that this apparent lack of appreciation was owing to the great expense that in the past has been entailed upon hosts of the Association; and it was suggested that some plan be devised whereby members would henceforth individually and collectively pay their bills and the hosts be thus relieved of what has become a very considerable burden. This advice is applicable to other associations, and with particular force applies to the case of the professional organizations having no direct claims upon the generosity of corporate interests, the expenses of entertainment having thus to be met directly by local members or shifted by them in whole or in part on residents by an appeal to their public spirit. Professional men as a rule have little surplus to draw on for such a purpose, and a loss of dignity is entailed—to say the least—when the money for the entertainment of the visiting body is obtained from those having no connection whatever with its objects. It is only of recent years, we believe, that this practice—which originated in connection with junketing excursions of beneficial orders and commercial bodies—has extended to professional organizations. Time was when these latter met their own expenses, the usual banquet being arranged for on the basis of each member attending it paying for his own plate; and the sooner there is a return to this good old practice so consonant with self respect, the better will it be for the prestige of the bodies concerned. If the current practice is continued, before long invitations will be a rarity, and when given can neither be offered nor accepted in the true spirit which should animate host and guest.

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The Central Station of the Future.

It would indeed imperil a reputation as a prophet to hazard a prediction as to future improvements in the generation and utilization of electric current. The imagination might be acute enough by nature for such a task, but if long fettered by facts it would be unequal to the effort. In fact, the less one knows of electrical matters the easier it is to give one's fancy rein in so dizzy a flight. It may be, of course, that Boomer's etheric engine, Faques's battery and Curbhowler's xenon light may in the fullness of time replace the apparatus with which we are now familiar, but we are here assuming that in the matter of generation at least, no revolutionary changes are immediately impending. The great suburban transmission system in process of evolution about Boston, which has just been described in our columns will serve as a text, and the need of cities as the salient theme. If the present tendency of rapid aggregation of population in large cities goes on, the future must prepare to meet conditions which are feebly sketched by the present situations in New York and London. Not only will there be demands for power, light and rapid transit hardly now to be imagined, but it will require desperate efforts to meet the requirements with sufficient completeness to make the conditions of city life in the least more than tolerable. Last winter gave us a taste of the situation which will be usual within a few years unless it be averted by the most active measures. The price of coal is on an upward gradient which is likely to grow steeper as time goes on, and the near future is quite certain to see anthracite far too much of a luxury to be used for the generation of steam.

The time is ripe for just such operations as are in progress about Boston, but on a scale even more imposing. The supply not only of the city proper but of the greater city from one or a few huge central stations is the logical step when we are hard pushed for fuel and harassed by smoke. Much has been said of the relative economy of small and large stations, but when the whole story has been told from the engineer's standpoint and quite irrespective of his conclusions, the citizen must have the last word. We believe the time has come when soft coal-burning industries must be relegated to the outskirts of cities, and the great central stations now being erected are taking a step in the right direction. Before many years we think that the smaller urban stations for direct supply of electricity at low pressure, now being maintained for convenience and for auld acquaintance sake, must go or be relegated to the state of emergency stations only to be used in case of a breakdown. They have served their purpose well, but the need for them has passed and they must pass with it. If any prime movers belonging to the future central station system are to be installed away from the main plant, the gas engine will become a great factor in the situation. Even a gas engine with its very undesirable products of combustion is not a pleasant neighbor, but it does not fill the air with smoke. The use of steam engines with coal for fuel stands a chance of being prohibited in the civilized city of the near future, and the electric motor and the gas engine, being fully capable of meeting all requirements in the way of power, they will come more and more to the front. Even heating can be divided between gas and electricity with the best of results when one works on a sufficiently large scale. We even now do not allow soap factories and tanneries to flourish in residence districts. Why should we endure an equally obnoxious shower of soot?

We see then for the future city hope in the combined efforts of electricity and gas. The stage we are now in is merely transitional. Imagine a city as it might be without means not already available. Twenty or thirty miles away on barren land, perhaps on tidewater, perhaps surrounded by a network of railway tracks, are the power works of the metropolis—long rows of coking ovens and mighty gas receivers, a constantly moving mesh of automatic conveyors and the towering stacks of a gigantic power station wringing from the coke its final tribute of energy. The gas finds its use in every building for all production of heat, and feeds whenever desired the huge gas engines of the urban auxiliary stations. For lighting and motive power the city depends entirely on electricity; no steam engine turns within the city limits, no chimney belches out a cloud of soot—the air is as clear and the sky as bright as on the prairies. The use of gas engine reserve stations serves to hold the balance of supply and demand as between electricity and gas. The prospect is no vision of a dreamer, but a possibility that might be realized at any time without passing the limits of conservative enterprise. The growth of cities is so swift and their demand for power so prodigious, that one has to look forward no more than a few years to see a market for power in one form or another so great as to justify fully the investment required for almost any reorganization of methods. Such an enterprise as we have described would of necessity be a complete monopoly and would thus imply rigid control by the municipality. The unutterable corruption of American municipal administrations is the sole bar to the success of such an advance. Progress waits for an era, not of Utopian fantasies, but of the common honesty that shall make for decent relations between great civic enterprises and the local governments under which they operate.

The International Conference on Wireless Telegraphy.

The action taken at the recent International Congress held at Berlin to discuss wireless telegraphy is likely to have a marked influence upon the development of the art in Europe, and to a lesser extent upon the development of the art in America. Until recently the circumambient ether of our planet, while teeming with electromagnetic waves of wave length lesser than an inch, depended almost wholly upon thunderstorms for its longer waves. The only radiograms were sent by the thunder god. Of recent years, however, artificially-produced electromagnetic waves, of the order of wave length of dekametres, have sprung into existence like a new species of creation, owing to the activities of electrical engineers. So long as the range of these waves remained limited to a few kilometres, it did not matter how, or where, they originated. Every electrician for himself, and the atmosphere for us all, became the natural creed of wireless telegraphers. But when these new creatures began to extend their range, and roam about from one country to another, this altruistic doctrine of let-alone became burdensome alike to him who sends and him who receives. The messages did not fall upon the place beneath, but rather seemed anxious to fall upon the antipodes beneath. Then the doctrine of law of the real estate man rose into consideration, that he who owns the soil owns the sky. The new command went forth—thou shalt not sully my ether with long electromagnetic waves.

So a congress was called at Berlin last month to deliberate upon the new state of the art and to say who owned the sky electromagnetically. After eight days of discussion, the congress adopted a protocol of eight articles, which was signed by the representatives of the United States, Germany, Austria, Spain, France and Russia. This seems to have been the first occasion on which the United States has been a party to an international agreement on telegraphy, and in a sense may be accepted as an indication of the policy of the day to assert our status as a "world power." Fortunately in this case there is no probability that our navy and army will ever be called upon in support of the obligation assumed. Telegraphic conferences are held in Europe at regular intervals, and delegates to these conferences are appointed by various countries of Europe, Asia, Africa and Oceania; but America has hitherto stood aloof, bounded by the Atlantic and Pacific Oceans and the Monroe Doctrine. But what telegraphy could not do by sea or land to bring America into the fold, telegraphy has done by air. According to the protocol, wireless telegrams have been described as radiograms, and have been brought into co-ordination with ordinary telegrams, under the rules of the St. Petersburg telegraphic convention. The United States is not a party to the agreement reached by that convention, but it would seem that the United States has now become a party to that convention so far as its provisions now apply to radiograms. The most important decision was that coast stations for wireless telegraphy are obliged to receive and transmit telegrams going to or returning from ships, without distinction as to the system of wireless telegraphy employed by the ships.

This rule can hardly be regarded as mandatory, and can only go into effect through the subsequent action of the various governments individually. In itself, the rule can only be of the nature of a suggestion, or consensus of opinion, from the conference. Moreover, it is nugatory in its present form. If, for example, the coast stations should have their receivers tuned to a particular frequency, then passing ships with a particular favored system of radiography would readily enter into communication with the stations, by using that frequency in their transmitting apparatus; whereas the disfavored ships would not operate the shore stations' receivers. The only complaint that the disfavored ships could make under such circumstances would be that the shore stations tuned selectively, and this allegation might be difficult to prove. Nothing would be easier for the shore stations than to ignore radiograms from disfavored ships without any tangible evidence of favoritism, unless compelled by the government, or the courts, to treat all vessels alike. The effect of such a ruling would naturally be adverse to the establishment of monopoly in any particular system of wireless telegraphy, so far as relates to the operation of coast stations with passing ships. In this respect the rule, if enforced, would apparently affect the contract which Lloyds' Agency has already entered into with the Marconi Company, which contract is stated to provide for the shore stations exclusive exchange of messages with vessels equipped for wireless telegraphy by the Marconi Company. Great Britain did not sign the protocol, declaring that no system of wireless telegraphy would be used by that country officially until guarantees of service could be given that hitherto have been unobtainable. This fact may avoid bringing the protocol into a test conflict with Lloyds' Agency. Italy also dissented from the protocol on the ground that to subscribe would involve breaking a contract already made with the Marconi Company.

Whatever results may flow from the session of this important congress, it seems likely that no license or charter will be granted by any of the governments whose representatives signed the protocol, for any system of wireless telegraphy contemplating monopoly or exclusive communication with vessels on the sea. This is in itself a step forward in the direction of civilization. The protection of international shipping, of lives and property upon the sea, is of greater international and national importance than the maintenance of any monopoly. It is difficult to see how a government could interfere consistently with the recognized rights of individuals, in the operation of the ether over the land for the purposes of wireless telegraphy; but when the welfare of ships on the ocean is taken into account, the general welfare which keeps the seas neutral territory tends to keep the ether above them neutral also. The convocation of this congress is but another evidence of the tendency of physics in general, and of telegraphy in particular, to unite nations in bonds of co-operation. Every new telegraphic development, such as wireless telegraphy, not only promotes rapid intercommunication, virtually leveling mountains and bridging seas, but also brings new ties for amity and mutual understanding, whereby war becomes more difficult to invoke. If wireless telegraphy should develop into such increasing range and utility as to carry any considerable proportion of intercontinental telegraph traffic, it would render a closer understanding necessary between America and Europe in the various details of telegraphic operation. For instance, the difference between the American and the European Morse codes would have to disappear and universal wireless telegraphy would necessitate a universal code for telegraphy of every kind worked by hand.

The Convention of the Edison Illuminating Association.

For some years past the Association of Edison Illuminating Companies has shunned cities as meeting places for its conventions, and has sought secluded pleasure resorts where the end of the season gives it an added retirement because of the absence of other guests. It must be admitted, however, that in developing this passion for privacy, the Association has also cultivated a very discriminating taste in hotels, so that the record of its transactions might serve equally well as a Baedeker of the best pleasure resorts in America. This year the success achieved in 1902 by the meeting in the beautiful new hotel at the foot of Mt Washington has again been followed up by the gathering at the Hotel Frontenac, a charming spot on one of the Thousand Islands, near Clayton; and the large attendance may in part be attributed to the reports which had circulated as to the attractions of a place, surrounded by a broad, deep river, whose only approach could be guarded by the vigilant eye of a single trusty. So quiet and withdrawn is the spot, even the caddies on the golf links have to make the trip over every morning, from Clayton, some few miles away, by steamer. There can be no doubt that by thus "letting concealment feed on its damask cheek" the Association is able to stick much closer to business; and its sessions are models of what work at a convention should be, with two and three of them, moreover, each day.

An element of melancholy was given to the convention this year by the absence of Mr. Luther Stieringer, so long the sergeant-at-arms, who died a few months ago in California. Although in every sense a free lance in the electrical field, fighting always for his own hand, Mr. Stieringer was one of the best friends and most loyal critics the Association has ever had, and it was with more than a tinge of sadness that the members in and out of meeting referred to his personality and to what he had done for the lighting art in providing it with some of its most useful and permanent features of security and flexibility. It is needless to add that his loss was appropriately recognized.

The meeting began on Tuesday, September 8, under the presidency of Mr. Louis A. Ferguson, of Chicago, but on account of the intervening Labor Day holiday, most of the delegates had arrived on Saturday or Sunday, and by the first day an attendance of at least 175 had been attained. The programme laid out, as given below, was followed out with trivial changes:

Tuesday, 9.30 A. M.—Roll Call, Announcement, Report of Executive Committee, Treasurer's Report, Report of Meter Committee. Discussion. Report of Storage Battery Committee, Report of Lamp Committee, Report of Committee on National Code. Paper, "Overhead Pole Line Construction and Operation," by Mr. A. H. Manwaring, and Mr. J. T. Hutchings, of Philadelphia. 8 P. M.—Paper, "Selection and Installation of High-Tension Switch Apparatus," by Mr. L. L. Elden, of Boston. Paper, "Operating Features of High-Tension Power Stations," by Mr. W. F. Wells, of New York. Discussion. Paper, "Comparison of European and American Engineering Practice," by Mr. Charles Schwartz, of Chicago. Discussion. Paper, "Notes on Commercial Features of European Lighting Practice," by Mr. Arthur Williams, of New York.

Wednesday, 9.30 A. M.—Paper, "Purchased Electric Power in Factories," by Mr. E. W. Lloyd, Chicago. Discussion. Paper, "Commercial Experience with Nernst and Meridian Lamps," by Mr. W. B. Thompson, of Detroit. Discussion. Paper, "The Development of Summer Lighting," by Mr. Edward A. Leslie, of Brooklyn. Discussion. Paper, "The Central Station and the Isolated Plant," by Mr. Douglas Burnett, of New York. Discussion.

Thursday, 9.30 A. M.—Paper, "Profitable Advertising," by Mr. Walter H. Johnson, of Philadelphia. Discussion. Paper, "Depreciation in Electric Light Plants," by H. M. Edwards. Discussion. 2.30 P. M.—Paper, "Results obtained with Steam Turbines in Milan," by Mr. Guido Semenza, of Milan, Italy. Discussion. Paper, "Steam Turbines," by Mr. August Kruesi, of Schenectady.

Thursday, 8 P. M.—Lecture on Illumination, by Dr. Charles P. Steinmetz.

Some part of the proceedings will probably be made available later, but as is well known, the Association sits in "executive session," at all times and hence a fuller report cannot be furnished. It was evident that the steam turbine was a topic uppermost in the minds of the members, and that great developments on their part await the tests which it is understood are now in process at the Chicago Edison plant, supplementing those already noted from Schenectady.

Although the Association does not invite outsiders, quite a few visitors participated in greater or lesser degree in what was going forward outside the convention hall. Among those present as guests were Dr. A. E. Kennelly, Professor of Electrical Engineering at Harvard University, and Mrs. Kennelly; J. G. White, of J. G. White & Co., and Mrs. White, A. J. Wurts, Westinghouse Electrical & Mfg. Company, Charles Blizard, Electric Storage Battery Company; T. C. Martin, Electrical World and Engineer; and Dr. C. P. Steinmetz, and Messrs. E. W. Rice, Jr., J. R. Lovejoy, A. L. Rohrer, and Messrs. Gilbert, Bates, Buddy, Hewlett, Wagoner, Gale and others, all of the General Electric Company. This parent company was, as usual, generous in its courtesies and hospitalities, and opened the ball on Tuesday by giving the ladies of the convention a delightful sail all around the Thousand Islands and Alexandria Bay.

Convention of the American Electrochemical Society.

As already announced, the fourth general meeting of the American Electrochemical Society will be held at Niagara Falls, N. Y., September 17th, 18th and 19th, 1903. The meeting will be held at the auditorium of the Cataract House, beginning at 9 A. M., Thursday, September 17th. Thursday and Friday afternoons will be devoted to visits to power houses and certain of the electrochemical plants which are open to visitors, and to other points of interest in the vicinity. Thursday evening there will be a smoker and entertainment at the Cataract-International. Friday evening a dance and reception will be given at the Cataract House. Saturday evening will be devoted to a trip to Niagara-on-the-Lake, Youngstown and Port Niagara by boat and trolley. The headquarters will be at the Cataract House. The special rates at the Cataract House and International Hotel are $3.50 to $5.00 per day American plan. For further information concerning hotels, the local secretary, C. L. Collins, 2nd, Niagara Falls, N. Y., should be addressed.

The following titles of papers have been announced, and are reprinted here for the benefit of those who may not have seen the earlier announcement: "A New Type of Electrolytic Cell," P. G. Salom; "Manufacture of Ferro-Alloys in the Electric Furnace," Dr. George P. Scholl; "Electrolytic Copper Refining," Dr. W. D. Bancroft; "Electrometallurgy of Gold," Dr. W. H. Walker; "Some Theoretical Considerations of Resistance Furnaces," F. A. J. Fitz-Gerald; "On the Supposed Electrolysis of Water Vapor," F. Austin Lidbury; "Efficiency of the Nickel Plating Tank," Prof. O. W. Brown; "Electrolysis of Sodium Hydroxide, by Alternating Current," Carl Hambuechen; "A Practical Utilization of the Passive State of Iron," Prof. C. F. Burgess; "The Present Status of the Theory of Electrolytic Dissociation," Dr. E. F. Roeber; "Berthelot's Law of Electrochemical Action," C. J. Reed. Other papers are expected from Dr. J. W. Richards, David H. Browne, Dr. L. Kahlenberg, Prof. C. F. Burgess, A. H. Cowles, and others. One session of the meeting will be devoted to the discussion of the theory of electrolytic dissociation, which will be opened by Dr. W. D. Bancroft.

Patents in Australia.

In trying to catch the socialistic labor vote in Australia, which, as is well known, has long been a country suffering from the dictation of trades unions, the Federal ministry has now introduced a Federal patents bill. One of the clauses is to the effect that on and after four years from the date of the invention no articles made in accordance with the specifications will be allowed to enter the Commonwealth. They must be produced in Australia. Again, if a patent be not worked within a certain specified period, say a couple of years, within the date of its being granted, it shall be declared null and void, wholly irrespective of any explanations which may be offered by the patentee. The whole tendency of the bill is adverse to the interests of inventors, and if accepted by the Federal Parliament it will discourage also the development of Australian inventive genius. Some light has been thrown on the action of the Commonwealth Ministry in the matter by the assertion that it is largely the work of a member of the Labor Party, who is a patent agent and holds advanced socialist views, the socialists holding that patent rights and monopoly of production are synonymous and opposed to the public interests.

Power Plant of the Cambridge Electric Light Company, Cambridge, Mass.

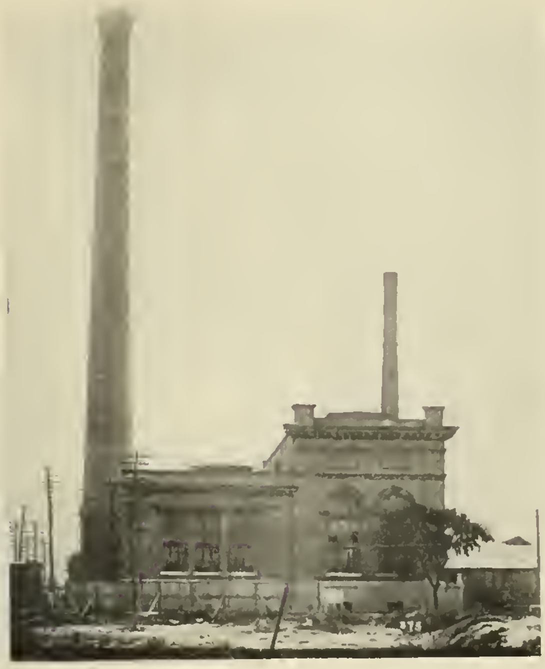

FIG. 1.—END VIEW OF STATION.

THE Cambridge Electric Light Company has recently completed a distinctly modern electric lighting and power plant on Western Avenue near the Charles River, in Cambridge, Mass. The new plant contains alternating-current apparatus of three-phase, 60-cycle type, the generators being direct-connected to vertical compound condensing engines using superheated steam. Among other notable features of the plant may be mentioned the lofty character of the building, which has resulted in well-lighted and ventilated boiler and engine rooms; an unusually light basement under the engine room, due to numerous outside windows in that story and to several openings in the engine room floor; the use of a traveling crane in the boiler room as well as in the engine room, and an extensive provision of special pipe hangers to allow for expansion changes in practically all classes of piping.

The power house is a steel frame building with brick walls and a timber roof supported by steel trusses. The street walls of the building are built with an enclosed air space of 8 in., and are faced on the outside with a cut-stone base course and surmounted at the roof by a heavy cornice and balustrade. In main dimensions the building is 106 ft. x 151 ft. 4 in. and is of the class in which the engine and boiler rooms are side by side, the longitudinal partition being composed, similarly to the street walls, of two 12-in. walls with 8 in. air space between. The boiler and engine rooms are of the same width, 50 ft., and are 145 ft. 8 in. long, but, if desired, one end wall may be torn down and indefinite extension made. The floor of the engine room is 10 ft. 9 in. above the level of the boiler room floor, and the basement floor 4 ft. 3 in. below it, leaving a clear height in that story of 13 ft. 8 in. In the boiler room, the lower chord of the roof trusses is 41 ft. 9 in. above the boiler room floor; in the engine room, the distance is about 52½ ft. In the case of each room, the roof has a large monitor. The interior walls of the boiler and engine rooms are of red glazed brick for the first 3½ ft., and are painted white, which is the predominating color inside of the building, above that point. The floors are all of fireproof construction. The crane in the engine room is a 25-ton, hand-power traveling crane, and in the boiler room is a crane of 5-ton capacity.

The boiler room contains two batteries of Babcock & Wilcox water-tube boilers, two boilers in each battery. There is space for a future installation of two similar batteries, so far as the present building is concerned. In addition to both main and auxiliary feed-water heaters, economizers have been provided, to utilize the heat of the flue gases. Located in the center of the present boiler room are two boiler feed pumps, the auxiliary feed-water heater and the economizer, the latter supported overhead, so that the floor space underneath is utilized for the pumps and heater. Incidentally the flue gases do not have to be carried downward in their passage from the boilers to the stack, which rises outside of the building as an entirely independent structure.

Each boiler contains 192 4-in. tubes 18 ft. long, arranged in 16 sections 12 pipes high, and two 42-in. steam drums 23 ft. 3⅝ in. long. They were built to carry 200 pounds pressure, and the steam connections are made so that before entering the steam header all the steam from each boiler must pass through a superheating coil which is located inside its respective boiler.

The smoke passage is located immediately behind the boilers and is of brick, its floor and ceiling consisting of arches sprung between light I-beams that extend from the partition wall to the boiler setting.

At the center of the boiler room the breeching is carried upward into the economizer setting, which is a brick structure carried on steel columns and beams from the boiler room floor and having brick arch floors and roof finished with Portland cement plaster. The setting is constructed to have a central direct smoke passage to the chimney with two sets of economizer tubes on each side. Half of the full boiler plant only having been installed, the second set of tubes has not been put in place, and as presently built, the economizer setting comprises one set and the by-pass. The economizer was built by the Green Fuel Economizer Company and consists of the usual 4-in. tubes 9 ft. high, arranged in one group of 520 tubes with one expansion space. The dampers of the inlet passages are hinged at the top and are lifted or lowered by means of a chain attached at the bottom of the damper and winding over a drum operated in each case by a hand crank through spur gearing. The dampers at the exit of the passages are suspended by chains at their axes, the chains passing through the top of the setting and twisting to turn the dampers. The economizer extends below the by-pass passage and the clean-out doors are located on the inner side of the economizer wall and under the by-pass passage. The chimney, which is located a short distance outside the boiler room, is of brick of the double-shell type, with a constant inside diameter of 9 ft. and a height above the grate bars of 255 ft.

The steam from each boiler is carried from the cross-connection joining the outlets of the two superheating coils in each boiler to a 16-in. header by means of a horizontal 8-in. wrought iron pipe bent horizontally. This pipe is connected into the side of the header, with a valve to the cross-connection and at the header. The header, which is of steel and supported by cast-iron roller bearing chains fastened by extension pedestals to the top of the smoke duct, is divided into four sections, corresponding to the four boilers, by gate valves. These are readily accessible from the roof of the smoke passage. The supply pipes to the engines already completed rise 8 in. in diameter in a long upward bend to a steam receiver and separator which is suspended in position by means of a special bend of gun metal passing through and anchored in the partition wall. From the top of the receiver, the engine supply continues 9 in. in diameter, with resultant reduction in velocity, and passes through the gun metal bend into the engine room where it reaches the high-pressure engine cylinder by means of long downward bend. Besides being a reservoir of steam, used to lessen the chance of pipe vibrations by the periodic cut off of steam and to supply a sudden demand of steam the receivers act as separators. These receivers and each section of the header are drained into a 3-in. drip main suspended below and run parallel with the header; from this the water is connected into a Holly receiver and returned, together with other clean high-pres-

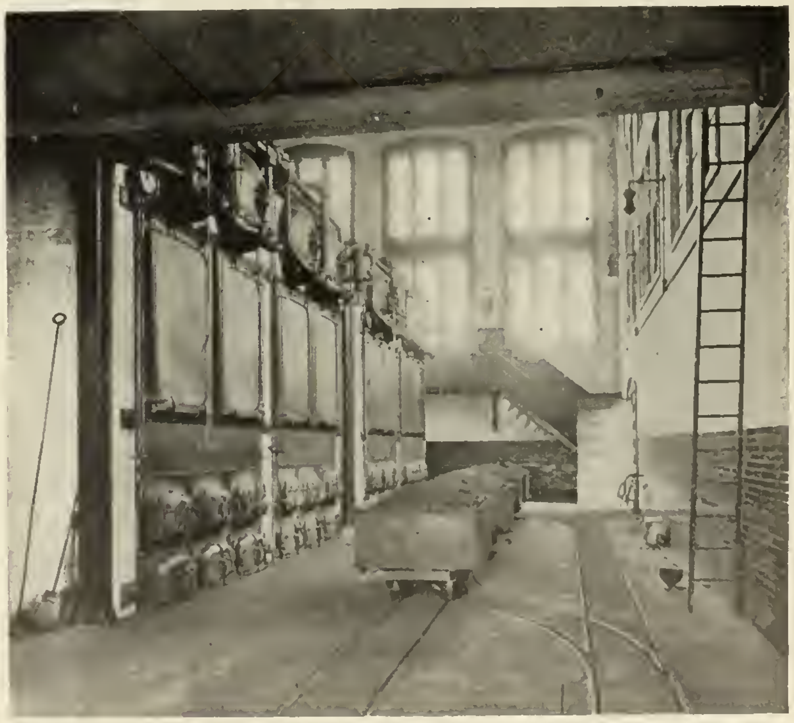

FIG. 2.—BOILER ROOM, CAMBRIDGE PLANT.

sure drips, into the boilers by means of the Holly system. For the supply of the various pumps, a 5-in. main is carried along the partition wall in the basement of the engine room, this main supplied by a 5-in. pipe from each end of the main header. The high pressure piping throughout is provided with the Vanstone joints with copper gaskets.

There are at present in the engine room two 500-kw electric generating units and a 1,500-kw unit and space for another 1,500-kw unit, making the capacity of the initial plant when entirely installed, 4000 kw. The units consist of McIntosh & Seymour vertical cross-compound engines and General Electric three-phase, 60-cycle alternators, the alternator and a fly wheel being located between the two cranks. The governing mechanism is of the interior fly wheel type, under control of a 1/8 hp motor mounted on the wheel and controlled from the switchboard for moving the weights to the desired position and thus to secure facility in synchronizing. The smaller engines have 18 and 38-in. cylinders and a common stroke of 42 in., and the large engine 31 and 64 in. cylinders and 48-in. stroke. The alternators generate a voltage of 2,300 volts. Current is transmitted, at this pressure, throughout Cambridge, being stepped down by transformers at the points of use. The switchboard, which was built by the General Electric Company, is located against the outside wall of the engine room, and the conductors pass out of the building through a wiring tower, which is a small shaft built against a rear corner of the boiler room.

Each engine is provided with a receiver for the passage of the steam from the high-pressure to the low- pressure cylinder, and the high-pressure cylinder is jacketed for high-pressure steam, and there is a high-pressure steam coil in the receiver. The condensation from each source is returned to the boilers by means of the Holly system. The exhaust steam from the low-pressure cylinder passes first through the main heater and then may be conducted to the atmosphere or to the condenser, the branch to the atmosphere having the usual back-pressure or relief valve for use when the condenser is in operation. The heaters were made by the Whitlock Coil Pipe Company, of Hartford, Conn.

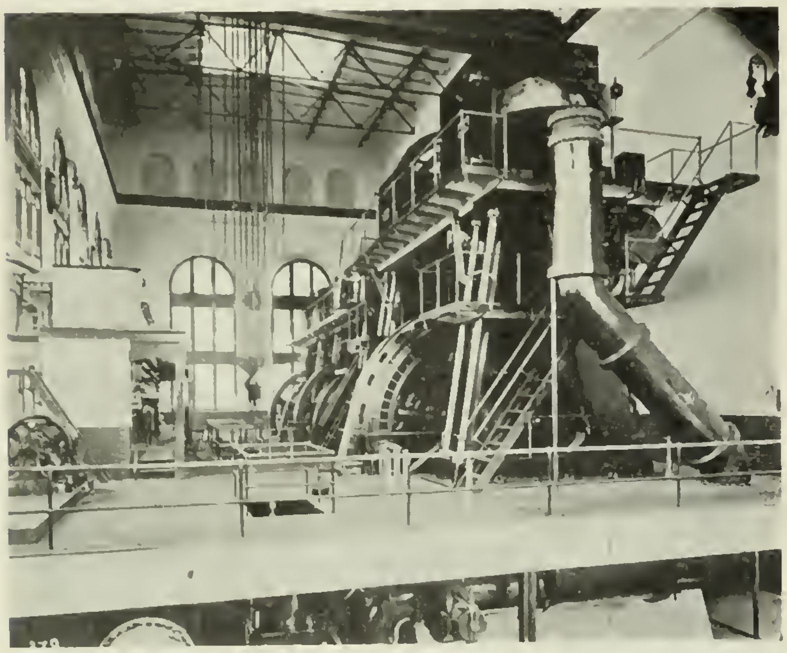

FIG. 3.—ENGINE ROOM, CAMBRIDGE PLANT.

The condensers are of the Blake vertical twin type of jet condenser, with 12-in. steam cylinders, 25-in. air pump and 18-in. common stroke, and 16-inch steam cylinders, 40-in. air pumps and 21-in. stroke. The reciprocating members rise into the engine room, and a light well has been built around them, giving considerable light to the basement in that way, in addition to that obtained from the basement windows. The condensers are located on the far side of the engine foundations from the boiler room and the main exhaust line is carried to the outside of the building independently of the exhaust from the pumps and auxiliary machinery. The exhaust piping throughout is of cast iron.

The condensing water is drawn from the Charles River through a tunnel to a well near the power house and from there through cast-iron injection pipes. The tunnel is circular in section, 4 ft. 6 in. in diameter, of 12-in. brick wall, and about 85 ft. long. Its inlet is protected with a grill of 1-in. iron bars, set vertically. The well is 8-ft. 6 in. in diameter, built with concrete walls 24 in. thick, and capped with a cast-iron cover; it is about 23½ ft. deep. It is fitted with a partition of wood with a copper-wire screen in the bottom, the partition dividing the well into two compartments, one in which the screened water is taken through the enlarged mouth of the injection pipe and the other in which debris collecting outside the screen can be removed. The screen consists of ⅛-in. copper wire, with ¾-in. mesh and has a free area of about 14 sq. ft. The condensing water piping throughout is of cast-iron, and in the power house is carried in a cement-lined trench below the basement floor.

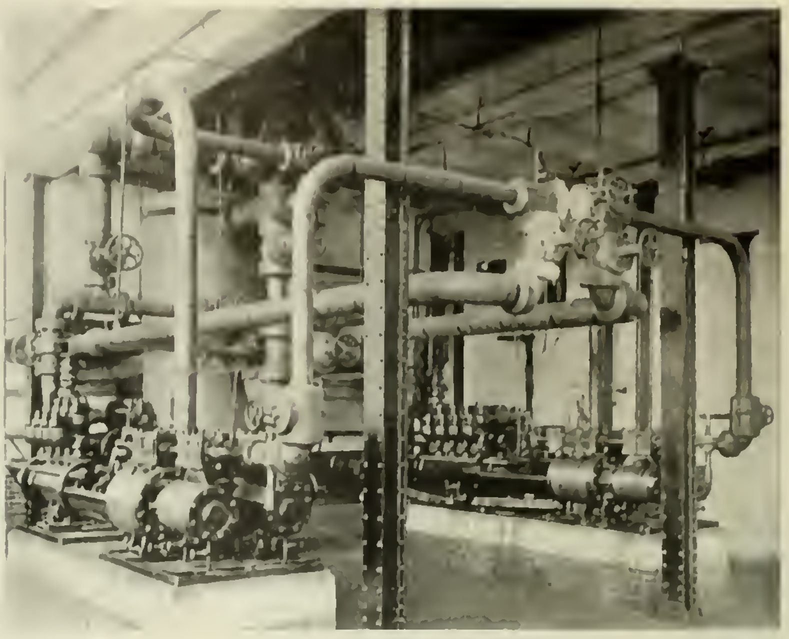

FIG. 4.—AUXILIARY STEAM PLANT.

Besides the condensers and the boiler-feed pumps, which are supplied from the auxiliary steam main, there is a steam-driven exciter unit in the basement, supplied from the same source. This is intended to supply the field current for all three alternators, but when desired the field excitation can be obtained, from a motor-driven exciter set in the engine room. This comprises an induction motor directly connected to a direct-current dynamo.

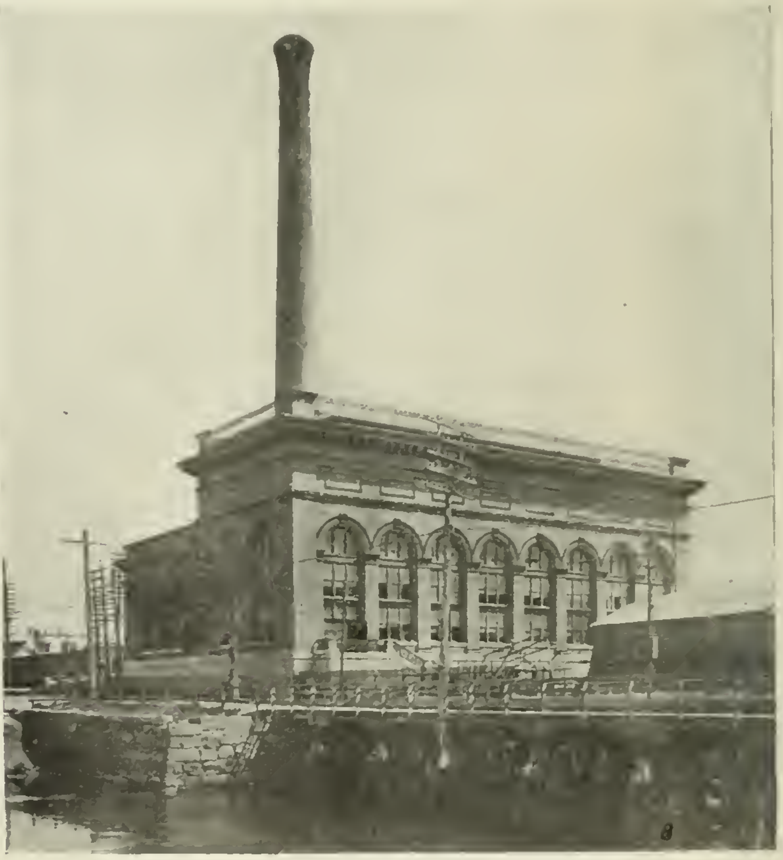

FIG. 5.—GENERAL VIEW OF CAMBRIDGE STATION.

Feed water ordinarily is taken from a rain water tank and, when necessary, from the city water mains through a water meter. No purification or water softening has been found necessary. There are two feed pumps, situated, as stated, underneath the economizer, one the reserve of the other. These are of the Blake outside-packed plunger type, designed for high-pressure work. They deliver the water usually through the main heaters in the main engine exhaust pipes, then through the auxiliary heater, for the utilization of the exhaust from the pumps and auxiliary apparatus, then through the economizer and into the boilers. Any one of the heaters may be bypassed, as may also the economizer. The feed pumps are governed automatically by means of a pump governor. The by-pass around the economizer is extended into an independent boiler-feed main, while that from the economizer makes a second feed main. The auxiliary heater is of the closed type, of the same make as the main heaters.

An extensive oiling system has been installed for the generating machinery. It includes a duplicate installation of filters and oil tanks under a compressed air system of circulation. The equipment is located in the basement against the engine foundations and facing the basement windows. The oil tanks rest on brick piers on the basement floor and are 4 ft. in diameter and 3 ft. high with dished heads, the heads turned in the same direction. The filters, which are of the Cross make, are 35 in. in diameter, 4 ft. 4 in. high, supported immediately above the level of the top of the oil tanks. The compressed air is furnished by a motor-driven air compressor, and a compressed air tank 3 ft. in diameter and 6 ft. 9 in. long is provided, suspended from the basement ceiling. A 1-in. pipe leads from the air tank to the tops of the two oil tanks, with valves so that either tank can be put into use, and there is a branch to this pipe for filling with fresh oil. The oil is forced from the bottom of each tank through 1-in. piping to the lubricating system. On its return it is delivered by 2-in. piping into the filters and thence by a ¾-in. pipe into either oil tank to be recirculated.

The power plant was designed by Messrs. Sheaff & Jaastad, of Boston. The general contractor for the structure, including the chimney, was Mr. F. B. Gilbreth, of that city, and the contractor for the piping was the Walworth Manufacturing Company, of Boston. Mr. D. E. Badger is chief engineer of the plant.

Power Plant of the Ottawa Electric Railway.

By John Murphy.

To visit the power house of the Ottawa Electric Railway Company is to be impressed with the conviction that the company's street car system is a model one in every particular. While much could be said about the cheerful, bright and clean cars, the natty and polite employees and the excellent condition in which the whole equipment is kept, the purpose of this article is merely to describe that part of the system which so quickly excites public interest if it happens to get out of order—namely, the power station.

Before the memorable fire of April 26, 1900, which destroyed the greater part of Hull and a large portion of the city of Ottawa, the power plant of the Ottawa Electric Railway Company consisted of two hydro-electric stations containing five Westinghouse generators. Of the latter four were belt-driven, four-pole machines, and one was a twelve-pole, direct-connected machine. The combined output of the belt-driven machines was 2,100 hp, and the output of the other was 2,000 hp.

The two stations were situated side by side and either was capable of supplying energy for the whole service. The belt-driven generators were installed in an iron-covered frame building of exceptionally rigid construction and the more modern outfit was contained in a fire-proof brick and steel structure. The latter unit was intended to preclude the possibility of a complete tie-up in the event of an accident to the other plant, as well as to provide for extensions of the service, and while its installation was in progress one of the belt-driven machines, a 700-hp generator, was removed to the auxiliary steam station of the Ottawa Electric Company, about a quarter of a mile distant, where it still remains. The fire of April 26, 1900, completely destroyed the building containing the belt-driven generators, but the new station was practically uninjured. The steam station also escaped destruction, as it occupied a comparatively isolated position.

In the fall of 1902 a building was erected on the site of the destroyed station in which there was installed and there is now in operation, the largest storage battery in Canada. It consists of 288 cells of the Electric Storage Battery Company's latest improved "chloride" accumulators. The elements of the battery are contained in lead-lined wooden tanks, which have been made large enough to permit of a 50 per cent. increase in the number of plates and in the output of the battery. Each tank now contains twenty-five plates, but there is space in each for thirty-nine plates. The tanks rest upon porcelain insulators supported by well-seasoned pine stringers suitably water-proofed, and the stringers are separated from the concrete floor of the room by vitrified bricks. This arrangement keeps the battery thoroughly insulated from the ground.

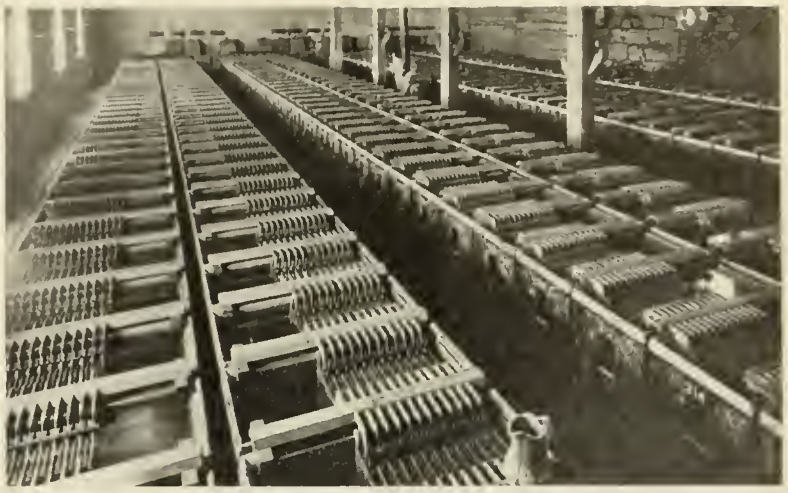

FIG. 1.—STORAGE BATTERY PLANT AT OTTAWA.

The maximum discharging and charging rates of the battery are 1,000 amp. and 350 amp., respectively. As the battery is thus able to take care of load changes amounting to 1,350 amp., and as the Ottawa Electric Railway's fluctuations in load are much less than this amount the generator load is an absolutely constant quantity.

It was only after a thorough canvass of the situation that the Ottawa Electric Railway Company decided to install the battery. The company foresaw that in the event of an accident to a water wheel, to a gate or to the gate-moving mechanism on their direct-connected unit, their entire car service would be dependent upon the services of the 700-hp steam-driven generator, and to avoid such a contingency additional power plant became a necessity. However, before reaching a decision the question to be solved was this: Which installation would give the best results—a steam-driven generator, a water-driven generator, or a storage battery? The steam plant's first cost and expensive operation were serious bars to its installation, and the hydro-electric equipment's inability to render assistance at times when it would be most needed—namely, during ice or low-water troubles—had much to do with preventing its selection.

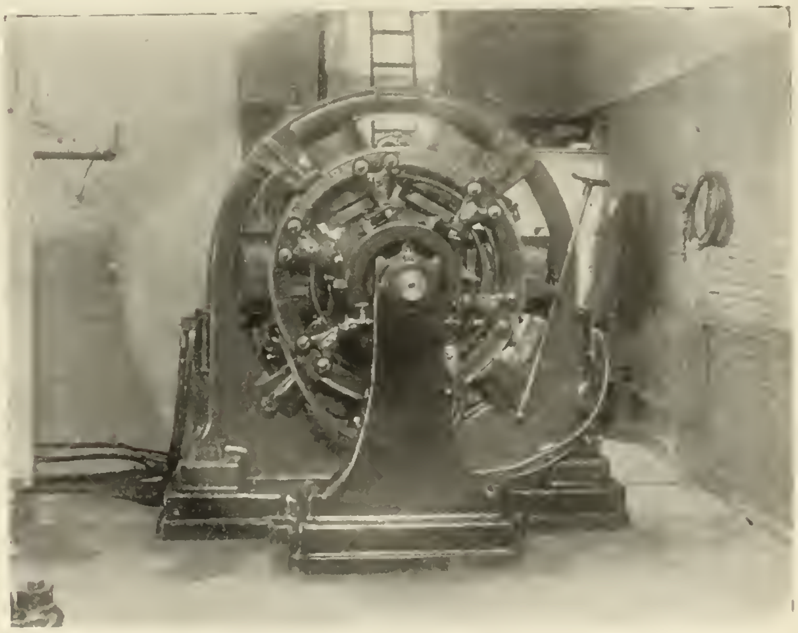

FIG. 2.—THE BOOSTER.

In the end the battery was decided upon, because it would immediately improve the service by maintaining constant e.m.f. at the power house, irrespective of load changes, and for the further reason that it would prolong the life of the hydraulic outfit not only by relieving the water wheels and gates from the jars occasioned by sudden variations in load, but also by saving the gate mechanism from being destroyed through its constant moving back and forth.

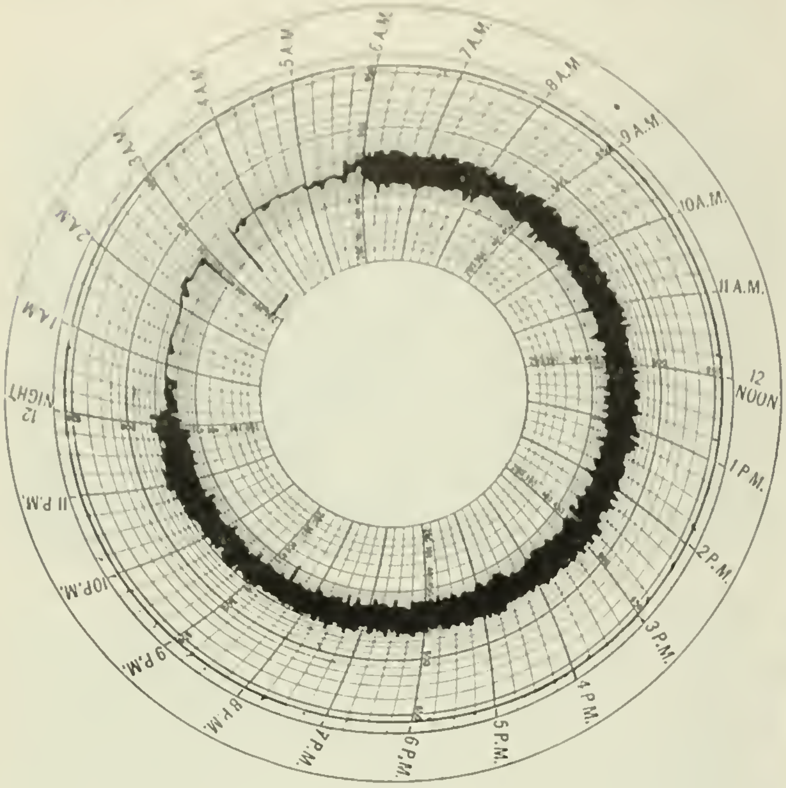

FIG. 3.—VOLTMETER CHART I.

A further and very important factor in determining the selection of the battery was that it would also act as additional plant. As is well known, street railway loads are of a fluctuating character, and peak hours exist. Thus it happens that between midnight and morning, battery charging can always be done and power thus stored during the night can be reserved for times of need. In connection with the generator at the steam station the battery is also able to take care of a respectable limited service. The beneficial results obtained from the Ottawa Electric Railway Company's battery during the past seven months are so apparent that the management have good cause to congratulate themselves on the wisdom of their choice.

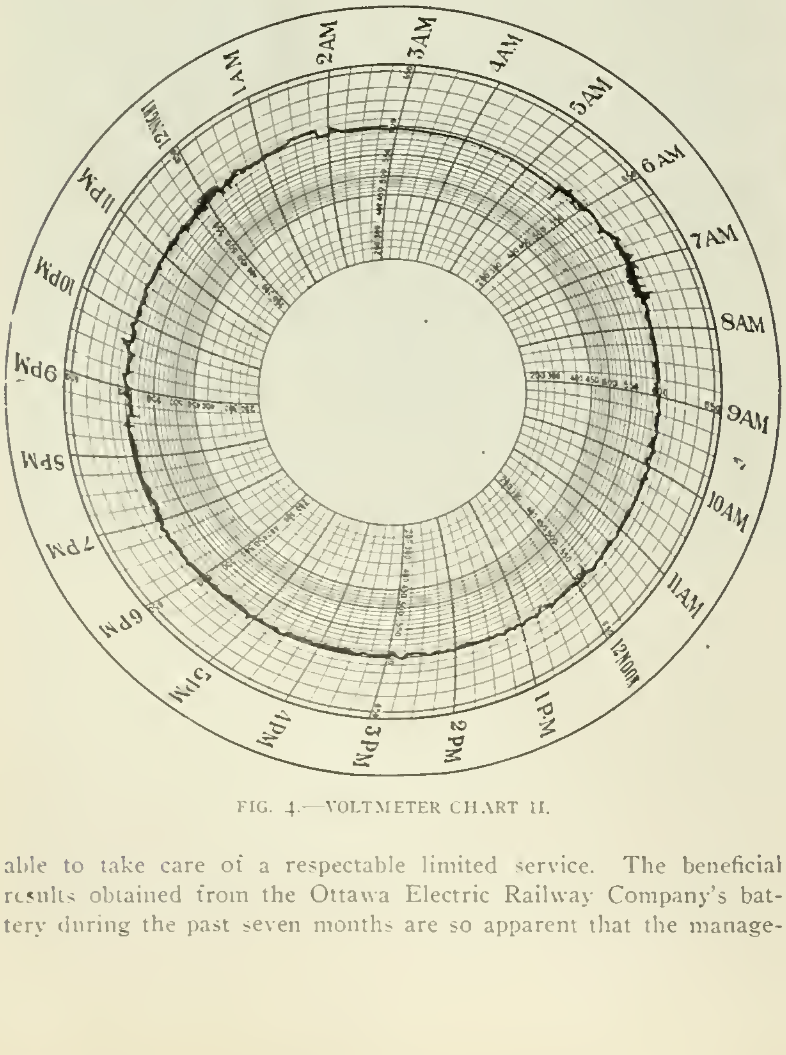

FIG. 4.—VOLTMETER CHART II.

Up to the time the battery was installed the water wheel speed and consequent generator e.m.f. was controlled by hand. The controller's efforts met with the degree of success which is illustrated by the recording voltmeter chart of Fig. 3. The 550 volt line was aimed at on this chart, but an average of about 520 volts was obtained, while sudden voltage jumps of 20 per cent. were not uncommon. Cars at distant points received about one half normal voltage when the power house voltage dropped, because the consequent rise in current which accompanied the fall in voltage introduced abnormal line losses, the process being a cumulative one.

A glance at the chart of Fig. 4 will serve to indicate what the battery daily accomplishes in the way of regulating the bus-bar voltage and generator speed. In fact, a comparison of the charts of Figs. 1 and 2 is a valuable object lesson. Chart I was made before the battery was installed; Chart II afterwards. Chart I illustrates wide speed and voltage variations which occurred despite the constant efforts of faithful attendants to prevent them. Chart II shows what is now done automatically and without the slightest waste of energy in its accomplishment. Both charts were made by the same voltmeter connected across the power house bus-bars. Many lighting plants are operated to-day whose voltage curves would not favorably compare with that of the Ottawa Electric Railway Company's Chart II.

It will be noticed that the normal power house pressure is now 600 volts. The generator's speed and its field charge were both increased slightly to obtain this pressure. The pressure was raised to 600 volts for the purpose of obtaining the many benefits available when working at this pressure, and also because it was felt that the battery would hold the pressure constant at whatever point was decided upon. Chart II shows that a variation from the zero point of more than 1½ per cent. is a rare occurrence. The vim with which the cars now ascend grades and the way in which they spring to life when the motorman moves his controller, are among the most gratifying improvements that have followed the installation of the battery.

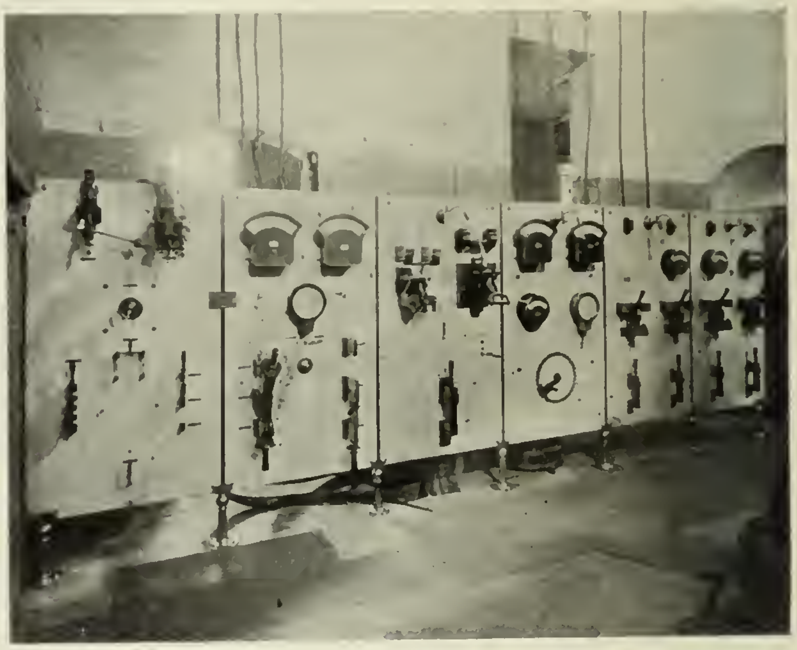

FIG. 5.—SWITCHBOARD.

The reduction in the amount of current used per car due to the increased voltage is also a feature worthy of special attention. The power house current output, with the same number of cars in operation, has been reduced 40 per cent. The average amount of current used per car, based on power house indications, under old conditions was 28 amp.—it is now 17 amp. The reduction in line losses on this account is a most important matter, as it will postpone for a long period the necessity of increasing the feeders throughout the system. A differentially-wound motor-driven booster works in connection with the battery, and it makes the latter so sensitively active that an absolutely constant load is kept on the generator.

The water wheel gates are not moved at all for the purpose of speed regulation. The gates are opened far enough to make the generator carry the average load, and the closest inspection of the tachometer fails to reveal any speed variation. A visitor could easily be persuaded that the generator was supplying an incandescent lighting service, so smoothly does it operate. An inspection of the line and battery ammeters, however, indicate that large and rapid load changes are always taking place.

The present plant, consisting of direct-connected generator and battery, is capable of supplying energy to a much greater number of cars than are ever used in Ottawa, and with the steam station a large amount of reserve power is always available. The illustrations represent the 2,000-hp, direct-connected generator, the booster, the switchboard, with the feeders cut off, and the battery room. It is interesting to note, in the switchboard picture, that while the battery and bus voltmeters' needles are reproduced quite clearly, the ammeter needles are not printed at all—the latter do not remain in one position long enough to be photographed.

Public Service Legislation in Massachusetts.

By Alton D. Adams.

Gas, electrical supply and railway systems are prominent objects of Massachusetts legislation in 1903. In general the character of most new legislation on these subjects is such as will increase the powers and privileges of the companies engaged in gas and electric service. Along with such increase, however, there is sure, in several instances, to be a larger degree of competition between public service companies.

Legislation tending toward an increase of competition in gas, electrical supply or transportation lines is rather against the established policy of Massachusetts, and the laws of the present year may be fairly said to be radical in this particular. It must be admitted, however, that these laws are not the result of any granger movement, or of any attack on public service companies as such; but rather to struggles between such companies themselves for public franchises. The fact is that Massachusetts presents so fertile a field for public service operations that companies engaged therein are often willing to extend their business even at the risk of competition. Along with the increase of powers and privileges some small additional burdens have been laid on gas, electric and street railway companies.

The tendency of gas and electric companies to extend their service areas has been favored in several instances by the Acts of 1903. Chapter 93 authorizes the North Adams Gas Light Company to extend its service into the town of Clarksburg, subject to the approval of the selectmen and the gas commissioners. Under like conditions the Pittsfield Coal Gas Company is authorized to supply electric light and power in the town of Dalton, by Chapter 159. The Edison Electric Illuminating Company, of Brockton, is given power, by Chapter 215, to extend its electrical supply into the town of Whitman, provided that consent of the gas commissioners and of the selectmen is obtained.

By Chapter 237 the mayor and aldermen of a city or the selectmen of a town through which the wires of a company are to pass are required to give the company a writing specifying the kind and locations of the poles, and the height at which the wires are to run. Any company, other than a street railway company, that desires to erect poles or fixtures along a public way, must apply, in writing, to the mayor and aldermen or the selectmen. The clerk of the city or town in which the locations are desired must mail notices three days before a public hearing on the petition of the company to owners of real estate along the public ways where the locations are desired. The fact that such notices were sent must be endorsed by the clerk on the specification of locations for poles and fixtures, and such specification is not valid without this endorsement of the clerk. After erection of the lines the mayor and aldermen or the selectmen may, after giving the company a chance to be heard or on petition of the company, may direct any alteration in the location of poles, and in the height of wires. All of these specifications and orders must be made a part of the city or town records. No permit is required for the renewal of poles once legally erected. This act is distinctly favorable to the companies in that it provides means by which the legality of pole and wire locations can be readily tested.

Chapter 417 authorizes the Boston, Brookline, Bay State, Roxbury, South Boston, Dorchester and the Jamaica Plain Gas Light Companies, also the Massachusetts Pipe Line Company, to combine in a new corporation to be known as the Boston Consolidated Gas Company. The provisions of this act are too extended to be discussed here, and those interested should refer directly thereto.

The most radical piece of legislation touching public service, for the year, is contained in Chapter 350, which empowers the Holyoke Water Power Company to generate electrial energy in Holyoke and South Hadley, and to sell this energy in all the cities and towns of Hampden and Hampshire Counties. Before sales can be made in a city or town the approval of the mayor and aldermen of the city or of the selectmen of the town must be obtained. Sales to any one purchaser may not be "in a quantity less than 100 hp at any time, nor until it has made with such purchaser a written contract providing that such purchaser shall use such electricity in his own business only, and upon his own property, except that it may sell to any city or town within the counties of Hampden or Hampshire which has established or may hereafter establish a municipal lighting plant, and any such city or town may purchase of said company electricity in any quantity and for any purpose for which said city or town can legally use the same."

The Supreme and Superior Courts are given jurisdiction in equity to enjoin the Holyoke Water Power Company from violating any of the provisions just named, or to enjoin a purchaser under one of the written contracts named from violating it, upon application of the mayor of any city or of the selectmen of any town in which the company may sell electricity. Wires and poles may be erected by the company subject to the provisions of the Revised Laws, and the company is generally subject to these laws except as noted. Unless the company builds a plant and engages in electrical supply within three years from the passage of the act, its rights thereunder cease. As to any city or town where the company does not engage in the sale of electricity the rights of the company shall cease at the end of ten years from the date of the act. This act may give rise to some interesting judicial questions. Though the company is authorized to *generate* electricity "for power purposes," the purposes for which it may be *sold* are not limited save as above stated. It may well be questioned, therefore, whether a customer of the company may not use the purchased energy for either power or lighting as desired. Though the "quantity" of electricity delivered to any one purchaser may not be less than 100 hp, the act does not state how many hours per day this rate of delivery must be kept up.

As is well known, the use of electrical energy for either power or lighting varies much as to its rate during the 24 hours of each day. It may, therefore, be a question whether the 100 hp named in the act must be the maximum, minimum or average load during the hours of daily use?

It does not appear that the mayor of a city or the selectmen of a town would have any interest in an injunction to restrain violation of the terms of the act as to the "quantity" of the electricity sold, unless the city or town has a municipal electric plant, but the courts are not given jurisdiction to grant an injunction to restrain such violation save on petition of these public officers.

The Holyoke Water Power Company owns the entire water power development of the Connecticut River at Holyoke. Large amounts of water power are now sold to manufacturers in Holyoke, and the act just considered makes it possible to transmit other large amounts of power to cities and towns within the counties named. Among these cities and towns are Springfield, a few miles down river, and Northampton, a few miles up river from Holyoke, besides dozens of smaller places. Electrical supply companies in this territory will watch the development of the water power transmission from Holyoke with no little interest.

Chapter 406 makes certain changes in the Revised Laws as to the returns that gas and electric companies are required to make to the gas commissioners. By Chapter 319 it is made an offence for any public service corporation to appoint or discharge any person at the instance of any employee of the government of the Commonwealth or of any county, city or town, from the Governor down. It is a like offence for any public officer to make any request relative to the employment or discharge of any person by a public service corporation. The same offence is committed by any person who makes use of any official request in an effort to obtain employment with a corporation engaged in public service. The fine to be imposed alike on any person or corporation guilty of this offence is not less than fifty nor more than one hundred dollars.

In Chapter 164 it is provided that, when a company engaged in the distribution of gas or electricity refuses to supply any person having a residence or place of business in a city or town where the company is so engaged, the gas commissioners, on petition of such person, may issue an order to the company to begin such supply on reasonable terms, after notice to the company to appear and show cause why the service should not be rendered.

The Revised Statutes provide for municipal gas and electric plants in certain cases, such plants to be paid for and owned by an entire city or town in each instance. In Chapter 221 a further step was taken by authorizing the Miller's Falls Water Supply District in the towns of Montague and Erving to establish an electric plant. This plant is to be owned and managed by the district and not by the towns.

Another extension of municipal activity was authorized in Middlefield, where the town had previously voted to build a telephone line. By Chapter 418 the appropriation of money for this purpose by the town was ratified.

In the charter of the Huntington & Westfield River Railway Company, Chapter 340, it is provided that any of the eleven towns in which the tracks of the railway may be located may subscribe to its stock or bonds. This company is authorized to own water powers and to transmit and sell electrical energy to electric light companies and to other street railways.

Five electric railway corporations, whose lines connect the cities of Lowell, Lawrence and Haverhill with points in New Hampshire, were authorized to consolidate by Chapter 400. The new corporation, the Northern Massachusetts Street Railway Company, was given authority to issue stock to an amount equal to the par value of the capital stocks of the five consolidating companies, and to exchange its stock for the stocks of these companies. After this consolidation is completed the act provides that the Northern Massachusetts Street Railway Company may lease its railway to the Exeter, Hampton and Amesbury Street Railway Company for a period of not more than ninety-nine years. This consolidation and lease are subject to the approval of the railroad commissioners.

Under Chapter 297 every street railway company is required to notify the medical examiner of the county, who resides nearest to the place of a fatal accident on its road, of that accident immediately. The company is also required to notify the railroad commissioners of any accident, concerning which these commissioners may require notice, within 24 hours after it occurs.

A special and learned commission appointed to consider the subject of street railways in Massachusetts a few years since decided among other things that the proper place for a street railway is in the streets. In spite of this well-considered opinion, which is of course shared by steam railways, the street railways persist in locations on private land for large sections of their lines. Heretofore the street railways have been at a disadvantage in Massachusetts because they could not exercise the right of eminent domain without a special grant from the Legislature, which was hard to get. As a result street railways have been forced to purchase private rights of way on the best terms they could.

Chapter 476 of the present year will serve as a partial remedy of this difficulty. This chapter provides that a Massachusetts street railway company may take land in a city or town for its tracks after approval by the Board of Aldermen in the case of a city or the selectmen in a town, the further approval of the railroad commissioners, and after a public hearing at which those interested can be heard. Such taking of land is further regulated by sections of the Revised Laws that refer to the taking of land by railroads.

The most important piece of legislation touching public service that was enacted during the session is found in Chapter 202, which authorizes street railway companies to act as common carriers of baggage and freight. This calling may be exercised by a company in any city or town when, after a public notice and hearing, it has obtained the consent of the Board of Aldermen of the city or of selectmen of the town, and also a certificate from the railroad commissioners that public convenience requires the service. Street railway companies are made subject, as to their carriage of baggage and freight, to local regulations of the aldermen or selectmen that have the approval of the railroad commissioners. The general laws relating to common carriers are also made applicable to street railways.

Legislation along this line has long been sought by the street railway companies of Massachusetts, and has as long been opposed by the steam railroad interests. In a few instances individual street railways have been grudgingly granted the privilege to carry small parcels, or a particular kind of freight such as coal or farm produce, or even ballast for their own tracks. One street railway charter, of 1902, granted the full powers of a common carrier.

Now comes the present general legislation, and the battle for the rights of street railways in the carrying business is in large measure won. Boards of Aldermen and selectmen will not be slow to give the public the benefit of street railway competition with steam roads in the carriage of freight. The railroad commissioners will fall below their past standards if they fail to see that public necessity and convenience generally require street railways to act as common carriers.

Professor Wilhelm Ostwald.

Professor Wilhelm Ostwald, of Leipzig, the famous German chemist, returned to Europe this week after a short visit, during which he opened the newly-built biological research laboratory of the University of Califorinia, by an address delivered in German. As is well known, Prof. Ostwald represents with Van't Hoff and Nernst, the highest authority in modern physical chemistry and electrochemistry. But while Van't Hoff is most famous as a worker and thinker along the most advanced theoretical lines, and Nernst is known to every electrochemist through his theory of solution-pressure, which has proven of immense value in the understanding of electrolytic processes, and to the broad public through the Nernst Lamp, Ostwald has been perhaps of more indirect but further reaching influence through the great number of his books and publications, which have really enabled the modern chemical and especially electrochemical views to become popular and recognized. Ostwald might justly be called the father of modern chemistry, not only because his books have had the very greatest influence in spreading this science, but mainly because no other physical chemist can look upon such a host of well-known and even famous pupils. Thus Nernst and Arrhenius proudly call themselves his pupils, and among our own better known men we may mention Profs. A. A. Noyes, W. R. Whitney and H. M. Goodwin, of the Massachusetts Institute of Technology; Prof. T. W. Richards, of Harvard; Profs. W. D. Bancroft and J. E. Trevor, of Cornell; Profs. M. Loeb, of New York University, and T. L. C. Morgan, of Columbia; L. Kahlenberg, of Wisconsin and H. C. Jones, of Johns-Hopkins. There is, indeed, scarcely a single one of our large universities which does not have one of Ostwald's pupils on its teaching staff.

The electrochemist in particular is indebted to Ostwald for his great work on electrochemistry, which is undoubtedly the best historical book ever written on this subject. It contains a critical review of all theories and publications bearing on this subject up to the year 1896. Were it even for this alone Ostwald's name would be gratefully mentioned; but it represents only a very small part of his activity along electrical lines. His investigations and those of his pupils were fundamental in establishing the theory of electrolytic dissociation, on which rests our modern views of electric conduction in liquids. His text-book on "General Chemistry," in two volumes, published in 1884, was followed in 1889 by the "Outlines of Physical Chemistry"—the so-called "small Ostwald"—and finally by the inexhaustible fund of practical laboratory methods and hints in the "Hand-book for Physico-Chemical Measurements," published in 1893, which can be found in the library of every well-read student of modern chemistry. Through these and through the *Zeitschrift für Physikalische Chemie,* founded by him in 1887 and edited since with the assistance of Van't Hoff, Ostwald has succeeded in carrying modern chemical views into all branches of natural sciences—into physics, physiology, medicine, biology. And it seems a significant recognition of this that Prof. Jacques Loeb, known to everybody through his wonderful work on the parthenogenesis of fish eggs, has selected Ostwald to open the new laboratory of biology at the University of California.

The publications as mentioned so far give but a very inadequate idea of Ostwald's tremendous activity. Since 1889 he has published the famous "Klassiker der Exacten Wissenschaften," generally known as "Ostwald's Klassiker" series. What popularity they have gained and how large a demand must have existed for such publications is readily seen by the fact that the 200th volume, will soon be reached. The list includes classics of the great scientists of the past who, being in advance of their time, had been overlooked and forgotten, until re-discovered by Ostwald and saved from oblivion. We Americans have particular reason to be thankful in this respect since it was through him that one of our greatest scientific thinkers was saved from the fate of dying unrecognized and not understood. In 1892 Ostwald translated into German the "Thermodynamic Studies" of the late Willard Gibbs, of Yale, whose beautiful and wonderfully comprehensive studies were in danger of being buried and lost in the *Transactions* of the Connecticut Academy. The attention of the scientific world was thereby drawn to them, and the curious thing happened that every scientist in Germany thus knew of a man who has not been fully appreciated to this day in his own country.

Ostwald's epoch-making book, "The Scientific Principles of Analytical Chemistry," appeared in 1894, and two years later all of his experimental researches together with those of his former pupils published while working under his direction, were compiled into four voluminous books entitled, "Arbeiten des Physikalisch-Chemischen Instituts der Universität Leipzig." It must be remembered that he was busy during these same years on his afore-mentioned great compilation, "Electrochemistry," and that in order to appreciate his tremendous capacity for work one must have read his innumerable abstracts and criticisms of contemporaneous literature, scattered through the forty odd volumes of the *Zeitschrift*. We must further extend the long list of his books by his "Outlines of Inorganic Chemistry" of 1900, and his very latest book, which was put on the market only a few weeks ago, his "School of Chemistry." Through these two books he aims at revolutionizing the very methods of teaching chemistry in a way which has been urged repeatedly in our schools, namely, by forcing the student to observe and to draw logical conclusions instead of telling him facts which he must take for granted. But Ostwald attacks the problem in so original a way and develops it so logically—one might say even playfully—that his book is bound to attract the greatest attention, since it surpasses all other attempts along similar lines.

PROFESSOR WILHELM OSTWALD.

But a nature so manifold and rich as Ostwald's seeks activity far beyond the limits of its own field. In the spring of 1901 Ostwald surprised his colleagues and his students by the announcement of a course of lectures on Natural Philosophy, which aroused the greatest interest and made it necessary for him to use the largest lecture-room in the University. These lectures were collected in his "Vorlesungen über Natur-Philosophie," a book which has had a very favorable reception in general, for no matter whether one's ideas agree with those of Ostwald, everybody will find in them a great many novel and delightful aspects. The ideas expressed therein have since found a new advocate in the *Annalen der Naturphilosophie*, a monthly journal published by him since December, 1902.

Americans are apt to believe that the man of science is not a practical man—that he helps but little or at least but indirectly to solve the important problems of everyday life. The success of men like Edison and many other great inventors seems to give support to the view generally held that practical men without scientific training preserve a keener eye for practical needs. It is useless to argue the question where the greater advantage lies when we consider the possibilities of application which present themselves to the man who is a leader among those who try to solve the mysteries of science with a complete mastery of our present scientific apparatus. The inventions of such men are apt to be more ingenious and revolutionary in their nature, while those of practical men produce, as a rule, improvements of known methods but not anything strikingly new in fundamental principle.

Now in Ostwald's case, we find the truth of this well illustrated, for his studies in the mysterious reactions grouped together under the so-called "catalytic reactions," have led him to devise a method of reproducing pictures, drawings, etc., which is attracting the greatest attention abroad, since it is absolutely independent of the action of light. The "Katatype" process promises to revolutionize all of our photographic printing methods, not only because it makes possible to print photographs in the dark, but mainly because it renders unnecessary the employment of the expensive silver bromide emulsion.

Ostwald's other important invention concerns the production of nitric acid from the inexpensive ammonia obtained from gas factories in large quantities. This promises to make German agriculture and the German army independent of Chile, which to-day furnishes by far the greatest portion of the valuable nitric acid in form of nitre.

Prof. Ostwald was born on September 2, 1853, in Riga (Russia), where he was graduated from the Gymnasium in 1872. From '72-'75 he studied Chemistry and Physics in Dorpat, now known as "Jurjew," and after attaining the degree of Bachelor of Arts, he became assistant in physics. Meanwhile he took his master's degree in 1877, and in 1878 the degree of Ph.D., when he was made assistant in chemistry in 1880 and professor in 1881. In 1887 he was called to Leipzig to fill the newly-created chair of general and physical chemistry, and since 1898 he has been director of the famous Institute which has been built entirely after his own plans, and which has served as a model for similar institutions. It is interesting to note that the California physico-chemical laboratory is an almost exact reproduction of Ostwald's institute. Upon his return from California and after a short visit with some of his former pupils, Prof. Ostwald was compelled by his engagements in Europe to return hurriedly, but expects soon to make another and longer visit.

Proposed Charter for Denver.

The proposed charter of the city and county of Denver, Colo., which was prepared by the recent charter convention, possesses several clauses of interest to public utility corporations. The charter is to be voted upon September 22, and a vigorous campaign is now on between its adherents and opponents. In general the local street railway, the steam railroad and other public service companies have expressed their opposition to the charter, claiming that its adoption would tend to have a restraining influence on all extensions of existing rights, and on the granting of new franchises. Gen. Irving Hale, Denver, representative of the General Electric Company, an electrical man well known throughout the country, was president of the charter convention, and the only engineer among the members. He would, therefore, naturally have been consulted to a great extent in the consideration of any clauses affecting general electrical and engineering matters. However, soon after the convention began its deliberations, he was taken seriously ill, not being able to return until ten days before the adoption of the charter by the convention. During these last few days his presence was evidenced by the striking out of some of the more obnoxious features of one or two clauses that had been previously adopted. One of these was a section providing that all poles and overhead wires in the business portion of the city should be removed and the wires placed underground within five years, and, in the rest of the city, within ten years. This meant the changing of the overhead trolley system of the Denver City Tramway Company to an underground conduit system. Gen. Hale was successful in explaining that this would place an unreasonable and too expensive obligation upon electric companies operating in a city the size of Denver. So the street railway system was exempted from this rule and the provision for placing all other wires underground was limited to the business section.

Another section that was adopted empowers the city council to make reasonable regulations concerning the operation and use of all franchises, and to fix reasonable maximum charges for water, light, telephone service, street railway fares, and other public properties. This clause was combatted by a number of the members of the convention, on the ground that a body of men such as would compose the city council was not competent to regulate and fix rates which vitally affect the operation and successful existence of public corporations, and that such power is liable to be used for blackmailing purposes. They did not succeed in having this section altered, the motion to reconsider being lost by a tie vote.

The proposition to submit to the voters at an early election the question of the city buying the Lacombe electric street lighting plant came up for considerable discussion. Under its franchise the city has the right to purchase this plant any year at a specified price, but convincing figures submitted showed that if the plant were purchased, its annual operation, including fixed charges and depreciation, not properly considered by the committee, would cost the city more than it is now paying the company for the street lighting furnished, and the convention decided that it would not pay to consider the proposition.

Another important matter accomplished was to limit all votes regarding installation and purchase of public utilities to tax paying electors, instead of to all voters.

A section of the new charter, naturally objected to by the friends of the Denver City Tramway Company, is one requiring all slots and conduits heretofore used for cable street railway purposes, to be removed within one year from the adoption of the charter. The tramway company has about twenty-eight miles of this cable track construction, a considerable part being on paved streets. In this track fifty-six-pound girder rails are used with special clamps bolted to the cable yokes. To remove the conduits and to substitute T rails for the cable rails would necessitate a heavy and apparently unnecessary expenditure on the part of the company.

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A Report Against Cleveland, O., Municipal Plant.

The board of directors of the Cleveland Chamber of Commerce have adopted the adverse report of the special committee on the proposed municipal electric plant for that city, the committee being T. H. Hogsett, E. J. Blandin and Amos B. McNairy. The report discusses figures presented in favor of the plant by Messrs. Bemis and Phelps, already noted in these columns, and pronounces them incorrect, saying further that "so important a step should not be taken by the city of Cleveland upon an investigation superficial and confessedly inaccurate." The report cites specific omissions and errors. The conclusions of the committee are as follows:

1. That the chief and practically the only reason urged by the city authorities, for taking the taxpayers' money to enter a competitive business is, that the city ought to be able to supply electricity to the citizens and light its streets cheaper than can be done by a private company. The experience of city governments generally throughout this country shows that municipal business is not conducted as economically or efficiently as private business, and that the authorities have no substantial ground on which to base their declaration that the city can manufacture and sell electricity cheaper than the private company.

2. The rates of the private company are not unreasonable, but on the contrary are lower than those made by similar companies in several American cities of a size comparable with Cleveland. But even if they were unreasonable your committee holds that the way to correct them should not be for the city to hazard the taxpayers' money in the dangerous experiment of building and operating a competing plant. Regulation and not ownership is the safe policy for the city and the city has complete power to regulate the rates and practices of any local lighting corporation. Wherever their rates are excessive they can be made unlawful, and reasonable charges established. Whenever their services are below a proper standard of quality or their methods oppressive or unjust the necessary corrections can be required by law.

In fact, without risking a dollar of the city's credit or adding a mill to the tax rate, the city can accomplish all that is possible through a municipal lighting plant, except to require that the business of supplying electric light and power to the citizens of Cleveland, shall be conducted at a loss.

3. It is not necessary for the city to take taxpayers' money to build and operate its own electric plant, in order to secure the reduction in cost of electricity that comes through the development of the art. The reduction made by the private company in the price per lamp per year for street lighting from $91.80 in 1896, to $75.00 in 1904 shows conclusively that the city has shared in the economies resulting from improved machinery and consequent lower cost of production. It ought not to be forgotten in considering this project that the business of supplying electricity is still in a developing state, and subject to rapid modifications through new discoveries. The most efficient machinery of one day may be rendered obsolete by the inventions of that following. The changes in machinery and methods are at times exceedingly costly and their expense can not be calculated in advance.

Under the contract system the risk of loss from this source is borne by a private corporation, and no part of it falls upon the taxpayers. With a municipal plant the entire burden would have to be borne by the city.

4. The errors and omissions that have been developed in the original estimates of Engineer Phelps and the statement submitted to the council on May 3rd, by Superintendent Bemis convince your committee that the council passed the original bond ordinance under an entire misapprehension of the facts. Your committee is compelled to conclude that, whereas the council authorized a bond issue of $200,000 and was led to believe that a further estimate of $200,000 would complete the plant for the West Side and furnish electricity for the public buildings on the East Side, the analysis of Mr. Phelps' statement shows that $500,000 would be a conservative estimate of the cost of the work now proposed and yet this is only the beginning of the undertaking as outlined by the city authorities to thoroughly cover the West Side territory, not to mention the vastly greater work of covering the territory on the East Side.

5. It is unjust to taxpayers to force them to pay extra taxes and invest these (also mortgaging the city's credit and indirectly every dollar's worth of local property) to go into a business venture which can only supply a small portion of the city's population and is very likely to run at a loss. Therefore your committee is strongly of the opinion that the bonds issued by the city for a municipal lighting plant should be a lien upon the plant only and not upon the entire assets of the city; and the payment of the principal and interest of such bonds should be provided for out of the net income from the plant. In this way the users will stand all the cost of supplying them with the service, and it will not throw part of the cost on taxpayers who are non-users.

The bids for such bonds would be a fair index of the confidence which investors have in a municipality's ability to conduct a business successfully. To issue bonds in this manner is not now allowed under the statutes; but your committee feels very strongly that if the city is to be committed to this undertaking at all, such action ought to be postponed until laws can be secured which will make it unnecessary that it should pledge its general credit for the purpose.

6. There is vital need in our city for a number of public improvements. At the same time there is a limit to the debt that our taxpayers can be called upon to bear. This necessitates a selection of the improvements to be pressed at this time. The city authorities evidently give precedence to the lighting plant, but your committee cannot concur in their decision. The city's need for pure water is far greater than for cheaper electric light.

The State board of Health is authority for the statement that our citizens are dying as a result of the existing condition of the water supply. The most ardent advocate of the municipal lighting plant cannot claim that the citizens have so much as asked for its construction.

If the city authorities are prepared to spend $500.000 for a municipal improvement on the West Side, it would be of inestimably greater advantage to our citizens to spend it in connecting the old water intake with the new intake, so that the West Side may at least have as good water as the East Side, than to risk it in an attempt to furnish electric service at a less cost. Probably most West Side citizens would also agree that the value of property on the West Side would be increased and the convenience of its citizens subserved much more by an additional viaduct than by electric current furnished by the city.

There are few if any of our citizens who will argue that a municipal electric plant duplicating good service already in existence should take precedence of sewers, parks, public buildings, improved harbor facilities, better fire protection or any one of several other municipal improvements for which the same amount of money might be spent.

7. The length of this report precludes the discussion of other subjects which might well be considered in connection with the proposed lighting plant, such as the question as to whether the merit system will govern in the employment of the necessary help; the question as to the advisability of restricting the field for individual initiative; the question as to whether our city departments are now being so well handled as to make the public eager to increase them; and many other questions that would furnish profitable fields for investigation and discussion.

8. Taking a broad view of the proposition the conclusion of your committee may be expressed in a single concrete statement. A tax is a compulsory contribution from a person to the government to defray expenses incurred in the common interest of all. The proposition under consideration is a proposition to levy a tax that is not for the common interest of all, but which has reference to the special benefits to be conferred on a comparatively few, namely, the users of the city's commercial lighting service. Therefore, it involves an improper use of the taxing power.

9. Finally, in closing this report your committee feels it to be only its duty to state that, after careful investigation it is at a loss to understand why this project to build a municipal electric plant should be brought forward by the city authorities at this time; and, your committee has been unable to obtain from the authorities themselves any sufficient reason for this improvement being advanced over others that are unquestionably of far greater importance to the health and general welfare of our citizens.

10. The recommendation of your committee therefore is that the board of directors of the Cleveland Chamber of Commerce transmit this report to the City Council with the earnest request that it be given consideration, in the belief that upon further investigation of the proposition to establish a municipal electric plant the Council will clearly perceive the inadvisability of proceeding with the project.

The Right of Way.*

By H. H. Vreeland.

It has always seemed to me, when the question of the right of way of street cars has been under discussion in our societies, that it has been approached from the wrong point. This defect in the discussion seems to arise from a lack of clear statement of what is meant by "right of way." Street railroads, in the sense that steam railroads enjoy this privilege, have no "right of way." A steam railroad operates along a strip of land, owned in fee, which it holds and uses for its special purposes against all intruders, and it can only be obstructed by trespassers. The case of a street railway is entirely different. It has a franchise to go along a rigid and appointed route on thoroughfares which are used in common by pedestrians and vehicles of every description.

This being the case, the question of "right of way," in so far as it is applicable to street railroads, becomes one not of right of way, but of precedence, since the general public has equal rights on the road. These roads or streets being dedicated to public use, it is the duty of the authorities to see that they are so policed as to obtain for the greatest number of people the fullest and freest use of the facilities which they afford. If street railroad men would view the topic from this point of view and insist that the streets are for the use of the people instead of corporations or individuals, the whole question, in a short time, would take on a different aspect. A railroad company is permitted primarily to exist, not for the aggrandizement of its owners or operators, but for the accommodation of the public. An individual citizen who enters and pays a fare does not thereby relinquish any of his rights to free passage along a public street, and there is hardly an hour of the day or night in which he can enter a car or a street anywhere in a city without finding company, so that the vehicle in which he rides represents not only his individual right, but the assembled rights of all his fellow passengers; and so it has always seemed to me, viewing the question from the standpoint I have indicated, that a crowded car, full of people, should, by mere preponderance of the number of individuals it contained, have a superior right of passage to a vehicle with a single individual in it, or to a van containing merchandise. If, before public bodies, it was unanimously insisted by railroad men that the reason they demanded "right of way" was because of their passengers, I think it would disarm much of the resistance which has met the attempt to secure police co-operation.

A good analogy between the rights which all street railroad operators claim for their vehicles is to be found in the rules of the road concerning United States mail vans. These have the right of way everywhere, and it is a misdemeanor to obstruct their free movements. The reason of this is not because the wagon is labeled "United States Mail" or because of any superior authority vested in the driver, but because the vehicle contains hundreds—it may be thousands—of business communications involving complicated business interests. For the same reason, I have always held that a street car containing a crowd of people—necessarily in haste or they would find a cheaper and more leisurely way of reaching their destination—had rights superior to other vehicles on street surfaces.

Added to all this is the fact that these public conveyances are restricted in their movements to a fixed way, whereas the others, in addition to being lighter and more easily moved, have a flexibility of route denied to tramcars.

Mr. Yerkes on Inflammable Underground Cars.

In a letter to the *London Times* on cars for underground service, Mr. Yerkes writes: "Cars have been run in the open for many years, and the custom of building the ordinary car has been followed for underground systems, as well as for surface lines. If a car takes fire on the surface, there is plenty of good air for the passengers to breathe after they have alighted from the car, and there is little danger of their being burned before they can vacate it. Under ground, however, the conditions are entirely different; therefore a different system of manufacture of cars must be practised.

"I would say that it is a very rare occurrence for a car to be set on fire directly from a motor. Fires occur from a short circuit in the wire connecting the motor with other parts of the train. These wires are run under the body of the car, and where there is anything wrong, like a faulty splice, which is generally the cause of fire, ignition of the woodwork which surrounds the arc must certainly take place. Iron tubing is no protection whatever. If an electric wire be covered with rubber or other non-conducting material, placed in an iron tubing, and a short circuit or arc be formed, by the separation of the wire, the iron tube will be melted, and it will disappear the same as though it were so much paper. Asbestos or its compounds will be burned or destroyed wherever exposed to the arc, and I know of no substance that will withstand the heat of an electric arc. In my opinion, non-inflammable wood, properly treated—and it can be properly treated in London—is the best material that can be used. Holes can be burned in it, as they can in iron, but it will not blaze or smoke. We have samples of wood that have been tested, and the result has always been the same. What is most desirable is a car that will not burn; in fact, there should be no portion of it that can create a smoke, for this smoke is more fatal than the flame itself. The flame cannot carry far, but the smoke permeates every crack and crevice. Another thing that I believe is most important is a system of ventilation that would force air into the tunnel and draw the smoke or foetid air from it. There is not the least difficulty in making our tunnels and tubes perfectly safe, indeed even more so than those railways whose carriages are running on the surface, from the fact that where there is nothing to burn it is impossible to have a fire; and that is what we must have in the tunnels, not only the cars, but the stations, and every particle of wood that goes into them, no matter how small or unimportant, must be so treated that it cannot burn."

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*A paper read before the Saratoga meeting of the American Street Railway Association.

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Recent Steam Turbine Developments.*

By W. L. R. Emmet.

WHEN the writer agreed some months ago to present a paper to this meeting he fully expected that its subject matter would mainly consist in a record of practical results accomplished with commercially operating machines and that such matter would be full enough to justify its presentation and discussion. Some months ago a paper was presented to the American Philosophical Society on this same subject which has since gone the rounds of the press. This paper dealt at some length with our expectations concerning the new steam turbine developments now going on at Schenectady, but gave no actual results other than those produced by a single 600-kw machine which has been operating for some time at Schenectady, and which is different in many respects from the machines now being built.

The scant array of established facts in this paper and the rather liberal presentment of expectations have called forth some criticism, particularly from European turbine builders. Such criticisms are not unnatural under the circumstances, and we are naturally eager to demonstrate to the world the soundness of the claims upon which the General Electric Company and its customers have based such large undertakings.

The writer had confidentially expected that before this date the 5,000-kw turbine recently installed at Chicago would have been fully tested and verified and that its results could be here presented to the members of this Association who are so deeply interested in the success of developments of this kind. We have fallen a little short of this expectation through such unforeseen delays as are usual in such cases, but still have produced results which are highly interesting and suggestive, although no complete tests have yet been made. The machine has been installed in the new station of the Commonwealth Electric Company, which is probably the finest and best-equipped station in the world, and has been connected to its regular equipment of boilers and condensing facilities. It has been started without any hitch or delay and has been operated repeatedly at full load and under a variety of conditions to test its performance. It has operated with a wonderful steadiness and perfection, has governed perfectly from full load to no load with only 2 per cent. speed variation and has in every respect shown itself to be a thoroughly desirable operating machine. A test of steam economy was also very carefully conducted on this machine, very perfect facilities for weighing water and maintaining a steady and accurately measured load having been provided. Unfortunately, the results of these tests were found afterwards to be entirely indefinite since a large leakage of circulating water, through a misplaced valve, into the steam space of condenser was discovered, which water had been weighed in connection with the condensed steam. When this was discovered it was too late to ascertain with certainty the amount of this leakage at the time of test. The flow with no load, however, indicated that this leakage was very large and the general inference drawn from our test is that a very fine steam economy was shown. We will, however, refrain from making any positive statements on this subject until we have obtained tests which are absolutely unquestionable.

All the conditions in connection with the running of this machine have given very favorable indications. The machine is connected so that the condensed water passes from the hot well through a heater and is pumped directly back into the boiler. This whole system was in operation and worked perfectly. The water returned to boilers was, of course, entirely free from oil and quite clear except at light load when the leakage from river water appreciably discolored it. The plant operated at full load with four 500-hp boilers fired out of the eight which have been provided for each machine. These boilers were fired with Illinois coal on chain grates, and their performance of the work is in itself an indication of good economy.

After this test run the machine was taken apart for the purpose of making a minor internal change which was thought to be desirable. The machine will not be required for service for some months, and our desire is to get it in the best possible condition in advance of the time when it will be required to carry a large winter load. The machine will probably be ready to run again within about a week or ten days and conclusive tests will then be made.

In order to properly understand the significance of the successful starting of this machine, it is necessary to review the history of its design and to compare it with engines of other types. After the experiments with Mr. Curtis's steam turbine inventions had proceeded for several years, certain experimental results were obtained which seemed to justify the production of commercial machines, and it was decided to build a commercial machine for use in the Schenectady Works. A 600-kw machine with horizontal shaft was designed, the mechanical arrangements being in most respects in accordance with the plans which Mr. Curtis had formed previous to that time for building the turbines. This machine was built and tested nearly two years ago.

These tests showed a high steam economy, and it was very soon decided that the performance of this machine justified the building of other commercial machines which could safely be relied upon to perform as good or better results. The question of mechanical design for these larger machines then became a matter of first importance. The steam economy could safely be expected to conform closely to that of the machine which had already been tested, but the whole question of cost and commercial desirability depended upon the mechanical construction adopted for accomplishing the desired results.

It was decided at this time to build a steam turbine unit as large as the largest engine driven generating unit in the country, and as the result of this decision the design of the machine now in Chicago was made up after a great amount of thought and study. This design embodied many very radical features as compared with other engines, turbines or machines of any character. The shaft is vertical; the whole weight of the revolving part is borne by an oil film delivered by a pressure pump to the lower bearing; the delivery of steam to turbine is controlled through a system of electrically operated individual valves worked by a small controller something after the manner of multiple unit train control system—a centrifugal governor moving the controller. The revolving field is mounted upon the same shaft with the turbine wheels, and the stationary portion of the generator is supported by the stationary portion of the turbine, the whole building up into the general form of a vertical cylinder about 25 ft. high and about 14 ft. in diameter. The total weight of the turbine and generator is about 400,000 lb. and its capacity is 5,000 kw at full load. It is capable of running at about 75 per cent. overload condensing, and at nearly full-load non-condensing.

The question as to why the vertical shaft design was adopted for this unit has often been raised and many doubts and criticisms concerning it have been expressed. It is not easy to explain all the reasons which lead up to its adoption but it may be said that the compactness and simplicity of this unit, which are its most marked characteristics, are largely due to the merits of this design. With the vertical shaft arrangement all lateral strain is removed from the bearings which align the shaft and all deflection of the shaft is avoided with a minimum number and length of bearings. This matter of properly supporting a shaft and keeping it exactly central and in perfect alignment is an important one where small clearances are desirable with a large diameter in the revolving part. To carry such weights as are necessary in the revolving part of this large unit many very large bearings would be required if the shaft was in a horizontal position. An elaborate system of forced lubrication with artificial cooling would be necessary in connection with these bearings, and a failure of any of these bearings would occasion serious danger to the operation of the machine. If the machine were built in a horizontal position it would be very difficult to so support the wheels that their clearances would not be affected by sagging of the shaft or looseness in bearings, and also, it might be difficult to place them with such a relation to each other that the clearance would not be affected by expansion of the shaft. In the vertical design the space between wheels is reduced to a minimum, the supporting structure is perfectly symmetrical and cannot be in any way distorted or put out of line either by mechanical or steam pressure strains or by the effects of expansion.

The oil pressure step bearing at the foot of shaft supports the whole revolving element in a balanced position by perfectly symmetrical suspension and preserves the exact relation of level between the stationary and revolving parts. As long as this step bearing fills its functions a multitude of mechanical difficulties and uncertainties are overcome.

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*A paper read at the Saratoga meeting of the American Street Railway Association.

At the time this design was adopted there was no good precedent for the support in this manner of such a weight operating at so high a speed, and there were many predictions of failure, examples being quoted where similar methods had failed with water wheels and other machines. It seemed clear, however, that with proper arrangements the operation of this bearing must be stable and reliable, and since forced lubrication was necessary to success in any case, it seemed advisable to put it where it would accomplish the greatest number of good results.

Experience with a number of machines has fully justified our decisions in this connection. The bearings have run perfectly with an inappreciable amount of friction, and when properly supplied with oil operate with perfect steadiness and regularity. In one respect these bearings have agreeably surprised us; that is, they have been much less injured by stoppages of oil than we expected. In the course of our experiments imperfect pumping arrangements have been used and repeated failures of the oil flow have been experienced, but in no case has any damage to the machine resulted. Even the cast-iron blocks which constitute the step bearing are, as a rule, not destroyed. Our experience has been that they cut and heat when the oil supply is removed, but in all cases the surfaces have ground themselves to an operating condition after the oil flow is renewed, so that the machine could be continued in operation. This might not always be the case, but it seems quite certain that the damage could never be as serious as that which would result from a failure of the lubrication system where heavy weights are carried on high-speed horizontal bearings.

In our newer machines we are providing a heavy stationary collar below the lowest wheel which can be used to support the wheels in case the step bearing is removed and which would serve as a brake to bring the machine to rest in case the step bearing should cut enough to allow the wheels to settle to a dangerous degree. Our experience has been that there is very little tendency to settlemnt of the shaft in case of such cutting, and this latter function of the collar will presumably seldom be called into requisition.

The oil for step bearings and also for the upper bearings of machines is delivered by a small electrically-driven pump which operates continuously from the exciter circuit. In most of the large plants where we are installing turbines we have recommended in addition to these electrical pumps, a weighted accumulator with steam pump arranged to keep it full automatically. This accumulator with its steam pump affords an automatic reserve for the lubricating system. Its capacity is such that there would be ample time to shut down the units even if everything in the station should be stopped by the bursting of a boiler or steam pipe.

The 5,000-kw machine in Chicago is the second of our vertical shaft turbines to be put into operation. The first machine of this type was one of 500-kw capacity installed by the Newport & Fall River Street Railway Company. This machine has been in daily operation since last June. During all this time its daily operation has been indispensable to the service of the plant, and there have only been two or three interruptions of a few minutes each which could be charged to its defects. It has, however, developed some minor troubles which have been the cause of some annoyance, and which it has been very difficult to correct owing to the almost continuous operation of the machine. With new types of machinery which have to be put in service without any period of experimenting some such difficulties and delays can hardly be avoided.

The only serious troubles at Newport have been with parts of governor and with valves which have given out owing to overstraining of springs or other mechanical causes which are easily corrected. These troubles have occurred as the result of continued service, and are being rectified as rapidly as it has been possible to analyze their causes and apply suitable remedies. Nothing has happened which suggests the possibility of a serious difficulty, and it can be safely predicted that a condition will very soon be reached in which the turbine can operate for an indefinite period with a very small expense for care and renewals.

Our machine at Newport has been tested and has shown results decidedly better than the reported tests of steam turbines of other makes; but the conditions have been such that we have reasons to believe that decidedly better results can be produced with slight changes in nozzles and adjustments of pressure. Up to the present time we have not been able to experiment with this machine or properly analyze its performance owing to the almost constant requirements of service. We are, however, installing a second machine at Newport, and very soon expect to make a proper analysis of its performances and to bring both machines to a representative condition. All the experience which we can gain with these early experiments is, of course, available for the prevention of similar troubles and mistakes in other plants.

One important matter in connection with the introduction of our turbines has been the establishment of proper condensing facilities in order that the great benefits of high vacuum might be realized to the greatest possible extent. In turbines which we have tested the steam consumption has been reduced from six to seven per cent. for every additional inch of vacumn above 25 in. Such a reduction is, of course, very important, and justifies large expenditures upon condensing apparatus. The fact that the turbine may be better than a condensing engine with equal vacuum must not be considered a reason for assuming that a condenser which is good enough for the engine is also good enough for the turbine. The selection of condensing facilities should be governed by the economic possibilities.

We have recently designed for some of our large new turbines surface condensers which themselves constitute the base and supporting structure of the machine. These condensers are of very ample cooling surface and are so arranged that the maximum degree of vacuum is obtainable with a given amount of water. One feature of our turbine which is very advantageous in obtaining a high vacuum is that it can be easily so arranged that the air leakage is reduced to zero. The two points where the shaft passes through the casing are fitted with packings which are kept sealed by steam. Another advantage is that there is no oil in the steam and consequently that the exterior of condenser tubes is kept perfectly clean. Several turbines with condenser bases are now being built, and it is probable that there will be a large production of machines of this type.

I have mentioned above that no oil comes in contact with the steam in these turbines and I need hardly call attention to the great importance of this fact. The condensed water can be delivered directly back to the boilers and all possibility of trouble in boilers from oil, dirt or scale is eliminated. Even in plants where feed water is good and cheap, this constitutes a great advantage since a considerable amount of heat is saved by using the condensed steam on account of its higher temperature. There is, however, no such a thing as perfectly pure and clean natural water, and there are few boilers that in their average working condition are perfectly clean. Cleanliness in boilers improves circulation and evaporation, prolongs life and constitutes, therefore, a very distinct and definite advantage.

The designs of these first machines started at Chicago and Newport are now about two years old. They were entered into upon the basis of a very limited experience with the turbine, and nothing to guide us other than the theoretical possibilities which previous tests had demonstrated. The period which has elapsed since the conception of these designs has been occupied in a battle with the innumerable difficulties attendant upon the production on a very large scale of radically new devices. When we became convinced of the practicability and the advantages of our designs, we determined that the possibilties could only be developed quickly through production on a large scale and by a concentration of force upon the work. We consequently decided upon guarantees which we felt certain of fulfilment and upon prices which would be attractive to our customers, and have taken a large number of orders for machines of several sizes. We now have on our books contracts aggregating more than 200,000 kilowatts in steam turbine generating units. A large proportion of these machines are now either finished or well under way.

This immense production has been introduced at a time when our regular manufacturing facilities were strained to the utmost and when the difficulty of obtaining or sparing good men was very great. The trials and difficulties of such an undertaking are hard to describe. A vast amount of very expensive special machinery has had to be designed and built and almost every step has required thought and experimenting. In such new work the average man cannot be made to advance with the same confidence that he does on established lines. He presupposes the possibility of difficulty or failure and is constantly being brought to a halt and making mistakes that he would not make under different circumstances. Important processes are handled carelessly and unimportant ones are unduly deliberated over. The strain is incessant and an abundance of faith is required in those who would direct such work.

As the work of developing these designs has advanced, experience has shown the possibility of better and simpler methods and the steady continuance of experiments has extended our knowledge of the theoretical possibilities. Consequently, new designs have been proposed and developed and we now have in production a large number of machines which we consider greatly superior to those which are now being put into service. This process of experimental development will continue, and the production and test of each new machine will extend our knowledge and make possible further advances.

Our machines at Newport and Chicago and other machines of about the same date are of what we call the "two stage" type. The Newport machine has two compartments with three rows of moving buckets in each compartment, and the Chicago machine has two compartments with four rows of moving buckets in each compartment. Our later large condensing machines have four stages or compartments with two rows of moving buckets in each. All the details of their design have been worked out in such a manner that their construction is greatly simplified, and the steam economy will presumably be much increased.

Thus, such successes as we may accomplish in the future will be the result of the large experience which responsibility for our existing work has entailed. We have been through long trials and have combated many predictions of failure, but the facts seem to indicate that we have succeeded and to promise that we will in future accomplish greater successes.

DISCUSSION.

Mr. Emmet's paper lead to a lengthy discussion, in which part was taken by Vice-President Ely and Messrs. John I. Beggs, C. O. Mailloux, E. G. Connette, J. G. White and the author. Mr. Beggs said he is very hopeful that the prediction of the General Electric Company that steam turbines will come into general use will be fulfilled. On the other hand, some of the best engineers in the country have expressed to him their doubts on the subject. At present there is nothing to do except to await the curves and tests which Mr. Emmet says are going to be made. He asked if there is not a new power looming up which may as far surpass the steam turbine as that machine surpasses the reciprocating engine, so far as economy goes—namely, the gas engine. If the predictions made for the gas engine, using either illuminating gas, producer gas or gas now produced as a by-product, are to be relied upon, it appears that the present cost of the kilowatt-hour may be cut in two and possibly reduced two-thirds, no matter how high the economy of the present steam plant. He said that a large engine building concern in this country has recently acquired the right to build here the Nüremburg gas engine, and that a 3,000-hp engine of this type will be installed at the St. Louis Exposition direct-connected to a 2,000-kw generator. In the northwest screenings now cost $3.50 a ton, which four years ago cost only $1.70, so that the importance of bringing down the cost of producing steam is of the greatest moment. Mr. Beggs said that at present a steam turbine unit such as Mr. Emmet describes, including the generator, can be purchased for about the cost of the corresponding reciprocating engine, and he remarked that he does not think he is divulging a secret when he states that the Westinghouse unit employing the Parsons steam turbine can also be bought at the cost of the reciprocating engine of equal capacity. Owing to the slower speed of the reciprocating engine, the cost of the accompanying generator becomes one-half that of the engine itself, and that this amount is saved in the turbine is important. An element that comes up in the question of the use of gas engines is the greatly-increased cost of the engine itself, and it is a question of commercial calculation whether this will be compensated for in reduced cost of producing power.

Mr. Ely referred to the fact that in the new plant of the Lackawanna Steel Company, at Buffalo, N. Y., the gases from the stacks of the blast furnaces and the ovens are washed and used as fuel, enough fuel being thus supplied for an installation of 40,000 hp of gas engines. Most of the units are of 2,000 hp. The engineer in charge is a Russian, and Mr. Ely added that in the matter of gas engines, their manufacture and use, we are far behind Europe. Mr. Beggs mentioned a case in the west where a large manufacturing establishment is building 80 ovens for the production of coke, and it is probable that the waste gases will be utilized in generating power. Mr. E. G. Connette suggested that since the gas engine question is a very interesting one it should be made a topic for discussion at the next meeting of the association. Mr. Connette pointed out that ten years ago at the Milwaukee meeting of the association he predicted in a paper that the steam turbine would finally supplant the reciprocating engine.

Mr. Mailloux said that if gas is obtained at a cost which is below 20 cents per cubic foot, the gas engine will be at least as economical as the steam turbine, especially where coal is relatively high; but when a producer is required to make gas the situation is quite different. He referred to a case of a plant of 15,000 kw for which he received estimates for a gas engine plant and also for a steam turbine plant. In the gas engine system the largest unit was about 2,000 hp, and consequently it would be necessary to have something like ten units, this would involve a larger building and a larger maintenance account owing to the greater number of units, and since the gas engine is not a simple device its cost of maintenance would not be small. He also found that to get the economy promised he would have to go into the chemical business; in other words, handle certain chemical by products; he was told that by the installation of a 3,000-kw plant there would be something like $50,000 a year recovered in the form of chemical by-products. The principal objection was that an initial outlay of over $1,000,000 was required, and in that particular case instead of coming out $100,000 ahead, as against the steam turbine, he would be nearly that much behind yearly.

Mr. Mailloux cited another case of a pumping plant in Mexico, where coal is $15 a ton delivered on a mountain 700 miles from the nearest coal mine. He found in that case that a gas engine operated with producer gas was better than a steam turbine and would pay for itself in something like three or four years. He investigated a case in Arizona where power was to be used in lighting and traction, and he found that the cost was more nearly even, the company being one producing gas as well as electricity. After a careful investigation the steam turbine was adopted. A further investigation has shown that in the present state of manufacture the cost per kilowatt of the gas engine outfit is at least twice that of the steam turbine outfit. He has had a station operating at Newport, R. I., under his direction which has been installed for a year, which has been running one steam turbine unit for a year, and for the last five or six months running two units of 400 kw each. The results have been so satisfactory that recently an order has been placed for two turbine units of 3,000 kw each. The cost of the latter is under $28 per kw, not including the piping or condenser. Mr. Mailloux considers one of the great points in the steam turbine is that it enables the station equipment to be greatly simplified, not only in detail but also in those things which eventually tell in maintenance. There are fewer parts and no adjusting parts. A feature of the steam turbine of the greatest utility is its ability to use high superheat, there being no practical limit to the amount of superheat that may be used. A turbine using steam at a pressure of 150 pounds and superheat up to 600°, gives as good economy as the ordinary engine with perhaps 175 or 180 pounds pressure, using fuel economizers. The cost of the station is less, the expense of running much less and the cost of producing power much reduced. Mr. Mailloux said that the only drawback thus far brought to his attention in connection with the steam turbine is the fact that it is not economical without condensation, and in fact requires a very good vacuum. He has had some difficulty in obtaining a satisfactory vacuum, but has no doubt that after some slight changes which he contemplates the difficulty will be overcome. He feels sure that the condensing outfit for the turbine requires much more care and greater first cost, perhaps $3 or $4 per horse-power.

Mr. J. G. White said that he agrees in the necessity of a high vacuum and high steam pressure with the steam turbine, and also on the advantage of reduced space and saving in initial investment and in oil and other supplies. However, what is needed to be known is how the steam turbine can be depended upon as to reliability. Can we install steam turbines to-day and be certain that they will start off without serious interruption, or at least that after a few weeks of operation they can be depended upon to take up the regular load and carry it day after day? He said he understood that in Newport there are two turbines in operation, and that the original one, which gave considerable trouble, is now said to be down to regular working basis, and that the second unit is in operation and running satisfactorily. He wished to ask how many stoppages there had been during the past sixty days or during some definite period in this plant.

In reply Mr. Emmet said that they had had experience with a 600-kw turbine in Schenectady of the earlier type, and a vertical shaft turbine at Newport, which is the newest type. The Schenectady machine has been in service two years and has been running almost continuously without any trouble of any kind. The machine located at Newport has carried its load continuously, and of the troubles experienced practically none interrupted the service. A record has also been kept of all stoppages, and service was only interrupted three times between June and September, the longest stoppage being less than twenty minutes. These were caused by a certain amount of trouble in the valves, which had to be corrected from time to time. If the Newport machine as it stands now in its present condition were improved and simply maintained by the renewal of the valve parts as they give out, it could be kept up and run at a small fraction of what it would cost to maintain a reciprocating engine of equal capacity. As to comparing gas engines and steam turbines, Mr. Emmet agreed with Mr. Mailloux that it is purely a question of cost of fuel as relates to the turbine in its present state of development. The calculated fuel economy of the gas engine in its best state of perfection is greater than that of any steam engine heretofore produced; but the very highest results obtained so far with the steam engine in the matter of fuel economy are not far below the results obtained from gas engines. The very best result from the gas engine show a thermal efficiency of 32 per cent., while the best result produced with highly superheated steam under favorable conditions in the steam turbine is something like 23 or 24 per cent. But gas engines operated on a commercial basis runs nearly to 26 or 27 per cent., which figures are not much in advance of the best steam turbine performances. Furthermore, as pointed out by Mr. Mailloux, the gas engine costs probably twice as much as the steam turbine unit, and if the latter is credited with the simplifications surrounding it, the difference is much greater. The steam turbine needs no heavy foundation and the ideal turbine plant will be far removed from the city, laid out on the lines of a coal yard, and an expensive building will not be required. On this basis the difference in cost will be greater than Mr. Mailloux has stated, and even if we capitalize the difference in fuel consumption between the two engines, the amount will not cover the difference in first cost.

Mr. Emmet said the steam turbine as it will be six months hence can be operated by a child indefinitely, virtually without maintenance. The wear and deterioration is nothing and the whole plant can be reduced to an ideal condition of simplification. On the other hand, a producer gas engine plant involves an immense maintenance cost and the maintenance of the engines will be twice that of steam engines, being twice as complicated and less capable of perfect lubrication. If coal continues to increase in cost and gas engines are improved at the same rate that the turbine has been improved, the time will come when fuel economy will be the only consideration, and gas engines will come into more extensive use. Mr. Emmet thinks, however, that the introduction of the steam turbine is certain to give the gas engine a long setback.

Mr. Beggs said that only eleven months ago the quoted cost of the steam turbine unit is double what it really is to-day. This reduction has obviously been brought about by competition between the builders who have acquired the right to construct steam turbines in this country. As to the gas engine in this country, we are in the same position that we were in three years ago with respect to the steam turbine—we scarcely know anything about it. As to the size of units, even the builders of the steam turbine to-day question whether it is not more economical and more advisable to install units of 2,000-kw capacity than units of 5,000 kw.

Referring to the Newport plant, Mr. Mailloux said that the first 400-kw unit was ready early last winter, and owing to a burn-out in one of the old units carrying the load, the turbine was pressed into service even though the packing had not been finished. It has not been stopped except during periods of light load, and then in order to complete the piping and adjustment of the unit. Little difficulty has been experienced in paralleling the two units; there was at first a slight hunting or some disturbance due to imperfect belting, which has been remedied. At first the attendants kept close watch of the unit, but they have become so accustomed to the machine that it is left to take care of itself.

Telephones in Churches.

The churches in New York City have, perhaps naturally, been rather conservative in taking up telephone service, but many have had it established during the past year. Every theatre in town now has telephone service, and many of them have established private branch exchanges.

Saratoga Convention of the American Street Railway Association.

Last week we devoted several pages to the Saratoga convention of the American Street Railway Association, then in full session, and we are now able to close our very full report of what was done by that body and its allied organizations. In every way the convention was a most successful affair, being favored moreover by magnificent weather. It was noted last week that September is not exactly the best season of the year for a street railway meeting, for it catches the roads busy with county fairs, fall festivals, labor-day exercises, harvest festivities and a number of end-of-the-summer holidays which throw heavy traffic on the lines; whereas the usual meeting time, around October, finds all that strain over. Hence, for many it has been quite difficult, if not impossible, to get away to Saratoga at this juncture. On the other hand, when it was decided for various reasons not to go to any city, a resort like Saratoga had to be chosen, and, of course, it had to be visited before the hotels closed, as well as after the usual summer rush had passed away, leaving the needed accommodations available. This meant the beginning of September, with the racing season over and the usual flower carnival a thing of the past. But Saratoga has admirable attractions of its own, inducing attendance, while there can be no question that the formation of the two auxiliary bodies has tended to build up and increase yearly the number of those in attendance.

Saratoga has always been identified with animal power rather than mechanical, and the fame of her horses and her race track has more than equaled that of her medicinal waters. As was shown recently in these columns, the region around Albany, Schenectady and Saratoga is rapidly becoming a centre of long distance, interurban electric railway work; but at the Springs itself there is usually little in sight to remind one of the trolley. Hence the fine display made by the energetic supply men in the grounds of the Grand Union Hotel last week was the more creditable because it had no local *raison d'etre,* no local system furnishing in itself a very complete exhibit of materials. Where everything has a horsey flavor and suggestion ordinarily, an electrical touch was given to the atmosphere, changing the entire environment. As everybody knows, the Grand Union has a vast central court of green lawns and shady paths, environed by the lofty verandas and shut in by the "cottages." It is also beautifully laid out and picturesquely sheltered by lofty trees, through which the sun glanced down brightly by day, while at night the booths were radiant with electrical illumination, so at no time was the effect of the vari-colored bunting, flags, plants, etc., other than grateful to the eye. Electrical World and Engineer, like some others, occupied a booth under the high-pitched veranda of the hotel, so that should the weather prove unpropitious there would be protection from the rain. This fear did not disturb some of the exhibitors who, trusting to luck, left their handsomely decorated space full open to the sky. A great deal of time and expense was bestowed, as usual, on the exhibits, some of the booths needing little to make them comfortable quarters, while brass railing and handsome furniture appeared everywhere in luxurious profusion. One railing that attracted great and deserved attention was that around the Pittsburgh Reduction space, and was built up entirely of huge tubes of aluminum for rail and posts.

Abstracts appeared last week of papers read at Saratoga before the American Railway, Mechanical and Electrical Association together with the following discussions. At the sessions of the American Street Railway Association proper, on Wednesday and Thursday, seven papers were read. Of these we print elsewhere in full the paper by Mr H. H. Vreeland, on "Right of Way," and that of Mr. W. L. R. Emmet, on "Steam Turbines."

Mr. Chas. A. Coons presented a paper on "Train Orders and Train Signals for Interurban Roads." He stated that a code of rules for interurban roads should follow very closely the rules in vogue on the best-managed steam roads. After considering the two forms of blanks used by steam roads for the handling of train orders, he suggested certain modifications for use on interurban roads. The modified blanks are, he said, being used with excellent results by the International Railway Company on its interurban lines. As to the relative merits of the telegraph and telephone for transmitting messages from the dispatcher to the operators along the line, the International Company considers there is little to choose between the two systems, and that either one will prove adequate if properly installed and properly maintained. The first cost is about the same and either system is liable to disarrangement if not properly watched. Further information is given concerning the details of train dispatching according to the system used on the International Road.

Mr. Michael Brennan, of Detroit, read a paper in which he discussed from the legal standpoint the practice of a certain class of lawyers making a specialty of cases of personal injury and whose fees are contingent upon ultimate success. He shows how the prosecution of personal injury cases has become a systematized business, which has led to considerable abuses. In referring to the expert witness, he said that under the present lack of judicial restraint which exists in the United States, he has become a stench in the nostrils of the judges of the land. He quoted the late Judge Baxter, Judge of the United States Circuit Court for the Sixth District, who said that "Liars are divided into three great subdivisions—first, the ordinary liar; second, the damned liar; and third, the expert witness." He pointed out that while in foreign countries there are proper regulations with respect to expert witnesses, in this country as yet little progress had been made to meet the evil. There are, however, at present several movements which it is hoped will lead toward the improvement of the situation. In conclusion Mr. Brennan said that a radical remedy should be applied to correct the abuses now incident to personal injury cases, and he suggests the re-enactment of the old common law prohibiting bargains for the division of damages and inofficious intermeddling in a suit by outsiders.

In the discussion of Mr. Brennan's paper, Vice-President Ely said that while it would be impossible to harmonize the statutes, rules and practices of courts that affect the matter in question, by reason of the association extending through all of the different States, still its recommendations are along the line of standardization, and they may be useful in bringing about or assisting in bringing about, some harmony in the laws.

Mr. J. B. McClary contributed a paper on "Freight and Express on Electric Railways," the result of 182 replies received to a circular sent out asking for data on freight and express handling by electric railways. He considered that there is no more vital subject before the street railways of the country than that of freight and express on electric railways. His investigations showed that of 182 roads which reported 71 handled freight and express; 45 admit that it is profitable, and they intend to increase their facilities for handling this business; 37 say that it is a very attractive feature of electric railroading, and 9 answer that while they carry freight they do not think well of it. The paper then proceeds to examine the replies more in detail, including the several methods of handling freight and express, and gives reproductions of way bills, tariff sheets and other forms. In conclusion, Mr. McClary said that new facilities have been brought into service from time to time to take care of the business; that the freight and express business pays now in a great many instances; that it can be made to pay in a great many more where it is not now paying, and that many roads not giving it any attention at present will soon adopt it.

In the discussion of Mr. McClary's paper Mr. Gotschall said that the subject treated is one of the most important as affecting coming electric railways connecting centers of population adjoining and about large cities. He has found that electric railways are receiving from express and freight business all the way from $500 to $900 a mile of single track. Mr. Mailloux suggested that owing to the importance of the subject it be made the topic of a discussion at the next meeting of the association. Mr. Beggs agreed that the question of freight and express is likely to become much more important with electric railways as time passes. In many of the States of the Union electric railways are not permitted to carry freight, and in Wisconsin parcels cannot be carried unless in charge of a passenger, and a company has no right to make any extra charge for them. He hopes that the time may come when the demand shall be made in all the cities of the country that electric railways be permitted to perform this great service to the community. Mr. G. Tracy Rogers, of Binghamton, N. Y., gave his experience with electric railway express business. In one instance the city officials objected to a freight car being left on the street, but the merchants came forward and protested since the service was a great accommodation to them and all the people on the line. The plan pursued is to farm the business out to an expressman on a percentage basis, and the business has been fairly profitable. A car makes two trips daily, the distance being about nine miles. Mr. C. Loomis Allen, of Utica, N. Y., said that in December last his company organized an express department on the Utica & Mohawk Valley Railroad. Three cars are operated about 12 hours a day, and in each village or municipality along the line there are teams for the delivery of express matter, and in each of the cities there are teams for collecting express matter. The expense has been in the neighborhood of about 70 per cent of the gross receipts. Mr. W. K. Morley, of Grand Rapids, Mich., said that his company has 45 miles of track on which are run three freight cars, each making a round trip daily. The company proposes to extend the equipment next year, as they find that the freight business pays. The same rates are charged as those of steam roads. Vice-President Ely said that the International Railway Company, of Buffalo, which operates several interurban lines, one of them being a 30 mile high-speed road, handles freight trains drawn by electric locomotives, and carries mail, express, freight, small crops and all kinds of package freight. He drew a distinction between the short hauls of the electric railways, and the profitable long hauls of the steam roads, and he said that if electric railways are to handle freight to any extent an arrangement must be made with steam railroads for cars. The expense of handling freight on electric railways under present methods is very considerable.

Mr. William Pestell read a paper entitled "Electric Welded Joints," which includes a considerable number of illustrations, and opens with a history of the subject from 1893, when tracks were thus welded in a number of cities, up to the present. A table shows that electrically welded tracks have been laid in nine cities, the total number of miles welded being 228. The paper contains a number of illustrations showing methods of welding, and gives in detail the method used in electrically welding twenty-two miles of track in Worcester, Mass. The conclusions of Mr. Pestell are that from the experience in the various cities where new track has been welded it would appear that where permanent grades have been established and the liability of changes in track location are apparently remote, the electric welding of tracks seems advisable. The expense of original construction should certainly be much less than it would be several years later when the joints commence to go down, and it is a question whether it would not be cheaper to weld a good splice bar joint bonded to the same capacity. A test on the electrically-welded joints showed conductivities ranging from 110 to 140 per cent., as compared with equal lengths of solid rail.

Mr. Richard McCulloch, of Chicago, presented an elaborate paper entitled, "Production and Distribution of Alternating Current for Large City Systems." In opening his paper, Mr. McCulloch said that several solutions suggest themselves in the question of power plants as follows: 1. To keep the best of the present plants and add to them as necessary, and adjust the distribution systems from them. 2. To abandon the present plants, construct an entirely new plant with a new distribution from it, using the old plants as substations if they are suitably located. 3. A combination of these two systems, consisting in the beginning of a new plant, the plans of which contemplate the operation of the entire system from it at some future date; putting at the present time enough apparatus in the station to take care of the growth of the system and adding to it from year to year as the other stations are abandoned.

The paper takes up in detail the case of the production of alternating current by steam power at a central power station, its transmission at high voltage to substations and its conversion there into 575 volts direct current for distribution by means of feeders to the trolley sections. The subject is treated under the heads of size of station; coal supply; building; coal and ash-handling machinery; mechanical stokers; boilers; engines; steam turbines; superheated steam; condensers; steam pressure; piping; auxiliaries; division into units; frequency; phase; operation of generators; switches; central station plans; transmission voltage; transmission cables; conduit; substations; rotary converters; storage batteries for substations; low-tension switchboard; substation plans; the relative advantages of alternating and direct-current generation and transmission. Among some of the more salient points brought out under these various heads are the following:

The use of mechanical stokers is recommended, and for the installation of boilers a two-story boiler room is usually required. With a special valve arrangement the steam may be used in ordinary engines superheated 150 degrees F. Some manufacturers of water-tube boilers now make an attachment to be placed in the path of the heated gases within the brickwork of the boiler by means of which 200 degrees of superheating may be obtained. It is recommended that the auxiliary apparatus, such as used with the coal and ash conveying machinery, mechanical stokers, feed and condenser pumps, cranes, exciters, elevators, etc., should so far as possible be driven by motors, preferably induction motors. In the case of one large alternating-current plant now being constructed, small alternating-current generators driven by turbines are being installed to furnish currents for driving all the induction motors in the plant. Rotary converters driven by this current furnish direct-current at 250 volts for exciting the main generators and for lighting the plant. A storage battery will be installed on this circuit to steady fluctuations and furnish a reserve in case of breakdown.

It is advisable to divide the plant into a number of entirely independent units. An emergency steam connection should be made between the steam headers, but for emergency use only. In any case it is best practice to carry the high-tension cables underground in conduits. Paper insulation for cables is preferred by many to rubber. The cross sections of the copper may be taken very conservatively at 1,000 circular mils per ampere for rubber insulated cables, and 900 mils per ampere for paper insulated cables. The copper cross section should be taken by estimating the drop in voltage at maximum load, but for the comparatively short distances of city work it will usually be found that the drop in voltage is very small in a cable properly proportioned for the current it has to carry. Owing to the rapid increase in the cost of cables when the voltage is above 10,000 volts for rubber and above 15,000 volts for paper insulated cables, these appear to be the limiting voltages for railway underground distribution. In city practice the substations should be designed and built with as much care as used in power plant construction, should contain sufficient reserve apparatus to prevent any ordinary breakdown, and should be constantly in charge of skilled attendants. There seems to be no reason why rotary converters should not be built in sizes as large as direct-current generators, which have been extensively built in sizes up to 2,500 kilowatts. For city service rotaries may have simple shunt fields instead of being compound wound.

The subject of storage batteries was discussed to some length. Figured at the one-hour discharge rate, the relative first cost of storage battery as compared with rotary converter for a steam plant, is approximately $90 per kilowatt first cost, and $130 per kilowatt for the rotary equipment, the latter figure consisting of $30 for the rotary plant and $100 for the corresponding steam plant and transmission line. A battery worked on a peak at its one-hour rate is apt to cost the same or somewhat less than the apparatus which it displaces. No general statement can be made in regard to the advisability of storage batteries, as the question should be figured out for each special case. The reserve function of the storage battery is especially valuable because it may be put into service immediately, having in this an advantage over a reserve steam plant.

The paper concludes with a discussion of the relative advantages of alternating and direct-current generation and transmission. The conclusion is that it is difficult to make any recommendation as to the choice of alternating or direct-current distribution for this depends so much upon local conditions. In some of the largest cities where heavy loads must be taken care of at long distances from the power station, or where the power station cannot be located near the centre of the load, or where reasons exist such as cheap coal, water transportation, etc., located some distance away from the centre of the load, alternating-current distribution from the power station will probably be found more economical; but if a location can be obtained near the centre of the load at a reasonable price and the city load is comprised within a radius of five miles from this point, as is the case in most cities of less than 250,000 inhabitants, it is probable that direct-current generation and distribution from a central station will be the more desirable.

Following are the officers-elect of the American Street Railway Association and affiliated bodies:

AMERICAN STREET RAILWAY ASSOCIATION.

President, W. Caryl Ely; first vice-president, Edwin C. Foster; second vice-president, John Grant; third vice-president, James F. Shaw; secretary and treasurer, T. C. Penington. Members of the Executive Committee: J. C. Hutchins, A. B. Colvin, G. Tracy Rogers, W. A. Smith and S. L. Nelson.

AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION.

President, E. W. Olds; first vice-president, Alfred Green; second vice-president, C. F. Baker; third vice-president, W. O. Mundy. Members of the Executive Committee: T. J. Mullen, H. H. Adams, D. F. Carver, H. J. Lake. Secretary and treasurer, Walter Mower.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA.

President, F. E. Smith; first vice-president, F. R. Henry; second vice-president, C. O. Simpson; third vice-president, J. J. Magilton; secretary-treasurer, W. B. Brockway. Executive Committee: H. J. Davies, O. C. Rogers, S. G. Boyle and H. M. Pease.

W. CARYL ELY.

WILLIAM CARYL ELY.

Mr. William Caryl Ely, the newly-elected president of the American Street Railway Association, is well known to the electrical fraternity through his connection with various electrical enterprises in Buffalo and Niagara Falls. He was born in Middlefield, Otsego County, N. Y., in 1856, his family being of New England origin. He studied law, and in 1882 was admitted to the bar at Ithaca, N. Y. He removed to Niagara Falls in 1885, where he continued the practice of law until 1899, when he retired in order to accept the presidency of the Buffalo Railway and allied companies, Mr. Ely was one of the original promoters and incorporators of the Niagara Falls Power Company, and was also the principal promoter of the Buffalo & Niagara Falls Electric Railway, of which he was the first president. He was also president of the Buffalo & Lockport and Lockport & Olcott Railways, in the construction of both of which he was actively engaged. In 1898 he successfully accomplished the consolidation into one system of all the electric railway systems in Buffalo, Niagara Falls, Tonawanda, Lockport and vicinity, together with other railways and allied interests around Niagara Falls in Canada. All of the operating companies with one exception have been consolidated into the International Railway Company, the entire capital stock of which is owned and held by the International Traction Company, Mr. Ely being president of both companies. The International Traction Company owns and operates 352 miles of electric railways, also two of the large bridges crossing the Niagara River.

Mr. Ely's active connection with the Pan-American Exposition and his interest in the undertaking was one of the elements that brought it to a successful issue. As a member of the Executive Committee of the Exposition he wielded a large influence in its affairs. Mr. Ely is a director in various banking and manufacturing concerns in Buffalo and Niagara Falls, and under his presidency no doubt the American Street Railway Association will, during the next year, continue to prosper and exert an everwidening influence in the national development of the electric railway.

E. W. OLDS.

EDWIN W. OLDS.

Mr. Edwin W. Olds, who has been elected president of the American Railway Mechanical & Electrical Association, is a man of force and of well-recognized ability. He was born in Vermont, where his father was proprietor of a general machine shop; and even during his years of school he was thus able to indulge his pronounced taste for mechanics. In fact, he was early placed in charge of work of the kind to which his whole life has since been devoted. For nearly fifteen years past Mr. Olds has been connected with street railway work, the introduction of electricity giving him an opportunity he was not slow to seize. In 1890 he became associated with the Denver Tramway Company, and in 1896 he joined the staff of the Milwaukee Electric Railway & Light Company, with which he is still connected in the capacity of superintendent of rolling stock. Mr. Olds is a man of very quiet and dignified bearing, a clear thinker, an admirable executive and one who enjoys the esteem and confidence of his associates. He took a prominent part in forming the new association last year, and has contributed actively to its proceedings.

Mr. F. E. Smith.

F. E. SMITH.

The new president of the Street Railways Accountants' Association of America, Mr. F. E. Smith, has been prominent for some years past in accounting work in the street railway field. Some years ago he was auditor of the Zanesville & Ohio Railroad Company, and later was auditor for five years of the Lynn & Boston system, one of the busiest in the country. When a large number of railways in New England were drawn together into the great combination and consolidation known as the Massachusetts Electric Company, Mr Smith was appointed general auditor for that corporation. About four years ago he went to Chicago, where at the present time he is auditor for the Chicago Consolidated Traction Company, as well as auditor for the receivers of the Chicago Union Traction Company, both being positions of great difficulty and responsibility.

Mr. Smith has always taken a very active part in the work of the Accountants' Association, and under his administration it is destined to be increasingly useful in perfecting the methods of account keeping in vogue amongst street railways.

Test of Wine by Telephone.

It is stated that M. Maneuvrier, assistant director of the Laboratory of Researches of the Paris Faculty of Sciences, has just discovered an infallible method of ascertaining by the use of the telephone how much a given quantity of wine has been watered. The principle on which the invention rests is the variable conductivity of different liquids. The originality of Mr. Manenvrier's ingenious application is his use of the telephone to determine to what degree the liquid under observation is a conductor.

The apparatus works as follows: Two vessels, one containing wine known to be pure, the other the same quantity of the wine to be tested, are placed on an instrument outwardly resembling a pair of scales. The telephone is in contact with both liquids. If the sample of wine under observation is as pure as the standard used for comparison, no sound is heard; if, on the contrary, it contains water, the telltale telephone "speaks," and the greater the proportion of water the louder the instrument complains. A dial on which a number of figures are marked is connected with the telephone. To ascertain the proportion of water in the wine tested the operator moves a hand on the dial until the telephone, which has been "speaking" all this time, relapses into silence. The hand has thus been brought to a certain figure on the dial. This number is then looked up in a chart, which the inventor has drawn up, and corresponding to it is found indicated the exact proportion of water contained in the quantity of wine.

M. Maneuvrier's remarkable invention can, he says, be easily applied to the testing of many other liquids and even solids, which may be adulterated by the addition of foreign matter possessing a conductibility different to that of the original substance.

Electrical Engineering in the Navy.

According to the *New York Herald*, Secretary Moody is considering the abolishment of the Navy Bureau of Equipment, and the distribution of its present functions among the remaining bureaus. In this event electrical engineering would come under the cognizance of one of the engineering bureaus of the navy.

Government Telegraphs and Telephones in Great Britain—I.

TELEGRAPHS.

The forty-ninth report of the British Postmaster-General, covering the operations of the Post Office for the year ending March 31, 1903, contains some interesting figures and statements relating to the working of the British telegraphs and telephones. Some of these are so striking that it is a pity to allow them to remain buried in a government report.

TELEGRAPH STATISTICS.

The total number of telegrams sent over the Post Office wires during the year was 92,471,000, an increase of 2.3 per cent over the number sent in the previous year. Ordinary inland telegrams account for 75,883,000, of a total value of $11,589,170. Curiously enough, while the number of telegrams was 1,161,000 in excess of the number of the previous year, the receipts were over $15,000 less, showing that the British public has been studying economy in the wording of its telegrams. The average value of an inland telegram fell from 14.9 cents to 14.82 cents. The rate is one cent a word, irrespective of distance, with a minimum payment of 12 cents, address and signature being charged for, not free, as in this country.

The following table gives the number and value of each class of telegram for the past two years:

	NUMBER.			RECEIPTS.		
Class of Telegram.	1901-2	1902-3	Increase.	1901-2.	1902-3.	+ or —
Ordinary (inland)	74,721,000	75,883,000	1,161,000	$11,606,385	$11,589,170	—$17,215
Press (inland)	6,216,000	6,453,000	237,000	683,900	718,700	+34,800
Foreign	7,627,000	7,901,000	274,000	1,816,265	1,881,495	+65,230
Railway, free	1,356,000	1,411,000	55,000	....	....	....
Railway, reduced rate	30,000	30,000	....	2,780	2,780	....
Government, free	482,000	793,000	311,000	....	....	....
Totals	90,432,000	92,471,000	2,038,000	$14,109,330	$14,192,145	+$82,815

The estimated value of the railway free telegrams, which are sent in payment for wayleave privileges, is $288,080 and of government free telegrams, $233,110, making a total of $521,190.

The British postal telegraphs are, as is well known, operated at an enormous loss, and a large proportion of this loss is due to the extraordinarily cheap rates at which press messages are carried. It will be seen from the table above that the press messages brought in only $718,700, or an average per message for 6,453,000 messages of a trifle over 11 cents. The average weekly number of words in press messages is given in the report as 14,890,712, giving a yearly total of 774,316,024, or an average number of words per press telegram of just over 120. Therefore, press telegrams are sent at the rate of eleven words for a cent, while the general public pays one cent for each word. This results in the Post Office doing for the press an amount of work equivalent to 70 per cent. of what it does for the public at about 6 per cent. of the price. This clearly must entail a very large loss to the Post Office, as one mill per word for telegrams over the length and breadth of Great Britain is a losing figure. If press telegrams were paid for at half rates the 774,316,024 words of press messages would bring in $3,871,580.12 in place of the $718,700 they did bring in during the past year, a difference of over $3,150,000, which would be more than sufficient to wipe out the deficit on the working of the system.

The explanation that has been given of the extremely low rates for press telegrams is as follows: When the government took over the telegraphs in 1870 a rate for press telegrams was established of 25 cents per 100 words, with 4 cents per 100 words or less for each additional copy of the same messages. The rate for additional copies was intended to apply to extra copies of messages delivered to separate addresses in the same town. But the astute business men of the Fourth Estate gave it a wider meaning and claimed that they were entitled to send the same message to any number of towns paying at the rate of 25 cents per 100 words for one transmission and 4 cents per 100 words for every other transmission. The Liberal Government of the day, wishing, it is said, to stand well with the press, conceded the interpretation of the rate desired by the press. So now we have the spectacle of the Postmaster-General refusing to admit magazines to the post at the newspaper rate of postage and at the same time making a present to the newspaper press of at least a million and a half of dollars annually in telegraphic facilities. No doubt the newspapers are well pleased, but it is not business.

The report states that every class of telegram shows an increase over the previous year, the numbers both of inland and of foreign telegrams being the highest ever recorded. The inland telegrams sent in June, 1902, exceeded those for June, 1901, by over half a million, the increase being due to the illness of the King and the postponement of the Coronation. On June 23 no fewer than 201,559 telegrams passed through the Central Telegraph Office in London, on June 24, 311,039, and on June 25, 314,126. The largest number previously recorded was 199,155 on the day before the funeral of Queen Victoria. The large increase in government free messages, 311,000, or over 65 per cent., was also chiefly due to those sent in connection with the illness of the King. The pressure of work at this period, both in London and in many of the provincial offices, was very severe, and taxed to the utmost the energies of the staff.

The total number of telegraph offices in the United Kingdom is 12,129, of which 9,777 are at post offices and 2,352 at railway stations and other "agency" offices. During the year 347 new telegraph offices were opened, as against 259 in 1901-2.

LINE CONSTRUCTION.

The telegraph lines suffered to some extent from storms during the year, notably in February last, but grave as was the interruption caused to the service, it has been a source of satisfaction to find how great an advantage is gained on such emergencies from the underground cable already laid northwards from London. During the year the underground line laid between London and Birminghan about three years ago was extended to Warrington, nearly 200 miles from London, where it joined existing underground lines between Manchester, Liverpool and Chester. In addition to this work pipes to the extent of 54 miles have been laid north of Warrington and during the present financial year it is hoped to complete the line of pipes to Carlisle, 300 miles north of London, and to lay a line from Manchester to Leeds, 45 miles, besides putting down underground work in one or two other places exceptionally exposed to storm damage. Reserve wires for use in emergencies, carried as far as possible by alternative routes, have been provided during the year in many parts of the kingdom.

Regarding the difficulty of carrying out new construction the report speaks as follows: "The construction of telegraphs both underground and overhead is becoming far more difficult than in former years. Not only by the growth of telegraph and telephone systems is the space available for overhead wires along the roads and streets getting filled up, but a new class of difficulties has arisen from the extension of electric light and power services. These services are operated by powerful electric currents, which would be a grave source of danger, alike to post offices and to the lives of my staff, if contact were made with telegraph wires through breakage or otherwise; and it is well that the statutory powers of the Postmaster-General enable me to insist on the provision of various safeguards wherever light or power installations are established near the telegraphs."

A TELEGRAPH MULTIPLE BOARD.

A great improvement in the metropolitan telegraph service has been brought about by an intercommunication switch, on the principle of a telephone multiple switchboard, which has been specially designed and has recently been installed in the Central Telegraph office. By its means the various London telegraph offices, which number between five and six hundred, are enabled to communicate directly with each other, thus saving the retransmission of the telegrams at the central office.

WIRELESS TELEGRAPHY.

The attitude of the Post Office toward wireless telegraphy has hardly been fairly represented, so the references to that subject may well be quoted in full. The report says: "On the subject of wireless telegraphy, I have had much communication during the past year with the other government departments concerned in the matter (the War Office, the Admiralty and the Board of Trade), with Mr. Marconi and with the two companies which possess his rights. It is now nearly eight years since Mr. Marconi first came to England and received at the hands of the officers of the Post Office all the assistance which they could give him; and the subject of wireless telegraphy has been watched ever since by them with the keenest interest.

"I have provided for the Marconi Company a private wire from Poldhu to Falmouth on the usual rental terms, and I have explained to the company the conditions upon which the Post Office can become its agent for the collection of messages to be transmitted across the Atlantic by the wireless system. I have found it necessary to impose certain conditions intended to safeguard other national interests, and I have also pointed out that, before the Post Office can act as agent for the company the company must satisfy me that it is in a position to carry on its business and transmit messages from one side of the Atlantic to the other. It is obvious that until I am satisfied on these points I should not be justified in accepting messages and collecting charges from the public for a service which the company might possibly not be in a position to perform efficiently.

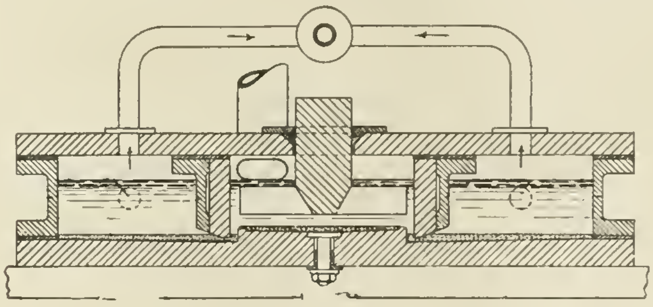
"I have also devoted much attention to the question of the establishment of ship signalling stations on the coasts of the United Kingdom for wireless telegraphy. This question involves the relations between the Admiralty, Lloyds and the Marconi Companies, and it has been possible at present to arrive at a definite position."

Recent Electrochemical Developments.

MERCURY CATHODE CELLS FOR THE ELECTROLYSIS OF BRINE.

Commercial success of the use of a mercury cathode in the electrolysis of sodium chloride for the production of caustic soda and chlorine, has, up to the present, been confined to the Castner-Kellner process which is successfully operated at Niagara Falls. Only two other mercury cathode processes have been tried in this country on a larger scale. The one is the Rhodin process, which was in operation for some time at Sault Ste. Marie, but the plant is now closed, apparently for the reason that the cost of the process is too high in these times of war between the chemical and electrochemical alkali companies in Europe, the market for the product being thereby utterly demoralized. The other process is that of G. & G. W. Bell, which is to be used in a plant of the Pennsylvania Salt Manufacturing Company in Wyandotte, Mich. While experiments have been going on there for quite a while, the process does not yet appear to be developed to a large industrial scale.

The process of G. & G. W. Bell is in general quite similar to the Castner-Kellner process. As shown in cut below, there is an electrolyzing chamber intermediate between two oxidizing chambers. The electrolyzing chamber contains sodium chloride, the anode being provided at the top of the cell, and a layer of mercury at the bottom forming the cathode. By electrolysis, the mercury of the cathode is changed into sodium amalgam. When the concentration of sodium in the amalgam has become sufficiently high, the amalgam is forced into the oxidizing chambers for the production of caustic soda. The mercury, thus freed of the sodium, is then brought back into the middle department and the same process starts again. The feature which distinguishes this process from the Castner-Kellner process is the automatic method of forcing the amalgam from the electrolyzing chamber to the oxidizing chambers, and forcing the mercury afterwards back into the electrolyzing chamber. This is accomplished by making use of the pressure of the gas developed during electrolysis. The gas exit is alternately opened and closed, with the result that the mercury is moved the one or the other way.



BELL MERCURY CATHODE CELL.

In a patent, granted on September 1, to Messrs. G. & G. W. Bell, some improvements of this cell are described. The pressure is produced in the oxidizing chambers by the hydrogen which is evolved there when the amalgam gives off the sodium to form sodium hydroxide. The subsequent release of this pressure is controlled by a valve in the main hydrogen pipe, the automatic operation of the valve being produced by electromagnetic means.

The principal condition which any process for the production of caustic alkali and chlorine must fulfil, is, of course, the provision of effective means to prevent the recombination of the anodic and cathodic products. Three general means to this end are known in the art: First, the mercury cathode which removes the sodium cations from the electrolyzing cell; second, the diaphragm processes, in which the anodic and cathodic compartments are mechanically separated by means of a diaphragm; third, the gravity process (Glocken process) in which the anodic and cathodic layers of the electrolyte are kept separate from each other automatically by utilizing their different specific gravities.

A combination of the mercury cathode process with the gravity process is made use of in a cell of Mr. A. Brichaux, of Brussels, for which patent was granted on September 1. The mercury cathode process has the disadvantage that the anodically-developed chlorine gas may saturate the electrolyte and thus come into contact with the amalgam cathode; this would, of course, produce reactions which are not wanted. To prevent this, the author employs a dense layer of saturated sodium chloride directly above the mercury cathode, and upon this layer of greater specific gravity a layer of lower gravity rests; this lighter upper layer contains the anode and may be saturated with chlorine, but the lower heavier sodium chloride layer acts like a diaphragm for the chlorine for the reason that it does not readily absorb the chlorine, so that the latter cannot reach the amalgam cathode.

ELECTROLYTIC PREPARATION OF LITHOGRAPHING PLATES.

A patent was granted on September 1 to Mr. O. C. Strecker, of Darmstadt, Germany, for a process of electrolytically preparing lithographic plates. The principle is to use the plate as one electrode in a suitable electrolyte, and to apply an alternating current by which a layer of oxides is formed on the metal; this layer is afterwards transformed by chemical means into an insoluble layer of salts adhering firmly to the metal. Preferably zinc or aluminum plates are used. A zinc plate is ground by means of a pad of felt and pumice powder, rinsed with water and dried. On this plate is fixed a lithographic design, the negative of the intended print; the plate is then gummed with a solution of gum arabic of medium strength, and when perfectly dry, the greasy substance is washed out by lithophin, which is a solution of asphaltum in benzine. The excess wiped off, the plate is then dried, and finally the gum arabic washed off by water. The lithographic design is then left on the plate as a layer of asphaltum. Aluminum plates may be treated in the same way with a similar result.

The plate is now used as electrode in a solution of 3 per cent. of a neutral phosphate, sulphate or the like. The passing of the alternating current causes the formation on the plate of a layer insoluble in water and probably consisting of oxides or hydroxides of the metals employed. As the character of this layer is either neutral or basic, it is not fit for printing purposes and must undergo another chemical treatment. In many cases a treatment with a weak acid is sufficient to make the plate fit for lithographic printing.

BATTERY INVENTION.

A patent which is of great interest in connection with the new Edison iron-nickel storage battery was granted on September 1 to Mr. E. W. Jungner, of Norrkoeping, Sweden. It has been well known for some time that Edison and Jungner have, independently of each other, been working along the same general lines of battery invention, both developing that general type of accumulator to which Dr. A. E. Kennelly has given the name of "oxygen-lift cell." The original application for his patent was filed by Jungner on April 17, 1899; it was then divided and the application for the present patent filed on June 23, 1902. While the reaction of the Edison iron-nickel cell may be briefly represented by $Fe + NiO_2 = FeO + NiO$, indicating that oxygen is "lifted" from the nickel to the iron, the general type with which Jungner's present patent deals may be represented by the equation $MOH + N = M + NOH$, where M and N are suitable metals. In this case hydroxyl is "lifted" from one plate to the other. An alkali hydrate is used in both cases as electrolyte. As suitable materials for M and N, Jungner mentions iron and manganese, the reaction during discharge proceeding in two steps, represented by the equations $Fe + 2\,Mn\,(OH)_4 = Fe\,(OH)_2 + 2\,Mn\,(OH)_3$ and $Fe\,(OH)_2 + Mn\,(OH)_4 = Fe\,(OH)_3 + Mn\,(OH)_3$. The theory for the "hydroxyl-lift cell" may, of course, be developed in a manner quite analogous to that of the oxygen-lift cell. In both cases the electrolyte remains unchanged. The first claim of Jungner's patent reads as follows: "In a reversible galvanic cell, an alkaline electrolyte and electrodes therein having action masses of metallic oxygen compounds, said active masses insoluble in the electrolyte under all conditions of working."

A patent was recently granted to Mr. G. E. Hatch, of Quincy, Mass., for an improvement of the type of cell in the development of which he has been interested for some time and in which rigid porous supports are used to hold the active material together. He now employs such porous supports only for the active material of the positive pole electrode, while the negative pole electrode is directly in contact with the electrolyte.

A similar construction is applied in a zinc-lead battery in a patent recently granted to J. Middleby, Jr., of Malden, Mass. In order to prevent the formation of zinc trees during the charge of the battery, he surrounds the zinc plate with a pair of porous inert plates; these porous plates are provided on their opposed faces with a series of ribs, and the zinc electrode is in contact with these ribs.

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New Telephone Patents.

COMMON BATTERY LINEMAN'S TEST SETS.

For many years, in fact almost from the advent of the telephone exchange down to the general adoption of common battery systems, the lineman's test set consisted of a "test box" containing a magneto generator and carrying a large diameter telephone serving for both transmitter and receiver. By howling at this telephone a lineman can make himself understood at some considerable distance from the central office. With common battery systems the magneto, however, became of little service to the lineman, who, therefore, often carried nothing but a head receiver, of which the transmitter qualities are very poor. This has led inventors to attack the problem of a satisfactory portable transmitter and receiver set. Patents have recently appeared for two such sets built upon entirely different lines. One represents the American Telegraph & Telephone Company, having been developed at the hands of Messrs. Barrett, Falk and Shreeve. The second has been patented by H. G. Chalkley, of New York City.

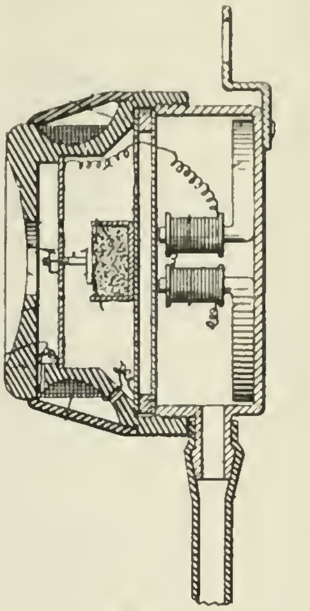

FIG. 1.—CHALKLEY PORTABLE TELEPHONE.

Mr. Chalkley's instrument is of very compact design and is shown in Fig. 1 in section. A two-compartment case carries both receiver and transmitter, the latter superimposed upon the former. About the transmitter case a resistance coil is wound, which is connected in shunt with the carbon button, both these being in series with the receiver portion. When a common battery line is available, the current from this enables the lineman to use his transmitter, the flexible tube from the receiver chamber serving to conduct the received speech to the ear. In case current is not available, the receiver may be actuated as a magneto transmitter through the same mouthpiece as before, the shunt resistance serving to overcome any disturbance at this time due to the carbon button.

Fig. 2 shows a section of the other instrument, which is of the hand microphone type. The handle of hollow sheet metal, shaped to conceal as far as possible all connections or delicate parts, carries a watchcase receiver at one end and a transmitter at the other end. The receiver and transmitter are mounted in approximately similar planes, so that the transmitter button will always be in a position to give good efficiency. The transmitter is of the "inertia" type, wherein both electrodes are supported by the diaphragm. The transmitter mouthpiece is peculiar, being a perforated curved plate, presumably to protect the diaphragm from injury.

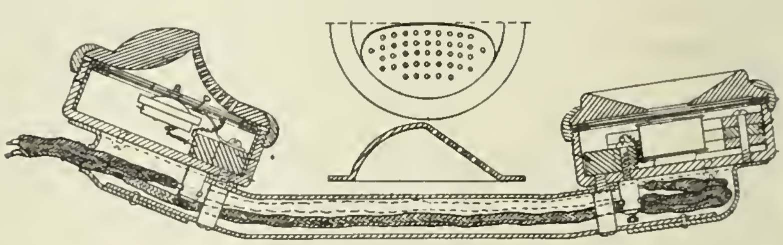

FIG. 2.—PORTABLE TELEPHONE.

PORTABLE SET FOR USE BY THE DEAF.

Mr. M. R. Hutchison has designed and patented a compact set of instruments to be carried by those partially deaf and used after the usual manner to assist in hearing. A receiver of special type, together with an automatic switch, the equivalent of the usual hook switch, a transmitter with sound concentrating horns and deflecting vanes and suitable batteries, are all mounted in a portable case, which may be closed to look like an ordinary box, or opened for service, by means of a controlling lever which locks in the desired position the sides constituting the deflecting vanes.

A DEPARTURE IN SELECTIVE SYSTEMS.

While the output of selective signalling patents has been almost continuous, the principles upon which the various systems have been founded have been limited to a very few fundamentals, namely, step-by-step selection, synchronous clockwork devices, polarized impulses and variation of frequency of the signalling current. We have now for consideration, however, a system based upon the Wheatstone bridge or potentiometer principle. This system is not entirely novel with the present patents, as an earlier patent granted to the same inventor, S. A. Reed, of New York City, described its application to a private line. The present patents are, however, the first appearance of its application to exchange lines.

The two patents for this latter application provide two very different systems, the one essentially series in connection and the second bridging, the foundation of the two systems being clearly indicated by the diagrams of Fig. 3. Consider first the left-hand diagram. It is evident that with the battery connected as shown there is the same fall of potential along each side of the loop, and this is equal to the battery voltage. It is also evident that for each point on one side of the loop, there must be one point on the other side of the loop of equal potential; consequently, if these corresponding points be connected, no current will flow on the connecting wire. It is also equally evident that if any two points not properly related be connected, current will flow. Now, in the diagram, the side of the loop, *q, A, B, G'* represents one side of the subscriber's line in question, consisting of the line wire between the stations and of an electromagnet in series at each station. This all being in permanent connection, the line enters each station at a certain fixed and constant potential. The side of the loop, *q, a, b, p*, is an artificial line of resistance wire of any chosen total resistance. Now, as before noted, a series of points can evidently be established upon this artificial line to correspond to the constant potential at each of the various stations. This would, however, involve a potential wire from each such station to the central office and the system would effect little saving over individual lines. If, however, a common potential lead may be used, then a saving of line is effected, as with only one side of the talking line required for the loop, the second side is available as the potential wire.

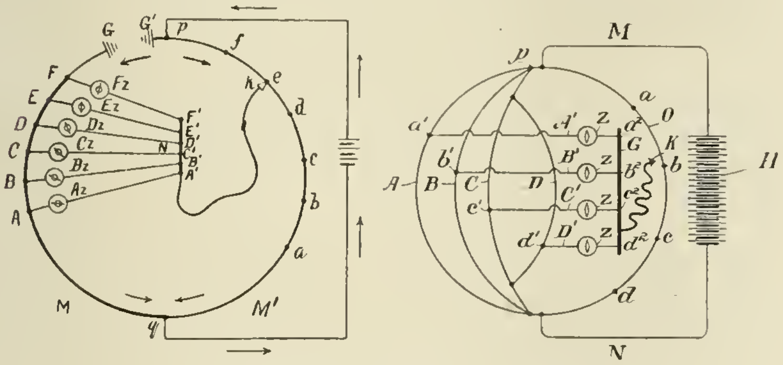

FIG. 3.—REED SELECTIVE TELEPHONE SYSTEM.

Now, it is a fact that a common potential wire may be used, provided that the electrical resistance from station to station when measured upon the potential wire be kept very high compared to the line resistance between the stations. It is easy to make this resistance high, as in order to use the equality of potentials of certain points as a means to selection, an electromagnet must be inserted in the tap to the potential wire, and it is very easy to make the resistance of this magnet and thus the resistance from station to station over the potential wire as high as desired. The combining of potential wires has one effect, namely, the displacing slightly of the equipotential points, but this is of no serious consequence as long as the number of stations to be selected be reasonable.

Fig. 3 shows in diagrammatic form the reduction of the system to practice. Herein at each station in one side of the line appears an electromagnet, *Y*. This is a polarized magnet controlling a switch arm. The switch arm swings between two contacts, from both of which it is normally held clear, but toward either of which it may be thrown at the will of the exchange operator. The forward contact is that completing the circuit of the normally open telephone set. The rearward leads to a device marked *z*, which is constructed like a coarse D'Arsonval galvanometer, the needle of which forms a mechanical stop for the switch arm except just when it is in its mid or undeflected position.

The act of selection is as follows: The operator desiring station *E*, depresses her battery key, *s'*, which causes the switch arms of all magnets, *Y*, to close their back contacts. The operator now presses selective key, *e*, when all needles, *Z*, will deflect except that at station *E*. This is evident from the consideration that point *e* was so chosen so that its potential shall equal that of the switch arm at *E*, and differs from that of every other station. At this stage, with all needles except that at the desired station deflected, the operator throws her snap reversing key, *P*. The sudden reversal of current and the polarized condition of the switch magnets combine to throw violently all switch arms forward. As this action is quick, the deflected needles do not have time to return before the switch arms strike them, and the needle and arm become mutually locked in a mid position. At station *E*, on the other hand, needle *Z* being undeflected, the switch arm takes its full stroke to the first contact anvil. It thus connects the telephone at *E* across the line where it may be rung in the usual manner, the operator using her regular ringing key. Of course, there is no danger of calling any station other than *E*, as at no other station is the bell connected to line.

Reverting to the right-hand diagram of Fig. 3, an explanation of Mr. Reed's bridging system will be readily intelligible. In this system as before we have one side of the loop formed of an artificial resistance line and the other side formed of the subscriber's line and polarized electromagnets. In this latter case, however, this line side of the loop is multiple in character, as the electromagnets being bridged, there is one branch for each station. These branches all have exactly corresponding potential fall along them just as did the two branches of the former system; and just as corresponding equipotential points were existent on the two branches in the former case, so now are they existent upon all branches of the present case. For convenience, however, but one point is chosen on each multiple branch, all these being compared to points upon the right-hand or artificial line side of the loop. The functions and construction of the polarized switching electromagnet and of the deflecting member are exactly similar to those of the former case, the resistances, of course, being adjusted to meet the new bridged conditions, and the switching magnet windings being provided with a potential wire terminal connected at such a point as to correspond to the potential of the proper central office selective key. As in this system both line wires are involved in the potentiometer loop, the earth must be used as the selective circuit.

There are many special features of the apparatus made necessary by the fact that selection is based upon a balance of potentials, which balance is easily disturbed. Thus, when a station calls it is necessary that the selective vane be mechanically locked by the calling subscriber until the operator answers, as otherwise when the operator locks the line she would lock out the calling subscriber with the other stations. Again, special provision must be made to enable one to call a station on his own line, etc. All these locks, keys and mutually acting attachments are a considerable disadvantage from a maintenance standpoint, while the use of a grounded selective circuit in the bridging system is highly questionable for locations with grounded trolley circuits. Nevertheless, the novelty of the system is such as to warrant considerable study.

Municipal Electricians' Convention.

The closing days of the eighth annual convention of the International Association of Municipal Electricians at Atlantic City, N. J., were made interesting in addition to the regular business and reading and discussion of papers by a lecture on "Wireless Telegraphy and Telephony," by A. Frederick Collins, who enlightened his hearers with information concerning an art which is rapidly assuming a practical and commercial form. Another interesting feature of the last night's session was the exhibition of the Cooper Hewitt lamp in operation.

The social features of the convention were much appreciated by the delegates and the ladies attending. The local reception committee and City Electrician A. C. Farrand made every arrangement for their entertainment, which was much enjoyed.

The officers elected for the ensuing year are A. C. Farrand, president; first vice-president, E. G. Petty; second vice-president, G. F. Macdonald, and secretary, Frank P. Foster, the latter having ably filled that office for many years with satisfaction to the association.

Among those attending the convention and not mentioned in our last issue were Mr. Howard H. Ballett, of the Anderson Porcelain Company, East Liverpool, Ohio, and C. B. Roulet, of the Osburn Flexible Conduit Company, New York.

An Expert Opinion on the New York Subway.

Mr. Maurice Fitzmaurice, chief engineer of the London County Council, has spent a week in this country, all of which he has devoted to the study of the subway and other local transportation systems. Of the New York subway Mr. Fitzmaurice had nothing but praise. He was most struck with the fact that the subway is at such a high level. "When this is finished," said Mr. Fitzmaurice, "I think you will have the finest subway that has ever been built. It is not to be compared at all with the London undergrounds, for they are all about 60 feet below the surface. You have to go down to them by hydraulic lifts—elevators. Of course it is much more convenient to go down only a few steps, as the people will do here. You cannot build things without a little inconvenience. When this subway is completed I think New York will be very well off as regards locomotion—better than any city that I know of. All the work upon it is absolutely first-class, the actual construction, materials—everything. As soon as the people have forgotten the inconvenience they have suffered, and that will not be very long, they will be very proud of it.

"I have been all over the elevated system," he said. "You get a very good rate of speed on that, I notice. I was interested, too, in the tramways. They are just getting some roads built in London with the underground construction, or sub-trolley, such as are in Broadway. The thing that astonished me most of all in New York was this: I went down to Thirtieth Street and Broadway the other morning at 9.30 o'clock to take a car to the lower city. Just as I got there a man with a double team and a cart filled with bricks threw his horses right across the down road surface cars. As it seemed to me a very extraordinary thing, I took out my stop watch to see how long he was going to stay there and block traffic, and he did it for eight minutes, stopping all cars going down at that busy hour of the morning. I think it was perfectly scandalous. Now, is that a usual thing in New York? I think if a man did that in London he would find himself in jail before much time elapsed."

Mr. Fitzmaurice said that he thought the subway would be perfectly safe, and that there would be no possibility of a repetition of the Paris horror beneath the streets of New York.

Taxation of Telephone and Telegraph Companies in Indiana.

The growth of the telephone business in Indiana is reflected in the figures taken from the report of the State Tax Board, which has recently completed the appraisement of the telephone companies over which the board possesses original jurisdiction in fixing assessments. There are 191 companies coming under the board's jurisdiction and these companies are compelled to bear a large increase of taxation. The total appraisement of the telephone companies was fixed at $6,819,552, an increase of $1,775,973 over last year. The increase is largely due to the building of additional lines, the rate of assessment and valuation of individual companies having been increased in many cases. The assessment and valuation of telephone property by the board is exclusive of real estate, structures, machinery and appliances. These are subject to local taxation.

There is a total of 127,287.54 miles of telephone wire in operation in the State. The lowest assessment against any company is $5 per mile, and the highest is $600 per mile. The telephone companies throughout the State will generally pay increased taxes under the assessment. The Central Union was raised $2 a mile, bringing its assessment up to $56 a mile. The company has built nearly 2,600 miles of line and this will bring its total appraisement up to $3,135,290, an increase over last year of $801,559. The New Telephone Company will pay taxes on $196,250, an increase of $9,750. The increase is made up because of the additional mileage, as the rate was reduced from $150 to $140 per mile. The appraisement of the New Long-Distance company remains at $25 a mile. With the increased mileage this will bring its appraisement up to $483,320.

The telegraph companies' assessments were reduced $552,201. The Western Union reduction was the greatest. Its assessment of $57 a mile, as fixed last year, was reduced to $40 per mile. With an increase of nearly 4,000 miles of line, its assessment will be reduced $503,280. The Postal Telegraph Company's reduction is $40,302, or $5 per mile. These reductions were made on the plea of decreasing business due to telephone competition.

CURRENT NEWS AND NOTES.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—Mr. La Rue Vredenburgh has accepted an appointment as reporter on advertising methods, and will present at the twenty-seventh convention of the National Electric Light Association, to be held in Boston next May, a very elaborate report of the most novel and striking features in this department of electric lighting. Mr. Vredenburgh is in charge of the Edison Electric Illuminating Company's exhibition department in Boston, which is one of the most complete of the kind in this country. The Wrinkle Department will be in charge of Mr. Charles H. Williams, of the Madison Gas & Electric Company, Madison, Wis. This department was suggested by Past President Doherty, and it is safe to say that the efforts of Mr. Williams will continue the value and interest which this important department has had to the members of the association.

WIRELESS TELEGRAPHY.—Mr. James T. Allen, examiner in the United States Patent Office, and the well-known compiler of patent digests, is engaged in compiling a digest to embrace the United States patents for wireless telegraphy under 15 subdivisions from 1,789 to date. The work is to include the full drawings, specifications, claims and also a list of the references cited while the applications were being examined, and in interferences and decisions. The great merit of Mr. Allen's previous publications is an indication of what may be expected in this latest work, which should be of the greatest value to all those interested in the subject of wireless telegraphy. Those desiring fuller information should address Mr. J. T. Allen, Room 321, United States Patent Office.

MARCONI GOING TO ST. LOUIS.—Mr. Marconi has, according to the *Wall Street Journal*, decided to go to St. Louis on the invitation of the Executive Committee of the St. Louis Exposition, tendered through Gov. Francis. After several days he expects to return to Cape Breton, there to begin the work of installing his new inventions, by means of which the height of the towers necessary for transatlantic transmission will be reduced over 50 per cent. It is his intention hereafter to divide his time about equally between the English and American stations for the purpose of securing the equipment and perfection of the same for the commercial transmission of messages across the Atlantic. "My consultation with Mr. Edison," Mr. Marconi says, "was highly satisfactory, and will, I hope, be productive of good results. I am highly pleased with Mr. Edison's hearty co-operation in the matter of the development of my system, and certainly expect the very best results will be obtained therefrom. The Marconi Company now has the expert services of the leading men in this line of thought in the world, in addition to my own. The question of interference, of which so much has been made by the press," Mr. Marconi continues, "is one which is really entitled to no serious consideration. Efforts to impede the operation of the wireless system can only be compared to the efforts of persons to destroy telegraphic communication between two points by grounding the wires. It is an operation which may be conducted in safety for a short time, but sooner or later detection and punishment follow. It is not a very satisfactory thing for a corporation or an individual to spend money merely for the prevention of an accomplishment by some rival whom they cannot meet in a fair competitive field, and will not be persisted in very long in the absence of any profit arising from such action. It is the policy of the Marconi companies to go quietly about their own affairs, without attempting to impede or annoy by placing obstacles in the way of its so-called rivals, and we believe that this policy will in the long run win out."

TROLLEY CURRENT COLLECTOR.—A patent granted August 25 to R. A. Emil Huber, of Zurich, Switzerland, describes a trolley current collector consisting of a curved arm having a motion in a plane at right angles to that of the trolley line. The arm is mounted on the side of the car near the top, the table carrying it being capable of vertical adjustment by means of a screw spindle. The curved arm can take a position suitable for making contact with a trolley wire above the center of the car or one alongside the car, or in any location intermediate of these limits.

MASSENA-MONTREAL TRANSMISSION.—It is stated that the city of Montreal is to have a new power company, through the efforts of Mr. McLea Walbank, formerly managing director of the Lachine Hydraulic Power Company. The company promoted by Mr. Walbank will bring in the power from Massena, N. Y., and, according to the survey made, the distance from the power there to the distributing station in Montreal will be 78 miles. The examinations already made show that between 25,000 and 40,000 hp can be secured according to the location that is secured. The announcement is made that Mr. Walbank, who is now in London, England, has been successful in securing the capital necessary to organize the new company.

MORE IMPROVEMENTS AT NIAGARA FALLS.—The upper power district at Niagara Falls, N. Y., is to receive another impetus, in the increase of the plant of the Oldbury Chemical Company, which is about to build four separate factory buildings on the property directly opposite the present plant. Contracts have already been let, and the work will be started immediately. These buildings will be of regulation factory building height, about 45 ft. in width, and from 100 to 125 ft. in length, and will cost from $20,000 to $25,000. They will be constructed of brick and iron, and the work will be pushed forward rapidly. The Oldbury Company is now rebuilding the structure recently destroyed by fire, and also erecting a new office building. When all its additions are finished, their plant will be one of the city's largest industries.

RADIUM FOR TESTING GEMS.—The American Museum of Natural History in New York City has received a quantity of radium which is not very large, but the radioactive power of which is second to none in this country. It was given to the Museum by Mr. Edward D. Adams, whose immediate object is to enable George F. Kunz, the gem expert, and Dr. Charles Baskerville, of the University of North Carolina, to carry on some experiments with gems. Mr. Kunz is very much interested in discovering the properties of the new gem, Kunzite, which is named for him, as noted recently in these columns. It is reported that this gem is very phosphorescent when exposed to the radium rays. A beginning has been made in the examination of the Bement-Morgan and Morgan-Tiffany collections of gems with the X-ray and radium rays. A report of the results will soon be made in a special publication of the museum. The specimen of radium which has been imported for the museum is of 300,000 radioactivity.

ALL-ENGLISH TELEGRAPH AROUND THE WORLD.—At the recent meeting in Canada of the Congress of the Chambers of Commerce of the British Empire, a resolution, offered by Sir Sandford Fleming, of Ottawa, was adopted expressing the opinion that all the self-governing British communities around the globe should be united by a continuous chain of state-owned telegraphs. In moving the resolution Sir Sandford said that there should be a continuous chain of state-owned electric telegraph girdling the empire and encircling the globe so that in the event of interruption from any cause, telegraphic communication may, nevertheless, be maintained by sending messages in the opposite direction; that submarine portions be laid, for better security, in deep water; and that no part of the electric telegraph circle touch land which is not British. The new Pacific cable is regarded as part of the chain. The cost involved in completing the whole scheme is estimated at about $20,000,000. It would be owned by Great Britain, Canada, New Zealand, Australia, India and South Africa.

ARTIFICIAL GUTTA PERCHA.—Mr. O. J. D. Hughes, United States Consul-General at Coburg, Germany, says: "A new concern has been started in England, with a branch in Germany, to manufacture artificial gutta percha under "Gentzsch" patents and rights. If the material should, indeed, realize the eminently satisfactory reports which have so far been obtained, there ought to be a very large market for this product, especially in view of the ever-increasing demand and the shrinking supply of the natural product. A well-known European expert is quoted as saying: 'I have recently had an opportunity of seeing some further results obtained by the German post office with submarine and land cables insulated with this new dielectric, and these results fully bear out the claims made by the inventor for the favorable qualities of his products.' It is especially worth noting that this official report amounts to a complete confirmation of the extremely favorable properties of the new gutta percha as regards its high insulation resistance and an inductive capacity considerably lower than that of the natural product."

"A DIABOLICAL MACHINE."—An amusing story is told of the failure of an attempt to establish a telephone service at Saint-Etienne des Gres, situated in the Tarascon district of France. The necessary apparatus had been packed all ready to start for the village when the carter heard that the inhabitants, being under the odd impression that the invention was the work of the Evil One, were determined to oppose its entry, and were resolved to arm themselves with their agricultural implements and to make a fight of it. The man said that he was willing to confide his cart and its contents to the electricians, but that as for himself he would not risk his life in such an adventure. A telegram was forwarded to Marseilles asking for instructions, and the reply came that the cart was to be left at Tarascon. What the sequel to the present deadlock will be remains to be seen; but meanwhile the good people of Saint-Etienne des Gres stoutly declare that they will have nothing to do with the telephone, which is "a diabolical machine." Is this another hoax on the provencal district which so bitterly resented Daudet's "Tartarin de Tarascon?"

S. R. A. N. Y.—The twenty-first annual meeting of the Street Railway Association of the State of New York is to be held at the Yates Hotel, Syracuse, N. Y., on October 6 and 7. The meeting is called a month later than usual on account of the close proximity of dates of the American Street Railway Association meeting at Saratoga. In view of the change of dates the Executive Committee of the State association appreciate the necessity of even a more determined effort than they have put forth heretofore to secure the desired large and representative attendance of both street railway and supply men. An unusually interesting meeting is anticipated. Numerous papers upon important street railway subjects will be presented and topics of general interest and profit will be thoroughly discussed. In addition to the business features of the meeting an excellent programme of entertainment, including the annual dinner on Tuesday evening, October 6, has been arranged by the local committee. Mr. G. Tracy Rogers, of Binghamton, is president.

GOVERNMENT OWNERSHIP.—Mr. R. T. Snedeker, of Kansas City, an ardent supporter of the single-tax theory, recently wrote a letter to Charles Francis Adams, of Boston, on the question of municipal ownership of street railway lines. Mr. Adams's letter in reply to Mr. Snedeker is as follows: "I can only say that, as the result of careful official examination on my part, I have never yet found in Europe anywhere a case of municipal or public transportation worthy of an instant's consideration as compared with our own. Whatever complaints you may make of it—private monopoly and all that—we here in America do things in the transportation line which in Europe they do not even dream of. Under the circumstances do not look for sympathy from me in a movement in that direction. The fact is, when it comes to handling private business, any and every government is, in my opinion, utterly incompetent, whether it is water system, schools, railroads, telegraphs, post offices or what not. Every time private enterprise would do it four times as well, at about half the cost. So far as I know, experience is uniform in this respect. Look at our school system. It is one mass of jobbery from beginning to end. The politicians and jobbers are always worming into them. If you are looking for another object lesson, study the Government Printing Office at Washington. Every document published—lumbering, clumsy, useless—costs notoriously twice what it would cost if issued by a private press. And the Post Office. Just look at the system of fraud, bribery and stealing now being brought to light. Please don't talk to me of doing business through governmental machinery. It is one colossal exhibition of waste, extravagance and incompetency."

GERMAN HIGH SPEED TRAINS.—The German Reichstag has voted $70,000 for a new track, to be laid upon the Berlin-Zossen line, for immediate experiments with electric trams. This is the outcome of the late well known experiments, during which a train, for a brief period, attained a speed of nearly a hundred miles an hour.

AN OUNCE OF RADIUM.—According to the *Anglo-Indian Review* it having been calculated that the energy stored up in one gram of radium is sufficient to raise 500 tons weight a mile high, an ounce would, therefore, suffice to drive a 56 hp motor car at the rate of thirty miles an hour around the world. The calculator evidently confused intrinsic energy, with capacity for transforming energy.

MODERN SCIENCE CLUB.—On September 8 there will be a general discussion of the subject of electric elevators before the Modern Science Club, 125 South Elliott Street, Brooklyn, N. Y., and some short papers on the theme are to be read. On September 22 Mr. J. A. Anderson will give a lecture on the Eastern Power Station of the Brooklyn Rapid Transit Company. Mr. R. Henderson is secretary of the club.

WIRELESS TELEGRAPH CONVENTION.—A cablegram from Berlin reports that the delegates of nearly all the countries which participated in the recent International Congress of Wireless Telegraphy in that city, whose sessions were secret, favored international control of wireless telegraphy and advocated that no land station shall refuse to take a message, if comprehensible, from any ship using a system different from that of the company owning the station.

WESTON STANDARD CELL.—In referring to the Weston cadmium cell in an editorial in our issue of August 22 entitled "The Legalized Standard of E. M. F.," by a slip of the pen this cell was stated to be a zinc-cadmium combination. As is well known, in the Weston cell the zinc of the Clark cell is replaced by cadmium, the other element in each being mercury. Correctly speaking, the Weston cell is a cadmium, amalgam-cadmium, sulphate-mercury combination.

A LIGHTNING CONDUCTOR.—An interesting episode is thus noted by the St. Louis *Globe Democrat:* "Some kind of a memorial should be presented to the engineer of the cogwheel railroad on Pike's Peak. Being struck by lightning and stripped of his clothing, he calmly attired himself in a Navajo blanket and continued his duties. We must ever feel an unquenchable admiration for such sprightly unconcern. It is quite customary when struck by lightning to make a great fuss about it; to demand the services of everybody in the neighborhood for our resuscitation and to bring the business we may have had in hand to a dead standstill."

INTERNATIONAL WIRELESS TELEGRAMS.—A special dispatch from Washington, of September 3, says: "The final protocol of the international wireless telegraph conference, held in Berlin last month, was made public to-day at the State Department. Gen. Greely was chairman of the American commission. This commission had no authority to make any agreement for the United States, but the protocol embodies in most of the essential features the views expressed by the American commissioners. Another conference will be held, and if all delegates have full powers the protocol no doubt will be embodied in a treaty for the government of international wireless telegraph communication.

THE RAOUL SUBMARINE.—The Lake submarine boat for sponge and pearl fishing is familiar to Americans. Experiments are now being made at La Goulette, Tunis, with a vessel, invented by Abbé Raoul, the Vicar-General of Carthage. It is made of steel, and resembles a huge porpoise. The entrance to the central chamber is hermetically closed by a heavy lid fastened with screws, and the occupants survey their surroundings through four portholes. A long spear terminating in a grappling hook, worked from the interior, seizes the sponge and deposits it in a net at the side of the vessel. The craft is propelled by accumulators through a cable attached to a vessel on the surface, with which it is also in communication by telephone. It is lighted by electricity, and a lamp hanging in the bow lights up the water bed for the sponge fisher.

EXPLOITING POPOCATAPETL ELECTRICALLY.—It is stated from the City of Mexico that the American syndicate which has just closed negotiations for the purchase of Popocatapetl volcano from Gen. Gasper Sanchez Ochoa plans to spend several million dollars in making their purchase of commercial value. It is said that in addition to the construction of a cog wheel railroad from the base to the mouth of its crater, a hotel will be built on its summit at an altitude of 18,000 feet. The most important adjunct of the proposed enterprise, however, is the establishment of a gigantic electric power plant on Mount Ixtaccihuatl volcano. The syndicate has acquired valuable water rights on the latter, and the power will be transmitted to Mount Popocatapetl and used to operate the cog wheel road and the hoisting machinery which is to be installed to get the sulphur out of the crater. It is also proposed to construct electric elevators in the crater by which sight-seers may descend several thousand feet and get a view by electric light of the great subterranean cavity. An electric elevator running "several thousand feet" would be worth going anywhere to see.

RÖNTGEN RAY TANNING.—It is stated from Cincinnati that experimenting has resulted in the discovery of a process of tanning, by means of which hides can be transformed into leather in a short time by the use of the X-ray. The hides will be soaked in lime for the separation of the fibres and removal of the hair, as is done now. When this has been completed, which usually requires about four days, the hides will be soaked in a solution of certain chemicals, a part of the invention, for about two hours, and will then be exposed to the X-rays for about fifteen or twenty minutes, which will thoroughly tan them. The finishing will then proceed in the way employed at present. Under the new system the chemicals absorbed by the hides during the two hours' soaking are said to be decomposed by the X-ray in less than half an hour. After the hides have been soaked in the solution they are put on a highly polished steel plate and a series of three tubes diffuse the rays upon their entire surface. They remain in this state for about twenty minutes, when they are ready to finish as usual into enamel, patent leather or any desired article. The great difficulty which the inventors met was to obtain a ray sufficiently strong to penetrate the entire hide. Now, twenty hides, one on top of the other, can be "rayed" at once. The inventor asserts that not only will this new process reduce the time necessary for tanning from four months to four days, but it will also reduce the cost of manufacture fully 75 per cent. As if this advantage were not sufficient, it is added that the cost of fitting up a plant necessary for the working of the process is only one-fourth the cost of erecting a plant under the present system.

LETTER TO THE EDITORS.

Wireless Reporting of the Yacht Races.

To the Editors of Electrical World and Engineer:

SIRS:—The history of reporting the recent international yacht races by wireless has demonstrated what was already apparent to most experts—the advantage of powerful apparatus; the incontestable superiority of the telephone receiver over the coherer and tape, and that certain ancient traits of human nature will crop out in any new field of competition.

As was to be expected, the syntonic system of which much has been heard of of late years, seems to have failed more or less completely under the attack of a 10-hp outfit on board a brick schooner. Yet with skilled operators using a responder and telephone, it was possible to easily read either of three different transmitters so long as these differed essentially in spark frequency, speed and style of sending. With the syntonic device which I have been using of late, it is practical to cut out all but the desired signal, or at least reduce the interfering sound to the desired extent. I am at work on further perfections of this method by which all but the most powerful atmospheric disturbances, such as from an electric storm directly overhead, conditions or interference which would render any telephone or telegraph line inoperative, can be cut out from the receiving instrument.

While it is well for lawyers at this time to consider carefully means for prevention of malicious interference with commercial wireless, especially when the interference is on a boat outside the three-mile limit (conditions which will obviously require special and international legislation), it is more fitting for the wireless expert to devote his attention to the technical and scientific remedies rather than to howl for the aid of the law.

The company that had the most to say against wilful interference during the races have been only getting a taste of their own medicine; when news of as vital and widespread interest as that of the *Erin's* approach to these shores was being received at our Coney Island station, the Marconi operator at Babylon kept his key depressed for minutes at a time in a futile attempt to break up communication.

Our stations at Block Island and Point Judith, through which the *Providence Journal* is publishing a daily newspaper on Block Island, frequently note apparent attempts at unnecessary interference from Sagaponack and Nantucket, yet the service there has been maintained from the start uninterrupted by these neighbors or by any passing boats, and from 2,000 to 4,000 words are transmitted regularly each night.

The same brick schooner tactics, more relentlessly pursued than at the yacht races, have been practised at the Chicago stations of the English company for some time, and it is not without thought of the Pharisees' unworthiness to "cast the first stone" that we listen to the charge of unfairness.

The past two years has demonstrated that the De Forest system has little to fear from interference from stations in legitimate commercial rivalry, and the yacht race incident has furnished in this country an object lesson similar to that which Mr. Maskelyn has recently contributed in England. It should serve as a stimulus to more refinement in wireless syntony and courtesy than practice has in some cases hitherto shown.

New York City. Lee De Forest.

DIGEST
OF
Current Electrical Literature.

Dynamos, Motors and Transformers.

Dielectric Hysteresis Loss and Capacity of High-Tension Machines.—Holitscher.—A long article, in which the author gives the results of an investigation to determine the hysteresis loss in the micanite tubes of high-tension machines, carried out with a 500-hp polyphase synchronous motor of 10,000 volts. The method consisted in connecting one terminal of the high-tension winding of a transformer with the iron of the machine to be tested, while the other terminal is connected to the coils of the machine. The individual phases are arranged parallel to each other at the connected end, while the other end is left open. The machine acts like a condenser, one layer of which is represented by the iron surface of the slots, while the other layer is formed by the copper coil, and the dielectric by the micanite tubes. The experiments were carried out at 53.3 cycles, with voltages varying from 5,000 to 21,500 volts. The watt losses in the low-pressure winding of the transformer were measured, and after disconnecting the machine, the iron losses of the transformer and the losses in the measuring instruments were measured under the same conditions. By subtracting these, the hysteresis loss of the machine under investigation at the different pressures is found. The author gives the results of his investigation in detail, with the curves. He finds that the losses are approximately proportional to the number of periods, and a loss from leakage by conduction can be neglected relatively to the hysteresis loss. The capacity and therefore also the dielectric constant of the material under investigation (micanite) is absolutely not a constant quantity. It changes with the electrostatic load within appreciable limits. On account of the lack of knowledge of the variation of the capacity, the increase of the dielectric hysteresis loss with increasing potential cannot be determined in advance. The usual law, hysteresis loss $= C E^2$ only has a limited application, with materials the capacity of which does not change, or with small electrostatic loads. In high-pressure machines with micanite tubes, the dielectric hysteresis loss at higher strains of the micanite is approximately proportional to the third power of the tension. In the determination of the efficiency of a high-tension machine, the dielectric hysteresis loss can be neglected, as the materials are mostly quite thick on account of safety against perforation; the strain is, therefore, small.—*Elek. Zeit.*, August 13.

Hunting of Alternating-Current Machines.—Hopkinson.—The conclusion of his article previously noted in the Digest. The theoretical results developed in the first part have been confirmed in a general way by experiments on a small alternating-current motor, separately excited. The various constants of the machine were determined and it was found that with the motor connected directly to the 94 to 98 volts, 50-cycle mains, it should be expected to be violently unstable; this was found to be the case. When the machine was connected directly to the mains as a motor with an exciting current of 30 or more, it very rapidly developed oscillations and finally dropped out of step altogether. The oscillations occurred just the same whether a large or small generator was working at the power station. They were not affected by putting heavy rings of copper around the pole-pieces in addition to the field winding. It was only by reducing the field current to 13.5 and loading the machine with a brake until the applied power was about 1,800 watts, that the "hunting" could be stopped. By inserting self-induction in series with the motor, the violence of the "hunting" could be gradually diminished; and at the same time its period could be gradually increased from about 0.35 to 0.45 second. With external self-induction giving a total reactance of about 3 ohms and resistance of 1.2 ohms, the stability depended on the load and on the exciting current; particulars of the experiment are given. Measurements and calculations of the coefficient of instability and the damping coefficient are given. The effect of increasing the dimensions of the machine on the results obtained is also discussed.—Lond. *Elec.*, August 14.

References.

Design for a 1-Hp Self-Starting, Single-Phase Induction Motor.—An illustrated article giving all the essential features of a self-starting induction motor capable of giving one brake horse-power on a single-phase circuit of 100 volts and 125 to 133 cycles, the speed of the machine depending, of course, primarily upon the frequency of the supply current. The synchronous speed at 125 cycles is 3,750, and at 133 cycles it is 6,400 r.p.m. The drawings are all dimensional, and all the information necessary for the construction of the motor is contained in the article.—*Amer. Elec.*, August.

Construction of Direct-Current Machines.—Dick.—A mathematical article, in which the author lays down some conditions and formulas, which illustrate in a comprehensive manner the changes in the dimensions of the armatures with different numbers of poles, assuming a certain coefficient of air-induction and a certain form of the pole shoes.—*Zeit. f. Elek.*, August 16.

Management of Alternating-Current Machinery.—Hanchett.—A popular discussion about running alternators in series and parallel.—*Central Station*, August.

Speed-Regulation of Direct-Current Motors.—Rogers.—A review of several methods for speed control of stationary and traction motors.—Lond. *Elec. Eng.*, August 14.

Power.

Electrical Plant Failures, their Origin and Prevention.—Campbell Cormack.—A paper read before the English Institution of Mining Engineers. The author gives an analysis of the break-downs which have occurred to several thousand electric machines ranging in size from an 800-kw dynamo to a ½-hp motor, the period of observation extending over about four years. He gives a table showing the relative frequency with which various portions of dynamos and motors were damaged, when break-downs occurred. He finds that the mechanical portions were responsible for 25.05 per cent., the brush-gear, terminals, connections, etc., for 7.01 per cent., the field magnet coils for 10.16 per cent., the armatures for 78.15 per cent. and the commutators for 33.6 per cent. When the accident was of a compound nature, several parts being injured, each is included in the table. The failures of the armature constitute the largest item. 29

per cent. under this heading being due to burning out, 19.5 per cent. were due to earthing through failure of insulation of the frame, and 15.6 per cent. to breakage of the wire. A second table shows the portions of the machines at which the break-downs originated, or the portions which, by being faulty, caused the break-down. The items include mechanical portions, 11.03 per cent.; brush gear, leads and terminals, 8.6 per cent.; field magnets, 8.58 per cent.; armature, 47.87 per cent.; commutators, 14.9 per cent.; starters, 4.7 per cent.; unknown, 3.13 per cent., and various, 1.56 per cent.; these, except the last three, are still further subdivided. A third table shows the causes to which derangements were due, 39.36 per cent. of which are attributed to constructional causes, including 18.36 per cent. of bad design, 7.4 per cent. perishing of insulation, and 13.6 per cent. bad workmanship; 3.71 per cent. are conditional causes, 1.37 per cent. of them being due to overloading, 1.56 per cent. to overrating, and 0.78 per cent. to unsuitability. Maintenance is credited with 31.46 per cent. of the causes, among which are dust and dampness, 7.4 per cent.; rough usage, 1.56 per cent., and defective attention, 22.5 per cent. There are 7.05 per cent. accidental and unavoidable causes, with reasonable care in construction and working, unknown causes, 13.1 per cent., and 5.48 per cent. caused by faults in accessories. The author states that the great majority of the faults in design appear to be in the electrical portions of the machines, and for the most part take the form of supplying too little insulation, insufficient insulating ridges, and improper arrangements for supporting the conductors and their insulation. The author is afraid that, owing to the stress of competition, a number of designers sacrifice to a great extent reliability to cheapness, particularly in the case of small and medium-size motors, the tendency being to design machines having higher rises of temperature than experience has shown to be compatible with reasonable durability of the machine. The author states that these statistics are compiled from machines, the superintendence of which is somewhat better than the average, and, owing to the elimination of a number of very bad machines, the plants are considerably better than the average. The results are discussed in detail.—Lond. *Elec.*, August 14; reprinted in *Eng. News*, September 3.

Electrical Driving of Winding Gears.—Hird.—A paper read before the recent London meeting of the English Institution of Mining Engineers. The author first discusses the Siemens-Halske system of electric hoisting, in which a battery of accumulators is used as an equalizer of the load. He then describes in detail the Siemens-Ilgner system, which makes use of a high-speed fly-wheel to provide the necessary storage of energy. The system consists of the following parts: 1, a motor capable of furnishing the average power required by the winding gear; it may be a three-phase induction or direct-current motor; 2, a direct-current generator, which furnishes the current for this motor, the machine being so arranged that the excitation of its field is variable from its full maximum through zero to its maximum in the opposite direction. By this means the supply voltage to the motor can be varied through the same range; 3, a small direct-current machine serving as exciter for the generator and the winding-gear motor. This special exciter is necessary to insure stability of the field, which could not be attained through such a wide range if the generator furnished its own exciting current; 4, a heavy steel fly-wheel, specially designed for high-circumferential speeds, so as to store a large amount of energy in proportion to its weight. The current from the generator is taken directly to the armature of the motor driving the winding drum, without passing through any switches, fuses or controlling gear. It is claimed as one of the special advantages of this system that no manipulation of the heavy main current is required, the whole of the control being effected by light switching gear dealing only with the small currents for exciting the field magnets. An ingenious automatic system of regulating the speed of hoisting, providing amply for security and guarding against misuse or negligence, is described at length. The action of the fly-wheel, being an important feature of the system, is discussed. When the lift commences, the power is at first supplied entirely by the generating station, but as soon as the demand has become greater than the average, the motor generator begins to slow down and its fly-wheel furnishes the excess of power required; as soon, however, as the demand for power has again fallen below the average, the motor-generator begins to speed up again, storing energy in its fly-wheel. It continues to do so after the completion of the trip and before the next lift begins, drawing this power from the generating station and providing it with a load during the period of rest. The author then takes up the question of steam consumption, actual trials of steam hoisting engines having shown a consumption of 114 to 77 pounds per effective hp hour under ordinary conditions of operation. With a fair average steam consumption of 20 pounds of steam per electrical hp-hour and assuming an efficiency of only 50 per cent. of the motor-generator, he deduces for the Siemens-Ilgner system a steam consumption of only 40 pounds of steam per effective hp hour of the useful load. No negligence of the operator can appreciably affect this figure, as the steam distribution in the cylinders is entirely beyond his control. The author states that broadly speaking the cost of an electrical winding plant, with motor generator and all controlling devices, would be about the same as that of a good modern steam winding plant of the same capacity.—Lond. *Elec.*, August 14.

Electric Motive Power in Mines and Collieries.—Scott.—A long abstract of a paper read before the South Wales and Monmouthshire Institute of Engineers. The author reviews in general the conditions of electric motive power and calls attention to the employment of a suitable starter. The question of insulation is then taken up and the author states that during many years of experimenting he has found cables insulated with bitumen to answer best for mining purposes. Motors are then discussed and it is stated that the polyphase type of motor best suited for mining purposes was the induction motor. The squirrel-cage motor had been advocated for all mining work, but in the author's experience, for motors over 10 hp, the slip-ring motor with cased brush gear, was far more satisfactory, and the additional risk introduced by the slipping was practically negligible. As to the best type of generating plant suited to colliery work, the type of engine most favored by engineers is stated to be the horizontal slow-speed coupled compound. The pros and cons for high or low-speed engines are discussed at length, as is also the question at which distance from the boilers it becomes better practice to adopt an electric motor in place of a steam engine. The approximate cost of generating electric power is then taken up and figures obtained in actual practice on a large scale are given. The other incidental advantages of the use of electric power are set forth in conclusion.—Lond. *Elec. Eng.*, August 14.

Boring and Turning Mill for Electric Generators.—A well-illustrated description of a tool recently built for the Allgemeine Electricitäts Gesellschaft, Berlin, and specially designed for large dynamo work. Dynamo housings to be turned are mounted on an outer base plate, which surrounds a rotating face plate with four tool-carrying columns. In turning armatures, the arrangement is reversed, the armature being bolted to and rotated with the face plate past the stationary tools which are now transferred to the outer fixed plate. All the setting and feeding motions are accomplished by electric motors. In order to be able to center a housing, without applying pressure to it and thus cause a deformation, an arrangement is made by which the face plate on which the housing rests can be moved in any direction.—Lond. *Eng'ing*, August 14.

REFERENCES.

Simple Prony Brake.—An illustrated article describing a very simple and substantial form of Prony brake.—*Amer. Elec.*, August.

Motor-Driven Mine Hoist.—An illustrated description of a small, compact and portable machine. The motor is of 7½ hp, 220 volts, drawing at full load a current of 30 amp. The controller allows twelve speeds in either direction.—*Eng. & Min. Jour.*, August 29.

TRACTION.

New Single-Phase System for Electric Traction.—An article describing the Westinghouse installation for the Baltimore, Washington & Annapolis Electric Railway. The type of motor is similar in general construction to a direct-current motor, but with its magnetic circuit laminated throughout and with such properties that it can successfully commutate alternating current. Curves for the power factor, the efficiency, the armature speed and the torque are given. The motor is a plain series motor, which can be operated on either alternating or direct currents and will have the same torque characteristics in either case. Single-phase, alternating current will be supplied in the operation of the road to the car at a frequency of 16⅔ cycles per second, the current from the overhead trolley wire being normally fed by one trolley at approximately 1,000 volts. The alternating current to the car is carried through a main switch or circuit-breaker on the car to an auto-transformer, connected between the trolley wire and the return circuit. At approximately 300 volts from the ground terminal, a lead is brought out from the auto-transformer and passes through an induction regulator to one terminal of the motors. For starting and for controlling the speed, the regulator is used with its secondary winding in series with the motors. This secondary circuit of the regulator can be made to add to or subtract from the transformer voltage, thus raising and lowering the voltage supplied to the motors. The range of voltage at the motor is to be varied from 200 up to 400 volts, or slightly higher. The transformer will supply 315 volts and the secondary regulator circuit will be wound to generate a maximum of slightly more than 100 volts. There will be four motors of 100 hp each on each car, the full rated voltage of each being approximately 200 volts. They will be arranged in two pairs, permanently connected in parallel, each consisting of two armatures in series and two fields in series. To insure equal voltage to the armatures in series, an equalizing action is obtained by the use of a small auto-transformer, connected permanently across the two armatures in series with its middle point connected between them. The fields are arranged in two pairs, with two fields in series and two in multiple. This parallels the fields independently of the armatures, so that one reversing switch may serve for the four motors and one balancing transformer may be used across the two pairs of armatures. The armature and field being connected in series, the entire current of the field passes through the armature as in series direct-current motors. The motor has eight poles and eight field coils, the latter wound with copper strap. The speed is approximately 650 revolutions at 200 volts. The difficulty of sparking has been overcome by so constructing the motor that the secondary or short-circuit current in the armature coil is small, and the commutating conditions so nearly perfect that the combined working and secondary currents can be commutated without sparking. The induction regulator or controller resembles an induction motor in general appearance and construction, the primary winding is placed on the rotor and the secondary or low-voltage winding on the stator. The rotor also has a second winding, which is permanently short-circuited on itself, its function being to neutralize the self-induction of the secondary winding as it passes from the magnetic influence of the primary.—*St. R'y Rev.*, August 20.

Modern Railway Power Station.—Viall.—An illustrated article describing the new high-tension, alternating-current installation of the Berkshire Street Railway Company. Three-phase current of 13,300 volts is generated at the central station at Pittsfield and transmitted directly to the transmission lines without the use of step-up transformers; one sub-station is 10 and the other 25 miles distant. This current is stepped down to 380 volts for use at the two 300-kw rotaries in the main station and two 250-kw rotaries in each of the two sub-stations, which deliver direct current at 600 volts to the trolley wire. The main generating units comprise two 750-kw, three-phase, revolving-field alternators delivering current at 25 cycles per second. Each alternator is excited by its own exciter set, consisting of a 20-kw, 125-volt, direct-connected generator. The electrical equipment of both of the sub-stations is identical. The transmission lines which are in duplicate are all bare copper wire carried on two cross arms, one circuit being carried on each side of the pole. Each circuit is arranged in the form of an equilateral triangle with sides 18 in. long. The insulators for the high-tension lines are of glass, having 7½-in. petticoats and supported on steel pins with glass sleeves. An electric signal system is described in detail, which is used on the line to show whether the section to the next turn-out is free or not.—*Amer. Elec.*, August.

Combined Railway, Lighting and Ice Plant.—An article describing the power plant of the Norfolk, Portsmouth & Newport News Company, at Hampton, Va., which combines a railway, lighting and ice-making station. The station is designed for a capacity of 2,625 kw in generating machinery and two 40-ton refrigerating machines. There are three alternating-current machines aggregating 1,300 kw. and two railway units with space for a third, giving a total of 1,325 kw. The smaller railway set comprises a tandem-compound engine and a direct-connected, 325-kw generator run at 100 r.p.m. The second railway unit has a cross-compound Corliss engine and a 500-kw generator at 90 r.p.m., while the third unit, which is yet to be installed, will be of the vertical type and of 500-kw capacity. Three alternating-current generators furnishing current at 3,450 volts and aggregating a capacity of 1,300 kw, comprise the lighting and power outfit. One cross-compound engine operating at 120 r.p.m., and two tandem-compound engines running at 150 r.p.m., are directly connected to these lighting machines.—*St. R'y Jour.*, August 15.

Utica & Mohawk Valley Railway.—An illustrated description of the system. At the Utica sub-station there are three 550-kw, oil-insulated, self-cooling transformers connected in delta, which reduce the 20,000-volt current to 360 volts, at which pressure it is delivered to one 500-kw and two 300-kw rotary converters. The rotaries operate over a common set of bus-bars and have no choke coils or inductance in the alternating-current leads. They deliver 600 volts direct current, which is sent out to the trolley line. In case of trouble, any transformer can be disconnected and the rotaries operated on the remaining two transformers connected in V. The arrangement of the apparatus in the other sub-stations is similar.—*St. R'y Jour.*, August 29.

Motor Trucks for the New York Subway.—An article describing and illustrating the design of the motor trucks for the subway equipment of the Interborough Rapid Transit Company of New York. Three hundred and fifty of these motor trucks will be built for the initial installation; half of them will carry Westinghouse and the other half General Electric railway motors, of 200 hp. Nose suspension will be employed in all cases, with a different arrangement, according to the construction of the motors. Particulars of this construction are given. The trucks will be unusually heavy and have been especially designed for severe service.—*St. R'y Jour.*, August 15.

Pneumatic and Electric Locomotives in and About Coal Mines.—Ackermann.—A short paper, with discussion, read before the recent meeting of the English Institution of Mining Engineers. The author enumerates the advantages of the electric locomotive as compared with the pneumatic; it is smaller, the installation of the system is easier and its efficiency is considerably higher than the latter. In the discussion a member mentioned the fact that he had replaced a 70-hp compressed air pump by a 12-hp electric pump and the latter did three or four times as much work as the former.—Lond. *Elec.*, August 14.

REFERENCES.

The Hudson Valley Railway.—A description of this line, whose power equipment comprises five generating stations, combining water and steam plants, and six sub-stations.—*St. R'y Jour.*, August 29.

Shock from High-Voltage Locomotives.—An editorial discussing the possibilities of receiving shocks from high-voltage locomotives when the latter are run on rails which are covered with sand or otherwise partly insulated; in such a case there is a dangerous voltage between the frame of the locomotive and the ground, and persons entering the locomotive are liable to receive shocks.—*St. R'y Jour.*, August 22.

Progress in Underground Electric Railways in London.—A short sketch of all of the underground electric railways in London, and particulars of the power station of the Metropolitan Railway, which is distinct from that of the Metropolitan District Railway. The station will contain four 3,500-kw steam turbines, directly-connected to generators, and provision has been made for an extension to contain two more sets. Power will be distributed at 11,000 volts without the use of step-up transformers.—*St. R'y Jour.*, August 29.

The Electric Motor as Railroad Motor.—Niethammer.—A short review of recent practice.—*Zeit. f. Elek.*, August 16.

Overhead Construction for Traction Work.—Welter.—An illustrated description of the overhead arrangement adopted by the Traction Company at Hagen, Germany. The profile adopted for the wire has a broad, flat shape. Protective measures taken against contact with telephone wires are described, as is also a complicated construction at a railroad crossing.—*Elek. Zeit.*, August 13.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Possible Economies in Central Station and Distributing Systems.—Dawson.—An article considering the general trend of modern practice in Europe and America. The author (who is an Englishman) points out that there are two directions in which improvements can be made in the future, one in the existing machinery and in the addition of labor-saving appliances; the other, in radical changes in the system, as for instance in the use of steam turbines, gas engines or possibly gas turbines, in place of reciprocating engines. Most of the labor-saving appliances in common use have originated in the United States; among them are coal and ash-handling apparatus, which is now considered a necessary adjunct of any large station. Mechanical stokers are also generally used. In Great Britain the moving chain stoker is the most popular. Continental practice inclines toward hand stoking on account of the cheapness of labor.

The boilers show no great change from former practice. In Great Britain the water tube boiler is very popular and at present about 30 per cent of the stations use a horizontal boiler of this type. In the United States this boiler is also used widely, but vertical water-tube boilers are also employed. On the continent boiler practice differs radically from that in the two other countries mentioned, and two-story boilers are usually employed. Mechanical draft is popular in America, although by no means universal; the author believes that its use is spreading in England. British and American practice lean strongly toward vertical engines; the standard engine for both countries is a vertical cross compound, while in Germany the horizontal engine is more popular. American and British engines are simpler in construction and the Corliss valve is largely employed, while on the continent the poppet valve is more generally used, largely because superheated steam is employed to a greater extent, and the German and Swiss engines are characterized by more complicated and intricate valve gear than in Great Britain and America. The relative advantages of superheated steam and the researches made with lubricants and packing which will stand the higher temperatures of superheated steam, are then discussed, and some tests with superheated steam are given. Steam turbines are coming into use; their advantages over reciprocating engines are given. Cooling towers are more usual abroad than here. In continental practice auxiliaries like pumps and exciters are more generally directly connected to the main engines, but the author prefers the American practice of independent auxiliaries as a rule. On the continent storage batteries are more general partly because triple-expansion engines are more generally used, and these do not give their best results under variable loads. Gas engines are more common on the continent than in Great Britain or America. The question of direct-current voltage is discussed. On the continent 750 volts are used, but it is questionable whether there is any material advantage gained thereby in view of the additional difficulties introduced in the design of railway motors. He refers briefly to polyphase traction; while it is used in Europe, the success has been due largely to local conditions, owing to the number of trains being small, the repairs are not an important item, and as water power is used, waste of energy is not felt. Engineers in Great Britain and the United States are looking forward, however, to the design of a practical alternating-current motor, especially a single-phase motor.—*St. R'y Jour.*, August 29.

High-Pressure Oil Switches.—Benischke.—A paper read before the German Electrotechnical Society. The author has found that two conditions have to be fulfilled, when large currents are interrupted under oil; first, no air must be allowed to get to the interruption spark, and second, the oil must enter with a certain pressure between the contacts, at the moment, when the current is interrupted, whereby the arc is suppressed at the moment it is generated. If these conditions are not considered, it may happen that such a large amount of oil is carbonized between the two contacts; that a conducting bridge is formed. The author fulfills these conditions in an apparatus constructed by him and illustrated diagrammatically in the adjoining figure. The leads are introduced through the lid of the case of the switch and are connected by the piece, *M*, when the switch is closed. The opening of the switch takes place by moving *M* downward, whereby the current is interrupted simultaneously at both contacts, *K*. A wooden plate, *P*, is connected to the piece, *M*, which, when the latter is pushed down, pushes the oil up towards the contacts, thus breaking the arc before it has reached a length of 2 to 3 mm. The carbonizing of the oil and the burning of the contacts is thereby reduced to a minimum. A description and illustration of a switch embodying this principle are given, together with an account of tests to which it has been subjected.—*Elek. Zeit.*, July 30.

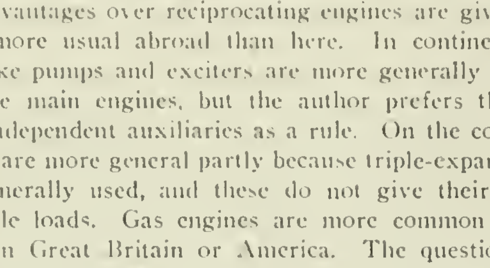

DIAGRAM OF OIL SWITCH.

Wimbledon, England, Electricity Works.—A well-illustrated description. Steam power is furnished by water-tube boilers, two of which are heated by four refuse destructors. The generating plant consists of five sets of alternators, 3 of 120 kw each and 2 of 350-kw capacity each. They furnish 2,250 volts at full load at 50 cycles. The engines are of the three crank compound type, directly-coupled by flanged fly wheel couplings. The transformers in the sub-stations vary from 10 to 50 kw capacity, and step the current down to 440 volts across the outer wires of a three-wire distribution system.—Lond. *Elec. Rev.*, August 14.

REFERENCE.

Construction of Connections and Switches.—Edler.—A paper presented before the Electrotechnical Society of Vienna. The author gives a method for the calculation of switching devices, where a number of connections have to be made. This object is to do away with the usual method of laborious trial. He demonstrates the method by the calculation of a number of examples, some of them more or less intricate. Diagrams illustrating the connections are given.—*Zeit. f. Elek.*, August 2 and 9.

ELECTRO-PHYSICS AND MAGNETISM.

Atmospheric Electricity Considered from the Standpoint of the Theory of Electrons.—Ebert.—A paper read before the Swiss Society of Natural Sciences. From balloon experiments carried out by himself and others, the author deduces that the electronic charge, or the number of electrons, generally increases very rapidly with the altitude, so that a proportionally very high degree of electrical conductivity for the highest strata may be assumed, and indeed must be assumed if phenomena like the Aurora are to be explained. In the lower layers of the atmosphere there generally is found a preponderance of the positive charges, apparently due to the fact that the terrestrial globe is itself negatively charged and therefore attracts the positive electrons. For this reason there is a preponderating number of positive electrons present above mountain summits, where the density of the terrestrial charge assumes a particularly high value. When a balloon enters a new stratum of air, there is also observed a sudden change in the electronic charge and also in the proportion in which the positive and the negative charges are mixed in these strata. Therefore, just as each stratum is characterized by a certain temperature and moisture, so it is also characterized by certain electric properties, which seem to be conditioned chiefly by its origin. Of special importance is the fact that the aqueous vapor condenses more readily upon the negative than upon the positive electrons, and consequently that during progressive condensation the negative particles are precipitated first, followed by the positive. The charge of free electrons present in a layer of air in which condensation has just begun, must be of great importance in the formation of clouds in that stratum. The author also gives an explanation of the electric charges in the clouds and investigates the problem of the permanent charge of the earth and the existence above it of a field of electrical tension.—*Meteorologische Zeitschrift*; reprinted in *West. Elec.*, August 8.

Dielectric Cohesion of Gases at Different Temperatures.—Bouty.—The author studied the variation of the dielectric cohesion of various gases with the temperature. He concludes from his measurements that the variation, if it exists, can certainly not surpass 1/100 between the ordinary temperature and 190° C. This result holds not only for air, hydrogen and carbonic acid, but also for gaseous mixtures such as those of hydrogen and carbonic acid or hydrogen and oxygen, for which the dielectric cohesion, measured at ordinary temperature, is very sensibly inferior to the mean of the dielectric cohesion of the mixed gases. The author thus arrives at the remarkable law that the dielectric cohesion of a gas or a mixture of gases, depends only upon the average distance of the molecules, as long as the molecule or the molecular groupings are not altered. At constant volume, the dielectric cohesion is independent of the temperature; at constant pressure it varies inversely to the absolute temperature.—*Comptes Rendues*, Tome 136, p. 1646; abstracted in *L'Eclairage Elec.*, August 8.

REFERENCE.

Röntgen Rays.—Kueppers.—An illustrated description of several recent apparatus and appliances in the X-ray practice for medical purposes.—*Elek. Anz.*, August 2.

ELECTRO-CHEMISTRY AND BATTERIES.

Iron and Steel Production in the Electric Furnace.—Goldschmidt.—A long, well-illustrated paper, read before the recent Congress of Chemistry in Berlin. The author reviews in detail the Stassano process, repeatedly mentioned in the Digest. Calculations of the charge for this furnace and the methods of operation are given, and also a detailed statement of the cost of production. The furnaces of Héroult and Keller are described and illustrated. Héroult uses two arcs, each working with 4,000 amp. at 60 volts alternating current. The weight of each melt is about 3 tons and several charges are finished in one day. The Kjellin furnace is also illustrated and a detailed statement of the cost of melting a ton of steel is given. A very complete bibliography of the subject is given at the end of the article.—*Zeit. f. Electrochem.*, August 6.

Determination of Molecular Weight at Very High Temperatures.—Nernst.—A paper read by this well-known physical chemist before the recent Congress of Applied Chemistry in Berlin. He determines the molecular weight of substances by vaporizing them at about 2,000° C., in an iridium furnace, which receives about 2,000 to 3,000 watts from the thick wire winding of an oil transformer.—*Zeit. f. Electrochem.*, August 6. (This furnace is presumably the one illustrated and described by that author in his paper before the American Electrochemical Society and published in the *Transactions*, Vol. III, p. 75.)

Units, Measurements and Instruments.

REFERENCE.

Radiating Rheostat.—Souli r.—An illustrated description of a rheostat composed of a German silver wire, wound in the form of a spiral on an insulating frame, and dipped into a non-conducting liquid like oil. The vessel containing the oil is constructed of a corrugated iron casting, in order to obtain a larger radiating surface. —*L'Industrie Elec.*, August 10.

Telegraphy, Telephony and Signals.

Telegraphy by Electric Rays.—Blochmann.—A popular, illustrated description of the author's system of telegraphy by the electric rays. He uses lenses formed of a substance with a high dielectric constant, such as rosin, glass or paraffine. The generating and receiving apparatus are enclosed in metallic casings, in the front of which such a lens is arranged, so that the electric rays have to pass through them. The lenses concentrate and direct them. The author states that he has succeeded in sending telegrams over a distance of over 1 km., with lenses 80 cm. in diameter and waves of 20 cm. length, which required less than one kw.—*Rev. Gen. des Sciences*, August 15.

REFERENCE.

Electric Signalling.—Walssoe.—An abstract with diagrams, of a description of the author's signal system, to transmit the positions of the mechanical line signals to the office of the station master for control purposes.—*Elek. Zeit.*, August 14.

New Books.

Public Lighting by Gas and Electricity. By W. T. Dibdin, F. I. C., F. C. S. New York: D. Van Nostrand Company. 537 pages, 216 illustrations. Price, $8.00.

A vast mass of information is included within the covers of this portly volume. Not all of this information is of the same value, or, rather, no one reader is liable to find all parts of this book of equal value to him. Mr. Dibdin's strongest suit is evidently practical photometry, and in this department he gives complete details of all the photometers now in use, together with much information concerning the effective use of each kind of photometer.

His discussion upon the different forms of gas burners, with their relative advantages and drawbacks, is also interesting and suggestive, especially as he often points out what is too frequently forgotten, namely, that each kind of burner is best adapted to one single set of conditions and that it does not at all follow that a burner which is economical in one case will be so in others. Accompanying, and often mixed in with, the practical part of the work is a great deal of discursive information on the English gas situation, including, however, many valuable tables and excerpts from official reports.

The portion of this work which deals with electricity does not seem to be either so authoritative or so valuable as that which deals with gas lighting. Some seventy pages are given up to a description of dynamos, motors, transformers and circuits, which is quite elementary, not to say amateurish, in its character, and these chapters might either have been altogether omitted or condensed into an introductory note of two or three pages. When the author comes to consider the economical efficiency of different kinds of electric light he reaches much firmer ground, though even here he conveys the impression that in practical theory as well as in broad grasp of the engineering principals which underlie the dispersion of power in the form of light, the English standards in electric lighting are considerably behind those of the larger central stations in the United States. As presenting, however, a view of English central station engineering, the work is of interest, and much instruction will be found in the sections above referred to treating of practical photometry and the efficiency of the electric light.

A Treatise on Electromagnetic Phenomena. The Compass and Its Deviations Aboard Ship. Vol. II. By Commander T. A. Lyons, U. S. N. New York: John Wiley & Sons. 580 pages, 203 illustrations. Price, $6.00.

The first volume of this work, which was reviewed in these columns, was occupied by the subject of "Electromagnetic Phenomena," which was designated as "Part I." The present volume contains five more parts, all of which pertain to the compass. This arrangement agrees with the title, but it seems to be an unique plan in book writing. The author justifies this plan on the ground that "all the matters dealt with affect the compass either proximately or remotely." In other words, the general information contained in the first volume is intended as a preparatory course of study, so as to enable the reader to understand the second volume, which treats specifically of the compass.

The author has certainly collected a large amount of information about the compass, and made a volume of pleasing appearance. His treatment of the subject is somewhat diffuse, but he justifies this, more particularly in connection with mathematical formulas, by the statement that "although the skilled mathematician may prefer the curtailed treatment, still it is thought that many others would rather have the easy transition than elegant brevity." One peculiarity of the author's style is the lavish use of capitals, reminding one of the "Fables of Aesop," and a correspondingly frequent use of italics.

The volume opens with an "Historical Sketch" of the compass, in which the author very pertinently says that every country, ancient and mediæval, has laid claim to the invention of the compass, and furthermore, that various writers have undertaken to sift the evidence, but with a result usually tinged with the bias of the writer. The construction of the ship's compass as used in the United States Navy is next considered, both as to actual construction and mechanical and magnetic principles involved.

"Part Third" treats of "The Ship a Magnet." "Part Fourth" of "The Mathematical Theory of the Deflections," "Part Fifth" of "Swinging Ship and Compensation of the Deviations," and "Part Sixth" of "Various Matters bearing on the Main Subject." It will be seen from this that the compass is very thoroughly discussed in all its relations. In fact, the book gives evidence of wide and somewhat careful reading, and, on the whole, good judgment in compiling; in some cases, however, the author's treatment of a subject is disappointing and does not come up to what one would expect from the writer of such an ambitious work. For example, the remarks on potential, in Part Sixth, which are accompanied with abundant references to standard works, lead one to expect an eclectic definition of potential formulated by taking the best from each of the classic writers; but the definition given is "The word potential indicates generally the condition to which it is applied—the power to do work"—which, although it may be true, conveys a minimum of information. After giving the equation of Laplace in its usual symmetrical form, the author says "This expresses mathematically the fact that the function V changes by the smallest amounts possible in the directions of the co-ordinate axes; it is, therefore, exactly applicable to the potential condition." The reviewer is not certain that he understands just what this means, but it certainly is not a lucid exposition of the meaning of the equation of Laplace. The equation of Laplace is an analytical statement of the fact that the sum of all the inward fluxes through a given closed surface is equal to the sum of all the outward fluxes through the same surface at the same time. That is, that the total flux, algebraically reckoned, is zero. This is equivalent to the statement that central forces and other physical quantities which have a potential, act like incompressible fluids. Further on the book states that to apply the equation of Laplace practically, its development into a series must be employed. This statement is entirely too broad. There are many cases where we have the solution of the equation in algebraic terms of finite number.

Elektro Metallurgie des Nickels. Von Dr. W. Borchers. Halle: Wilhelm Knapp. 36 pages, 4 illustrations. Price, 1.50 marks.

This book is not at all up to the standard set by previous books in this series, and is open to serious criticism in several particulars. It is manifest that the author has inflicted his own "ego" obtrusively on every one of the thirty five pages of the pamphlet. Practical achievements of Americans are neglected while "paper" processes of foreigners are given undue prominence. In America, for example, there have been two electrolytic nickel processes that have each produced several hundred thousand pounds of "electro nickel," assaying Ni 99.50 per cent. or better, which metal has been sold for commercial purposes. The reviewer refers to the process of the Canadian Copper Company, developed by Mr. David H. Browne, and that of the Balbach Smelting & Refining Company, developed by Messrs. F. A. and Wm. Thum. A careful perusal of the book finds no mention of these processes, and the index shows neither the name Browne nor Thum. The process of a certain Herr Guenther, who had the advantage of studying at Aachen, receives much attention, to the exclusion of the work of the above-mentioned electrometallurgists, who have demonstrated processes to their credit. However, the book contains some information of a theoretical nature and might be of use to him who knows how to read "cum grano, NaCl."

Electrical Problems. By Prof. William L. Hooper. Boston: Ginn & Company. 170 pages, illustrated. Price, $1.25.

This is intended for a text-book for electrical classes in colleges, and the problems contained are well chosen from the different branches of electricity. Beginning with the simpler applications of Ohm's law as usual, they proceed to inductance of coils, capacity of condensers, thermo-electricity, electro-chemistry, efficiency of batteries, generators, motors, etc. Then alternating currents are taken up, the problems including cases of constant and varying values of resistance, inductance capacity and frequency. The next set of problems relates to calculating winding tables and making drawings for direct and alternating-current armatures, and to armature reactions, field windings, etc. The last set of problems relates to the winding and operation of transformers, rotary converters and induction motors, and to the testing of dynamos and the transmission of power.

There is a wire table for "B. S. G." sizes, evidently meaning B. & S. G., giving the diameters in mils and millimetres, areas in circular mils and square millimetres, weight in pounds per 1,000 ft. and kilograms per kilometre, resistance per 1,000 ft. and per kilometre at 0, 20, 40 and 60° C. It is not stated on what data this table is calculated, but probably, so far at least as specific gravity is concerned, the data are substantially the same as for the much-quoted table of the American Institute of Electrical Engineers, for although most of the weights given do not agree in the two tables, the difference is as likely to be one way as the other. The resistances are in nearly the same category, some being lower in this table and some in the Institute table. The differences appear to be chiefly due to errors in the calculations, for, as already stated, they are pretty evenly balanced between positive and negative. These errors in all probability exist in both tables.

Das Elektrische Kabel. By Dr. Phil C. Baur. Berlin: Julius Springer. 327 pages, 72 illustrations. Price, 8 marks.

This is a book upon electric cables. It is limited to a description of the materials used and methods employed in insulating underground circuits. The first portion deals particularly with insulating materials, describing their characteristics both electrically and mechanically and giving considerable valuable technical data, particularly as to insulation resistance. The next division deals with telephone cables and is probably one of the most complete exponents on this subject in print. The matter is fresh and embraces the most recent German experiments upon the Pupin system of balancing inductances. Then comes considerable descriptive matter relating particularly to the manufacture of cables of all kinds, especially those intended for alternating currents.

An exceedingly interesting feature is a number of specifications giving dimensions of conductors, insulating material, armor and sheathing. The last third of the volume is devoted to a description of conduit work, as it is found in Europe, while finally a very fully illustrated account of cable manufacturing machinery is appended, many of the illustrations appearing to be taken from working drawings. Excepting in the earlier pages of the work, little mathematics are encountered. It is descriptive and written from the standpoint of the central station manager, as well as that of the manufacturer.

Electric and Magnetic Circuits. By Ellis H. Crapper, M. I. E. E. New York: Longmans, Green & Co. 379 pages, 62 illustrations.

This text book, which is the best elementary treatise on the subject the reviewer has yet seen, is a notable exception to the usual treatises on electricity and magnetism in that it takes up each subject from the practical point of view, giving worked numerical examples as well as numerous exercises for practice, nearly 700 of the latter being contained in the book.

In order to give an adequate idea of the aim and scope of the book we cannot do better than to quote from the preface: "Twenty years ago Lord Kelvin made the following statement at a meeting of the Institution of Civil Engineers: 'In physical science a first essential step in the direction of learning any subject is to find principles of numerical reckoning, and methods for practically measuring some quality connected with it. I often say that when you can measure what you are speaking about, and explain it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind.' As many otherwise useful and excellent text-books on electrical engineering give very little or no opportunity for the student to obtain this essential acquaintance with the quantitative side of the subject, there appears to be a real demand for a book that does supply this want, and this the author claims for the present volume. The plan adopted in this book to meet this demand has been to deduce the fundamental principles of electrical engineering from the system of practical electrical units, now universally used as a basis, and to deal with the various elements of the subject in the same order that the engineer meets with them in practical everyday work. An earnest endeavor has been made to introduce nothing but the simplest mathematics."

The subject is divided into eleven chapters, as follows: (1) Practical Electrical Units (with exercises on electric currents, resistance, Ohm's law, work and power). (2) Electric Circuits and Electrical Effects (with exercises on series circuits, shunts, insulation resistance, condensers, arrangement of cells, heating effects, and chemical effects). (3) Principles of Distribution and Design of Mains (with exercises on house wiring, Kelvin's law, electric light and power circuits, and 3-wire system). (4) Magnetism (with exercises on magnetism, magnetic fields, magnetic moments, torsion balance, oscillation of a magnet, and intensity of earth's magnetism). (5) The Magnetic Circuit (with exercises on magnetizing coils, reluctance, permeability, ampere-turns, pole strength, intensity of magnetization, and magnetic circuit of dynamos). (6) Coil-Winding Design (with exercises on coil winding-problems, field winding of dynamos, and tractive force of magnets). (7) The Generation of Electrical Pressures (with exercises on generation of e.m.f. in armature, drag on armature conductors, etc). (8) Types of Dynamos (with exercises on efficiency calculation of series, shunt, and compound-wound dynamos). (9) The Electric Motor (with exercises in electric motor and electric traction problems). (10) Efficiencies and Dynamo Calculations (with exercises on output, speed, and efficiency of electric motors). (11) Systems of Electrical Units (with exercises on the conversion of the different systems of units, etc). In an appendix, a number of tables of physical constants, wire gauges, logarithms, etc., are given to aid in solving the numerical examples, and a key to the exercises is attached.

The present book forms an introductory volume of a complete treatise on Electrical Engineering, and deals with continuous-current circuits only. Whilst a considerable portion is devoted to the practical application of electricity, it is not intended to be a text-book on the design of distributing mains or continuous-current machinery, but to indicate how the fundamental principles may be applied to the many and varied problems encountered in practical work. The subject of alternating and polyphase-current circuits is not taken up, as this branch of electrical engineering is to receive special treatment in a second volume now in preparation.

The book is clearly written and will be found of great help not only to beginners, but also to more advanced students of electrical engineering.

Mr. C. P. Steinmetz's work, "Alternating Current Phenomena" has been translated in French by Henri Mouzet, and issued by Vve Dunod, at 21.50 francs. The same work has also been translated into German.

BOOKS RECEIVED.

Die Strassenbahnen in den Vereinigten Staaten von Amerika. By Gustav Schimpff. Berlin: Verlag von Julius Springer. 190 pages, 224 illustrations. Price, 6 marks.

Grundriss der Deinen und Angewandten Elektrochemie. By P. Ferchland. Halle: William Knapp. 266 pages, 59 illustrations. Price, 5 marks.

Grundriss der Reinen und Angemandten Elektrochemie. By P. Ferchland. Halle: Verlag von Wilhelm Knapp. 271 pages, 59 illustrations. Price, 5 marks.

Electrical Engineering Measuring Instruments. By G. D. Aspinwall Parr. New York: D. Van Nostrand Company. 322 pages, 370 illustrations. Price, $3.50.

Secondary Batteries. A Practical Handbook for Owners and Attendants. By an Engineer. London: H. Alabaster, Gatehouse & Company. 77 pages, illustrated. Price, 4 shillings.

Elementare Voilesungen uber Telegraphie und Telephonie. Von Dr. Richard Heilbrum. Berlin: Georg Riemens. 164 pages, 45 illustrations.

Die Kerstellung der Akumulatoren. Ein Leitfaden. Von F. Grunwald. Halle: Wilhelm Knapp. 158 pages, 91 illustrations. Price, 3 marks.

Electric and Magnetic Circuits. By Ellis H. Crapper, M. I. E. E. New York: Longmans, Green & Co. 379 pages, 62 illustrations.

Distribution de L'Energie par Courants Polyphases. Par J. Rodet. 2 ieme Edition. Paris: Gauthier-Villars. 562 pages, 213 illustrations.

Die Elektrochemie. Industrie und Gewerbe-Ausstellung in Dusseldorf, 1902. Von H. Danneel. Halle: Wilhelm Knapp. 84 pages, 66 illustrations. Price, 6 marks.

Koniglichen Technischen Hochschule zu Aachen. Von Dr. Wilhelm Borchers. Halle: Wilhelm Knapp. 62 pages, 89 illustrations. Price, 6 marks.

Tests of the Edison Storage Battery.

From a report recently made by Mr. W. Hibbert on tests in England of the Edison storage battery, we extract the following details, and reproduce several sets of curves based on the data of the tests.

The standard automobile cell is of rectangular shape. It stands 13 in. high (over all), measures 5.1 x 3.5 in. horizontally, and weighs 17.8 pounds. It contains 14 positive and 14 negative plates. Each plate is made of sheet steel, nickel-plated, punched with 18 rectangular holes. In each of these holes is inserted a flat pouch or pocket containing the active material. The walls of these pockets are perforated by exceedingly fine, short slots, through which the liquid can penetrate. Thus the current can easily pass to and from the active material contained in the pocket.

Both positive and negative plates are alike, except in respect of the active material. The pockets in the negative plate contain finely-divided iron; those in the positive contain peroxide of nickel. The liquid is a 20-per-cent. solution of potash. This suffers no change during the action of the cell, except the loss of a small quantity of water, which is decomposed whilst the cell is being charged. A small quantity of electrolyte suffices as it acts merely as an electrolytic conductor and not as an active material in the ordinary sense. The plates may, therefore, be fixed very near each other, for the narrow intervening space allows an adequate supply of potash solution.

The proximity of the plates does not apparently involve danger of short-circuiting. The plates are thin, but being made of steel their rigidity is exceptionally good. Mechanical stability is further assured by vulcanized rubbed separators, the whole forming a compact mass, calculated to resist all the ordinary mechanical shocks it is likely to undergo.

The only special mechanical difficulty which seemed probable was the chance that the gases evolved during a "charge" might eject some of the active material from the pockets. During the test, therefore, the pockets were watched carefully, especially during very heavy charges, but without any evidence of loss.

The cell is sealed in its steel case. Two stout connecting pins (from the positive and negative plates respectively) come through liquid-tight bushings of vulcanized rubber. These pins are made slightly conical, as are also the connectors which fit on them, and the mechanical finish and easy grip of this terminal add to the value of the battery. On the top of the case there are also a spring stopper with rubber flange, covering the hole by which the electrolyte is introduced, or distilled water added from time to time; and a vent hole guarded by a gravity valve. This latter provides for the escape of the gas evolved during charge. The hole and valve are covered by a gauze nipple, which prevents escape of spray while allowing gas to pass. Acting on the principle of Sir Humphrey Davy's safety lamp, the same gauze further prevents any chance of explosion should a flame be brought near to the exit.

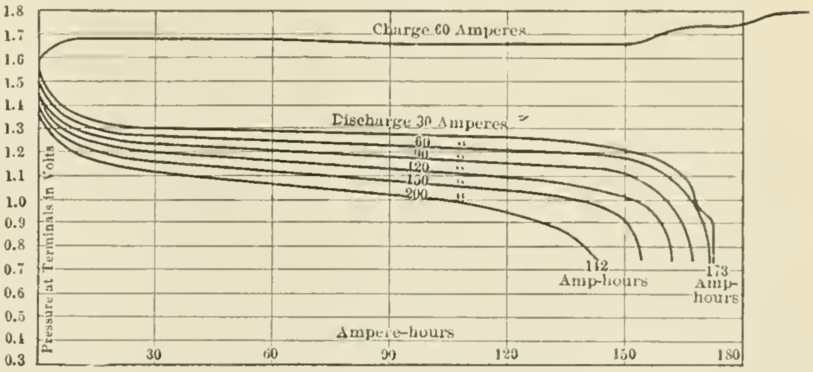

FIG. I.—CURVES OF DISCHARGE VOLTAGE.

The e.m.f. is 1.33 volts. The internal resistance is 0.0013 ohm. The output at 60 amp. is 210 watt-hours, or at the rate of 11.8 watt-hours per pound of cell. The discharging value at high rates of discharge rises to many times the normal. The cell suffers no appreciable polarization, and therefore recovers its normal voltage almost instantaneously when the current returns to an ordinary value.

In the accompanying curves, Fig. 1 shows the pressure during discharge. Each line corresponds to a constant current, the discharge rates varying from 30 to 200 amp. This last is a high rate for a cell of this size, but the experiment proved that the cell could stand it without injury. It took the succeeding charge in an excellent way, and yielded the 30-amp. curve immediately afterwards. At 120 amp. the output was 91 per cent. of the maximum. Even at 200 amp., the quantity (ampere-hours) is 82 per cent. of the maximum.

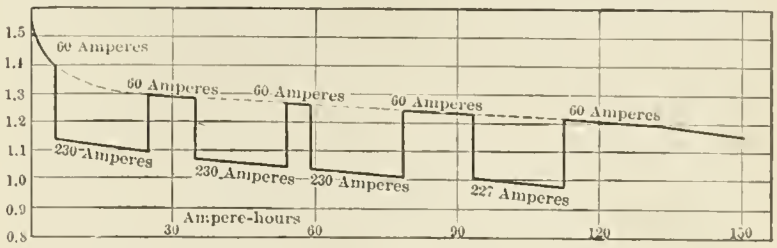

FIG. 2.—CURVE INDICATING FLEXIBILITY OF CELL.

In Fig. 2 are given the results of one out of many experiments, intended to test the flexibility of the cell. The standard cell was discharged, starting at 60 amp. After a time (5 minutes) the current was suddenly increased to 230 amp. A little later the current was reduced again to 60, and so on, as shown by the curve. The cell yielded this great current for short intervals and recovered almost instantaneously. It does not appear to be injured in any way, and subsequent charging and discharging seemed to be quite normal.

An important point in traction cells is the rate at which they can be charged. Experiments on this point demonstrated that the Edison cell will absorb 70 to 75 per cent. of its full charge in one hour. Fig. 3 shows the result of one of these experiments. The cell charged for one hour only, at the excess rate of 175 amp. It was then discharged and gave data for the curve. This shows that it absorbed and could deliver 124 amp.-hours out of the 175 put into it at this very great rate.

After three months' work with very many charges and discharges the capacity of the cells remains the same as at the beginning. It has neither increased nor diminished. Examination of the plates after three months' work does not indicate any signs of corrosion. The plates are as even in surface and as rigid in strength as at the beginning.

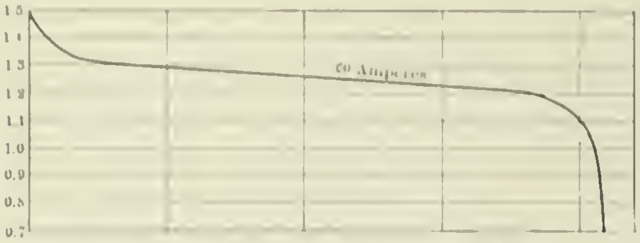

FIG. 3.—TEST CURVE OF A TRACTION CELL.

The standard cell was sent to England from America via Paris, and therefore underwent two transshipments, together with many loadings and unloadings, and journeys by rail and road. This long and varied journey was made in its ordinary working conditions, the plates and fittings in the case fixed as in use. The only difference was one that the cell traveled without the liquid, so that the plates were more or less exposed to air.

On its arrival, having in it no liquid except that which had trickled off the plates to the bottom, it was joined to a voltmeter and gave 1.33 volts. The full quantity of electrolyte was then put in and the cell given a first charge and discharge. The output following this first charge was 174 amp.-hours, a figure identical with that obtained after further treatments.

Power Plant in the Patton Paint Company, Newark, N. J.

The new works of the Patton Paint Company, recently erected at Newark, N. J., is one of the most modern paint factories ever built. It consists of a five-story building with a tower—the paint factory proper—a low building to accommodate the shipping and storage departments, and a building for the power plant.

In the power house the boiler room is separated from the engine room by a fire-wall and contains two Coatesville return tubular boilers, each of between 175 and 200 boiler-horse-power. The gases of combustion are conveyed to a chimney 80 ft. high and 4 ft. in diameter on the inside. From the boilers an 8-in. steam main leads through the dividing wall into the engine room and connects to a 12 and 24 x 36-in. Hewes & Phillips horizontal cross-compound condensing Corliss engine, which runs at 125 revolutions per minute and drives by direct-connection a 125-kw, 250-volt Crocker-Wheeler direct-current generator. Floor space and arrangements for future piping connections have been left to allow for the installing of another engine-generator unit of the same apparatus and size. In the meantime it is so provided that if the load exceeds the capacity which the engine has when running in its normal manner, the high-pressure cylinder may be caused to exhaust to the atmosphere and the low-pressure cylinder may be supplied directly with live steam reduced to at least 80 pounds for the sake of safety, or still lower, depending upon the amount of the overload. The compound engine may thus be resolved into two simple engines. This is perfectly allowable as the generator is abundantly capable of carrying a much greater overload than the engine under regular conditions of operation it is designed for.

The electric current is generated at 250 volts and supplies an average load of 475 amperes divided among eighteen motors, ranging in size from 1 to 35 hp and aggregating 366 hp; 17 arc lights and 200 incandescent lamps. After working hours the engine is stopped and the incandescent lighting is thrown on to the city alternating-current service for the night.

The switchboard is very clearly shown in one of the accompanying cuts. At present it consists of three panels with the usual instruments, switches, etc., and which from left to right are identified as generator, station and distributing panels, respectively. Eventually when the second engine is installed the board will be extended by the addition at the ends of duplicate generator and distributing panels.

In the main factory building wherever line shafting is used it is driven through a Renold silent chain by a Crocker-Wheeler motor on the floor above. On the fifth floor there are two motors, one of 35 and one of 15 hp, each of which drives a lead chaser. These are pieces of apparatus in which white lead, the foundation for all of a certain class of paints, is worked and freed of its contained moisture. On the fourth floor there are two 35-hp and one 20-hp motors, driving shafting on the floor below. An accompanying cut shows one of the two larger motors and the manner in which they are housed to protect them from the powdered white lead and dust which is very apt to be floating in the air. The third floor has a pair of similar 35-hp motors and one 10-hp motor all driving through the floor with chain connections. These motors are not enclosed, but sheet-iron casings cover the chains and sprocket. Another cut shows the two 35-hp motors at close range with one of the casings removed, exposing the chain. It is interesting to add that, at the time the picture was taken the motors were running at 800 revolutions per minute and, although a time exposure was made, the rotating parts are the only ones that are blurred, indicating how very slight was the vibration. On the second floor there are two 10-hp motors, driving paint mixers on the first floor, and three 15-hp semi-enclosed Crocker-Wheeler motors direct-connected to so-called "Giraffe" mills, in which the white lead receives its final grinding.

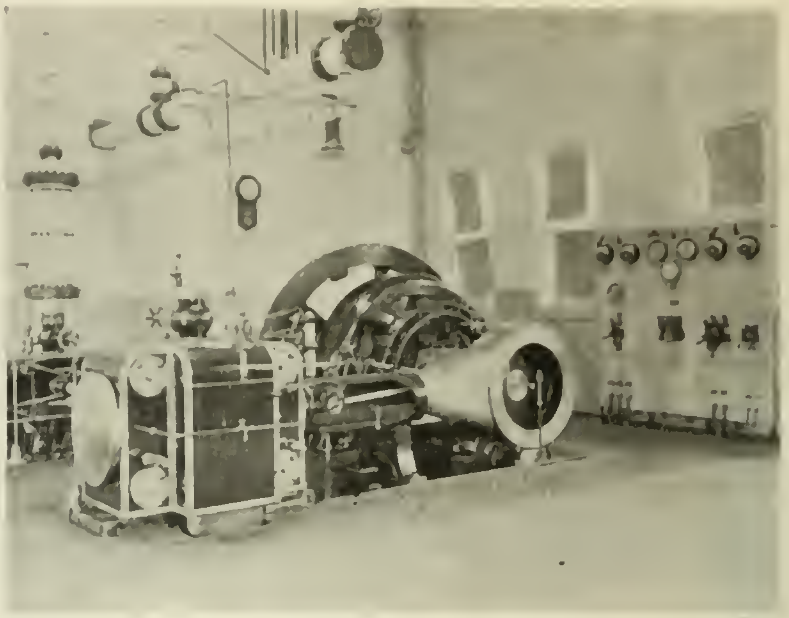

FIG. 1.—VIEW OF ENGINE ROOM.

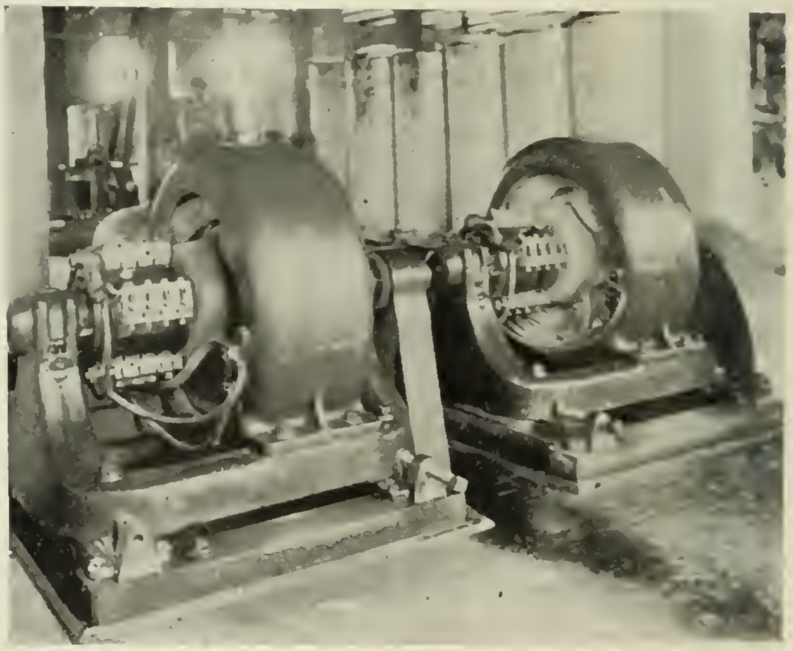

FIG. 2.—TWO 35-HP MOTORS.

In the cellar there are four motors. One of 12 hp operates a slow-speed freight elevator which was installed by the Morse-Williams Company, of New York. At each floor the elevator shaft is provided with an automatic gate which rises and falls as the car passes that floor, being fully open only when the bottom of the car is exactly at the floor level. A 7-hp motor running at 1,100 revolutions drives a 7½ x 4-in. air compressor, giving it a capacity of 35 cu. ft. of air per minute. The compressed air is used to blow dust out of motor armatures, etc., and is drawn from a storage tank in which the pressure is maintained at a constant value by the action of the air on an automatic switch. A 20-hp motor is belted to a 2¾ x 3-in. duplex water-circulating pump, and a 3-hp motor is geared to a Deane Holyoke triplex oil pump. The latter is used in connection with an especially interesting system for handling the various kinds of oil used in the manufacture of paint. In the first place the oil is received at the plant in tank cars and is pumped therefrom to the one of the several storage tanks in which its kind is kept. The triplex pump is arranged with proper pipe connections and valves to make this selective distribution possible. For instance, if it is raw linseed oil that the car contains, it is passed to a certain 60,000-gallon tank in the yard, or if it is refined linseed oil it goes to another 60,000-gallon tank. Similarly, if it be turpentine it is delivered into one or the other of two tanks provided for those liquids.

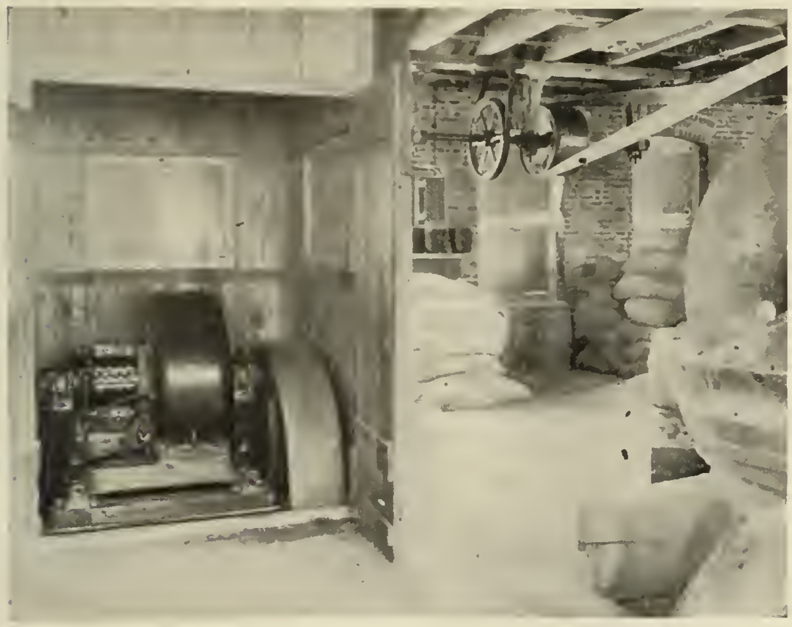

FIG. 3.—ONE OF THE "HOUSED" MOTORS.

Messrs. Hooper & Company, of Newark, N. J., were the architects for the building, and Mr. William R. Siegle, now chief engineer of the plant, superintended the installation of the mechanical and electrical features with the advice and consultation of Mr. Ludington Patton, secretary and treasurer of the company, and the late C. A. Funck, then superintendent. The Bailey Company, of Milwaukee, installed the heating system; the Crocker-Wheeler Company, the generators and all but a few of the smaller motors; and the Hewes & Phillips Iron Works, the engines and boilers.

New California Transmission Enterprise.

Several stockholders of the California Gas & Electric Corporation, including W. S. Tevis, are seriously considering the construction of an electric power transmission plant in Mono County, California. It is the intention to transmit power about 100 miles to mining districts in Nevada, including Tonopah. Some of the capitalists are interested in the mining country around Bodie and Lundy and it is possible that power will be supplied first at those points, unless mining should become more active in Tonopah. Two forces of engineers have been in the field for two months, and T. E. Theberath, who has been in charge of the California Gas & Electric Corporation's construction work at the new Nimshew power house, has been detailed for the electrical engineering work on this new project. The company has three new 2,500-kw, three-phase generators ready for shipment, which could be used for the Tonopah transmission. The plant and pole line can be constructed within four months if it is decided to push the work. Leevining Creek is one of the proposed sources of water power, a 1,600-ft. head being available. The Owens River Power Company, which also contemplates the construction of a 90-mile transmission line to Tonopah, has called a meeting of its shareholders for October 12 for the purpose of voting $2,000,000 in bonds, to secure funds. This company can develop 9,000 hp with a 400-ft. head of water by building four and one-half miles of flume. The location of the plant will be only 4,500 ft. above the sea level.

Cleveland Telephone Police Signal System.

In our issue of last week we referred to the contract recently awarded for the City of Cleveland, Ohio, for a complete new police signal equipment. The award of this contract closed a long contest, the main questions in consideration between the various systems proposed having been as to the relative value of a system based upon a telephone instrument with the other necessary signalling equipment, as compared with a system based on a telegraph instrument with its auxiliary appliances.

Previous to the development of independent telephony practically all police system equipments employed telegraph apparatus with circuit line construction for reporting and signalling to the central office from the various stations or patrol boxes, these circuit telegraph signal systems having had practically the monopoly in police department equipment. At the beginning of Mayor Johnson's administration the entire matter of a signal system for Cleveland was advertised, calling for bids under specifications allowing free and open competition. Bids were received under the last specifications nearly a year ago. All known makes of apparatus and systems were thoroughly investigated by special committees and experts, as well as by Mayor Johnson and other city officials personally. The three years' investigation resulted in the adoption of an equipment radically different from the old line telegraph system, and the contract has just been closed for a complete equipment of the police signalling and telephone system, put on the market by the Municipal Signal Company, of Chicago, and manufactured exclusively for them under the Cregier patents by the International Telephone Manufacturing Company.

The contract comprises nine combined operating desks, call indicating and connecting switchboards complete with power boards, power plants, and all other necessary central office apparatus pertaining to the electrical equipment, together with 200 weather-proof street patrol boxes, in all amounting to nearly $30,000.

In the face of each board is placed a map of the district for which it is intended in which is mounted line lamp signals for each patrol box, showing the exact location of the box. The map also shows the fire boxes and engine houses and the principal buildings or important points in the district. The board is also provided with special indicators for an emergency or wagon call signal, together with keys for conveniently cutting in the operator's set or ringing generator, with regular line lamp signals, answering jacks, proper answering, ringing and connecting appliances, and also a complete operator's telephone set in duplicate.

The patrol boxes contain a complete telephone equipment for giving a regular reporting signal to the office; also a distinct emergency or wagon call signal, a bell for an answer back signal, a heavy compound ringer with large gong for a patrolman's recall signal, cut-out switch, and proper protectors, all mounted in a heavy iron weather-proof protection box.

The system is arranged for giving two separate and distinct signals from the patrol box to the central office; two separate and distinct signals from the central office to the patrol box, as well as complete telephone equipment for oral communication between any of the boxes or any points of the system. It is a full central energy system requiring no local batteries or parts subject to deterioration at the box. Each patrol box is connected directly with the central office, avoiding all possible chance of mistakes in signalling or reporting.

This system was originally invented and patented as early as 1891 and a full district installed when extending the Chicago system in 1899. The entire city of St. Paul was equipped with the service several years ago, and it was adopted by Col. Berne, of the Pan-American Exposition for its police department used during the Fair.

Electric Hoists for Hamburg American Docks.

The most extensive installation of electric hoists for use on docks in this or any country is to be made at the new Hamburg-American docks at Hoboken, N. J. There will be 24 hoists operated by motors having an aggregate capacity of no less than 1,200 hp. The equipment will be used for loading and discharging all kinds of freight.

The hoists will be of two drum type direct connected to motors of 50-hp capacity each. Each machine will be capable of handling 8,000 pounds, i. e., 4,000 pounds on each drum. Each drum will be independently operated and controlled by Cutler-Hammer 50 500-volt controllers. The circuit breakers, switch and field discharge resistance will be on the fire wall. On each side of the motor and within reach of the operator a push button will be placed which, in case of an emergency, he can press, and thus open the circuit breaker. The wires for the motors will be laid on steel conduit, which will run under the pier, the wires coming up at each machine. No overhead wires at all will be used. Power will be supplied by the United Electric Light Company of New Jersey. The cost of operating one of the equipments for 10 hours at present rates (5 cents per kilowatt hour) has been found to be $1.75.

The hoists have been designed by Mortimer Norden, of the Norden-Bittner Electric Company, New York. Six are now being built by the Consolidated Iron Works, Hoboken. The same number of motors will be manufactured by the C. & C. Electric Company, New York.

The Norden-Bittner Electric Company has the contract for the hoisting installation and also for lighting of the docks which will be done with 300 arc and 1,500 16-cp incandescent lamps.

"Norbitt" Exhibit at Atlantic City.

The most extensive exhibit made at the Atlantic City Convention of the Municipal Electricians was that of the Crouse-Hinds Electric Company, of Syracuse, N. Y., a view of which is given herewith. This consisted in a showing of the well-known "Norbitt" specialties in the "Grotto" of Hotel Rudolf. The display brought out the handsome decorating effects possible with "Norbitt" sockets, receptacles and moulding. For the decoration of the Convention Hall the same specialties were furnished gratuitously by the Crouse-Hinds Company, which made a very pleasing appearance, much commented upon by the delegates. The entire exhibit was under the personal supervision of Mr. F. M. Hawkins, of the New York office.

"NORBITT" EXHIBIT.

Kellogg Telephone Contract.

The Kellogg Switchboard & Supply Company, of Chicago, has been awarded the contract for a switchboard and telephones for Linton, Ind. The contract calls for an 800-line switchboard with ultimate capacity of 3,000, and telephones. The directors of the New Home Company, of Linton, compose part of the board of directors of the Knox County Telephone Company, of Vincennes, Ind. On account of the satisfactory results from Vincennes they ordered an exact duplicate of the board for Linton.

Exhibits at the Saratoga Convention.

Following is a continuation from our issue of last week of notices of exhibits at the Saratoga Convention:

General Electric Company.—In place of making the usual elaborate exhibit of apparatus, the General Electric Company furnished one of the most striking and enjoyable features of the convention exercises by providing a trip to the Schenectady works for the delegates. As the great shops are only some forty minutes' ride from Saratoga, and are in themselves a tremendously impressive exhibit of the development of electrical industry, a better plan of entertaining and interesting the convention could not well be devised. A special train provided by the company, in charge of several of its officials, left Saratoga at 1 P. M. on Thursday, carrying about 700 people, including a great many ladies. This train was run on arrival directly into the General Electric yards, and the visitors were escorted to a new shop—No. 84—some 800 ft. in length, and of proportionate width, which it is proposed to devote entirely to the manufacture of the Curtis steam turbine. It seems to be the practice of the General Electric Company whenever a large party visits the works to put up a new building for its entertainment, the result being that the increase in the number of G. E. shops is remarkably rapid. After admiring this colossal building, the party proceeded upstairs to the gallery, which runs along one side, and at one end of which a sumptuous luncheon was provided for about 800 people. This function was presided over by Mr. J. R. Lovejoy, the head of the railway department of the company, assisted by several other of the leading officers, who happened to be in Schenectady, including Messrs. Rohrer, Potter, Hamill, Emmett, Haskins, and others equally well known. Owing to the magnitude of the gathering, and the speed with which lunch was served, there was little opportunity for speechifying, but Mr. Lovejoy made a pretty little speech of welcome on behalf of the company, which was responded to with equal felicity by Mr. Caryl Ely. After luncheon the party dispersed in squads to go through the shops, particular attention being paid to No. 20, where the steam turbine work is at present carried on. Thinking that many of the ladies might not care to visit the shops, a special trolley ride around the city was given on their behalf, the cars being tastefully draped with smilax. At a late hour in the afternoon, the special returned to Saratoga.

The Magnetic Equipment Company, of Chicago, the concern which has the device for increasing the traction of wheels on rails by means of magnetism, had a small model car equipped with the magnetic adhesion device. C. A. Ballard, treasurer; B. H. Honey, secretary; W. B. Frazier, chief engineer, and W. T. Davidson, general representative, were on hand explaining the apparatus.

The Stuart Howland Company had their exhibit in one of the parlors of the Grand Union Hotel, and made there a very elaborate display of the street railway overhead line materials, brackets, trolley catchers, swivel, trolley harps, and other well-known devices which they handle. H. W. Smith, from headquarters in Boston, and H. De Steese, from the New York office, were on deck.

The Norbitt Specialties.—One of the most popular corners at the convention was situated in the hotel grounds just off the main piazza of the hotel. It is known as "The Pagoda" and is conducted as a restaurant by the Grand Union Hotel. It was here that the people attending the convention found their best opportunity to display that feeling of good-fellowship which is so characteristic of these gatherings. What made it especially attractive were the tasteful decorations, consisting mainly of incandescent lamps festooned all over the pagoda, the lamps being covered with red shades. This decoration was placed there especially for the convention, and was furnished by the Crouse-Hinds Electric Company, Syracuse, N. Y., who used the Norbitt temporary socket for the purpose. Everybody commented upon the beautiful appearance of "The Pagoda," and recognized the merit for decorating purposes of the Norbitt socket.

Inspecting the Schenectady System.—Upon the invitation of Mr. E. F. Peck, general manager of the Schenectady Railway Company, a number of those who took part in the General Electric trip to Schenectady, made a flying tour over the local trolley system in a private car provided for the purpose. This party included Messrs. H. N. Vreeland, Caryl Ely, W. J. Clark, J. G. White, J. H. McGraw, John I. Beggs, and many others—some twenty-five in all. A run was made first over the Troy division, and the car then came back and made another run over the line which runs almost as the crow flies direct from Schenectady to Albany. Not only did this trip give an opportunity to take a glance at the car barns and other plants of the company, but every opportunity was afforded to inspect the magnificent work that has been done in roadbed and line construction. It may, in fact, be questioned whether there is a better equipped system in the country, or one which is handled with greater ingenuity and progressiveness, the result being that the receipts of the company have been increasing with leaps and bounds. Refreshments were provided on the special car, and at the close of the trip Mr. Peck was most heartily and deservedly thanked by all who had enjoyed the Schenectady Company's hospitality.

The Gould Storage Battery Company had a neat booth on the lawn, which was devoted to an exhibit of their cell for railway and other purposes, together with detailed parts showing the construction of the plates employed in the different types. There were also sundry views around it of well known installations. And, among others, Messrs. Donaldson, Oakman and Draffen were on hand to receive and entertain the numerous callers at the space.

The Standard Paint Company had a handsome booth out on the lawn in charge of Messrs. C. Earnshaw, F. F. Van de Water, and N. D. King. An interesting exhibit was made of the well known P. & B. productions, including electrical compounds, ruberoid tape and cloth, armature and field varnish, insulating tape, etc. Particular stress was laid upon the new feature of car wiring, lately introduced by the company, giving particular attention to the insulation and protection of motor leads. The leads are first wrapped with ruberoid motor cloth, and this is overwound with P. & B. insulating tape. In this manner a very effective equipment and economical insulation is afforded, which appears to be as enduring as it is flexible, and minimizing the number of short crcuits which might otherwise arise from defective insulation. A very handsome pocket book, card case and notebook in one, was distributed.

Eugene Munsell & Co. had, in charge of Mr. C. E. Coleman, a very interesting exhibit of their Empire and Micante insulating specialties in their booth on the lawn. Samples of these were made up in handsome little books, so that each visitor could take away pieces of the material with him for investigation and testing. A large quantity of these was handed out during the convention. Mr. Coleman was also very busy discussing with a great many of the street railway managers the qualities of these insulating cloths and papers.

The Standard Vitrified Conduit Company not only had a very neat exhibit, but, like Rosalind, hung signs on all the trees in the vicinity for the benefit of Orlando, the street railway managers. The exhibit included a great variety of the clay conduit in single and multiple form, and third-rail insulators. Mr. B. S. Barnard, president of the company, was present, and was assisted by his son, Mr. W. H. Barnard, who had charge of the exhibit.

Crocker-Wheeler Company, of Ampere, N. J., did not make an exhibit but distributed a special bulletin devoted to their generators a growing number of which are being used in street railway service. The company was represented by Messrs. C. W. Startsman, F. B. de Gress, S. Russell, Jr., H. J. Sage and R. N. C. Barnes A souvenir match safe was given away

Noark Fuses were a constituent part of the H. W. Johns-Manville exhibit as noted in these pages last week, and Mr. Sachs, the inventor, was present. A great hit was made with the pencil got up in the form of a fuse, label and all, and of the exact color, the renewable lead being moved by a turn of the fuse. Everybody in the convention seemed to be carrying one of these.

American Circular Loom Company was represented by Mr. Otto W. Uthoff, whose firm at St. Louis is agent also for the Banner Electric Company.

Garton-Daniels Company, of Chicago, were represented by Secretary J. V. E. Titus.

Robins Conveying Belt Company had out in a booth on the lawn a working model of their well-known conveyor, operated by electric motor. It was, indeed, one of the features of the exhibit section, and drew a constant and admiring crowd. The concern was represented by C. K. Baldwin, A. B. Proal, John Fuller and M. S. Murray.

E. P. Roberts & Co., of Cleveland, were represented by Mr. W. C. Andrews, chief engineer of the New York office.

Western Electric Company sent to the convention Messrs. R. M. Campbell and R. H. Harper.

Bridgeport Brass Company, whose "Phono" wire has become widely known among sheet railway men, was represented by Mr. Wylie Brown, of the New York office, who had samples with him.

Le Valley-Vitae.—The Le Valley-Vitae Carbon Brush Company made an exhibit of sample boards containing specimens of the brushes it makes, and carbon brushes were distributed at the booth by President J. V. Clarke and Mr. W. H. Bell. They were assisted in their efforts to instruct the street railway men by an "electric advertiser," which did a good share of the talking.

W. R. Garton Company, of Chicago, was represented by the well-known president, from whom its name is taken. Mr. Garton distributed leather card cases and aluminum letter openers as souvenirs, and was heard to refer accidentally to electrical supplies.

Michigan Electric Company, of Detroit, was represented by President J. E. Lockwood, who, it is announced, is to take hold of Bullock interests in his territory.

St. Louis Exposition was represented by Prof. W. E. Goldsborough, department of electrical exhibits, and Cloyd Marshall, superintendent of electrical machinery in the department of electricity. Both did loyal service to the cause, viz., a meeting of the Association at St. Louis next year.

E. W. Bliss Company, of Brooklyn, showed in the veranda of the Grand Union Hotel some very fine high carbon steel gears and pinions for all classes of electric railway work, etc. These are called "Projectile Bliss," and illustrate the precision and beautiful accuracy of metal working done by this concern. A working group showed one of the gears meshing into nine pinions, so that their smooth running could be tested.

Concerns Represented.—Among the concerns represented but not exhibiting were the following: S. B. Condit, Jr., of that named company; N. T. Clark, of W. E. Baker Company; A. F. Eslep, of R. D. Nuttall Company; C. E. Speirs, of D. Van Nostrand Company; W. A. Neff, of Forest City Electric Company, Cleveland; John A. Stewart, of that named company; E. F. Kirkpatrick, McRoy Clay Works; G. B. Foster, Wagner Electric Manufacturing Company; J. W. Lyons, Allis-Chalmers Company; W. R. Bonham, Jandus Electric Company and Buckeye Electric Company; E. G. Bernard, of the company of that name; E. Beatty, Electric Motor & Equipment Company; T. J. Creaghead, the Creaghead Engineering Company; F. J. Coakley, Samson Cordage Works; W. C. Egert, Globe Electric Company; W. S. Eckert, National Conduit & Cable Company; E. H. Heilstedt, Chicago Mica Company; H. W. French, Consolidated Engine Stop Company; E. L. Hartpence, Empire Wire Company; H. W. Knott, Elmer P. Morris Company; I. L. Storey, Magneto Electric Company; E. R. Mason, Porter & Berg Company; J. H. Parshall, Ball & Wood Company; Norman McCarty, Diesel Engine Company; H. W. Pope, American Telephone & Telegraph Company; C. E. Meech, Wilmarth & Morgan Company; H. F. Sanville, Waclark Wire Company; W. S. Sisson, D. & W. Fuse Company; G. W. Swan and U. G. Tingley, John A. Roebling's Sons Company; A. P. Eckert, Safety Insulated Wire Company.

American Electrical Works, of Providence, R. I., was represented by Messrs. N. J. Watson and Frank B. Baker.

Bell Telephone.—The American Telephone & Telegraph Company extended the courtesy of free long distance telephone service to all active members of the Association, a privilege that was very much appreciated. Messrs. H. W. Pope and Wendell Baker were in attendance.

Chase-Shawmut Company, of Boston, and its specialties, were spoken for by Messrs. H. P. Moore, F. D. Masterson and E. Howe.

National Lead Company, of Chicago, made an exhibit of babbitt metal journal bearings and of Phœnix metal armature bearings, and the display included a journal bearing that had seen continuous service for not less than 13 months under one of the heavy cars operating on the Detroit United Railway, where, it is stated, this metal is now used exclusively on all the cars. It is natural that so important a feature in the work should receive, as it did, considerable attention from the street railway men present. The company was represented by Messrs. J. R. Weithas, of New York; R. D. Pierson, of Detroit, and A. Benzel, of St. Louis.

Gold Car Heating Company had a simple and tasteful exhibit out on the lawn of their well-known electric car heaters. One of the sets was arranged to show the method of regulation. The recent census statistics give a vivid idea of the manner in which electric heating has made its place in the street railway art, and the Gold people are receiving, as they deserve, great credit for their important share in this advance. Among those who represented the company at the convention were Messrs. E. E. Gold, president; J. E. Ward, general manager; W. H. Stocks and Frank Cahill, the chief engineers.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was very dull and entirely professional, there being a holiday feeling and an absence of activity. There was a rather strong undertone of more favorable views about money market conditions, while uncertainty regarding the corn crop and a threatened curtailment of anthracite coal consumption seemingly induced caution. There were few features apart from heaviness in the traction stocks on the unexplained deal in Metropolitan and the reactionary tendency of Amalgamated Copper on an adverse decision. Electrics were weak and listless in sympathy with the general market. Brooklyn Rapid Transit lost ¼ point net on sales of 17,740 shares, the closing quotation being 45½. Metropolitan Street Railway, on total sales of 23,650 shares, declined from 110½, the highest figure, to 111, the lowest, closing at 112¾, this being a net loss of 1¼ points. General Electric fluctuated between 165 and 162, closing at 163—one point lower than last week's closing price. Western Union closed at 83⅛, this being a net loss of ⅝ point. Following are the closing quotations of September 8:

NEW YORK.

	Sept. 1	Sept. 8		Sept. 1	Sept. 8
American Tel. & Cable	79	79	General Electric	163	162
American Tel. & Tel	133	132	Hudson River Tel	..	..
American Dist. Tel	23	24	Metropolitan St. Ry	114¼	112⅝
Brooklyn Rapid Transit	45½	43¾	N. E. Elec. Veh. Trns	..	..
Commercial Cable	.	..	N. Y. & N. J. Tel	..	..
Electric Boat	11	13	Marconi Tel	3	1⅞
Electric Boat pfd	40	38	Western Union Tel	83¾	83
Electric Lead Reduction	1¼	1¼	Westinghouse com	164	165
Electric Vehicle	6	4⅛	Westinghouse pfd	170	170
Electric Vehicle pfd	8	7½			

BOSTON.

	Sept. 1	Sept. 8		Sept. 1	Sept. 8
American Tel. & Tel	133	132½	Western Tel. & Tel. pfd	82	81½
Cumberland Telephone	..	.	Mexican Telephone	1¼	1⅜
Edison Elec. Illum	..	..	New England Telephone	123	124
General Electric		..	Mass. Elec. Ry	21½	21⅛
Western Tel. & Tel	13	13	Mass. Elec. Ry. pfd	80	79½

PHILADELPHIA.

	Sept. 1	Sept. 8		Sept. 1	Sept. 8
American Railways	..	..	Phila. Traction	95½	95½
Elec. Storage Battery	56½	56⅛	Phila. Electric	6⅞	6¾
Elec. Storage Battery pfd.	56⅛	56½	Phila. Rapid Trans	..	..
Elec. Co. of America	8¾	8⅝			

CHICAGO.

	Sept. 1	Sept. 8		Sept. 1	Sept. 8
Central Union Tel	..	..	National Carbon pfd	88	88
Chicago Edison	.	..	Metropolitan Elev. com	..	..
Chicago City Ry	165	170	Union Traction	4	4½
Chicago Tel. Co	..	.	Union Traction pfd	..	..
National Carbon	20	20			

BELL TELEPHONE OF PHILADELPHIA.—President U. N. Bethell, of the Bell Telephone Company, of Philadelphia, has issued, under date September 1, 1903, a circular to stockholders as to the company's issue of $2,000,000 of new stock. The directors have voted to offer to the stockholders 40,000 shares of the new stock of this company for cash at par ($50 per share). Each stockholder will be entitled to subscribe for such new stock in the proportion of one share for every six shares that he then holds; that is, a right will attach to each share of the then outstanding stock to subscribe for one-sixth of a share of new stock, but subscriptions must be for full shares. The right to subscribe will expire at 3 o'clock in the afternoon of Monday, October 12, 1903.

BELL TELEPHONE MERGER.—Articles have been filed with the Secretary of State of New Jersey merging the American Telephone & Telegraph Company of New Jersey, the New York and Philadelphia Telephone & Telegraph Company, and the Midland Telephone & Telegraph Company into the American Telephone & Telegraph Company of New Jersey. The new company has an authorized capital of $130,000, and is a long-distance branch of the Bell Telephone system. The officers are Edward J. Hall, of Morris Township, N. J., president; Edward P. Meaney, of Newark, vice-president; Melville Egleston, of Elizabeth, secretary, and James P. Vail, of New York, treasurer.

DIVIDENDS.—Chicago Telephone directors have declared the regular quarterly dividend of 2½ per cent., payable September 30. The directors of Commercial Cable have declared the regular quarterly dividend of 2 per cent., payable October 1. The Western Union Executive Committee has recommended the declaration of the regular quarterly dividend of 1¼ per cent. The regular quarterly dividend of 1½ per cent. will be paid on Manhattan Railway Company's capital stock October 1 by the Interborough Rapid Transit Company, lessee. The Chicago City Railway Company has declared a quarterly dividend of 2¼ per cent, payable September 30. The directors of the Electric Boat Company have declared a quarterly dividend of 2 per cent on the preferred stock, payable October 1, 1903.

Commercial Intelligence.

THE WEEK IN TRADE.—The tone of reports from business centers shows that there was a spirit of conservatism with a tendency to eliminate anything in the nature of speculation or overextension on general business. Activity continues in manufacturing industries except in some lines of iron and steel. Some improvement is noted in the car situation, and the railroads continue to report larger gross earnings, but increased cost of operations or heavy improvements limit net receipts. Traffic congestion is already noted at several points, despite the fact that crops have only just begun to move, and railway earnings in August show gains of 9.3 per cent. over last year, and 17.4 per cent. over 1901. All jobbing trade reports indicate further improvement. Finished iron and steel are reported in better demand at Pittsburg. The prices of these metals as a whole, however, show little change: the hardware trade is fully up to expectations. Copper ruled quiet but steady throughout the week, a fair volume of business being transacted. Quotations are unchanged at 13¾ to 13⅝c. for Lake; 13¼ to 13½c. for electrolytic; 13 to 13¼c. for cathodes, and 12¾ to 13c. for casting stock. The usual midsummer volume of business failures is noted, although it is pointed out that the August suspensions foot up a larger total of liabilities. The number of failures for the week ending September 3, as reported by *Bradstreet's*, numbered 162 against 142 the previous week, and 133 the corresponding week last year.

KELLOGG TELEPHONE ORDERS.—At the Kellogg Switchboard & Supply Company's factory the following apparatus is in course of construction: A straight multiple exchange equipment is being made for Cleveland, Ohio, with an immediate equipment for 7,680 lines, in 18 sections of three positions each, with an ultimate capacity of 18,000 lines. The new Kellogg four-party selective system is to be installed in connection with this exchange, each cord circuit having a four-button indicating ringing key in addition to the regular cord equipment. This switchboard is to replace the old four-division local battery equipment now in use in Cleveland, which was at the time it was installed nearly four times as large as the largest straight multiple board then made. Common battery exchanges of the latest type are being constructed for the following cities: Pasadena, Cal., 1,500 lines present equipment, mounted in a framework for 7,200 lines ultimate; McKeesport, Pa., 1,000 lines present equipment, mounted in 3,600-line framework; London, England, for Lavender Hill Exchange, National Telephone Company, 800 lines present equipment; Linton, Ind., 800 lines, with 3,000 lines ultimate; St. Louis, Mo., South Office, 2,520 lines, with 7,200 lines ultimate, requiring at present nine sections of three positions each; St. Louis, East Office, 1,080 lines, with 7,200 lines ultimate, requiring five sections for present installation; Taunton, Mass., 300 lines, 800 lines ultimate; also four complete common-battery switchboards of about 400 lines present equipment each, for San Bernardino, Long Beach, Santa Ana and Redlands, Cal. These latter have each an ultimate capacity of 1,200 lines. All the manually-operated switchboard equipment to work in conjunction with the Automatic Exchange at Dayton, Ohio, and Grand Rapids, Mich., is nearly completed at the Kellogg factory. The apparatus for Dayton consists of a multiple toll board of two sections of two positions each, also a wire chief's desk and a combined trouble clerk and information clerk's desk, each of the latter having two positions, both equipped. The Grand Rapids (Mich.) equipment consists of a present equipment of nine two-position sections of multiple tollboard, and one two-position section of rural line board; also a switching section of 12,000 lines equipped for 5,500 lines and a two-position chief operator's desk, a two-position wire chief's desk and two two-position information clerks' desks. The Kellogg Company is also making extensions to the following exchanges: St. Louis, main office, an addition of two incoming trunk sections of four positions each, to work in conjunction with the present four-division main office switchboard. Los Angeles, Cal., is to have a third extension of 1,080 lines, making the total equipment of the exchange 9,120 lines. Vincennes, Ind., is to have a 160 additional equipment, making a total of 800 lines for present operation. St. Charles, Mo., and Belleville, Ill., are to have each an additional section equipment. The greater part of this work is now nearly ready for installation.

WESCO SUPPLY COMPANY.—The following important announcement has been issued by the Western Electrical Supply Company, of St. Louis: "Owing to the constant growth of our business during the past ten years we have found it advisable to increase our cash capital and divide our business into two parts. That portion of our business relating to electrical supplies and its good will and stock of goods, we have sold to the Wesco Supply Company, a new company just organized, with ample capital to continue that business, under the personal management of Mr. R. V. Scudder. The Wesco Supply Company has a large cash capital, and pays us cash for all merchandise and a bonus for good will. The other part of our business, the building of electric light plants and electric railroads, will be retained by ourselves, and we will hereafter restrict ourselves to this branch of our business, and now have on hand contracts calling for orders for nearly a million dollars in this department. All liabilities of the company will be liquidated by ourselves. We expect shortly to increase the capital to $300,000, and will discount all future purchases. The company will continue to be personally managed by Mr. H. K. Gilman, with offices at Chemical Building, St. Louis, Mo. Mr. H. K. Gilman, of the Western Electrical Supply Company, will retain an interest in the Wesco Supply Company and will serve as one of its directors. Both companies will be officered by old employees of the Western Electrical Supply Company, and with ample cash and better facilities than ever before, will undoubtedly continue the record of success made by the old concern."

WASHINGTON WATER POWER.—A dispatch of September 4 from Washington, D. C., says: "The Great Falls power scheme, which the late Benjamin F. Butler set in motion twenty years ago, and which has languished during the interval through financial and administrative difficulties, has been revived, and was to-day given a chance to develop into practical results by the formal approval by the War Department of the plans for the proposed dam. On the endorsement of Gen. Gillespie, Chief of Engineers, the specifications for a dam to be built below the government dam, which fills the reservoirs for the water supply of Washington, are approved, and the work is expected to be begun within a short time. The plans describe a work which will provide electric power for lighting Washington, furnishing motive power for its street railroads and a multitude of other institutions requiring power. The new dam will extend across the Potomac River and join the government dam on the Maryland side. Its construction will make it necessary to raise the government dam two feet. This change in the government property is to be made at the expense of the power company. As the whole work is above the head of navigation, the permission of the government applies only to such questions as are involved in the possible interference with the water supply rights of the government."

45,000 HP of SWISS TURBINES FOR MEXICAN PLANT.—Some important contracts have just been placed for various equipments to be installed in the huge hydraulic plant now under construction at Necaxa, State of Puebla, Mexico, by the Mexican Light & Power Company, Limited, of which concern F. S. Pearson, consulting engineer of the Metropolitan Street Railway, New York, is one of the leading spirits. The initial capacity of the plant which in the first instance is to generate power for transmission to Mexico City, some 90 miles distant, will be 45,000 hp. Ultimately the plant will be capable of generating 80,000 hp. The turbines now ordered will be six in number and of 7,500-hp capacity each. The Swiss engineering firm of Escher, Wyss & Co., of Zurich, secured the contract. Their bid was some $20,000 less than that submitted by American concerns competing. The Riter-Conley Manufacturing Company, of Pittsburg, has been awarded a contract for 1,800 tons of steel pipe varying from 48 in. to 51 in. in diameter. The contract for the generators which will call for six machines of 5,000 kw each, will be let early next month through the New York offices of the company in the Columbia Building, 29 Broadway.

ALLIS ENGINE ORDERS.—The Allis-Chalmers Company, of Chicago, Ill., reports a long list of engine sales for July, including Stilwell-Bierce & Smith-Vaile Co., Dayton, Ohio, one 16-in. x 42-in. girder frame Reynolds Corliss engine. Consumers' Heat & Electric Company, Bloomington, Ill., one 20-in. and 32-in. x 36-in. heavy-duty cross-compound Reynolds Corliss engine. Columbus Buckeye, Lake & Newark Traction Company, Columbus, Ohio, one 34-in. and 68-in. x 46-in. vertical cross-compound condensing heavy-duty Reynolds Corliss engine. Coe Brass Manufacturing Company, Torrington, Conn., one 22 and 44-in. x 42-in. and one 19 and 38-in. x 42-in. combined horizontal and vertical compound Reynolds Corliss engine; two air pumps and two jet condensers. Rock Hill Water, Light & Power Company, Scranton, Pa., one 20-in. x 42-in. girder frame Reynolds Corliss engine. Memphis Consolidated Gas & Electric Company, Memphis, Tenn., one 27 and 72-in. x 48-in. horizontal cross-compound, heavy-duty, direct-coupled Reynolds Corliss engine.

BIG POWER HOUSE.—Work is to be begun forthwith on the power house of the Pennsylvania-Long Island Railroad at Long Island City. All the buildings on the block between Third and Fourth Streets and Front and West Avenue are to be removed at once, and the pile foundations for the power house laid. The power house will be one of the largest in the United States. It will have a frontage of 250 ft. and will cover an area of 125,000 sq. ft. The building will be pushed rapidly to completion so that the trains on the Atlantic Avenue division may be operated by electricity. It is expected that all the foundations will be laid before the cold weather sets in. Sixty-four ducts will be laid for feed wires for the Atlantic Avenue division, between Flatbush Avenue and Jamaica. Westinghouse, Church, Kerr & Co. are the consulting electrical engineers on this plant.

TRUCKS AND MOTORS FOR WELLINGTON, NEW ZEALAND.—The British electrical engineering and contracting firm of Macartney, McElroy & Co., Limited, New York offices Havemeyer Building, has placed contracts through the London offices of the J. G. Brill Company, of Philadelphia, and the General Electric Company for trucks and motor equipments respectively for the Wellington (New Zealand) electric traction system. There will be 27 Brill 21E trucks and eight pairs Brill Eureka maximum traction trucks. The motor equipments will be General Electric, 54 double-type, 500-volt. The car bodies will be built in England, the British Electric Car Company having secured the contract.

BALL ENGINE SALES.—The National Steel Foundry Company, New Haven, Conn., has recently purchased from the Ball Engine Company, Erie, Pa., a 400-hp, tandem-compound engine for direct-connection to a 250-kw generator. Among recent sales made by the Ball company, in Detroit, Mich., are: One 300-hp tandem-compound, direct-connected engine for the Packard Motor Car Company, for the Wills Creek Coal Company; one 300-hp simple engine, direct-connected engines for the Arcade Building; one 300-hp simple engine for the Wills Creek Coal Company; one 300-hp simple engine, direct-connected, for the Detroit Iron & Steel Company.

NEW CHANGEABLE ELECTRIC LETTER SIGNS.—The United Electric Light Company of New Jersey has placed a large contract with the Norden-Bittner Electric Company, New York, for new changeable electric letter signs, which will be used in Newark, Hoboken, Paterson, Camden, Jersey City and Trenton. The Norden-Bittner Electric Company, New York, has purchased the stock and interests of the Knickerbocker Electric Sign & Construction Company, the National Sign Material Company and M. J. Jolly & Co., all manufacturers of electric signs.

NEW ENGINE SHOP.—The S. M. Jones Co., Toledo, Ohio, are building an engine shop 260 x 75 ft., to be equipped to build gas engines of large power. They will also install a foundry plant 100 x 140 ft. They have been manufacturing engines of small size for some years, but the extension is for the purpose of manufacturing multiple cylinder vertical trunk piston engines for electric light service; also horizontal and vertical double-cylinder tandem-compound, double-acting engines for the same class of work, but for larger horse-power; probably nothing below 100 or 150 hp.

EDISON STORAGE BATTERY.—A telegram from Orange, N. J., of September 4 says: "The Pennsylvania Railroad Company is negotiating with the Edison Manufacturing Company with a view of securing a storage battery with which to light its cars. The new iron plate cell which Mr. Edison invented about a year ago probably will be slightly modified to meet the requirements. Though the order has not been actually placed, it is generally believed that it will be for many thousands of the batteries, and that apparatus has been designed which will successfully light trains."

NEW EQUIPMENT FOR CENTRAL BUILDING.—A new electric lighting and power plant is to be installed in the Central Building, 143 Liberty Street, New York. The generators, three of 100-kw capacity each, will be built by the C. & C. Electric Company. The boilers, three units of 150-hp each, will be manufactured by the Babcock & Wilcox Company. Mr. J. P. Hall, of 131 Liberty Street, is letting the contracts.

ELECTRIC CARRIAGE CALL ORDERS.—The Electric Carriage Call Company, New York, has received orders for the carriage calls to be installed in the Hudson Theatre, New York. Six will be put in the Waldorf-Astoria. Through the company's agents in Philadelphia, Kirkpatrick & Binder, orders have been sent for three calls for the Academy of Music and two for the new Bellevue-Stratford Hotel.

ELECTRIC TRACTION FOR MONTEVIDEO.—The city of Montevideo, Uruguay, is to have an up-to-date electric traction system. The horse lines controlled by the London financial house of Baring Brothers, New York connections, Baring, Magoun & Co., will be electrically operated. The lines are known as the Este, Reducto, Pocitos & Bacoe roads. They aggregate about 10 miles in length.

CARS FOR HUDSON RIVER TRACTION COMPANY.—Messrs. Ford, Bacon & Davis, New York, have ordered four cars from the J. G. Brill Company, of Philadelphia, for the Hudson River Traction Company. The motor equipments will be General Electric.

General News.

THE TELEPHONE.

DENVER, COL.—With the completion of a new copper wire circuit between Denver and Cheyenne telephone communication may be established between Denver and towns as far north as Billings, Montana.

COLUMBUS, GA.—The Adams Telephone system of Stewart County, has been extended to this city.

MACON, GA.—There is some talk of establishing a new telephone system in Macon to oppose the Bell Company. Some years ago another system would have been established had not the Bell Company inaugurated a greatly improved service.

BOISE, IDA.—The Interstate Telephone Company, of Spokane, capitalized at $20,000, has filed articles of incorporation with the secretary of state. The chief place of business of the company will be in Kootenai County.

STERLING, ILL.—E. A. Emmons has organized a telephone company south of this place.

DIXON, ILL.—The officials of the Jo Daviess County Telephone Company have changed the name of their company to Pitcher Telephone Company of Jo Daviess County.

RUSHVILLE, ILL. The Grange and Illinois Western Telephone Companies have agreed to allow the use of their lines to each others' subscribers. The agreement is for one year.

GREENUP, ILL.—The village board of Mulberry Grove has granted a franchise to E. J. Bancroft, of Greenup, to put in a telephone exchange there. It is the intention of the company to build lines to Woburn, Van Burensburg and Fairview.

EAST ST. LOUIS, ILL.—Preparations are being made by the Kinloch Telephone Company to establish a branch exchange in East St. Louis. It is believed that with a branch exchange much quicker and better service can be given the East St. Louis subscribers on local calls.

JERSEYVILLE, ILL.—The Illinois Telephone Company has withdrawn its petition to the Jerseyville City Council for a franchise to operate its lines within the city limits. Arrangements have been completed with the Jerseyville Telephone Company whereby the toll lines of the former company may be used by the subscribers of the latter.

SHELBYVILLE, ILL.—At a meeting of the stockholders of the recently incorporated Queen City and Shelbyville County Mutual Telephone Company the following named officers were elected: President, T. F. Dove; secretary, W. O. Bennett; treasurer, B. W. Kerr. Directors: Jacob Ulwer, W. O. Bennett, Michael Kessel, E. A. Richardson, W. T. Walker, George Griffith, T. F. Dove.

FORTVILLE, IND.—The Fortville Telephone Company has been incorporated with a capital stock of $10,000.

MOUNT CARMEL, IND.—The Union Telephone Company has been formed, capital $10,000. Directors: J. R. Collins and others.

LAWRENCEBURG, IND.—The People's Telephone Association of Indiana has purchased the line of the Dearborn County Telephone Company.

VAN BUREN, IND.—D. E. M. Beekman and E. O. Woods purchased the Van Buren telephone system of R. W. Lowe. Mr. Beekman sold the plant to Lowe six or seven months ago for $3,000.

ANDERSON, IND.—The strike of the electrical workers' union against the Central Union Telephone Company in this city, Alexandria and Elwood has been declared off and the boycott of the trades councils of the three cities has been lifted. The strike has been on for two months.

WHEATLAND, IND.—The Wheatland Independent Telephone Company has been incorporated by Samuel S. Weaver, John H. Overhay, John S. Nicholson, Charles Nicholson, Andrew E. Nicholson, John H. Niblack and Hamilton Williams, who are also the board of directors for the first year.

INDIANAPOLIS, IND.—The Inter-State Telephone Company, of Wisconsin, has complied with the foreign corporation law by filing a copy of its articles of association with the Secretary of State, showing that $4,000 had been invested in lines constructed in northwestern Indiana.

INDIANAPOLIS, IND.—The Fisher Telephone Company, of Hamilton County, has been incorporated with a capital stock of $5,000. An exchange will be established at Fisher's Station and lines extended throughout the adjoining communities. T. A. Fisher A. F. Beaver, J. A. Noury and A. C. Harrison are directors for the first year.

CARMEL, IND.—The Union Telephone Company has been incorporated with a capital of $10,000. The company will operate throughout the State, but especially in the counties of Hamilton, Boone and Marion. The board of directors includes John R. Collins, William B. Hood, Richard J. Moffit, Albert Kinger and Le Roy J. Pattey.

MARION, IND.—The strike of the electrical workers of the United Telephone Company has been called off, differences settled and the men returned to work. The men have been granted an increase of 25 cents on their daily wages, but the company steadfastly refused to recognize the union in signing an agreement. The strike has been on since August 12. The linemen of the United Telephone Company at Bluffton, Huntington, Ft. Wayne, Gas City and other points have been striking in sympathy with the Marion men.

EVANSVILLE, IND.—A proposition to charge the city $960 a year for new telephones by the Municipal Telephone Company has raised a storm of protestation. The Cumberland Telephone Company is at present furnishing the city telephones free and it is difficult for the citizens to understand why the promoters of the Municipal Telephone Company, who claims to be working so hard "for the interest of the city," want to charge the city $960 for the use of its telephones. The cry is raised that the new telephone company is not going to be municipal.

BLUFFTON, IND.—Twenty-six linemen employed in stringing cables for the United Telephone Company in this vicinity have gone out on a sympathetic strike. They have no grievance, but were ordered out because of a strike at Muncie and Marion by members of the same Electrical Workers' Union with which they are affiliated. The Marion strikers demand an increase from $2.50 to $2.75 a day and a reduction of from 9 to 8 hours. Most of the men are employed by the Butterfield Construction Company, which has the contract for improving the system of the United Company here and in Marion, Hartford City, Montpelier and other points.

DAYTON, IA.—The Farmers' Telephone Company has been voted a local franchise.

HARLAN, IA. The Harlan & Avoca Telephone Company is extending its service to Tennant.

NEOLA, IA.—The Shelby Telephone Company has finished a line from that city to Neola by way of Persia.

DUBUQUE, IA.—The Iowa Telephone Company will make improvements in its plant at Dubuque and put in conduits.

DES MOINES, IA.—The Shelby Independent Telephone Company has increased its capital stock from $10,000 to $25,000.

CLINTON, IA.—The Clarinda and Shambaugh Mutual Telephone Company has been formed with a capital stock of $2,000. S. R. Turner is president.

DES MOINES, IA. The Audubon County Farmers' Mutual Telephone Company has been formed; capital $15,000. J. H. Mahony, president, and H. W. Stearns, secretary.

APLINGTON, IA.—The Cedar Valley Telephone Company, with headquarters at Waterloo, put in a local exchange in this little city of about thirty instruments, connected with an automatic switchboard. It will also connect with two farmers' lines recently incorporated by farmers and local business men residing at and near Aplington.

TIPTON, IA.—By an amendment to its articles of incorporation the New Liberty Independent Telephone Company, which is capitalized at $60,000, has changed its name, and headquarters from Scott to Cedar County, by adopting the title of the Tipton Independent Telephone Company. The company has a line from Tipton to Davenport connecting with various rural lines along the way.

DES MOINES, IA.—The contract for the erection of the Iowa Telephone Company's building has been let to F. M. Garthwait, of Chicago, for $37,000. The switchboard is now being erected by the Western Electric Company in Chicago. All the down-town wires will be placed in underground conduits and the wires outside of the business district will be on newly erected poles that are now being prepared. The wires will be in cables for the most part. New telephones will be put in over the entire system. The improvements will involve an expenditure of $200,000.

SIOUX CITY, IA.—With the Iowa Telephone Company offering a reduction and large concessions to prevent the granting of a franchise in Sioux City to a rival and the Sioux City Telephone Company, with a freshly signed contract with the independent companies of western Iowa at hand, asking for the right to operate, a telephone war may not be far distant. The Sioux City Telephone Company has practically closed a twenty-year contract for toll connection with the four independent telephone companies which operate about 10,000 telephones within seventy-five miles of Sioux City, provided the Sioux City Company obtains a franchise to operate a telephone system here. By the terms of the contract the independent lines are to construct lines to Sioux City as soon as the Sioux City Telephone Company's lines are laid. The companies included in the contract are the New State Telephone Company, the Cherokee County Telephone Company, the Maple Valley Telephone & Telegraph Company and the New Monona Telephone Company.

COVINGTON, KY.—The council will advertise for proposals for the construction of a telephone, telegraph and messenger system in the city. A franchise was granted a short time ago, but the courts declared it to be illegal.

COVINGTON, KY.—The North Kentucky Telephone & Telegraph Company has applied for a franchise in Covington. The company has recently been organized with $100,000 capital by F. K. Ludlow, M. M. Durrett, S. Kincon and others of Covington.

OWENSBORO, KY.—The Rural Home Telephone Company has filed articles of incorporation. The capital stock is fixed at $25,000. H. K. Cole and J. K. Woodruff, of Owensboro, and F. A. Lundquist, of Chicago, are the incorporators. The company will establish automatic exchanges in small towns in conjunction with the home telephone of this city.

ESQUINAPA, MEX.—A new telephone line has been constructed between this place and La Concepcion.

OCATLAN, MEX.—A telephone system is to be established in this district, embracing Ocatlan and a number of other towns.

MINACA, MEX.—A telephone line is to be built between here and the San Antonio y Anexas hacienda by Baskin & Ten Eyck, of this place.

MACUSPANA, MEX.—A new telephone line has just been constructed between this place and Jalpa and another between Teapa, this state, and the town of Tocotalpa.

GUAYMAS, MEX.—Luis Velasco, who was granted a concession by the government for the establishment of a telephone system here, will soon have the new service ready for operation.

PUEBLA, MEX.—The state legislature has authorized a tax to be levied in the municipality of Porfirio Diaz, the sum thus obtained to be used in constructing a telephone system in that district.

SAN LUIS POTOSI, MEX.—The new telephone line constructed between this city and the town of Venado has just been opened for business. It was built at the personal expense of Governor Blas Escontria, of this State.

IONA, MICH.—The Palo Telephone Company has been incorporated with a capital stock of $6,000. Directors: F. A. Hargrave and others.

BATTLE CREEK, MICH.—The Jackson & Battle Creek Traction Company now has telephones installed at each switch along the route, so that cars can be dispatched from switches if necessary.

DETROIT, MICH.—The Bell Telephone Company is buying thousands of cedar poles of firms on the Menominee river this year, and it is estimated that it will ship 20,000 poles during the summer months.

HART, MICH.—The Oceana Telephone Company of this city has just installed a 240-capacity generator-call "visual" switchboard in its office in this city. The board is of Stromberg-Carlson make. It has also equipped its Hart, Shelby and Montague offices with Stromberg-Carlson lockout apparatus, and has the same installed on some of its new party lines. So far this summer this company has built 46 miles of new metallic country lines and 10 miles of 10-pin cross arm pole lines. Its new building is now in process of erection.

PARK RAPIDS, MINN.—The Union Telephone Company will build an exchange here.

CYRUS, MINN.—The Stevens County Telephone Company has put in a local exchange at Cyrus.

FOLEY, MINN.—The Maple Leaf Telephone Company has been granted a franchise for a local exchange.

DAYTON, MINN.—The Northwestern Telephone Company will build a line from here to Ithaca and connect with Anoka.

MORGAN, MINN.—The Redwood County Rural Telephone Company will build a line north connecting with the Franklin line.

MINNEAPOLIS, MINN.—The directors of the Tri-State Telephone & Telegraph Company have declared a quarterly dividend.

LEWISTON, MINN.—The Lewiston Telephone Company has been organized at Lewiston and articles of incorporation adopted fixing the capital stock at $10,000. The officers are: President, John Gaffney; vice-president, Henry E. Wirt; secretary, Peter C. Daley; treasurer, B. S. Blanchard.

MINNEAPOLIS, MINN.—The Northwestern Telephone Exchange Company has filed amendments to its articles of incorporation, which will increase the limit of indebtedness from $2,000,000 to $4,000,000. This has been made necessary by the extensions the company has made this season and contemplates making in the near future. Improvements costing $800,000 have been made this year, and extensive alterations of the system are to be completed before the summer is over. The station on the East Side is to be enlarged.

BERTHA, MINN.—The Hewitt-Wrightstown Telephone Company which was organized a year ago, held its first annual meeting at Wrightstown and reelected the following officers: President, J. E. Stitzel; vice-president, A. A. Burch; secretary, B. Aldrich; treasurer, E. W. Smith. Seven managers were elected, one for each of the seven branches, which center at the head office in Wrightstown. The company's success during the past year has far surpassed the hopes of its supporters. It was organized to erect lines in Otter Tail and Todd counties, but the by-laws were so amended that lines can now be built into all surrounding counties. It was decided to incorporate under the state law.

STURGEON, MO.—The New Century Telephone Company has increased its capital stock from $10,000 to $20,000.

BOONE, MO.—The Centralia Telephone Company has distributed poles preparatory to connecting a line with Tulip.

MADISON, MO.—A mutual telephone project is materializing in this vicinity. Maud, Middle Grove and this place are interested.

RICHLAND, MO.—Mr. E. E. Noe has been granted a 20-year exclusive franchise in this town and will establish a telephone exchange here.

KANSAS CITY, MO.—The Oklahoma & Kansas Telephone Company has purchased the property of the Grant County Rural Telephone Company.

JEFFERSON CITY, MO.—The Harrison County Mutual Telephone Company, of Bethany, has increased its capital stock from $9,000 to $100,000.

CURRANT WINE, MO.—The contracts have been signed for a telephone line from here to Doniphan. T. L. Wright is covering the country with telephone lines.

EXCELSIOR SPRINGS, MO.—The Missouri Valley Telephone Company is extending its line to Excelsior Springs and if the independent line from Kansas City does not meet it there it will be extended into Kansas City.

MOUNTAIN GROVE, MO.—The Mountain Grove Telephone Company, with $10,000 capital, has been organized here. The officers are E. H. Farnsworth, president; Thos. W. Hackworth, secretary, and L. H. Slaughter, treasurer.

BEAVER CROSSING, MO.—At a meeting of the stockholders of the Beaver Crossing Telephone Company held for the purpose of amending the articles of incorporation, the name of the corporation was made the Seward County Telephone Company. The amount of the capital stock of the company is to be $50,000.

DILLER, MO.—The Diller Independent Telephone Company, at its recent annual meeting, declared a dividend, which was paid by the treasurer before the meeting adjourned. The following officers were elected by the board of directors: President, E. S. Loock; vice-president, Thomas Nelson; secretary, A. L. Lintsman; treasurer, J. C. Herwig.

CHILLICOTHE, MO.—The transfer of the Chillicothe telephone system from Leach & McArthur to the Theodore Gary syndicate, which was to have been made August 1, has again been postponed. Funds which were to have been used in making the Chillicothe purchase are understood to have been required at Joplin, where the syndicate also owns the exchange.

ST. LOUIS, MO.—An independent telephone company was organized at a meeting of citizens of St. Louis County, August 28. The meeting was held in a special car, provided by the St. Louis, St. Charles and Western Railroad Company, while making a trip from Wellston to St. Charles and return. Those who signed the articles of agreement were F. A. Heidorn, D. C. Taylor, Ernest Marshall, Fred Essen,' Ed Miller, Julius Kessler, Doctor J. D. Pfister, William Wehmeyer, Christ Von Gruben, Alex Kessler, E. Bissell, J. F. Houseman, J. B. C. Lucas, Peter Kerth, Ed Rannells and Henry Weber. Articles of incorporation will be filed as soon as the attorneys for the company can prepare them. The headquarters of the organization will be in Clayton.

BOZEMAN, MONT.—The Yellowstone Park Telephone & Telegraph Company will build a line here from Norris.

BILLINGS, MONT.—D. S. Murray, general superintendent of the Rocky Mountain Bell Telephone, and Hugh Thomas, traffic manager of the company, have just completed a deal for the company's extension.

GREAT FALLS, MONT.—The Rocky Mountain Bell Telephone Company has paid to the treasurer of Cascade County, this State, $1,082 in payment for county licenses on telephone instruments since 1899. The case was contested, and the money paid after a decision by the Supreme Court.

KEARNEY, NEB.—A neat up-to-date directory for the Home Telephone Company has been issued. It contains a complete list of the subscribers in Kearney, numbering about 500, the Platte Valley and other places with several hundred subscribers.

NEWPORT, NEB.—The Newport, Hammond & Southern Telephone Company has been organized with a capital stock of $3,000. The officers are C. M. Thompson, president; L. F. Brown, vice-president; M. E. Smith, treasurer; Robert Good, secretary. The line is already built and doing business from this place to Perch, and Hammond, twenty-five miles south, and branch lines are now being proposed.

MEREDITH, N. H.—The first cable ever laid in the waters of Lake Winnipiscogee has been put down, connecting the New England and Meredith telephone lines together on Bear Island, the second largest island in Lake Winnipiscogee.

JERSEY CITY, N. J.—The Eastern Illinois Independent Telephone Company has been incorporated at Jersey City; capital $500,000. Incorporators: Charles N. King, Le Grand Bouker, W. Monds Greene.

JERSEY CITY, N. J.—The Eastern Illinois Independent Telephone Company has been incorporated at Jersey City; capital, $500,000. Incorporators: Charles N. King, Le Grand Bouker, W. Monds Greene, Jersey City.

ALAMAGORDO, NEW MEX.—The telephone line of the Alamagordo & El Paso Telephone Company between this place and El Paso has been completed.

WESTVILLE, N. Y.—The Westville Telephone Company has been incorporated; capital, $1000. Incorporators: Frank Green, Almarin Baldwin, Thos. Gurney, E. B. Coats, M. A. Stillwell, John M. Cady, K. H. Baldwin, all of Westville, N. Y.

PLATTSBURGH, N. Y.—The Clinton Telephone Company of Plattsburgh has been incorporated to construct lines in Plattsburgh and northern New York. The capital is $50,000 and the directors are John M. Wever, B. S. Ramsey and Isaac Merkel, of Plattsburgh.

JAMESTOWN, N. Y.—A new independent telephone company has been organized in Jamestown, to be known as the Ashville & Panama Telephone Company. The company takes possession of the Appleby telephone lines, which extend through the towns of Busti, Harmony, Chautauqua and Sherman and a portion of Warren County, Pa. The new company elected George W. Appleby, president; Brewer D. Phillips, vice-president, and Alton H. Appleby, secretary and treasurer.

TROY, N. C.—The Troy Telephone & Electric Light Company has been incorporated with an authorized capital of $10,000 and the privilege of increasing to $100,000. The object of the corporation is to operate and maintain telephone and electric lighting systems in the State. O. M. Wade, J. B. Blair and W. A. Cochran are among the incorporators.

ST. MARYS, OHIO.—The St. Marys Telephone Company will install a new automatic switchboard.

DILLONVALE, OHIO.—The Vigilant Telephone Company has been formed with a capital of $3,000.

HAMILTON, OHIO.—The Bell Telephone Company has applied for franchises for a number of extensions to its toll lines in this county.

SEBRING, OHIO.—The Columbiana County Telephone Company has announced an increase in rates. The company claims to be losing money at present rates.

DILLONVALE, OHIO.—The Vigilant Telephone Company, capital $3,000, has been formed by Jacob Barkhurst, Wm. A. Gerke, H. T. Roe, T. O. Guyton and others.

AMSTERDAM, OHIO.—The Kilgore Telephone Company has declared a 35 per cent. dividend on its Harlem-Kilgore line. The wires are now being extended to this place.

VAN WERT, OHIO.—The Central Union Telephone Company has applied for a franchise in Van Wert. The service of the Home Telephone Company has been subjected to considerable criticism of late.

CLEVELAND, OHIO.—The gross earnings of the United States Telephone Company for the first six months of 1903 were $151,726; operating expenses, $89,102; net earnings, $62,604; surplus for stock, $2,883.

CINCINNATI, OHIO.—The managers of the Hamilton Home Telephone Company now have a line into Cincinnati and within the next week or two there will be direct connection between Hamilton and Cincinnati over their lines.

SYCAMORE, OHIO.—The Rural Telephone Company of Sycamore is making great gains in this section and over 50% of the farmers within a radius of Sycamore are now supplied with the service. New extensions are being planned.

WAPAKONETA, OHIO.—The Buckland Telephone Company has been organized with the following officers: H. D. Bowsher, president, I. B. Bowsher, secretary, and Dr. R. W. Sharp, vice-president and treasurer. The company will build a telephone system in this county.

TOLEDO, OHIO.—The Toledo Home Telephone Company has celebrated the first anniversary of the opening of service in Toledo. The exchange started with 2,500 subscribers and now has 7,100. New cable is to be laid and other improvements will be made at once.

SHARON, OHIO. W. F. Laubach and H. C. Spicer, receivers for the Sharon & Copley Telephone Company have sold the line to E. A. Hawkins, of Copley, for $800. This line was built eight years ago by W. B. Arnold, and was one of the first to be independently operated in the rural districts.

CLEVELAND, OHIO. The semi-annual report of the Cuyahoga Telephone Company shows a great improvement in the condition of affairs. Gross earnings for the first six months of the year were $201,565; operating expenses, $104,967; net earnings, $96,598; fixed charges, $58,115; surplus, $38,483.

PORT CLINTON, OHIO. The new direct line of telephonic connection between Port Clinton and Toledo has been put in operation. The line belongs to the new Ottawa County Telephone Company. There was used in the construction of the new system more than forty miles of copper wire in one continuous stretch.

FREMONT, OHIO. Stockholders of the Fremont Telephone Company will meet September 8 to vote on a proposition to increase the capital stock from $60,000 to $100,000 for the purpose of installing a new central energy switchboard of the latest pattern. The company is in a very prosperous condition and is earning at the rate of 12% on its common stock.

NEWARK, OHIO. The directors of the Newark Home Telephone Company have declared a dividend of 1% on common stock. The company has 1,100 telephones in Newark and 750 in the surrounding territory. The Granville exchange will be enlarged and several new farmers' lines will be built. Additional equipment will be purchased for the Newark exchange and the capacity of the toll board will be doubled.

SPRINGFIELD, OHIO.—The work of building the United States Telephone Company's line from the county line to Springfield has been commenced. This city has connection with Dayton over the independent line now, but in order to talk with Dayton it is necessary to connect via Kenton and Columbus, while the new line will do away with this roundabout circuit and give communication with the Gem City direct.

CINCINNATI, OHIO.—The Interstate Telephone Company of Cincinnati has been incorporated with $10,000 capital stock by S. P. Kineon, F. K. Ludlow, Theo Horstman, H. C. Hulbert, Eugene Zimmerman and R. H. Ellison. The company proposes to construct a telephone system between Cincinnati and Dayton and will apply for a franchise in Cincinnati. This will make the third company fighting for a franchise in this city.

CINCINNATI, OHIO.—The Cincinnati Telephone Company has increased its capital stock from $50,000 to $1,000,000. This is the new independent telephone company that proposes to invade the field here. The company has made arrangements to connect with the United States Telephone Company's long distance line. Local capital is largely behind the new company, with some Indiana capital also interested. R. C. McCracken, Jr., is president of the company, and Robt. W. Seebaum is secretary.

SALEM, OHIO.—The city solicitor has been instructed by the council to defend the rights of the people in the matter of the rates fixed in the franchise of the Columbiana County Telephone Company. The company is making an effort to raise rates. The company is controlled by the Federal Telephone Company of Cleveland. It is claimed that the company has invested over $300,000 and that thus far it has operated at a loss of $60,000. The company has 850 business telephones and 1,204 residence telephones in Columbiana County, which is said to be about twice as many as the Bell Company has.

HAMILTON, ONT.—The Bell Telephone Company, under the by-law, is given an exclusive franchise for five years.

INDIANA, PA.—The directors of the Indiana Telephone Company have authorized J. C. Rugh to make improvements on the line in Indiana to the amount of $5,000, changing to the metallic system.

YORK, PA.—The Pennsylvania Telephone Company is making improvements to its lines in this city, which, when completed, will have cost over $15,000 and will then give the people of York as good service as any city in the country.

UNIONTOWN, PA.—The Tri-State Telephone Company has about 500 telephones connected up in Uniontown and about the same number in Connellsville. The remaining 100 in Uniontown are now in working order. The company has decided to build an independent line to secure Pittsburg connections.

CONNELLSVILLE, PA.—C. A. Berg, of the Tri-State Telephone Company, stated that the company has decided to build an independent line from this section to Pittsburg. The company has its line built to Somerset, and is preparing to make connection with the Maryland, West Virginia & Pennsylvania Telephone Company, which will give Fayette County connections with all the towns between here and Cumberland, and beyond that place.

MONTREAL, QUE.—A new telephone system in the city of Montreal and district, is about to be established by the Bell Telephone Company of Canada, at an estimated cost of about $1,000,000. Extensive preparations are being made in the new building, now in course of construction on Hospital Street, to receive the complete new telephone apparatus and equipment. The ultimate capacity of the switchboard will be 9,600 subscribers' lines. In addition to providing for local subscribers, the apparatus will provide a new switchboard for long distance service. In that portion of Montreal, known as the east exchange, telephonically, a new building will be provided. The switchboard in this exchange will also have an ultimate capacity of 9,600 subscribers' lines. There are at present about 14,000 subscribers in Montreal, and provision is being made in the new system for an expansion to 50,000 subscribers. Switchboard provision will be made for 100 long-distance operators, only about 20 operators are now at this special line of work in the city. The growth of the long distance business is exceedingly rapid throughout Ontario and Quebec. Several gangs are now at work in extending lines along the south shore of the St. Lawrence River, connecting many towns and villages that have not, as yet, telephone communication with Montreal. The Bell Telephone Company has also under consideration the improvement of its entire system throughout Canada.

MANNING, S. C.—The Manning Telephone Company has been chartered with a capital of $5,000, by F. C. Thomas, D. M. Bradham and W. L. Jenkins.

JOHNSON CITY, TENN.—The Cumberland Telephone Company is seeking to gain an entrance into this city and has asked the city council for a franchise.

MEMPHIS, TENN. The Tennessee District Telegraph Company will do business in Memphis. The legislative council, by a vote of 7 to 2, has granted it a twenty-five-year franchise, although it has attached thirteen stringent conditions named by the live-wire committee.

CHATTANOOGA, TENN.—The Hamilton County Telephone & Power Company has been organized. All the stockholders are Chattanoogans and men of wealth. A franchise will be asked for and it will start work on an independent exchange as soon as it is granted.

SONORA, TEX. A telephone system is being installed here by Rust Bros., of San Angelo, Tex.

SEALY, TEX. The Southwestern Telegraph & Telephone Company will establish a local exchange here.

LA GRANGE, TEX.—The Commercial Telephone Company is building a new telephone line between this place and Carmine.

PORT ARTHUR, TEX.—It is announced that W. H. Rogers, who is at the head of the Rogers Pipe Line Company, will construct a telegraph and telephone line between this place and Jennings, La.

NAVARRO MILLS, TEX. The board of county commissioners of this county has granted French & Griffith, of Corsicana, the right-of-way for the construction of a new telephone line to connect this place with the town of Purdon.

SAN ANTONIO, TEX. It is announced that H. E. Huntington, who recently acquired practically all of the independent long distance telephone lines in Texas, aggregating about 1,000 miles, will immediately expend $400,000 in making extensions of these lines. Frank B. Smith, of San Antonio, who is in charge of the system can give information in regard to the proposed improvements.

AUSTIN, TEX.—It was stated that H. E. Huntington, who recently purchased all of the independent telephone toll lines in Texas, aggregating 1,000 miles, and for which he paid $400,000, has practically closed negotiations for the purchase of the independent telephone exchanges located at Austin, San Antonio, Houston, Corsicana, Waco, Beaumont and nearly a score of other towns in this state, Louisiana and Indian Territory. The amount involved in the purchase of these exchanges exceeds $3,000,000.

SALT LAKE, UTAH.—The Independent Home Telephone Company has announced its intention of beginning the construction of its Ogden building immediately.

SALT LAKE, UTAH.—The Bell Telephone Company, of this city, has absorbed the lines of the Teton Telephone Company by private transfer. The price has not been stated.

SALT LAKE, UTAH.—General Manager Murray, of the Rocky Mountain Bell Telephone Company, has asked the city engineer for a line along which to construct a conduit for the burial of its telephone wires on South Temple Street for a distance of two miles.

LA RUE, W. VA.—The La Rue Telephone Company has been formed; capital $50,000. Charles J. Stehl, La Rue, is agent.

STOREY, WIS. The Belleville Telephone Company will soon connect lines with the Oregon Company at Story.

MILWAUKEE, WIS.—The Escanaba & Lake Superior Railway has equipped its telegraph lines with composite telephones.

IRON RIVER, WIS.—The Home Telephone Company's exchange at Iron River has been opened, 100 telephones being in use. Direct toll connection has been made with Ashland, and a number of cities down along the line of the Central are placed in telephone communication.

ASHLAND, WIS. Senator Lamoreux and T. C. Jacks, of the Home Telephone Company, have made arrangements for the building of a toll line to connect Ashland, Washburn and Iron River. Later on the toll line will be extended from Iron River to the head of the lake.

MILWAUKEE, WIS.—The "nickel in the slot" telephone has proven a success, and in the last six months over 1,000 of these instruments have been installed by the Wisconsin Telephone Company, until now about 4,000 are doing a daily business in saloons, drug stores, groceries and residences.

BELOIT, WIS.—The stockholders of the Beloit Telephone Company held their annual meeting recently and elected directors and officers as follows: D. H. Polock, M. J. Ward, C. A. Gault, Chas. Franz and W. H. Grinnell. President, Chas. Gault; vice-president, M. J. Ward; secretary and treasurer, D. H. Polock.

LAKE NEBAGAMON, WIS.—A new telephone company has been recently organized at Lake Nebagamon, a small town. Forty telephones have been installed and it is thought that very soon the number will have grown to sixty. The company expects a large patronage from the farmers. The officers are W. S. Carr, president; B. F. Jare, secretary, and M. Hendrickson, treasurer. All are business men of Superior.

Electric Light and Power.

LANETT, ALA.—It is stated that the establishing of an electric light plant is being considered.

DADEVILLE, ALA.—Bids will be received Sept. 22 for constructing an electric light plant in this city at a cost of between $7,500 and $10,000. J. H. Lovelace is clerk. Press reports state that the City Council has ordered an election to be held Sept. 21 to vote on the question of issuing $10,000 bonds to install electric lights. It is stated that a dam will be built at Black's Shoals, about two miles from Dadeville, and power transmitted from there.

LITTLE ROCK, ARK.—The College Hill Light & Traction Company has been chartered. The capital stock is $195,000, all subscribed. E. K. Smith is president; J. D. Sanderson, vice-president; E. J. Spencer, secretary; J. L. Chatfield, treasurer.

REDLANDS, CAL.—The Holton Power Company intends to develop the power of East Side canal at a cost of about $75,000. The time for receiving bids has not yet been decided upon. W. F. Hoet is president.

LEWES, DEL.—Bonds to the amount of $10,000 are reported sold for the purpose of extending the electric light plant and sewerage system.

TAYLORVILLE, ILL.—Wm. J. Mower has petitioned for a franchise for an electric light plant.

FRANKLIN, KY. The Franklin Electric Company will increase the capacity of its lighting plant by the addition of a 30-kw alternator, exciter and switchboard, and also one 50-hp automatic engine. The machinery has been purchased and will be installed by Mr. W. H. Isbell. It will also probably add a number of new alternating street lights and extend its lines in the near future.

TEHUACAN, MEX.—Ramon de la Fuente has let the contract for the installation of the new electric light plant here.

CHILPANCINGO, MEX.—A new electric light and power plant is to be installed here. It will supply the city with 50 arc and 200 incandescent lights.

ACAPULCO, MEX.—Thomas Levison, an American claiming to represent a Pittsburg, Pa., syndicate, has been investigating the situation here with the view of establishing an electric light and power plant.

TAMPICO, MEX.—At a meeting of the Tampico Electric Light & Power Company the stockholders authorized the capital stock to be increased from $150,000 to $225,000. The company let the contract for installing its electric light and power plant to a Germany company. In addition to supplying the city with lights, the company will also furnish power for industrial concerns of the city.

BOYNE CITY, MICH.—The Council has granted an electric light franchise to Ernest A. Stowe and C. C. Follmer, of Grand Rapids.

LANSING, MICH.—The Alpena Heat, Light & Power Company, of Alpena, $500,000 capital, has filed articles of incorporation. The company was incorporated under the laws of Maine although it seems to be strictly a Michigan company.

LYONS, MICH.—The Ionia Electric Company has completed its concrete dam in Grand River. The water is carried through a stone flume to the power-house, in which are two Leffel water wheels, and the power is carried to Ionia, seven miles distant, at 2,500 volts.

HALLOCK, MINN.—J. S. Leary is reported interested in the construction of an electric light plant.

BAGLEY, MINN.—M. J. Kolb and John Bohmer have secured a franchise for an electric light plant.

FAIRMONT, MINN.—An ordinance is before the Council to provide for the issue of $16,000 electric light bonds.

ST. CHARLES, MINN.—The St. Charles Electric Light Company has been incorporated, with a capital of $10,000, for the purpose of installing and operating an electric light plant in this city, until such time as the city is able to purchase same. N. Kiefer is reported interested.

ST. LOUIS, MO.—The Suburban Electric Light & Power Company has increased its capital stock from $10,000 to $100,000, all the increase being paid.

WASHINGTON, MO.—A. A. Tibbe has sold the electric light plant and the telephone system to Henry Hibbler and John Earnst. The new firm took charge of the business the same day. Mr. Hibbler is assistant cashier of the bank of Washington and Mr. Earnst is the proprietor of a greenhouse at the same place.

FARMER, N. Y.—It is reported that the Ovid Electric Light Company, of Ovid, will extend its lighting system to Farmer.

ROCKWOOD, PA.—The contract for the town lighting plant has been awarded to the Iron City Engineering Company, Pittsburg, Pa.

PORTAGE, PA.—The Portage Light, Heat & Power Company has been incorporated here. Incorporators: H. A. Tompkins, J. J. McDonnell and others. It is stated that the purpose of the company is to supply current to Portage and neighboring communities, including Wilmore, Puritan, Cassandra and Jamestown.

LOYSBURG, PA.—Bedford Electric Light, Heat & Power Company is reported to have been organized with $250,000 capital to harness the stream below Loysburg. The water will be carried two miles by a conduit about 6 feet in diameter. A power house will be erected and a large main wire will be placed along the line connecting Loysburg, Waterside, Woodbury, Martinsburg, Rolling Springs, Hollidaysburg and Altoona on the north and Bedford County towns on the south. Harvey Linton, of Altoona, is the engineer. An electric road is also being considered.

HOUSTON, TEX.—The new power house which the Houston Electric Company to be erected here will cost about $11,000.

SAN MARCOS, TEX.—The San Marcos Electric Light & Power Company is enlarging and otherwise improving its plant at this place. William Greene is president of the company.

AUSTIN, TEX.—It is proposed to establish an electric light and water works plant at Austin for supplying lights and water for the several state institutions situated here. The legislature at its last session appropriated $155,000 for this purpose. Dr. B. M. Worsham, superintendent of the State Insane Asylum, can give information.

AUSTIN, TEX.—The Austin Electric Light & Power Company has entirely rebuilt its system and enlarged its power plant. This was rendered necessary in consequence of the break in the big dam at this point in April, 1900. The company now has a very complete steam plant on its property, which gives much better satisfaction than did the old water power.

BURLINGTON, VT.—According to the preliminary estimates submitted to the Board of Aldermen by Prof. Freedman, the cost of constructing a municipal electric light plant of 250-kw will be about $56,390, and $20,000 per year for operation.

MENOMONIE, WIS.—An important water power development is being planned at this point. It is intended to utilize the entire power of the Red Cedar River, including the powers at this point and at Rice Lake, a distance along the river of nearly 70 miles. It is calculated that there will be a minimum of 10,000 horse power available. The Wisconsin Power Company is developing the enterprise and Mr. J. H. Colter, of Chicago, is the principal promoter of the new company.

CAMBRIA, WIS.—The village will vote on the establishing of a lighting plant.

NEW LONDON, WIS.—Reports state that the proposition to issue electric light plant bonds carried.

STEVENS POINT, WIS.—The Stevens Point Lighting Company is stated to have purchased the water power at Jordan on Plover River, and will transmit electrical power to this city.

The Electric Railway.

PUEBLO, COL.—The surveying corps of the Rapid Transit Company in charge of R. L. Kelly, has about completed preliminary surveys for the electric railway projected to connect Pueblo with the Beulah Valley, 30 miles southwest. The railway expects to do a large freight business, and already has assurances of a business of 1,000 tons a day. The road will start at the post office in Pueblo. It is possible that a plant will be located at the coal mines in the vicinity of Florence and high-tension power lines built to substations on the road. The following are officers: George Peck, of Cincinnati, Ohio, president; John J. Burns, of Pueblo, vice-president and secretary; James N. Carlisle, of Pueblo, treasurer. The constructing company is known as the Pueblo & Beulah Realty & Construction Company, and W. A. Beatty, room 17, Opera House Block, Pueblo, is the president and general manager.

SPRINGFIELD, ILL.—The Decatur, Tuscola & Champaign Railroad Company has been incorporated. The capital is $5,000. The incorporators are J. H. Culver, Charles S. Hankins, William H. Black, J. M. Clokey, D. L. Campbell, J. L. Ray, Ashton Campbell, Charles Eckhart and A. W. Wallace.

INDIANAPOLIS, IND.—The directors of the Indianapolis & Shelbyville Traction Company are receiving bids for the construction of 28 miles of road between Shelbyville and Greensburg. Robert C. Light is president of the company.

INDIANAPOLIS, IND.—Charles F. Smith, general manager of the Indianapolis & Martinsville Rapid Transit Company, is advertising for bids to construct 24 miles of road between Martinsville and Bloomington. There will be about a quarter of a mile of tunneling.

LAKE CHARLES, LA.—An interurban electric railway is to be constructed between this place and Grand Lake, a distance of eighteen miles. City Engineer C. M. Boren, of this place, can give information.

NEW IBERIA, LA.—The New Iberia Railway Company has been organized here for the purpose of constructing and operating an interurban electric line between this place and Morgan City. The contract for the construction of the road will soon be let.

WORCESTER, MASS.—According to a statement made by President Ned C. Hinds, of the Hartford & Worcester Street Railway, work on the construction of this line will soon be begun on locations granted in Massachusetts. James F. Shaw & Company, of Boston, are to build the line.

BOSTON, MASS.—The Boston & Northern Street Railway Company is purchasing land along Highland Avenue, Salem, for a new electric line which will connect Town House Square, Salem, and the Scollay Square, Boston, by an almost direct route, enabling cars to make the distance in an hour's run.

MARLBORO, MASS.—Extensive improvements are planned for the Marlboro Street Railway, which has recently passed into the hands of James F. Shaw, of the Boston & Worcester Street Railway Company. The Boston & Worcester system of safety appliances, by the use of telephones, flags, lights and torpedoes, is to be adopted. The line runs from Marlboro Junction to Hudson, and through cars are operated between Hudson and South Framingham over the Framingham, Southboro & Marlboro Street Railway.

VERA CRUZ, MEX.—The street railway line which is owned and operated by the Cementerio Particular Veracruzano, S. A., is to be extended from its present terminus to the Alameda. Additional equipment will also be purchased.

PUEBLA, MEX.—A committee of the city council has been appointed to arrange for the extension of the street railway system here from the Paseo de Bravo to the Cerro de San Juan. The company will purchase a considerable amount of building material and additional rolling stock. Dr. Miguel A. Salas, of this city, can give information.

FRONTERA, MEX.—It is stated that the Orizaba Rubber Plantation Company, of Chicago, Ill., which owns an extensive plantation situated near here, will soon commence the construction of an extensive electric railway system which will be used principally to transport freight. It is proposed to utilize the falls of the Tulija River for the purpose of obtaining power for operating the system. Colonel J. H. Sanborn is president of the company.

SAUK RAPIDS, MINN.—The Watab Dam Improvement Company has under advisement the project of establishing an electric railway from here to Watab, a distance of three miles, and also a line to the granite quarries, two miles north of town. The plans are being prepared by engineers of the company, and a report will be ready in a few weeks.

ST. LOUIS, MO.—The St. Louis & Olivet Railway Company has been incorporated, with a capital stock of $100,000. The incorporators are W. Carl Feld, S. S. Senne, E. H. Daves, A. W. Werremeyer and W. E. Heapes.

ALBUQUERQUE, NEW MEX.—The Albuquerque Traction Company has been organized here with a capital stock of $250,000.

NEWARK, N. J.—The eleven officials and directors of the North Jersey Street Railway Company indicted for manslaughter in connection with the Clifton Avenue grade crossing accident of Feb. 19 last, in which nine pupils of the Newark City High School were killed, were placed on trial before Chief Justice William S. Gummere in the Circuit Court here Aug. 31. They were acquitted, the jury rendering a verdict of "not guilty."

TRENTON, N. J.—After a delay of nearly three months the Delaware Valley Traction Company has obtained a franchise in Ewing Township. The ordinance empowers the company to construct a road, beginning at the city line, near the State Hospital, and proceeding out the Birmingham road through Trenton Junction to Birmingham. This franchise, together with the Hopewell franchise gives the company a continuous line through Mercer to the Hunterdon County line. The company already has a franchise in Lambertville, and the only break in the route is about a mile and a quarter in West Amwell Township, in Hunterdon County. It is probable that a petition will soon be sent to Common Council for permission to extend the road into the city from the State Hospital to the entrance of Cadwalader Park. As soon as all the franchises are obtained, work of construction will be begun.

BROOKLYN, N. Y.—It is said that the Brooklyn Rapid Transit Company proposes to prosecute every conductor who may be caught acting dishonestly, instead of simply discharging each man and putting him on its blacklist, as has been the policy heretofore.

ROCHESTER, N. Y.—The Rochester & Easton Railway, which is being built between Rochester, Canandaigua and Geneva, N. Y., is expected to be completed and ready for operation about Sept. 15. Forty-one miles of track have been laid, the poles and brackets have been placed, and the remainder of the work is confined to stringing wires. There are two power houses, one at Canandaigua and the other at Geneva. A large car house has also been built at Canandaigua, where the offices of the company will be located.

CINCINNATI, OHIO.—A deal is now pending between the officers of the Cincinnati, Lawrenceburg & Aurora Traction Company, the Cincinnati Interterminal Company and the Indianapolis & Shelbyville Southeastern Traction Company, which, if completed, will link Cincinnati and Indianapolis with a direct line.

YOUNGSTOWN, OHIO.—The Youngstown & Southern Electric Railway Company, which is building a line from this city to East Liverpool, is in negotiation with builders for three electric engines of the largest type, each to haul 20 cars of 50 tons capacity. The company will open up the coal fields between here and East Liverpool that never before have been tapped.

NEWARK, OHIO.—The Newark, Martinsburg & Mt. Vernon Traction Company has just been organized with the election of the following officers: Edward H. Everett, president; Dr. J. W. Shromtz, vice-president; John A. Chilcote, treasurer; F. E. Elliott, secretary; Edward Kibler, counsel. The company has secured practically the whole right of way from Newark to Martinsburg and from Gambier to Mt. Vernon by private plan.

OTTAWA, ONT.—Mr. Roland L. Porthiem, of Edinburgh, Scot., and several other English capitalists, are promoting the project of running an electric railway in the province of Ontario, from Port Stanley to Hamilton through Woodstock, St. Thomas, London and Brantford.

PETERBOROUGH, ONT.—At the meeting of the City Council, the franchise to the Peterborough & Ashburnham Radical Electric Railway Company, which is practically the American Cereal Company, was agreed upon. The principal clauses of the franchise provide that 5 miles of railway within the town are to be equipped and in operation not later than July 1, 1904. The plans of the company include extensions to Dabburnham, Lakefield, Young's Point and Chemong.

ALLENTOWN, PA.—The Blue Ridge Traction Company has filed thirteen extensions at the Recorder's office, in Allentown, showing proposed lines aggregating 48.7 miles.

DOYLESTOWN, PA.—It is the intention of the New Jersey & Pennsylvania Traction Company to extend its line from Newtown to Willow Grove and make a connection with the lines of the Union Traction Company, of Philadelphia, within a year. The line is to be built via Richboro, Southampton, Davisville and Hatboro.

HARRISBURG, PA.—The directors of the Harrisburg & Lewisberry Street Railway Company have decided to extend the line from Lewisberry to Bowmansville by way of Lisburn. The final merger of the Harrisburg & Lewisberry Street Railway Company and the Star Street Railway Company is expected in a few weeks.

PITTSBURG, PA.—E. H. Converse & Company, Pittsburg, have secured the contract for preparing plans and specifications for the Paulsboro Traction Company, whose proposed line is to extend from Woodbury to Paulsboro and Billingsport, and thence to Swedesboro, via Clarksboro, in New Jersey. Surveys will be commenced at once. Messrs. Converse & Company will be pleased to hear from parties interested.

WILKESBARRE, PA.—Counsel for the Lehigh Valley Railroad has petitioned the Court to restrain the city of Wilkesbarre from interfering with or preventing the construction of the railway tracks on the old canal bed of the new electric line, which seeks to enter the city over that route. The city has policemen stationed at all crossings, and refuses to allow the employees of the company to proceed with the laying of the tracks under the threat of arrest.

BERWICK, PA.—The Berwick & West Nanticoke Electric Railway Company has purchased the old Pennsylvania Canal Company's dam at Nanticoke, where it will build a power plant for the purpose of operating not only its own cars, but those of the Columbia & Montour Traction Company. The company has also acquired the right to use such sections of the old towpath as may be available in getting its tracks from Berwick to West Nanticoke. Negotiations are also pending for an extension to Plymouth, where connections would be made with the Wilkesbarre & Wyoming Valley Traction system.

MONTREAL, QUE.—The directors of the Montreal Street Railway have decided to ask the shareholders of the company for power to make an issue of $1,000,000 stock additional. A special meeting of the shareholders will be held on September 10, and if the issue is agreed upon, it will be offered to the shareholders at par. The object of the directors in asking for new capital, is to improve the road bed and construct new lines and cars. With the new stock issue, the company will have a capital of $7,000,000 in stock.

PROVIDENCE, R. I.—The Providence & Taunton Street Railway Company it is said is considering the extension of its tracks to Hunt's Mills.

WOONSOCKET, R. I.—A second survey is being made by the Providence & Burrilville Street Railway Company of the route of its proposed line between Woonsocket and Providence. The route is through North Smithfield, Lincoln and Smithfield to Centerdale, and will be several miles shorter than the present railway route. President Ray, of the Woonsocket Street Railway Company, is interested in the project.

CLARKSVILLE, TENN.—The local street railway company of Clarksville has in view several possible extensions.

MEMPHIS, TENN.—The City Railway Company has applied for a charter at Memphis. It is proposed to have a capital of $50,000. The incorporators are St. Louis capitalists, and are: F. R. Harris, R. P. Cary, W. A. Buckner, T. T. East and M. M. Bosworth.

CORPUS CHRISTI, TEX.—The city council has granted Moling Bros., a franchise for an electric street railway and an electric light and power plant.

CLARKSVILLE, TEX.—A movement has been started looking to the construction of an interurban electric railway between this place and Paris, Texas, by way of Mt. Pleasant and Bogata.

BEAUMONT, TEX.—It is announced that the Beaumont, Sour Lake & Port Arthur Traction Company's line which is now being constructed to Sour Lake will be continued from that place to Saratoga, a distance of about ten miles.

SALT LAKE CITY, UTAH.—United States Senator Reed Smoot and Hon. E. C. Loose, Provo capitalists, have under contemplation the construction of an electric railway from Provo to Brigham City, covering the portion of the state where the business traffic is greatest.

BEAUMONT, TEX.—It is stated that the Beaumont, Port Arthur & Port Neches Electric Company will build a power house. The machinery will be placed to furnish power for operating more than 200 miles of electric road doing freight and passenger business and to furnish power for the oil fields at Beaumont, Sour Lake and Saratoga. Designs for the system are now being drawn, and, according to reports, the order for the machinery will be placed shortly.

NEWPORT NEWS, VA.—The Hampton Roads Railway & Electric Company has filed a mortgage on its plant for $300,000, to cover a bond issue for that amount. The bonds are issued for the purpose of making extensive improvements.

NORTON, VA.—The Wise Coal Company is said to be interested in a scheme to build an electric railway system to the coal fields of Southwest Virginia, connecting Norton, Big Stone Gap, Tom's Creek, Appalachia and a half-dozen other mining towns.

SPOKANE, WASH.—The Chelan Railway & Navigation Company, with a capital stock of $350,000, has decided to construct an electric railway system, which will connect Chelan with Chelan Falls and Chelan Lake with Columbia River.

EAU CLAIRE, WIS.—The Chippewa Valley Electric Railroad Company has filed an amendment increasing its capital stock from $200,000 to $400,000, and enlarging the scope of its business so as to enable it to furnish electric power for manufacturing and commercial purposes.

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THE AUTOMOBILE.

AUTOMOBILE BEER DELIVERY.—The Anheuser-Busch Brewing Association will inaugurate an automobile service for the delivery of its beer. Two machines, said to be the largest of their kind in the world, were received by the firm August 18. The practicability of the vehicles will be thoroughly tested and if the service meets expectations, 176 more of the same kind will be ordered. The automobiles are 24 feet long 10½ wide and the wheels have tires three inches in width. They have a carrying capacity of 30,000 lbs. The vehicles will be operated by electricity and geared to a speed of 20 miles an hour. In business and congested thoroughfares, however, this rate will be materially reduced. It is thought that the entire service will be operative by the first of November. The installation of this service by the company means a displacement of 216 wagons and 432 horses. Each automobile will cost $2,700.

New Industrial Companies.

THE SNELL ELECTRIC SIGN COMPANY is to establish a plant at Toledo, Ohio. The company will manufacture an automatic electric block signal intended for use on electric railway.

THE RUTLEDGE MANUFACTURING COMPANY, of Brooklyn, N. Y., has been incorporated to manufacture dynamos; capital, $5,000. Directors: Lincoln G. Gochen and John S. Ross, of Brooklyn, and Frank Kling, of Manhattan.

THE CLIMAX ELECTRICAL SUPPLY & CONSTRUCTION COMPANY, of Bluefield, W. Va., has been incorporated to deal in all kinds of electrical supplies. Capital $10,000. Incorporators: W. P. Hawley, P. M. Walizer, R. S. Jones, T. A. Martin, W. A. Pankey, of Bluefield, W. Va.

Personal.

PROF. F. A. C. PERRINE, president of the Stanley Electric Manufacturing Company, is visiting San Francisco.

PROF. WILHELM OSTWALD sailed for Europe Sept. 8, his engagements there rendering his present visit to this country very brief. Prof. Ostwald hopes soon, however, to make another and more extended visit.

GEN. IRVING HALE, of Denver, the well-known representative there of the General Electric Company and recently president of the Denver Charter Convention, has been in poor health since his Philippines campaign and has now been ordered East for a long rest and vacation.

MR. B. OVERLY has been appointed general manager of the United States Telephone Company at Cleveland, Ohio, to succeed Mr. H. H. Robinson, who resigned on September 1 to accept the General Managership of the Illinois Telephone & Telegraph Company, of Chicago, as noted last week.

MAJOR G. O. SQUIER, Signal Corps, U. S. A., is now in San Francisco, having completed his tour of foreign service, and is now stationed as chief signal officer of the military department which includes California, Nevada and the Hawaiian Islands. His experience in cable laying in the Philippines has been quite unique.

MR. J. F. MACARTNEY, of the British electrical engineering and contracting firm of Macartney, McElroy & Co., Limited, is now in the States en route for New Zealand, where he will go in connection with the construction of the Wellington electric traction system. His firm has the contract valued at about $650,000 for the construction of the permanent way, the overhead equipment and the rolling stock.

PROF. W. E. AYRTON will sail Oct. 3 for the United States as a member of a British Commission to study American educational methods. President Butler, of Columbia, has drawn up for the Commission an elaborate itinerary of visits. The Commission is being sent by Mr. Alfred Mosely, who some time ago sent to this country a delegation of representatives of British trade unions to report on American industrial methods.

MR. J. R. LOVEJOY, manager of the Railway Department of the General Electric Co., was presented on Thursday, September 3, with a handsome silver punch bowl and ladle, by some forty representatives of the railway department. The street railway convention at Saratoga brought many of these together and thus enabled them to participate personally in the presentation. It is needless to say that Mr. Lovejoy was utterly surprised and not less appreciative of this mark of esteem and friendship on the part of his staff. In fact he confessed during the day that the episode had rather unnerved him for the duty of presiding at the luncheon given at the works to the convention.

MR. C. N. DUFFY, the well-known secretary and auditor of the Chicago City Railway Company, has resigned from that position to become comptroller of the Interurban Street Railway Company and the allied Metropolitan properties, and has assumed his new duties. Mr. Duffy was formerly secretary and treasurer of the St. Louis Union system. He was one of the organizers of the Street Railway Accountants' Association and president of that body in 1900. He is a man of great force of character and of most amiable disposition, but a rigid disciplinarian in all matters of finance. He is a powerful accession to the Metropolitan staff and a decided acquisition for financial and electrical circles in New York City.

Trade Notes.

STONE & WEBSTER announce the removal of their offices in Boston to the new India Building, State Street corner of Merchants' Row, dating from September 1.

PORCELAIN SOCKETS.—The latest publication of Pass & Seymour, Solvay, N. Y., is a pamphlet descriptive of their line of porcelain sockets, which includes types for all classes of electrical work.

HOBART GAS ENGINE DYNAMO.—By a printer's error, the address of the manufacturers of the gas engine type dynamo described in these columns last week was given as Troy, N. Y., instead of Troy, Ohio.

THE F. BISSELL COMPANY, Toledo, Ohio, gives in a recent folder an illustrated list of their specialties, including an automatic portable hand lamp, pole platforms and seats, cable cars, trolley and line fittings.

THE WACO ELECTRICAL SUPPLY COMPANY, Houston, Tex., of which Charles A. Hobson is general manager, will erect a large building in which it will establish a branch electrical supply house.

CATALOGUES WANTED.—The Electro-Dynamic Company, 212 Ionic St., Philadelphia, asks us to say that it will be pleased to have manufacturers of machinery send copies of their latest catalogues to it, addressed to T. D. Brown, Pur. Agt.

THE VOUGHT-BERGER COMPANY, La Crosse, Wis., has issued a neat folder descriptive of a new telephone—No. 45—which it is placing on the market. A number of improvements have been introduced in this type, which is so constructed that it can readily be changed from series-magneto to bridging and vice versa, and for use on common-battery circuits.

THE THOS. E. CLARK WIRELESS TELEGRAPH-TELEPHONE CO., Detroit, Mich., announces that it is erecting stations at Pontiac, Mich., on the State Fair Grounds, for the purpose of carrying on commercial telegraphing. The company has just issued another bulletin with a full description of its instruments, and information on "Space Telegraphing," by Thos. E. Clark.

INDUSTRIAL ELECTRICITY.—With this title Sargent, Conant & Co. have issued a well-written pamphlet outlining their method of doing business, which is that of contracting engineers. Given the results wished to be accomplished, and the conditions under which these results are to be obtained, an estimate is given of the cost at which the necessary plant will be furnished installed and ready for action.

DUNCAN WATT-METERS.—The Duncan Electric Mfg. Company, Lafayette, Ind., in its bulletin No. 1 of 28 pages, gives an excellent technical description of the Duncan type of integrating watt-meter for direct current lighting and power service. All the details of the meter are illustrated and described at length. The final pages of the book contain instructions for cleaning meters in service; testing and installing meters, and instruction for reading dials.

C. & C. MOTORS.—Bulletin No. 145 of the C. & C. Electric Company is confined to a partial list of the users of C. & C. motors taking service from the mains of the New York Edison Company. No less than 30 large sized pages are necessary to contain this list. The extent to which this type of motor is used in New York City is well illustrated by the fact that the list of churches in that city in which it has been installed contains more than three score names.

MONTHLY CALENDARS.—The practice of sending out monthly calendars appears to be increasing. The remarkably handsome biographical calendar cards of the Bullock Electric Company are well known, and we have recently received calendar cards from the Pittsburgh Transformer Company and the Lumen Bearing Company, of Buffalo, N. Y. The former owes its very artistic appearance to a well-disposed oval portrait of a handsome maiden, and the latter to a picture in colors of a vessel at sea.

THE COAL HANDLING MACHINERY installed by the C. W. Hunt Company, of West New Brighton, N. Y., at the Lincoln Wharf power station of the Boston Elevated Railroad Company has recently lowered the world's record for rapid unloading. The coal was raised 90 feet above tide water and delivered to the storage pockets at the rate of 320 tons per hour. The installation follows in general design the standard Hunt steeple tower rig, the moving gear and coal cracker being electrically driven and the hoisting engine direct connected. The overhand of the folding boom is 40 feet, and the capacity of shovel 2 tons.

EUREKA TELEPHONE.—One of the handsomest telephone catalogues that we have thus far seen is that recently issued by the Eureka Electric Company (No. 23). The 70 pages are printed on half-tone paper of the finest quality and the illustrations are excellent examples of the best grade of high-tone work. The stamped cover indicates how an excellent effect may be produced with the absence of any color. The catalogue contains little short of 100 excellent illustrations showing the long line of telephonic apparatus manufactured by this company, which includes everything in telephonic installations from the smallest detail up to exchange switchboards.

"NEW AMERICAN" TURBINES.—A pamphlet that will be much appreciated by the hydraulic engineer and others interested in water-power development has just been issued by the Dayton (O.) Globe Iron Works Company. The 98 pages, which are printed on excellent paper, include finely executed half-tone engravings of numerous hydraulic installations employing the "New American" turbine, as well as detail illustration of all types of this turbine. The final pages contain sections giving technical information on the measurement of water powers, construction of wheel pits and head and tail races, directions for setting wheels, and also several useful tables.

WESTINGHOUSE CIRCULARS.—Three recent trade publications of the Westinghouse Electric & Mfg. Company have for their respective subjects "Direct-Connected Railway Generators," "Westinghouse 68 and 68C Railway Motors," and "Type S Motor." The first mentioned illustrates and describes in detail a class of railway generators ranging in power from 100 to 2,700-kw and in speed from 300 to 75 r.p.m. Among the illustrations of the circular on railway motors are two sets of curves setting forth all the important data of operation. The Type S motor is illustrated in open, semi-enclosed and enclosed form, and tables give the speed and weight of sizes from 1½ to 20-hp.

THE SANGAMO ELECTRIC COMPANY and its hustling agents, the Electric Appliance Company, announces the placing upon the market of the Gutmann duplex watt-meter for alternating current. The Gutmann watt-meter is well known and its high qualities are accepted as facts, but the new duplex meter is a boon to the 50 volt plants which in the course of time are likely to change to 100 volts. This meter can be used with equally accurate results on 50 volts and 100 volts without any change whatever in the mechanism of the motor, and without calibration. The only modification that is necessary when a plant which has the duplex motor installed, changes its lighting circuit from 50 to 100, is to send its meter man from house to house changing the shunt wire connection from the binding post marked 50 volts to the binding post marked 100 volts. The Gutmann duplex watt meter is identically the same in appearance as the standard 100 volt meter and is of the same weight and dimensions. Instead of having a single shunt wire connection in the connecting box underneath the meter proper it has two shunt connections, one marked 50 volts, the other 100 volts.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 1, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

736,189. TELEPHONE APPARATUS, Charles G. Burke, Brooklyn, N. Y. App. filed Feb. 11, 1901. (See page 442.)

736,518. ELECTRIC SYSTEM OF TRANSMISSION, Robert A. Ripley, Stamford, Conn. App. filed June 14, 1902. (See page 441.)

736,536. PAPER HOLDING DEVICE FOR TELEPHONES; William Hale Sherman, Newport, R. I. App. filed May 8, 1902.

736,616. INDICATOR ATTACHMENT FOR BELLS, Charles E. Munroe, New York, N. Y. App. filed Jan. 5, 1903.

737,566. ELECTROLYTIC APPARATUS; George Bell and George William Bell, Liverpool, England. App. filed June 18, 1901. (See page 441.)

737,575. ELECTRIC INCANDESCENT LAMP; Walter B. Burrow, Norfolk, Va. App. filed July 2, 1902. Carbon plugs holding the ends of the filament are set into a two-part stopper occupying the neck of the lamp.

737,576. MAGNET CORE FOR DYNAMO ELECTRIC MACHINES; Walter B. Burrow, Norfolk, Va. App. filed Aug. 14, 1902. A triangular passage is formed through the core for the insertion of a piece of metal on one side or the other of the passage to determine the direction of the magnetic flux through the core.

737,582. RESILIENT MULTIPLE CONTACT TROLLEY; Edward S. Cobb, Los Angeles, Cal. App. filed April 14, 1903. The flange and tread of the wheel are made up of a series of spring plates against which the wire bears.

737,589. ELECTROMAGNET; William M. Davis, Chicago, Ill. App. filed April 26, 1901.

737,590. TELEPHONE EXCHANGE SYSTEM; William M. Davis, Chicago, Ill. App. filed Dec. 2, 1901.

737,608. THRESHOLD ILLUMINATING DEVICE; George Hall, Providence, R. I. App. filed March 11, 1903. An incandescent lamp is arranged at elevator landings to throw its rays across the threshold whenever the elevator door is opened, so that passengers may clearly see the relative position of the landing and the floor of the car.

737,613. ELECTRIC BATTERY; Henry Halsey, New York. App. filed Dec. 6, 1902. To decrease in a battery the polarization due to gases, he exhausts the gases by means of a pump.

737,614. ELECTRIC BATTERY; Henry Halsey, New York. App. filed Dec. 6, 1902. The electrodes are in form of cylinders which are so mounted as to be revolved in opposite directions in order to stir the electrolyte thoroughly.

737,635. ELECTRIC ALARM FOR ELEVATORS; Fred O. Kinnecom, Providence, R. I. App. filed Feb. 24, 1903. A magneto generator supplies current while the car is in motion to operate alarm bells at the various landings before the car reaches them.

737,659. SUSPENDING DEVICE; Conrad M. Pitel, Meriden, Conn. App. filed March 6, 1903. A spring drum arrangement for the flexible suspending cord of an incandescent lamp.

737,661. JUNCTION BOX, CONDUIT AND ELECTRIC WIRING MECHANISM; Frederick J. Ravlin, Chicago, Ill. App. filed April 7, 1903. A junction box to be applied to a roof in a water tight manner, and having internal passages through which branch wires can be led from the box into the building, all parts being well insulated and weather-proof.

737,668. ELECTRIC ARC LAMP; Albert Schweitzer, Pittsburg, Pa. App. filed Sept. 18, 1899. Details.

737,689. ELECTRIC HEATER OR RHEOSTAT; Charles Wirt, Philadelphia, Pa. App. filed Dec. 5, 1902. Two-part clamps for the ends of the resistance units are arranged in a series and held together by a single clamping rod.

737,703. SELF-INDUCTION COIL; George A. Campbell, Newton, Mass. App. filed Feb. 8, 1902.

737,704. SELF-INDUCTION COIL; George A. Campbell, Newton, and Wilton L. Richards, Malden, Mass. App. filed Feb. 8, 1902.

737,710. ANTI-INDUCTION METHOD FOR TELEPHONE SYSTEMS; William Condon and Albert Barrett, Kansas City, Mo. App. filed March 24, 1902.

737,711. ANTI-INDUCTION TELEPHONE SYSTEM; William Condon and Albert Barrett, Kansas City, Mo. App. filed March 24, 1902.

737,715. TELEPHONE-EXCHANGE SYSTEM; William M. Davis, Chicago, Ill. App. filed Dec. 2, 1901.

737,720. ELECTROMAGNET; James Duncan, Boston, Mass. App. filed June 1, 1903. (See page 442.)

737,764. MODE OF AND APPARATUS FOR REGULATING THE CHARGE AND DISCHARGE OF STORAGE BATTERIES USED IN CONJUNCTION WITH DYNAMO ELECTRIC MACHINERY, ETC; Robert S. McLeod, Manchester, Eng. App. filed Jan. 19, 1903. The regulation is accomplished by providing a booster having several field coils so connected to the various circuits to be regulated that the voltage of the booster changes in magnitude and sign so as to insure a comparatively uniform output of the generating plant notwithstanding fluctuations in the load.

737,781. SELF-WINDING ELECTRIC CLOCK; Emil Schultz, Potsdam, Germany. App. filed July 2, 1901. Details.

737,823. ELECTRIC ARC LAMP; Tito L. Carbone, Grunewald, Berlin, Germany. App. filed Dec. 30, 1902. General improvements in a lamp in which the electrodes are inclined to each other at an acute angle, each electrode consisting of two carbon rods, also inclined to each other at an acute angle.

737,824. ELECTRIC ARC LAMP; Tito L. Carbone, Grunewald, Berlin, Germany. App. filed Jan. 6, 1903. Further improvements in a lamp similar to the preceding.

737,825. ELECTRIC ARC LAMP; Tito L. Carbone, Grunewald, Berlin, Germany. App. filed March 25, 1903. In a lamp of the character above described, the arc is held steady by a magnetic ring surrounding it, said ring being connected with the core of a coil by a number of rods and the coil being adjustable in position along the core to shift the influence of the magnetic lines upon the arc.

737,840. ELECTRIC LOCK; William H. Hollar, Philadelphia, Pa. App. filed March 10, 1902. The operating devices for the bolt work which ordinarily consist of springs having to be compressed by the operator each time the door is locked, are, in this case, operated by an electric motor.

737,866. INDICATOR FOR LOCATING SUNKEN METALS; Charles F. Pike, Philadelphia, Pa. App. filed Aug. 22, 1902. A bell containing a pivoted arm is let down into the water and the arm allowed to drag upon the bottom; when it strikes a magnetic object, its angular position which is indicated by suitable mechanism on the deck of the vessel, determines the location of the object.

737,869. SELECTIVE SYSTEM, Sylvanus Albert Reed, New York, N. Y. App. filed Aug. 1, 1901. (See page 442.)

737,870. SELECTIVE SYSTEM, Sylvanus Albert Reed, New York, N. Y. App. filed Dec. 31, 1902. (See page 442.)

737,882. PROCESS OF ELECTROLYTICALLY PREPARING LITHOGRAPHIC PLATES, Otto Carl Strecker, Darmstadt, Germany. App. filed April 19, 1900. (See page 441.)

737,893. INCANDESCENT LAMP SOCKET; Joseph L. Yost and Owen F. Kenney, Toledo, Ohio. App. filed June 12, 1903. Details.

737,894. SUPPORT FOR TELEPHONE RECEIVERS, Ephraim Bass, New York, N. Y. App. filed Nov. 22, 1902. (See page 442.)

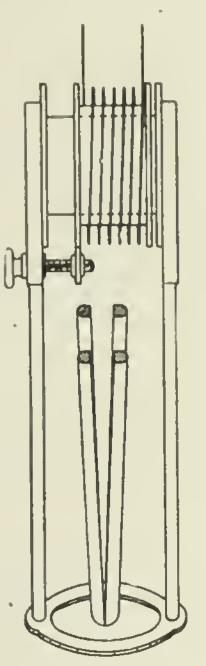
737,896. RAILROAD BOND; Horace M. Bellows, Huntingdon Valley, Pa. App. filed May 18, 1903. The opposed ends of the rails have aligned recesses in which there is a coiled spring forming the bond.

737,900. ALARM ATTACHMENT FOR ELECTRIC BELLS; Henry Blakeney and A. Riley Baker, Dallas, Tex. App. filed June 30, 1902. By turning a lever a vibrating bell can be changed into a tap bell.

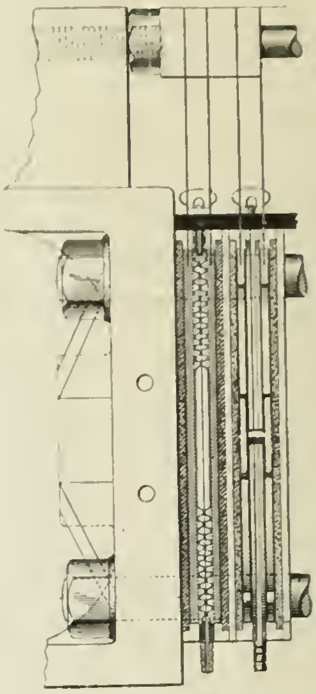
737,922. DROP SWITCH FOR TELEPHONES; George L. Gulliford, Bloomington, Ill. App. filed Dec. 2, 1902.

737,935. THIRD RAIL FOR ELECTRIC RAILWAYS; Lloyd G. Johnstone, New York, N. Y. App. filed June 9, 1903. An electric heater is applied to a third rail for the purpose of melting ice that may form thereon.

737,936. CONTACT DEVICE FOR ELECTRIC RAILWAYS; Henry F. Kellogg, Wellesley, Mass. App. filed Oct. 15, 1902. Instead of a trolley wheel, a number of independently movable blocks are bunched together and formed with a groove along which the wire runs.



737,825. Electric Arc Lamp.



737,982.—Rheostat.

737,946. SUPPLEMENTAL BASE FOR OUTLET BOXES; George L. Martin, New York, N. Y. App. filed March 4, 1903. A supplemental base of special construction that can be applied to boxes of different sizes and shapes.

737,949. CIRCUIT CONTROLLER; Edwin J. McAllister, Newark, N. J. App. filed July 29, 1902. An apparatus for controlling the various circuits of an electric sign.

737,982. RHEOSTAT; Edward Weston, Newark, N. J. App. filed July 9, 1902. A rheostat composed of a series of electrodes in combination with a fluid medium under pressure for regulating the contact between the electrodes to vary the current flow therethrough.

738,025. DRY CELL BATTERY; Edwin R. Gill, New York, N. Y. App. filed Dec. 20, 1901. The carbon electrode is in the form of a conical screw which is driven into the powdered material of the battery and thereby compresses a thin layer of such material adjacent to the electrode to furnish good contact between the two elements.

738,056. TROLLEY; Moses Nicholls and Clark J. Smith, Ottumwa, Iowa. App. filed Dec. 15, 1902. Details.

738,059. SCREW ATTACHING MEANS FOR ELECTRICAL DEVICES; Henry T. Paiste, Philadelphia, Pa. App. filed July 20, 1901. To prevent a screw from working loose, it is given a prismatic head and countersunk in a cavity which permits the head to turn therein when it is set in place, but which is filled with a compound to act as a lock for the screw.

738,078. ELECTRIC BELT FOR MEDICAL PURPOSES; Ebenezer Smellie, Glasgow, Scotland. App. filed April 3, 1903. Details.

738,094. ELECTROLYTIC PROCESS; Arthur Brichaux, Brussels, Belgium. App. filed Oct. 4, 1898. (See page 441.)

738,099. INCANDESCENT LAMP SOCKET; Walter A. Church, Binghamton, N. Y. App. filed June 20, 1902. Two half sections of insulating material are screwed together to form a block and provided with internal chambers for the reception of the various metallic and movable parts of the socket.

738,110. REVERSIBLE GALVANIC BATTERY; Ernst Waldemar Jungner, Norkoping, Sweden. App. filed April 17, 1899. (See page 441.)

738,113. SYSTEM OF ELECTRIC LIGHTING; Henry Leitner, Woking, and Richard N. Lucas, Byfleet, England. App. filed Dec. 22, 1902. A system of train lighting in which two dynamos are used in a manner to neutralize the effect of changes in the speed to maintain a constant voltage. The invention resides particularly in inserting resistances in the various circuits, some of which are of a nature to increase their conductivity when heated, while others are of the opposite nature.

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SUMMER LIGHTING LOADS.

It was a very interesting and suggestive paper for central station men that Mr. E. A. Leslie, of Brooklyn, N. Y., read before the Edison convention last week on the development of summer lighting, accompanied by a reprint of the Brooklyn Edison bulletin showing what has been done at Coney Island, the great seaside resort of New York. When we recall how slight was the summer business of the early lighting companies, because of the short hours of burning and the extent to which consumers had gone away for holidays, it is hard to realize how enormous is the business now done, thanks to power service, fan motors and the call for current at amusement resorts. We cannot refrain from quoting a passage from Mr. Leslie's suggestive paper where he says: "The most striking and significant feature lies in the fact that we require more machinery to handle our 'summer load' than is required for our preceding 'winter load,' an unusual and perhaps unique reversal of the ordinary conditions." Now, it is rather rare for a company to have the chance to supply current to a resort visited by 300,000 people on a summer day that was partly wet, but every city, as Mr. Leslie contends, has now some provision for the summer entertainment of its population, and out of this condition new sources of revenue should arise. There is even a possibility that in this respect the lighting companies might emulate the example of the street railway companies, which have established or assisted in creating no fewer than 352 pleasure parks on their lines, from which in many cases revenue is derived additional to that brought in by the car fares. It is an undeniable fact that such places as Luna Park at Coney Island are popular as much for their lighting and illumination effects as for any other reason. As Mr. Leslie remarks, in a passage which is an eloquent testimonial to the social value of electric lighting, before such spectacular effects were introduced, serving to light usefully as well as to merely amuse, most people went home from Coney Island by daylight. Now they are as ready to go at night as by day, and even greater amusement schemes have been set on foot as the result of the demonstration of what the electric light can do.

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CONDITION OF THE STREET RAILWAYS.

We have already presented and reviewed in these columns the statistics of the American street railway industry as compiled by the United States Census Office. A further study of the figures, of considerable interest, is to be found in the paper read before the street railway accountants at Saratoga by Mr. W. M. Steuart, chief statistician of the United States Census Office, under whose supervision the work has been done. One striking remark made by Mr. Steuart was to the effect that during last year no dividends were paid on $667,000,000 of common and preferred stock, or not less than 50 per cent. of the total issued. Moreover, accepting the figures as published, the stock issued and the funded debt outstanding, for all roads, exceeded the cost of construction by $140,000,000. This is suggestive data, but it must be evident to anyone who considers the subject that something more than the cost of construction goes into the value of a street railway property. The franchise, of course, has a value, but we are not considering that item. There are other elements that go to the creation of a property, and many of them are rather intangible; but they are necessary to the creation and development of any enterprise. In real estate values they may constitute part of the "unearned increment," which it is often assumed comes to the owner without any effort of his own. Such a view is largely erroneous, however, except in the case of unimproved property, while as regards a street railway it is a notorious fact that the trolley benefits real estate and other material elements in the community far beyond any value that might attach to its franchise. The record of trolley development is replete with instances of enormous benefit conferred on large masses of population by the new means of rapid transit.

In this paper Mr. Steuart offered also some valuable suggestions as to possible improvements in the standard form of accounting. These changes are apparently necessitated by the fact that very often a street railway property is no longer a simple, self contained enterprise, but is become a complex organization, particularly in respect to owning and operating electric light plants. It would appear that an opportunity is here presented for bringing the electric light companies into line, and before the street railway accountants as a body do anything, we hope they will get into touch with the National Electric Light Association. That body has taken up the question of a standard form of accounting from time to time, but to-day the subject is as open as it ever was, and thus something could be done to harmonize with the street railway industry. Not alone, moreover, are lighting and street railway properties being worked in common, so that a form of accounts to suit both is desirable, but these two electrical interests in turn operate other plants, such as water works and ice works, and now some of them have taken up telephony. The telephone industry again is absolutely without standard methods of accounting, and it is very hard to find out just "where it is at," financially and economically. Mr. Steuart's voice is as that of one crying in the wilderness, but he renders a public service in taking up the matter, and in beginning with the Street Railway Accountants' Association, which has already done such excellent pioneer work in bringing system out of chaos.

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Opportunities for Wireless.

Reading the accounts of the total interruption of wire traffic in England last week by storm and again in Florida this week, we cannot help being impressed with the splendid opportunities that exist for wireless telegraphy; and we cannot help wondering why it is not adopted, at least as an emergency safeguard, by the existing land line systems. We have reason to know that some officials of the telegraph service expect to see such a step taken at no distant date, but meantime nothing of the kind happens. Here an excellent chance to achieve distinction is meantime afforded our own United States Signal Corps, about whose use of the wireless a good deal has been heard from Alaska and other points, although specific data are lacking. The establishment of a general system under the control of the Signal Corps, linking all the military posts, would give an admirable chance for threshing out the undeniable difficulties that confront overland wireless messages. The growth of a military system covering at first comparatively short distances, and then extending to more distant posts, would result in the accumulation of most important practical data in the hands of trained observers, and would tend very strongly to make the government entirely independent not only in emergency work, but in its ordinary routine communications. And in this connection one must consider the lessons that the yacht races have taught as regards the matter of interference. Apparently the whole region around New York was reeking with etheric waves, while rival operators pounded each other with dissonant and incoherent messages. Truth to tell, it is about time for syntonic working to fish, cut bait or go ashore, as the fine old Gloucester epigram has it. If the rival wireless systems can really avoid interference with each other and live like Christians in peace and concord it is high time that they did it. Wireless telegraphy is a most notable discovery; as an art it has a great future before it, and has certainly come to stay, but it is no easy job to discover what are its real, as distinguished from its assumed properties. That there is much still to be learned about it is evident enough, but this fundamental matter of the syntonic working that is absolutely necessary to insure non-interference ought to be settled first of all. On the other hand, while that question is being threshed out, the Signal Corps would have a relatively easy time of it, for its work would generally be done in remote regions with interference, innocent or malicious, reduced to a minimum.

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The Niagara Meeting of the American Electrochemical Society.

The American Electrochemical Society this week meets the second time at Niagara Falls within a year and a few days, thus indicating the predominant place which that locality holds in the American electrochemical industry. It may be added, however, that in view of the manner in which almost all of the electrochemical works at Niagara have, by agreement, been closed to visiting members of the Society, the attraction to that place is one more of sentiment than having an utilitarian reason. Moreover, were it not that the electrical fraternity of Niagara is happily endowed with much more than the usual spirit of hospitality—in the social sense—the wisdom of asking it within little more than twelve months to be the host for three electrical meetings might be questioned. Much has been said of the desirability of the American Institute of Electrical Engineers and the American Electrochemical Society becoming affiliate to the extent of holding, regularly or occasionally, joint meetings, and it would seem that since both organizations this year had a desire to meet at Niagara, it should not have been a particularly difficult matter to have come to an agreement as to a date for a common meeting that would have been convenient for both societies. Since the fields of the two societies overlap to a considerable extent, and since almost every subject discussed by either society has some interest to the members of both, it is to be hoped that the failure in the past in arranging joint meetings does not signify that some insuperable difficulty has been found which will continue to prevent the two bodies coming together.

The programme for the present meeting includes 16 papers, or less than the number read and discussed at the meeting of the society at Niagara Falls last September. What is lacking in number will, however, judging from the titles of the papers and the authors, probably be more than made up in quality. The two most important entries on the programme are a discussion on electrolytic copper refining, to be opened by Prof. W. D. Bancroft, and a discussion on the theory of electrolytic dissociation, to be opened also by Prof. Bancroft. In the past the theory of electrolytic dissociation has met with little respect when the subject has come before meetings of the society, and we have several times referred to the flippant manner in which it has been treated on such occasions. We hope that at Niagara the subject will receive a full and fair discussion on its merits and without a show of the prejudice which unhappily appears to have been engendered by the ill-advised manner in which some of the German exponents of the theory have denounced all those who have ventured to criticise it. Whether the theory will eventually be fully substantiated or not, the fact will remain that the discussions and the thought to which it has given rise have been of the highest value to electrochemical science; and the names of those who have become identified with its development are not of men whose opinions can be dismissed with contempt. Meantime the

Society may be congratulated upon its growth and vigor, showing that a place existed for it. All the electrical bodies are in this excellent condition, which is again a testimony to the state of the art. The expansion of the Institute has thus aroused surprise in some quarters, but obviously it could not take place without the material necessary for building up, and that material is found not alone in the prosperity of the industry, but in the existence of increasing numbers of young engineers infused with professional pride as well as with enthusiasm for the ideas and forces they are called upon to apply in the social and physical world.

STEAM VS. ELECTRICALLY DRIVEN BOILER PUMPS.

In the Digest is given an abstract of a paper read before an English society, treating of the relative economy of steam and electricity in driving the auxiliaries of electrical plants, in which comparison the electric drive naturally comes out ahead on the score of efficiency of power. What appears surprising, however, is the low figure implied for the consumption of steam by steam-driven pumps, which in an extreme case was only two or three times as great as the steam consumption at the generator corresponding to the power required by a motor driving a pump. Owing to the manner in which steam is worked in steam-driven pumps, they are notoriously wasteful, tests having shown that the quantity of water for a horse-power hour in the case of boiler pumps ranges from 100 to 150 pounds. Consequently, the ratio on the basis of the comparison made by the author should naturally appear to be as 5 or 6 to 1. However favorable such a comparison may be, it still remains a matter of doubt if boiler feed pumps should be electrically driven. Owing to their situation close to the boiler, the objection to steam-driven auxiliaries aside from their inefficiency, does not apply; in attendance they are more adapted to the care of the firemen or water tender than the electrically-driven pump; and, as pointed out by the author, when auxiliary pumps are electrically operated safety requires the use of a storage battery in connection with a plant in which all of the auxiliaries are electrically operated. Moreover, since the percentage of the power generated by the main engines which is consumed in feed pumps is very small, the saving to be effected by the substitution of the electric drive would seem to scarcely justify the additional expense and complication. With the exception of the steam pumps, however, there appears to be no reason why auxiliaries should not all be electrically driven, though in some cases the requirement of an exhaust for feed-water heating may enter.

A TEST THAT WOULD BE USEFUL.

Ever and again we find it appropriate to say a good word, generally coupled with certain admonitions, concerning our old friend the primary battery. Of late years it seems to have been lost in the shuffle, so that the regularly quarterly return of the battery with valuable chemical byproducts has failed, and even the fine old secret depolarizer has lost its potency. And yet with all its faults it has not lost our regard. It did sterling service for the telegraph and the telephone and stirred the aspirations of a generation of electricians, now for the most part gone, but whose names are written in enduring bronze. And in spite of the dynamo and the storage battery, it is quite certain that there is to-day a greater reward waiting for a really good primary battery than ever before. Besides the thousand-and-one minor domestic uses of the battery, there is an immense demand for the highest grade of service in the sparking devices of explosion engines. For automobile use alone the call for batteries is enormous, and although the best of the dry batteries now in use are by no means to be despised, they still leave much to be desired. The work in automobiles and launches is really rather severe and calls for a battery of far higher powers than are usually to be found. It is a steady pull, that sort of service, and involves rather serious consequences. And besides this there is a considerable amount of rather heavier work that would often be turned over to a primary battery if one having the right qualities were available.

First in the list of qualities desirable in a primary battery to meet modern requirements is eternal preparedness for action. No cell that requires to be set up for use or that contains a porous cup for the depolarizer is seriously to be considered, for sooner or later diffusion will get in its work. Next in importance, perhaps, is thoroughness of depolarization. Steadiness of voltage is always desirable, but it is of even greater importance that polarization, if present, shall not go beyond a certain moderate amount. If a cell will give at the start 1.5 volt it may fall to 1.25 without great detriment, provided that it will stay there. Of course, the higher the initial voltage and the steadier it remains in service, the better, other things being equal. Low internal resistance is also a property of great importance for the modern uses of batteries. Not only does it mean efficiency, but the possibility of use in many places where a high resistance cell would be inapplicable. Besides this, the modern battery must be either "dry" or sealed, so that the electrolyte may not slop, and it must be free from corrosive fumes. Finally, it must be compact in form and reasonably cheap. By the latter requirement we do not mean that it must sell for a quarter, but that the upkeep shall not be unreasonably great or the replacement cost more than a dollar or two. Of the batteries now in use, many fulfill some of the requirements admirably, but none quite well enough. The best cells of the Leclanché type come nearest to filling the bill, but they cannot be depended on to hold their voltage under heavy rates of output, particularly when made up in the "dry" form. The best of them do pretty well, but they will stand improvement. A heavy-duty Leclanché properly designed would find a better market now than ever before. If a cell could combine the readiness and cleanliness of a Leclanché with the endurance of the venerable Grove or Bunsen cell it would be very near the ideal.

Now, let us suggest that the St. Louis Exposition is near at hand, and that there is no better time or place for the exploitation of the best batteries that American ingenuity can devise. Let every manufacturer put his wits to work and bring out something a little better than has yet been put on the market. Then let all hands unite in a request not for the perfunctory tests and awards that belong to a great exposition, but for a genuine and thorough competitive battery test on the good old fighting principle of every one for himself and Devil take the hindmost. Unless we greatly mistake, such a competition would bring to light some very remarkable cells and would stimulate business to an extraordinary degree. Under such a spur a class of cells would be made far superior to those now in common use, and the consumer would be led toward the use of a better class of goods than are generally to be found on the market. There is always the chance, too, of bringing out something radically new and tremendously effective, for to win out in a test of such sort would be a prize worth the struggle. Expositions of late have lost in value to the exhibitor by keeping clear of rigorous tests and such like savage competition, and in trying to please everybody have pleased nobody. General tests are, indeed, a pretty severe proposition, but a little affair of the kind suggested would not be difficult to conduct, and the results would have no small commercial importance. The winner would be forthwith besieged by gentlemen in goggles and rubber jackets, and his factory would echo the squawking of their horns.

Tesla Split-Phase Patent Sustained.

Judge Archbold, of the United States Circuit Court for the Eastern District of Pennsylvania, has handed down a decision in a case involving the Gutmann wattmeter, which sustains the fundamental Tesla split-phase patent. The principal defense was a publication by Ferraris in 1888 on the rotary field and of the means for obtaining polyphase from single phase currents. These disclosures were made in a paper read by Prof. Ferraris before the Royal Academy of Sciences of Turin, Italy, in March, 1888, a portion of which was published on April 22 following, in *L'Elettricita*. The Tesla patents in suit were not applied for until December 8 following, but the court held that the testimony in the case showed conclusively that Tesla had, early in May, 1888, a complete grasp of the split-phase idea, and not only is the invention beyond question carried back by it to that period, but the patent not being able to be worked out in a day, ground is thus laid for an earlier date if there is fair evidence to warrant it. The court holds there is such evidence, testimony showing that Tesla disclosed the principles of his invention at a date prior to April 22 to his patent solicitor, the date being somewhere between the 8th and the 18th of April. This evidence is supported also by the testimony of a former business associate of Mr. Tesla, who states that Tesla spoke to him of the idea in the summer or fall of 1887. The date claimed by Tesla of his discovery was September, 1887.

After reviewing at great length the testimony as to priority between Ferraris and Tesla, and deciding in favor of the latter, the court considered at equal length the question of infringement of the Tesla split-phase patent by the Gutmann meter. Its conclusion is that the construction of the meter is in effect a motor in which the armature is operated upon by two independent interconnecting circuits produced by passing through them a divided and dephased alternating current derived from a single source, this apparently realizing the patents in suit. After further consideration of the principles of the meter in suit, the court decided that the meter infringed the Tesla patent. The finding is that the patents in suit are valid and have been infringed.

An interesting portion of Judge Archbold's opinion is that in which he gives a history to date of the opinions rendered in suits involving the Tesla split-phase patents. Judge Townsend, in reviewing the fundamental patents, discussed the alleged disclosures of Siemens, 1878; Bailey, 1879; Deprez, 1889, 1884, and Bradley, 1887, and the claims advanced for them as anticipations, which he held to be unfounded, and these conclusions were affirmed on appeal. The essence of the invention was declared by Judge Townsend to be "the production of a continuously-rotating or whirling field of magnetic forces for power purposes by generating two or more displaced or differing phases of the alternating current, transmitting such phases with their independence preserved to the motor, and utilizing the displaced phases as such therein."

The same patents came up before Justice Brown and a similar result was reached. The Dumesnil (1884) and the Cabanellas (1885), two French patents, which had not been brought forward before, were particularly relied on as anticipations, but were distinguished from those in suit in a carefully-expressed and convincing opinion. These French patents, however, according to Judge Brown, established that Tesla was not the first to employ alternating currents out of phase with each other for power purposes, so that the expressions in previous cases which attributed this to him would have, as he thought, to be qualified if not recalled. But it was at the same time pointed out that in neither the Dumesnil nor the Cabanellas was there a resultant magnetic force, the distinctive feature of the Tesla invention; each of the others named providing for the independent action of separate alternating currents operating on different ends of the motor armature without any play of the magnetic and electric forces in between. "As it stands, the Cabanellas patent is unintelligible to me, but taking it as it is explained by the defendant's experts and illustrated by the exhibit in evidence (of the correctness of which, however, I have much doubt), there is nothing more at the best than a mechanical combination of the two operative devices like the opposite cranks on the same axis of a locomotive driving wheel. There is no conjoint operation as in a Tesla motor of the two energizing circuits by means of a combined magnetic influence to produce a common result. It is important, however, to observe that while in no sense anticipations, the Dumesnil and Cabanellas serve to limit the invention of Tesla—if not, indeed, so limited in his patents themselves—to a device in which a magnetic resultant of dephased alternating currents exist, the mere use of alternating current out of phase with each other made otherwise effective being something aside and different."

The derivative patents in suit were first considered in the Dayton Fan & Motor case and affirmed, and a decision rendered in substantial accord with those which had preceded it. One defense there, as in the present suit, attempted to be made, was that it involved no inventive skill when once the practicable use of alternating currents of different phase was established, to substitute the dephased split current which was a well recognized equivalent; but it was not so held, nor could it be in the present case. This question was practically put at rest in this court by the decision of Judge McPherson in a case where two of the earliest Tesla split phase patents were sustained. But aside from that, and upon an entirely independent consideration of it, Judge Archbold says the same conclusion must be reached.

The patents in suit were also before Judge Lacombe, and in addition to the attack made upon them in other cases, it was further urged that, in the paper read by Prof. Ferraris before the Royal Academy of Sciences, of Turin, Italy, March 18, 1888, a portion of which was published on April 22 following, at Milan, in *L'Elettricita*, a journal devoted to electrical subjects, not only was there a full disclosure of the transmission of electric power by means of alternating currents of different phase, but also the use for the same purpose of a dephased split current derived from a single source, the same as in the patents in suit. Upon a due consideration of the opposing proofs, the invention of Tesla was held to be carried back of this publication; but on appeal the decision was reversed, the evidence brought forward by the complainants not being considered sufficient for that purpose; a conclusion which was followed by Judge Colt in a case by the same plaintiffs against the Stanley Instrument Company, in the First Circuit, not yet in print. This, said Judge Archbold, in concluding his review, and the matter of infringement, are the overshadowing questions in the present case.

Discussing the contention that a meter is not a motor, and that on this ground of itself no infringement can be charged, Judge Archbold said that, as pointed out by Judge Lacombe in the Catskill case, while the Tesla patents contemplate the production of power, they are silent as to the amount of it; and as a meter armature rotates against the action of a permanent magnet and turns a spindle which operates the registering devices, the production of some power is necessarily involved. It is somewhat aside from the question, but still it is a circumstance that Gutmann himself, in accordance with whose patents the meters in question are constructed, recognizes and claims therein that this device may be used for power purposes also. No doubt the strict object of a meter of this class is to measure and record the element which passes through or actuates it, gas, water, the electric current, or whatever it may be; but where, as here, it is, in mechanical construction, nothing more than an adapted motor with meter attachments, it cannot escape infringement on the plea. Judge Archbold holds that there is nothing in conflict with this, when rightly considered, in what is said in an opinion cited relating to a water meter. The attempt there made was to defeat a special safety appliance of a water meter by references drawn from the general motor art, and it was in that connection that it was held that the two were not the same.

Fires of Electrical Origin.

The fire report of the Electrical Bureau of the National Board of Fire Underwriters, dated July 10, 1903, contains some 30 notices of fires since April 10, 1903, due to electrical causes. In one case the static electricity from a belt ignited benzine vapor, causing a loss of $189,000. No less than nine of the fires resulted from the use of flexible cord conductors, and several others from the melting of open-link fuses. Improperly-installed and unprotected lamps in show windows were the cause of several fires. With scarcely an exception none of the fires would have occurred had the installation been in accordance with the present code of underwriters' rules.

Institute Meeting.

The next meeting of the American Institute of Electrical Engineers will be held at 12 West Thirty-first Street, New York, September 23. The topic of the evening will be "Electro-Hydraulics." The following papers will be presented: "An Efficient High-Pressure Water Power Transmission Plant," by George J. Henry, Jr., and Joseph N. Le Conte; "Electric Motors for Centrifugal Pumps and Fans," by A. J. Bowie, Jr.; "A Suggested Hydraulic Unit," by R. L. Montague.

York Haven, Pa., Transmission Plant.

The electrical transmission plant of the York Haven Water & Power Company on the Susquehanna River, at York Haven, Pa., is approaching completion, all the outer and interior constructive work on the plant being concluded and the completion of the installation of the machinery is all that remains. By the beginning of 1904 the plant will be distributing its power throughout the counties of York and Lancaster, and much machinery that is now being operated by steam will derive its motive power from the new and cheaper source.

The project is due to Mr. Henry L. Carter, who formed the York Haven Water & Power Company, which was chartered with officers as follows: Henry L. Carter, president and manager; Judge W. F. Bay Stewart, vice-president, and Henry W. Stokes, treasurer. Mr. Thomas Green was made superintendent of construction and several thousand men were soon set to work upon the preliminary labors of the construction operations. The power house is 478 ft. long and 51 ft. wide, in which are installed 40 turbine water wheels of 600 hp each, each pair of which operate a 750-kw generator, or a total of 20 generators, together with two turbines, of 250 hp. each with generators for excitation.

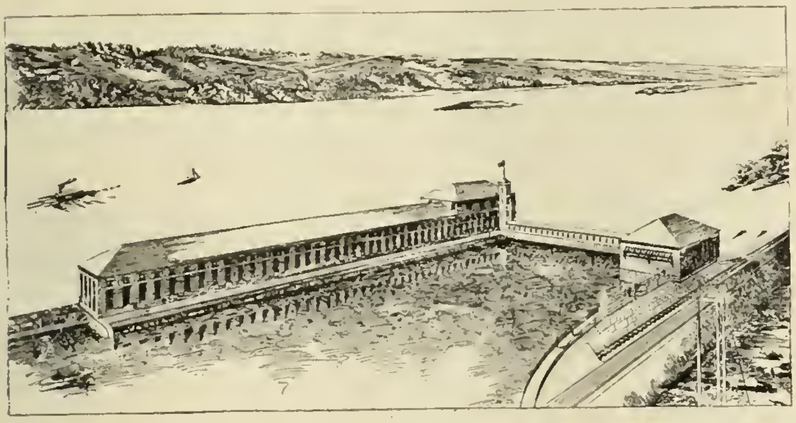


FIG. 1.—THE YORK HAVEN POWER HOUSE.

Extending from the building to the falls is an immense granite wall 3,500 ft. long and from 28 to 34 ft. high. It is 6 ft. at the top and from 16 to 20 ft. at the bottom. The wall encloses a race 500 ft. in width and 16 ft. in depth. To construct this it required 100,000 cubic yards of masonry. At the intersection of the wall is a large crib dam, 30 x 20 ft. wide, varying in height from 18 to 7 ft., and 3,000 ft. long. It is built diagonally across a portion of the falls.

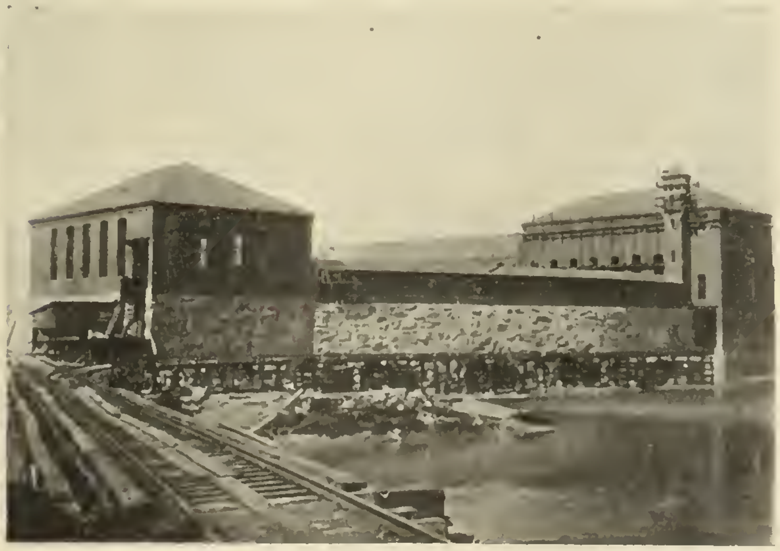


FIG. 2.—END VIEW OF POWER HOUSE, YORK HAVEN.

The dam is constructed of heavy timber and ballasted with stone. The timbers are anchored to the bed rock of the river by heavy anchor bolts. The purpose of the dam is to raise the natural head of the water to a greater fall.

To insure a durable foundation for the power house and its massive machinery blasting and excavating below the surface had to be resorted to, and a firm mass of rock far below the banks of the river was reached, and a large structure now rests on this natural foundation. To construct the building it was necessary to build a cofferdam, the dimensions of which are 500 x 240 ft.; 45,000 bags of sand, 250,000 ft. of timber and 10,000 cubic yards of stone were used for the purpose. To provide against interruptions to the work by high water a pumping station to draw off the leakage was established. Twelve derricks, extensive hoisting apparatus and portable railways were also necessary to facilitate the work.

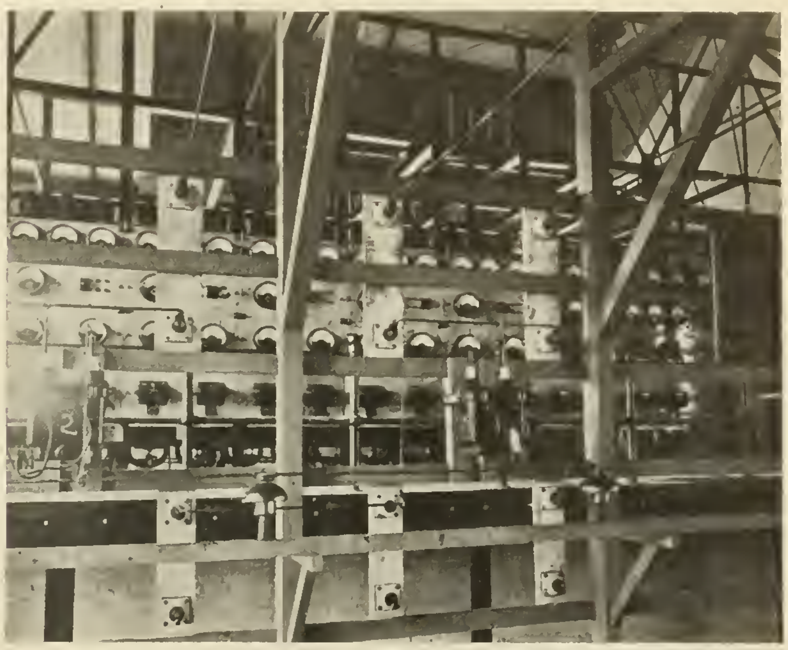


FIG. 3.—MAIN DISTRIBUTING BOARD, YORK SUB-STATION.

An operation not less important than those described was the installation of the electrical and water power machinery to be used in generating and controlling the 20,000 hp to be generated. The work of installing the machinery is in charge of Mr. T. A. W. Shock, who for twelve years was an electrical engineer on the Pacific coast, where he was identified with the pioneer Sacramento transmission plant and other important engineering work on the slope. He has installed all the electrical apparatus, both at the power house, at York Haven, and at the step-down station. Mr. Shock will continue in the service of the company in the capacity of its electrical engineer.

The generating station at York Haven is built for twenty 750-kw, 2,400-volt, 60-cycle alternating-current generators. Each generator is operated by two 79-in. turbine wheels. There are also two 230-kw exciters, each operated by 62½-in. turbine wheels. These exciters have each sufficient capacity to excite the fields of the twenty generators. Six generators are to be installed this fall. All this apparatus is placed on the main floor of the building. At the south end of the building is a second story, which extends about 70 ft. north, on which are situated switchboards for the individual generators, and upon which are located all the electrical instruments for measuring the output of each machine, and also the total output of

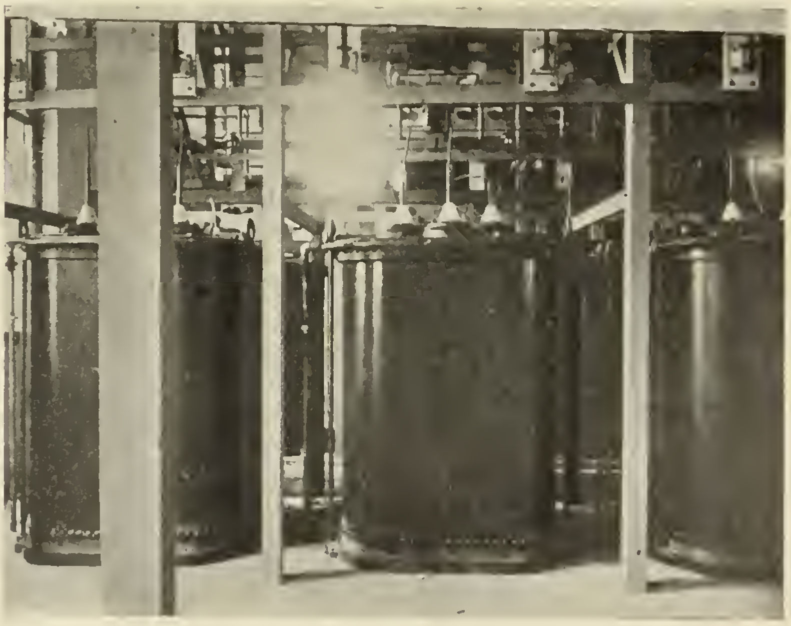


FIG. 4.—OIL WATER-COOL TRANSFORMERS, YORK SUB-STATION.

the station. From this point the switchboard operator will control all the generators and water wheel governors on the main floor. The power is conducted from the main station through a wire alley to the transformer house by means of twenty four 1,000,000-circular mil cables.

In the transformer house, or step-up station, at York Haven, are situated twelve 1,100 kw transformers, with all the necessary lightning arresters, switches and indicating devices for controlling the apparatus therein installed. The secondary voltage of the transformers is 2,400 volts and the primary voltage is 24,000 volts.

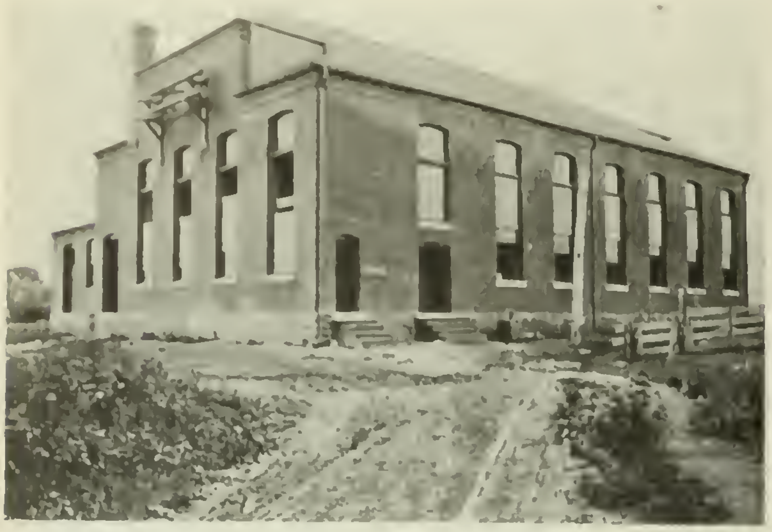


FIG. 5.—EXTERIOR VIEW OF SUB-STATION AT YORK.

The current is conducted from the transformer house, at York Haven to York, Pa., at 24,000 volts, through distributing switches located near the entrance of the building, by means of two distinct three-phase circuits. Each circuit will transmit 5,000 hp, thereby giving a combined capacity of the pole line of 10,000 hp. Each pole is set 6 ft. in the ground, 40 ft. in length and 8 in. at the top. The top cross arm is 4 in. x 5 in., 12 ft. long, and the lower cross arm is 4 in. x 5 in., 9 ft. long. All the cross arms are well braced with angle braces and all corners are well guyed and anchored. Where the line changes direction, double cross arms and double pins are used, so that the possibility of trouble is reduced to a minimum.

At the York sub-station current passes at the entrance of the building, through high-tension, oil circuit-breaker switches, and through line-distributing busses. There it is conducted to lightning arrester banks and thence to transformer busses, and to 6 transformers of 800-kw capacity each, where it is transformed down from 24,000 volts to 2,400 volts for distribution. From the secondary side of the transformers, the current is conducted through oil transformer switches to the main distributing switchboard by means of bus-bars located in ducts under the floor and underneath the switchboard gallery.

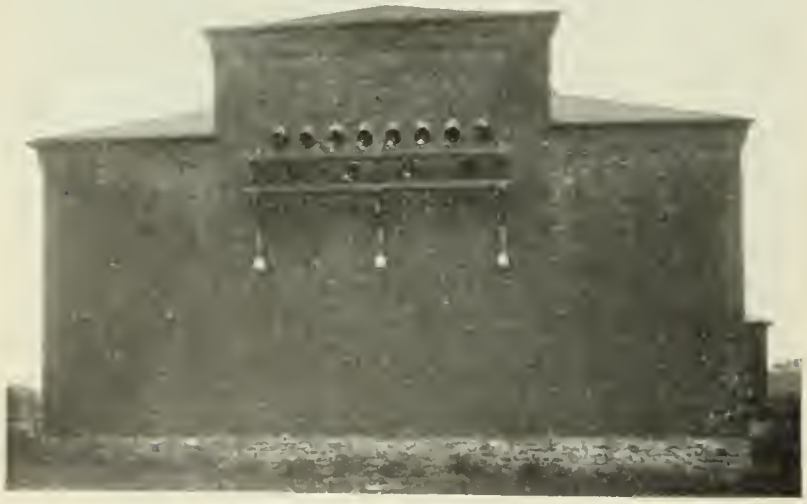


FIG. 6.—METHOD OF CARRYING HIGH-TENSION WIRES INTO YORK SUB-STATION.

The distributing switchboard is divided into 5 feeder panels, 2 totaling panels, giving the total output of the sub-station, and one lighting panel for lighting the building. Each feeder is equipped with two three-pole oil circuit-breaker switches and each connected with its own bus-bars. Each panel is also equipped with all the necessary voltmeters, ammeters and wattmeters for the purpose of recording the output of each panel. The totaling panels are equipped with the necessary ammeters, voltmeters and wattmeters for recording the total output of the sub-station.

From the switchboard current is conducted through lightning arrester banks to the main distributing line. The transformers, both for the transformer house and sub-station, are of the oil water-cooled type.

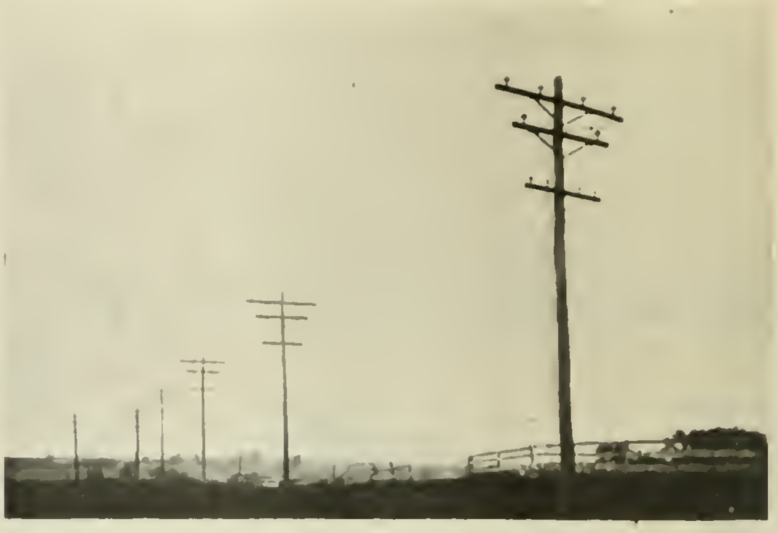


FIG. 7.—VIEW ALONG MAIN LINE BETWEEN YORK HAVEN AND YORK.

The Stanley Electric Manufacturing Company, of Pittsfield, Mass., furnished the complete equipment of the plant and its system, the turbine wheels being of the Poole Engineering & Machine Company's make.

By duplicating everything in the way of equipment from the generators through to the distributing side of the switchboard in the sub-station, it will be possible to give double service, if such is needed. Over half of the 20,000 hp which the plant will distribute has been contracted for by mills and factories located in York.

Power will be supplied for operating the local electric light plant, so that the city of York will be indirectly lighted by the power plant on the Susquehanna River. It is stated that capitalists from Pittsburg, New York and Philadelphia have already secured sites at York Haven for new manufactories, while other towns near by are attracting industrial promoters.

Kelvin on Radium.

A special dispatch from London of September 12 to a New York daily newspaper says: "What Prof. C. V. Boys termed 'the miracle of radium' has naturally received much attention in scientific circles. At the meeting of the science branch of the British Association Lord Kelvin, in a paper which he read, made an interesting suggestion in connection with its perpetual emission of heat at, according to M. Curie's calculation, a rate of about 90 Centigrade calories per gram per hour. He said that if the emission of heat at this rate went on for 10,000 hours there would be as much heat as would raise the temperature of 900,000 grams of water 1° C. It seemed utterly impossible to Lord Kelvin that this would come from the store of energy lost out of a gram of radium in 10,000 hours. It seemed, therefore, absolutely certain that the energy must somehow be supplied from without. He suggested that ethereal waves might in some way supply energy to radium, while it was emitting heat to matter around it. Lord Kelvin illustrated his theory by the following comparison: Suppose a piece of white and a piece of black cloth, hermetically sealed in similar glass cases, were submerged in similar glass vessels of water and exposed to the sun. The water in the vessel containing the black cloth would be kept very sensibly warmer than that containing the white cloth. Here the thermal energy was communicated to the black cloth by waves of sunlight and was given out as thermometric heat to the water in the glass around it. Thus through the water there was actually an energy traveling inward in virtue of the waves of light and outward through the same space in virtue of thermal conduction. Lord Kelvin suggested that experiments be made comparing the heat emission from radium wholly surrounded with thick lead with that found in the surroundings heretofore used."

The Electric Drive as Applied to Machine Tools, with Special Reference to Railroad Shops.

By C. H. Hines.

Much has been written upon the above subject during the past two or three years, and it would seem as though the ground had been most thoroughly covered. But withal, there is such a wide diversity of opinion on the subject, both as to the merits of different systems, economics, current to employ, load factors and other details; and the data given of the performance of tools so equipped vary so greatly in each article that has been written on the subject, that the firm or company looking over the field with a view to so equipping their shops may well be puzzled, and hesitate as to what to adopt, or how to figure on cost, when so many "Doctors" disagree. The consulting engineer is now called upon; but in many cases he also may be in doubt. The subject is so new and the recent developments in air hardening steel so rapid, that but few engineers unless specialists in this particular line, have had the necessary practical experience on the subject, and their reports are rather apt to be based on what they have read or observed in some of the plants so equipped.

Once in the market both buyer and engineer are flooded with data, pamphlets and arguments from the advocates of the respective systems that are in use, each with the most specious arguments as to the superiority of the system that he advocates. By the time all arguments have been sifted, the party interested is still at a loss to know what is *best*. The advocate of the multi-voltage system says "a motor for every tool for economy and increased production," and states the large number of varying speeds his system permits. He also shows that the expensive first cost is compensated for by the increased production of the finished material. The three-wire, two-voltage advocate now comes in and presents the same argument, but offers a system at much less initial cost and a little less speed range; and lastly comes the alternating-current man, who recommends small groups driven by constant-speed induction motors.

All of the above systems have their respective merits no doubt, and I do not propose to go into details concerning them, as there has been much written about them for the trade, and papers have been presented before the different societies by those who are far better informed on the subject than I am. What I propose to consider here is what is best suited to the requirements of the average railroad shop with a large proportion of old tools, that proposes to change to the electric drive system.

If a shop is to be built new throughout, and is to be provided with a complete outfit of new machine tools, and if the work to be done is of a varied character so that the character of the output changes constantly, then there is in my mind no doubt of the superiority of the individual motor, with varying speeds. If, on the contrary, the shop to be changed consists largely of old tools, but too serviceable to be "scrapped," and the work to be done is practically of the same nature, year in and year out, as is the case in railroad shops, then it becomes a question of whether it would pay to attach individual motors to old machines, most of them unfitted for modern high-speed steels, or to arrange the tools in small groups adapted to the class of work which they are called upon to perform, or in other words, to adapt the work to the tool, providing such speed changes as might be necessary by mechanical means. As an example, a wheel lathe does practically the same class of work at the same speed the year through, and the limit of speed is soon determined. Now it would be folly to attach to such a tool a variable-speed motor with its high initial cost simply to provide for an occasional "hard spot" or unusually hard pair of tires, for cone pulleys would take care of such rare cases.

By judicious grouping the constant-speed induction motor is indicated for the majority of such cases. Its simplicity and absence of commutator render it practically "fool proof"—a most desirable feature—while the low cost of maintenance is also in its favor. It will do its work faithfully year in and year out, with a minimum of attention. Some of the largest railroad shops in the country are being thus equipped.

There seems to be at the present time a tendency to rush to extremes in the matter of the individual drive, and in the course of a few years, when the smoke of battle has cleared somewhat and the results and tests of time have become apparent, it will then be seen more clearly whether the results obtained have in many cases justified the enormous initial outlay that is attached to the multi-speed individual motor.

I have now endeavored to answer the question as to the system best to use in these cases, and the next question that presents itself is, what percentage of load factor must be allowed, this in turn depending largely on the total amount of power to be supplied and the grouping. There is a large amount of data in print giving the estimated horse-power of different machine tools, but this data varies so widely, with different conditions that when one is confronted with the problem of estimating the horse-power required for a shop in which a large percentage of the tools are old ones, the best method to pursue is to make a test of as many typical tools as may be required.

This is very easily and simply done. During the past two months I have made an exhaustive test of iron and wood-working machine tools for the equipping of a large railroad shop, and it was done with little trouble, with no interference with the work. A small generator and balancer was secured and located centrally in the shop to be tested, taking power from the countershaft; a small motor and controller was mounted on a substantial truck provided with four small strong iron wheels. This was readily shifted from tool to tool, and belted either direct to the tool or to the counter, the wheels blocked and the machine then worked up to the limit at different speeds and cuts. The capacity of the tool and its maximum horse-power were quickly determined. Of course, the tests may be elaborated as desired. This method is the only accurate way of determining horse-power in such a shop as I have described, and the small cost of the test is repaid a hundredfold. I obtained by the above method a collection of the most interesting data, which I hope to publish at some future time.

Having by this means ascertained the aggregate horse-power of the tools, the next question is what percentage of this shall be taken as a load factor for the power station. In this as in the question of power data authorities differ, some going as low as 20 per cent. in the case of the individual motor drive, where the aggregate power of the tools is large. But in the case of grouping such as I have described, a factor of 40 per cent to 50 per cent. is a much more conservative estimate and will be found by actual test to more closely approximate the actual working conditions, and be the safest factor upon which to figure the copper required.

In deciding upon the sizes of motors to be provided for the different tools, care must be taken in the case of the induction motor that the question of power factor is considered, as if the motors are much too large for the work they are to do, the station will have a large factor of wattless current to deal with.

Of course, in such a shop as I have described it will be necessary perhaps to have a small amount of direct current for cranes and there will be perhaps a few large tools that it may pay to equip with individual variable-speed motors, although in view of the recent developments of the induction motor for crane service even this may be done away with and alternating current used throughout. If, however, direct current is preferred for this small proportion of the entire load, it can be easily taken care of by a rotary transformer or a motor-generator set, depending upon the frequency that is used. If the frequency is low, say 25, then my preference is for the converter; but if the frequency is 60 or higher, then the motor-generator set is the more reliable.

The motors and systems to be employed having been decided upon, the next question is the copper for the mains and the best method of installing the same. In many of the railroad shops there are tunnels for carrying the steam, air and other pipes, and these tunnels have been utilized also for the electrical mains. This is possibly a good method, although the question of the dryness of the tunnel and the possible dangers to the workmen in case of failure of the insulation, must be considered; and as most shops are grouped close together, it would seem that an overhead roof-to-roof bare copper construction would answer all purposes and be far cheaper. So-called "weather-proof" wire for overhead construction is at the best but a "bluff" to the public, except in crowded streets, where it may serve to keep telephone and telegraph wires from short-circuiting the power leads; but in such an installation as I have described it is useless, and the extra expense of the so-called insulation may better be applied to substantial supports for the power lines.

I have in this article briefly outlined what has been decided upon for the equipment of one of the largest railroad shops in the country, after a most careful review of all systems and methods. I hope at some future day to be able to give a detailed description of the plant and tests, and in the meantime trust that these few ideas may prove of service to others who are called upon to meet similar problems.

Fessenden's Work in Wireless Telegraphy.

BY A. FREDERICK COLLINS.

IN the ELECTRICAL WORLD AND ENGINEER of August 23, 1903, I described the salient features of Prof. Fessenden's new system of wireless telegraphy, the text being taken from a large number of patents which had just been issued to him. Recently I have had an opportunity to examine the practical details of the new system, and to obtain besides a statement from Prof. Fessenden relating to the development of his "sliding half wave" theory, which was laid before the American Institute of Electrical Engineers in 1899.

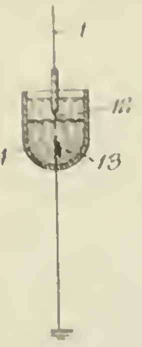


FIG. 1.—DIAGRAM OF RECEIVER.

In taking up the subject of wireless telegraphy, Prof. Fessenden devised means whereby the intensity of the effects at a receiving station might be quantitatively measured and also means for measuring the strength of the oscillations at the sending station. With this apparatus a large number of measurements were made of the energy required to operate a coherer, and it was found that from one to four ergs were required to produce an indication with the most sensitive form of coherer then in existence. As a telephone will produce an indication with an expenditure of .000001 of an erg it became evident that the commonly-expressed opinion that the coherer was an instrument of marvelous sensitiveness was entirely wrong. A number of experiments were made to develop new forms of receivers and receivers were finally evolved, which produced an indication with a fraction of a per cent of that required to operate a coherer. The nature of the phenomena was thoroughly investigated. The length of the waves and of their harmonics was measured by placing a quantitative receiver in the vertical wire and generating electromagnetic waves by an oscillating system placed about a mile away whose capacity to earth and whose inductance for rapidly oscillating currents could be accurately determined. Then by varying the inductance and plotting the intensity of the indications received the various resonance points and the wave length of the vertical wire was determined.

In plotting the course of the waves three pieces of apparatus were employed. First a vertical wire with a quantitative receiver. This on being moved about in a lateral direction gave one co-ordinate. Secondly, a bundle of fine iron wires surrounded by a few turns of wire in the circuit of which the quantitative receiver was placed on being moved in a vertical direction giving a second co-ordinate. On immersing the receiver in the earth or water the depth to which the waves penetrate, may be ascertained. A third piece of apparatus consisting of two large copper triangles placed apex to apex with the quantitative receiver between their apexes, the bases of the triangles being grounded. This enabled the presence or absence of currents in the surface of the earth or water to be observed.

A transmitting station was placed on a boat on one side of an island, and about 100 yards from shore on the other side of the island was a receiving station set on a small wharf running about 50 yards into the water.

By the use of these three sets of instruments the course of the wave was traced from the boat to the station. It was found that the waves traveled along the surface of the water until they reached the shore of the island, the intensity falling off as the square of the distance after the first few wave lengths, and that the height of the waves increases directly with the distance. No currents were generated in the water or earth in the direction of propagation of the waves. On reaching the shore the waves were found to climb the bank which was about 50 ft. high, and at the point where the direction of the waves changed from along the water to up the slope of the bank currents were generated. Midway up the bank the current disappeared again, but reappeared once more at the top of the bank, where the direction of the waves changed again, but when the waves struck the level surface of the earth the currents disappeared once more. It is thus ascertained that currents are only generated in the earth at the point where the direction of the waves were changed. The course of the waves was then traced with similar results across the island, which was almost free from trees, down the opposite bank and out to the station on the wharf. Obviously the height of the waves was not measured throughout the full distance, as this would have required some means of reaching up into the air to a considerable distance, but the other dimensions were accurately taken.

By these experiments, in conjunction with those by which the wave lengths were determined, the fact was absolutely established that the theory given in the transactions of the American Institute of Electrical Engineers, December, 1899, was absolutely correct. In particular the much disputed question as to whether the waves were accompanied by earth currents was definitely settled.

With the aid of the data thus obtained, Fessenden devised an entirely new system of wireless telegraphy. It differs so widely from the systems used previously, that it may be considered of a different class. The characteristics are as follows:

1. The use of a conductor at the sending station not only grounded, but provided with a conducting surface for at least a distance of one quarter wave length. 2. The use of a closed auxiliary circuit at the sending end for prolonging the oscillations. 3. The method of signaling by throwing in and out of tune instead of by stopping and starting the oscillations. 4. The use of multiple antennæ, and verticals of large capacity evenly distributed. 5. The practically continuous generation of electromagnetic waves. 6. The method of obtaining electrical radiations of any desired frequency from a continuous current without the use of an interrupter. 7. The method of producing electrical waves in groups having a definite group frequency, whether the group frequency is the same as the discharge frequency or independent of it. 8. The method of obtaining constant capacity and inductance by the use of metallic masts and guys surrounded by choking coils so as to prevent absorption of energy. 9. The use of the "wave chute" for leading the waves out of cities or over obstructions. 10. The use of a medium surrounding the vertical conductor for obtaining the same effects with a vertical as with a large conductor.

At the receiving station the fundamental differences between Prof. Fessenden's and the older systems are:

1. The use of a current operated constantly receptive receiver instead of the voltage operated coherer. Not only is the current operated system receiver many times more sensitive than any coherer, but in addition it is only by its use that sharp tuning can be accomplished. With current operated receivers a resonant rise in effect of 400 per cent. has been obtained, while the best results given by experimenters who have worked with the coherer give resonant rises of less than 10 per cent. In the paper published by Count Arco recently the resonant rise is given as 2½.

2. By the use of a cumulatively acting receiver. This means that all the energy received is utilized in producing indications. In this respect it differs fundamentally from other receivers, in which the indication is proportional to the maximum intensity instead of being as in the case of the cumulatively acting receiver, proportional to the integral value.

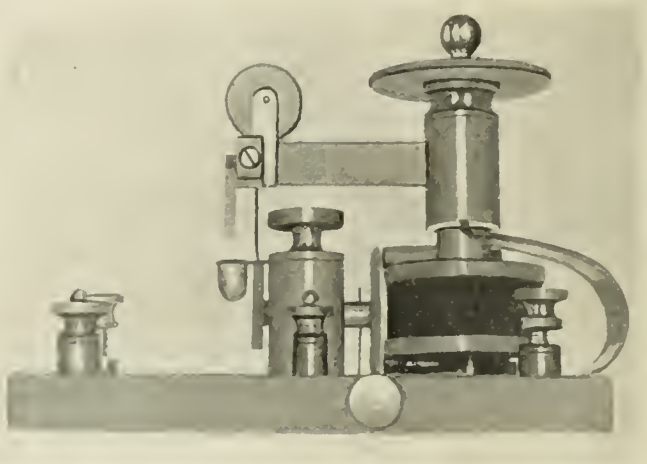


FIG. 2.—LIQUID BARRETTER.

3. The use of a closed tuned circuit instead of an open tuned circuit, which permits of much better resonance being obtained than with an open tuned circuit.

4. The use of a receiving device tuned not only to the wave frequency but also to the group frequency of the discharges.

It is evident that selection can never be accomplished by tuning, since in tuning a resonant rise of more than 100 cannot be calculated on. The amount of resonant rise is dependent upon the dampening coefficient of the resonant circuit, and since it is practically impossible to get a circuit the losses of which do not amount to an appreciable fraction of one per cent., it is evident that this value cannot be greatly exceeded under ordinary conditions. Hence, if *A* is within one-quarter of a mile of the second station *B*, and *B* is telegraphing to a third station *C*, 100 miles away, *B* and *C* being in tune, but *A* out of tune, then *A* will receive 160,000 times as much energy as *B* will, and the resonant is 100 times the non-resonant value, the effect on the receiver of station *A* will still be 1,600 times greater than that necessary to produce a signal. This calculation exposes the absurdity of attempting to work wireless telegraphy by wave tuning alone. By group tuning in addition to wave tuning the effect can be still further cut down one-hundredth of this, reducing the effect of *B* to the same as that of a distant station, and as the ear itself is a selective organ it is possible to obtain very good actual working results.

5. The employment of means whereby a station may not only be receiving messages from another station a thousand miles away, while another station is working within a few yards, but also whereby messages may be sent from a station, while messages are being simultaneously received from another station.

6. Means for indicating to any station whether the station to which it is desired to speak is sending, receiving or free, and whether it has gotten out of tune or not.

7. Means for telephoning messages instead of telegraphing, based on the throwing in and out of tune of the sending station by means of a telephone transmitter.

As will be seen from the above the system worked out by Prof. Fessenden differs entirely from the coherer system used by other experimenters, although some of the devices mentioned above, for instance, one form of the current operated constantly receptive receiver, being one in which the receiver depends on magnetic action and the auxiliary circuit for prolonging the oscillations and the capacity aerial have been lately used in connection with other systems. It may be mentioned here that the closed circuit for prolonging the oscillations has been attributed to Prof. Braun by Dr. Fleming, but there is no evidence or publication to show that Prof. Braun used, or described, this until some years after Prof. Fessenden's application was filed.

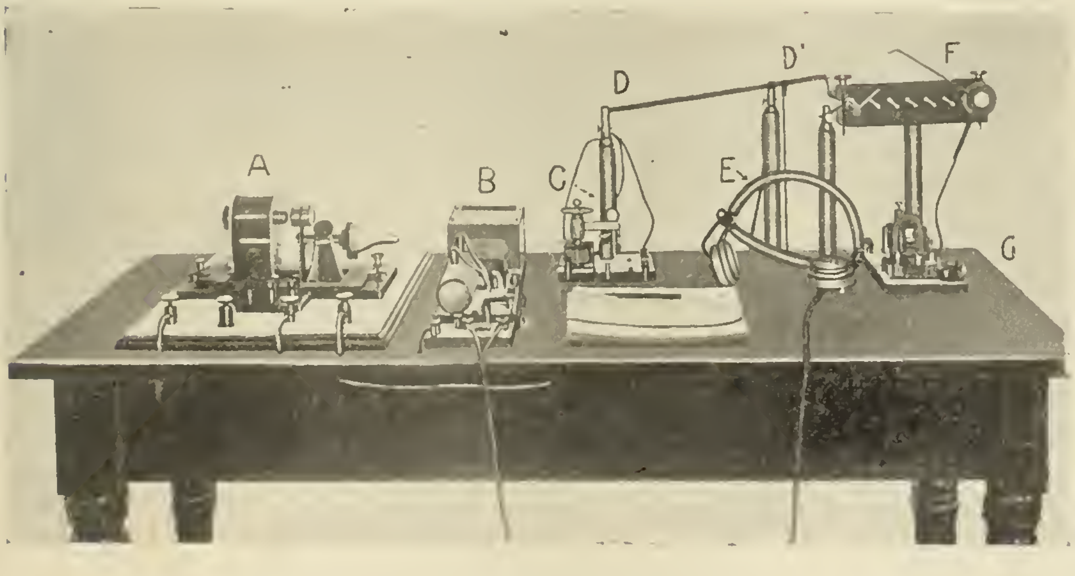


FIG. 3.—COMPLETE SENDING AND RECEIVING APPARATUS.

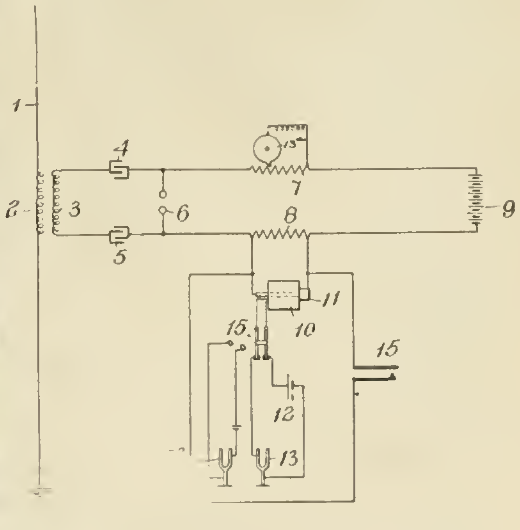


FIG. 5.—ELECTRO-MECHANICAL SYSTEM.

The most important of another budget of patents recently issued to Prof. Fessenden is one covering a modification of the hot-wire instrument called by the inventor a "barretter," from the old French word "barretor," "exchanger," from its property of exchanging a given amount of high frequency energy for continuous current energy, the latter form being easier to manage.

In the new form a very small column of liquid is substituted for the small platinum wire used originally. Various forms are used, for example, a diaphragm with a minute hole in it connected to a body of liquid, or a minute wire immersed in the liquid so as to concentrate the resistance of the liquid in the neighborhood of the point. Fig. 1 shows one form of this receiver in diagram.

The liquid barretter has a number of advantages over the platinum wire barretter, the most important being the fact that it is impossible to burn it out on account of the fact that the liquid vaporizes in case of a very heavy discharge. For this reason, as seen in the illustration of the complete set, it is not necessary to protect it against atmospheric disturbances or to enclose it in a metallic box, as a strong spark may pass within a few inches of it without injuring it or throwing it out of adjustment. Fig. 2 is a half-tone reproduction of the barretter.

A second advantage is the fact that its sensitiveness is much greater than that of the hot-wire barretter, and hence also greater than that of the Solari coherer, since the temperature coefficient of liquids is very much greater than that of metals. In the case of the liquid the same amount of energy which would produce a change of one-quarter of one per cent. in the resistance of a wire barretter, produces a change of 12 per cent. in the resistance of the liquid barretter.

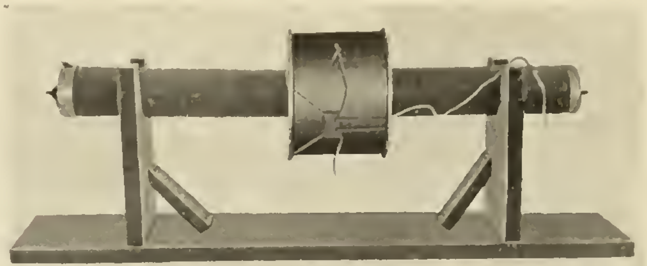


FIG. 4.—INDUCTION COIL.

It is to be noticed that the action of the waves decreases the resistance of the liquid barretter on account of the fact that the temperature coefficient of liquids is generally negative. This fact, i. e., that the resistance decreases instead of increases further adds to the efficiency of the receiver. It gives sufficient change to permit its use with a syphon recorder.

By means of receivers of the current actuated type (which may be called "current" kumascopes in distinction to "voltage" kumascopes, such as the coherer) very much sharper resonance is obtained than is possible with the coherer. A resonance curve has been obtained with a barretter in a circuit having a capacity .000279 microfarad, inductance .039 millihenry, in which the resonant rise is almost exactly 100 times the effect outside the point of resonance. It is believed that this degree of resonance has never been obtained heretofore. The distinctive feature of these devices is that they are used below the critical resistance, while coherers and similar devices must be used above the critical resistance.

Another patent covers a method of generating electromagnetic waves and splitting them up to groups periodically and arranging them independent of the discharge frequency. (Fig. 2.) Thus a double selectivity is accomplished; i. e., the receiving circuits are tuned to the wave frequency and also to the group frequency so that interference is impossible unless both the wave frequency and the group frequency of the interfering waves have the right values. This method is of considerable importance because the number of tunes is necessarily limited, while by tuning to the wave frequency and to the group frequency the number of combinations possible is measited by millions. Another patent is of the same general character, but covers tuning to group frequencies broadly whether identical with the discharge frequency or not. It also covers tuning to the group frequency electrically or mechanically.

Two other patents cover apparatus and method for sending and receiving simultaneously, and a third covers the combination of a carbon coherer and a step down transformer.

The final patent covers an improvement in the class of imperfect contact receivers, with means for moving the surfaces continuously relatively to each other, and a receiving mechanism adapted to respond to a particular frequency.

Fig. 3 shows a complete sending and receiving system employed by Prof. Fessenden, except the induction coil, which is illustrated in Fig. 4. The different parts on the table, from left to right, as shown by the letters, are an interrupter of the vibrating type *A*; Prof. Fessenden's improved system of generating and receiving electromagnetic waves (this latter device is shown diagrammatically in Fig. 5); an automatic device for cutting in and out the transmitter, *C*; a pair of head telephone receivers *D*; a multiple spark-gap *E*, and a telegraph key *F*. The object of the invention shown at *B*, Fig. 3, and in Fig. 5, as stated in the patent specification, is to provide for the generation at the sending station in varying order of two or more series of waves, each of the series differing from the other series, the selective reception and transformation and utilization of the different series and finally the recording at each receiving station of only such series of waves or impulses as are sent in a particular order.

In practice a series of two or more vertical wires for sending out the waves 5*a* 5*b*, etc., are connected at the sending station, *A*, to a series of two or more terminals or knobs, 4*a*, 4*b*, etc., of a series of two or more induction coils connected as usual with the spark-gap balls and also to ground.

The inductors of the coils are connected in circuits, including a source of electromotive force 2, and each circuit also includes make-and-break mechanism, all of which has been fully described by Prof. Fessenden in a patent dated August 12, 1902. The make-and-break device consists of metal discs, 3*a*, 3*b*, etc., held in position on the shaft 20, which is rotated at a constant speed by a motor 20*a*. The shaft is connected electrically to one pole of the generator 2, and the disks 3*a* 3*b*, are also in electrical contact with the shaft; these are provided with shoulders 22, arranged to make connection with the plates 23*a* 23*b*, etc., and are connected to the opposite pole of the generator 2; by rotating the shaft the circuits of the generator 2 may be made and broken in any pre-arranged order, since the disks are adjustably held in position for an interval of time.

The rate of rotation must bear a fixed ratio to the rate of movement of the tape at the receiving station. The periodicity of the electric waves is dependent upon the $\sqrt{\text{inductance}} \times \sqrt{\text{capacity}}$, and as inductance and capacity vary with the length and the diameter of the wires, the latter are so proportioned relative to each other that the periodicity of the waves emitted by one wire will be different from the waves produced by the other wires. By adjusting the disks 3*a* 3*b*, etc., on the shaft the series of waves may be sent out in any desired order.

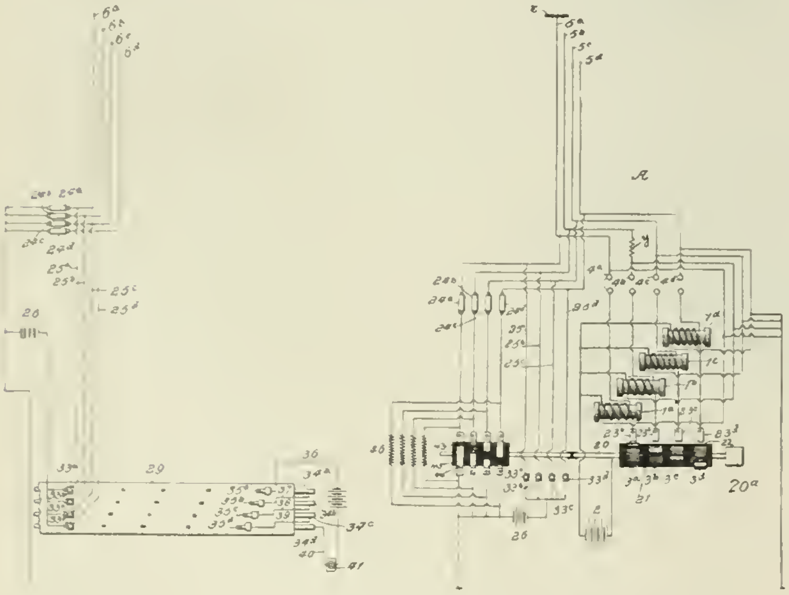


FIG. 6.—ELECTRO-MAGNETIC WAVE GENERATOR.

The receiving device, *B*, is formed of an equal number of aerial wires, 6*a*, 6*b*, etc., and having the same electrical dimensions as the radiator system at *A*. The devices controlled by the oscillatory currents set up in the resonator system are tuned to the frequency of the oscillation so that the indicating or recording mechanisms connected with each resonator system will be actuated and controlled only by the oscillations induced by the corresponding radiator at the sending station.

The multiple spark gap shown at *E*, Fig. 3, consists of an adjustable series of rollers between which the spark passes; the multiple spark increases the range of the transmitter and reduces to a minimum the noise of the disruptive discharge, so objectionable where large coils are employed.

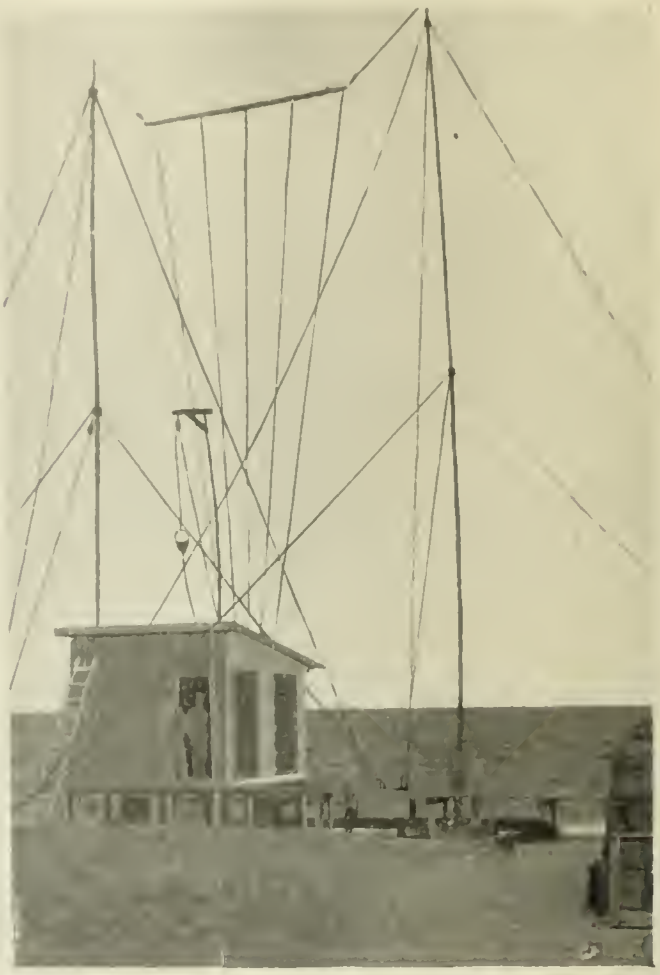


FIG. 7.—VIEW OF STATION AND ANTENNÆ.

These are but a few of the many devices invented and patented by Prof. Fessenden. The apparatus just described, however, is in constant use between the proving stations and operates as decisively, and with the same certainty, as an ordinary Morse instrument.

Electric Lighting in Boston.

According to a publication of the Edison Electric Illuminating Company, of Boston, on February 24, 1903, that company was furnishing electricity equivalent to 867,682 16-cp incandescent lamps, consisting of 481,975 incandescents, 8,064 arcs and 19,800 hp in motors. This was being distributed to 13,067 customers. This is a growth from 300 incandescents in 1886.

A few years ago a comparison was made between the large cities of the world with a view to ascertaining the number of 16-cp incandescent lamps used in each, in proportion to its inhabitants, and the following results were obtained, the figures giving the number of lights per 1,000 population:

	16-c.p. lamps.		16-c.p. lamps.
Boston	1232	Baltimore	373
New York	859	Brooklyn	286
Chicago	730	Edinboro	242
San Francisco	660	Vienna	246
St. Louis	600	Paris	185
Cincinnati	551	London	184
Philadelphia	375	Berlin	176

In view of the great increase of the business of the Boston Edison Company during the last three years, Boston probably still stands in the lead, and with even a greater difference in its favor than when the above statistics were compiled.

Government Telegraphs and Telephones in Great Britain—II.

LONG-DISTANCE TELEPHONE STATISTICS.

In the preceding article a review was made of the report of the British Postmaster-General on telegraphs in 1902-3. Some interesting figures are also given in the report regarding the long-distance service which has been operated by the Post Office since about 1896, when the trunk wire system of the National Telephone Company was bought for about $2,100,000. On the 31st of March last the number of Post Office trunk wire centers was 355, an increase of 27 in the year. The total number of trunk lines in use was 1,309, as compared with 1,165 in the previous year, an increase of 144 circuits in the year. The total length of the long-distance circuits was about 46,740 miles, containing about 93,000 miles of wire. The capital expenditure on the purchase and development of the trunk line system up to March 31, 1903, was $10,462,000, including $1,124,900 spent during the year under review.

The total number of trunk line conversations during the year was 11,574,229. The corresponding figure for the previous year was 10,080,716, the increase being 1,493,513, or 14.8 per cent. This increase was only slightly above the increase in facilities, which was, according to the figures for capital expenditure, just over 12 per cent. The gross revenue from the long-distance service was $1,374,175, as compared with $1,203,280 for the previous year, and the average payment for each conversation was 11.4 cents, which is almost the same as the average value for the last four years.

From these figures it is evident that the Post Office long-distance telephone service cannot be a very paying proposition. The average length of each circuit is 34 miles, which shows that the average rate per mile, at the average value of 11.4 cents per message, is 0.364 cents. The average capital cost per mile of wire has been $112.50, while the average yearly revenue per mile of wire is only $14.75, or 13.1 per cent. on the capital. The average yearly number of messages per circuit is 8,842, equivalent to an average traffic per circuit per working day of 29.4. The rates are extremely low, beginning with 6 cents for distances up to 25 miles, but it is obvious that they have been pitched too low, as a gross revenue of 13.1 per cent. on the capital expended is only about sufficient to pay interest and depreciation charges, leaving maintenance and operating expenses as dead loss.

In the last month of the financial year the charge for a trunk call of six minutes' duration between 8 P. M. and 6 A. M. was made the same as that for a call of three minutes' duration during the day. The time during which the change has been in operation is too short, however, for it to have had any material effect upon the traffic.

TELEPHONES IN THE PROVINCES.

The Post Office does a small amount of telephone business in the provinces and this business shows a slight increase which is treated of with due pride in the report, as follows: "The total number of subscribers to the Post Office exchanges in the provinces has increased to 4,433, as compared with about 3,700 on March 31, 1902. At the end of 1899, when a more active policy was initiated in this branch of business, the number of subscribers to provincial exchanges was about 1,250. The increase in the interval is due not only to the establishment of exchanges in places which are not served by the National Telephone Company, but also to the growth of the business in those areas in which the company and the Post Office have been in active competition. In the South Wales district, for instance, where the number of Post Office subscribers was only about 370 at the end of 1899, the number has now increased to 2,255."

THE LONDON TELEPHONE SYSTEM.

The gem of the Post Office report, however, is the reference to the London telephone service. Great progress has been made during the year, resulting in the establishment of seven exchanges and the partial construction of four others. The total number of subscribers' telephones working in connection with these exchanges on March 31 last was 9,122. The number added during the year was 8,628, and it is believed that this number has not been exceeded during the first year of working of any other local telephone system. The "Central" exchange serves 7,054 of the 9,122 stations in use, and is now the largest exchange in the London area. The other six exchanges are all small ones. The ultimate capacity of the "Central" exchange, which is situated close to St. Paul's Cathedral, is 14,000 lines. The work of extending the switchboard to its full capacity is being rapidly carried on, and plans are in preparation for the construction of another exchange of the same size for the service of the same district. In the construction of all the exchanges on the Post Office system, the necessity for providing for a rapid and continued growth of business has been kept in view. The construction already done provides to a large extent for an increase to 30,000 stations, and to a smaller extent for a still further increase.

The underground system contained 971 miles of pipe, and over 102,000 miles of cable conductor. About 16,700 miles of wire have been used for telegraph purposes, and about 21,800 miles are in use for the telephone service, leaving about 63,500 miles spare. Each line directly-connected with an exchange has involved the provision, on an average, including local junctions, of 1.35 miles of metallic circuit. The average cost of construction has been $92 per mile of metallic circuit. The average subscriber, therefore, costs in line plant $124.20. The total average cost per subscriber, including exchange apparatus, is given as $191, thus placing the central office and sub-station plant at an average of $66.80 per subscriber. The report goes on to say: "If allowance be made for a balance of spare wires, amounting to 25 per cent. of the wires in use, such as is necessary for the efficient working of an exchange system, the average cost will be increased to $222." Here the Post Office officials fall into a strange error. The provision of spare plant in a large telephone system, or even in a small one if development is expected, has to be much in excess of their estimate. A surplus of 25 per cent. of the wires in use is 20 per cent. of the whole plant. The figure that should be taken is more like double this. As a telephone plant is always in process of extension, the spare plant seldom falls below 40 per cent. of the whole. At this rate, which is about the usual figure, the average cost per subscriber would be not $222, but $317. And it is very likely that the average cost per working line of the Post Office London telephone system will never fall below $300, while for many years to come it will be considerably above that figure. At present it is over $600, as the total capital expenditure to March 31, 1903, was $5,562,500 for 9,122 stations.

Taking the capital expenditure per line as ultimately averaging about $300, it is clear that the Post Office London telephone service is destined, at the present rates, to net a handsome annual loss. The rates, as announced in the Electrical World and Engineer, when they were given to the public nearly two years ago, are $85 for unlimited service and $25 *plus* 2 cents a call for inner London, and 4 cents a call for outer London, on the message rate basis. There are lower rates on the outlying exchanges for party line service. It appears from the accounts that about four-fifths of the Post Office subscribers take service at the message rates, and it further appears that they originate very few calls. This may improve later, but it is never likely to improve very much, as the low flat rate necessarily divides the telephone users sharply into two classes—the moderate and large users who will take the flat rate and the very small users who will take the message rates and remain small users. The message raters have to guarantee $7.50 for calls, so there is practically a minimum rate of $32.50 for from 180 to 360 calls a year, according to whether they are 4-cent or 2-cent calls, and a maximum rate of $85 for unlimited calls. This is a scheme of rates that may please the telephone-using public very well, but has little charm for the supplier—in this case the taxpayer.

Since the English custom is to pay telephone rates yearly in advance it is easy to see what the average revenue per subscriber is. The total for rentals, message fees and public office receipts is $285,435, which gives an average per station of $31.50. This is just 10½ per cent. on the average capital cost of $300. If depreciation be taken at 7½ per cent., which is the usual figure in this country, interest at 3 per cent. and sinking fund at 3½ per cent., a total of 14 per cent., each subscriber would be required to provide $42 a year. So there is a net loss, on a commercial basis of $10.50 per subscriber, without counting operating expenses at all. What the actual operating expenses per subscriber in London may be is not easy to estimate, but we should doubt if, considering the immense area to be served and the difficulty of the work, they will fall below $35 a line when the plant is fairly running, and probably, under government management, not below $40. The total net loss per line will, therefore, eventually be from $45 to $50 per line. This is a conservative estimate, and by no means an extravagant value is placed on any item of expense. To put the matter in another way, in order to make the enterprise commercially sound it would be necessary to obtain an average revenue per subscriber of at least $80 to $90 a line. With a maximum rate of $85 for unlimited service and a minimum message rate of $25, this is clearly impossible. If there were no maximum rate, and message rates exclusively were in force it might be possible eventually to get the average rate up to a paying figure.

The accounts for the first year's working of the system are of little value for purposes of comparison as the greater part of the system was brought into use during the year, so that the amount for operating expenses is no criterion of a full year's working expenses. They are as follows, pounds being converted into dollars at $5 per pound.

POST OFFICE TELEPHONE SERVICE, LONDON AREA.

An account of the above service from its commencement on March 1, 1902, to March 31, 1903:

RECEIPTS.

Subscribers' rentals.		
In March, 1902		
At flat rates ..	$3,410	
At toll rates	11,915	
		$15,325
In financial year, 1902-03		
At flat rates ..	$53,840	
At toll rates	227,590	
	$281,430	
Less proportion proper to year 1903-4 . . .	$159,670	
		$121,760
Message fees in addition to fixed minimum of $7.50 per subscriber		2,865
Call office fees (public stations)		1,140
Rentals of wires leased to National Telephone Company..........		90
Miscellaneous receipts		935
Value of services rendered to gov'm't departments without paym't.		5,100
		$147,215

EXPENDITURE.

Maintenance of system	$49,100
Salaries, wages, etc., of staff, including provision of pensions of established staff	50,205
Rent, rates, fuel and light, including estimated rental value of premises already belonging to the department	12,950
Miscellaneous expenses (stationery, traveling, etc.)	4,135
Balance available towards meeting depreciation, interest, etc. (vide notes)	30,825
	$147,215

NOTES.

1. The estimated amount required to provide for depreciation of plant, inclusive of spare wires, is $137,475, and interest at 3 per cent. on the capital expenditures of $5,562,500 is $166,875, making together $304,350.

2. Terminable annuities have been created, payable from the vote for the telegraph service, to provide for the repayment, with interest at 3 per cent., of capital raised for telephone purposes under the Telegraph Act of 1899. The proportions proper to the London telephone service of the annuity payments already made are as follows: Payment on April 1, 1901, $122,030; payment on April 1, 1902, $288,863.

3. The annuities provide for the repayment of the capital in 12-15 years, while the estimated life of the plant averages 36 years. The annuity required for interest and sinking fund on a capital expenditure of $5,562,500, repayable in 30 years with interest at 3 per cent., would be $283,920.

These notes are a highly interesting commentary on the balance sheet. From note 1 it appears that to meet depreciation—which is reckoned at slightly under 2½ per cent.—and interest at 3 per cent., a sum of $304,350 is required. The actual amount available as gross profit from the first year's working is $25,725. A balance of $30,825 is shown in the balance sheet, but the sum of $5,100 "value of services rendered to government departments without payment" is ingeniously shown as a receipt whereas it is, of course, not really a receipt at all. So that on this basis there is a loss on the first year's working of $288,625. Even assuming that the present plant can serve three times the present number of subscribers, which is a liberal assumption, and that the operating expenses remain proportionately the same, which is also assuming what is unlikely to be the case, there will still be a deficit of over $235,000 a year.

This is on the basis of the very modest figure for depreciation of 2½ per cent. It seems to us that the Postmaster-General is over-sanguine in estimating the depreciation of telephone plant at as low a figure as that, and that past experience, in this country at least, does not warrant the assumption that the average life of telephone plant will be anything like 36 years. Conservative American telephone men put telephone depreciation at no lower than 7½ per cent., and even granting that telephone plant might be expected to show greater stability and endurance under British Government management than under the strenuous conditions of American commercial development, it would hardly seem safe to put the depreciation at a lower average figure than 5 per cent. Adding interest at 3 per cent., a gross profit would be required sufficient to pay 8 per cent. on $5,562,500, or $445,000 annually.

But the notes show that even more is required of the returns from the system. If the capital were to be repaid in 30 years sinking fund and interest would absorb just over 5 per cent. on the capital, or $283,920 a year. But the annuities created for the repayment of the capital practically constitute a sinking fund to extinguish the capital within 15 years, and to provide for this requires annually about 8½ per cent. on the capital, or $472,000 a year. This would mean, with depreciation at the Postmaster General's figure of 2½ per cent., a total of $611,875 a year, or with depreciation at the more conservative figure of 5 per cent., $751,000 a year. If the present plant proves capable of serving three times the present number of subscribers, and the present ratio between operating expenses and revenue is preserved, the plant will eventually produce a gross profit of about one-tenth of the last named sum.

It is well known that the Post Office has put in a thoroughly modern plant for its London service, but the department cannot be congratulated on the business aspects—or prospects—of its telephone venture. The Postmaster-General has informed the British public, through the House of Commons, that his London telephone system was expected to prove a profitable enterprise, but the figures he presents show that such an expectation is little likely to be realized. It is rather a sad spectacle to see British postal telephones following British postal telegraphs along the inglorious path of annual deficits, especially in view of the recent declaration of the Postmaster-General that he could not conceive of any successor of his in office allowing private enterprise to continue in the management of the telephone service when the telephone licenses expire in 1911. During the past year private telephone enterprise paid the Postmaster-General in royalties no less than $815,000. This princely sum, paid for the mere right to exist, gets a line in the report. As a mere question of dollars and cents it would look as if the Post Office would do better to leave the telephone service to private enterprise.

Coming back to the financial results of the telegraph department, we find that the total expenditure for the year was $21,586,855, and the total receipts, including an amount of $460,605 "estimated value of services to other departments," $18,619,330, leaving a net deficit of $2,967,525. This requires some modification, however. The Post Office keeps no capital account and makes all its extensions out of revenue. As the Post Office as a whole, postal and telegraph services combined, makes a net profit of $17,900,000 a year, over and above all expenditures, it can well afford to do this. In case of the telegraph finances, extensions and buildings account for a large sum, $2,450,775 for the year under review. Deducting this from the gross deficit of $2,967,525, we get a net deficit of $516,750 on the actual working. To this should properly be added the sum of $1,494,300, the annual interest on the stock created for the purchase of the telegraphs in 1870 (which was about $50,000,000), making a total deficit of $2,011,050. What the present capital value of the British postal telegraph system is the report does not state. Sir William Preece, in a recent lecture, put it at not less than thirty millions sterling, say $150,000,000, which is probably not an excessive estimate. If interest were paid on this sum at the same rate as on the original capital, the present annual deficit would be almost exactly $5,000,000. Perhaps the British public may be congratulated on having acquired, out of the profits of the Post Office as a whole, a telegraphic system worth thirty millions of pounds and admittedly fairly efficient. But on the whole our sympathy is with the critics of the Post Office who systematically condemn the steadily increasing telegraphic deficit. As a specimen of business management, the administration of the telegraphs and telephones certainly does not reflect credit on the British Post Office. It should prove a warning to those who advocate Federal ownership of telegraphs and telephones in this country.

Statistics of the Street Railway Industry.

At the convention of the Street Railway Accountants of American Association a very able and interesting paper was presented by Mr. W. M. Steuart, chief statistician of the Department of Manufactures, United States Census Office, on the work done by the Office in compiling the figures of the industry since he appeared before the body at the Detroit convention last year. The leading data have already been published in these columns, but Mr. Steuart brought up a number of new facts and threw various side lights on the statistics obtained. In doing this he emphasized alike the importance of the work done by the Cenusus Office and of that which the Accountants' Association is trying to do, and he enlarged on the necessity of "standardization" in this respect.

The extent to which the roads are patronized is indicated by the fact that more than 5,800,000,000 passengers of all kinds were carried during the year. This is sufficient to give more than 200 rides to each inhabitant of the cities and towns having a population of 4,000 or over at the census of 1900. They give employment to an army of 140,000 persons, thus making at least 560,000 dependent upon them for their support. The salaries and wages paid annually to their operatives amount to more than $88,000,000. The average annual wages per operative compare favorably with those in other lines of industry, and there are very few that give constant employment to a larger force or have a larger pay roll.

The financial transactions of the companies are rapidly approaching proportions which will outclass those of our largest industries. The authorized capitalization in 1902 amounted to $2,870,629,316, while the gross earnings from operation were $247,553,999, and the net income after deducting all expenses, both operating and fixed charges, was $30,596,977. The statistics for the physical equipment of the roads indicate the great diversity of industries that are, in a measure, dependent upon them for their prosperity. The construction of 22,577 miles of track was a great stimulant to the steel rail market, while the building of 67,000 cars made a great demand on the numerous industries dependent upon such work. The manufacture and installation of the engines and boilers to generate more than a million horse-power reported for the power plants of the electric railways was sufficient to keep our largest foundry and machine shops busy for many months. The extent to which the manufacturers of electrical apparatus are dependent upon the roads is indicated by the fact that almost 5,000 large generators, transformers, boosters, auxiliary generators, rotaries and motors were in use, also over 16,000 storage battery cells, and this does not take into consideration the electrical equipment of the cars, wiring of the road, or the lighting and telephone facilities.

The Census Office received reports from 987 companies, but if the present rate of consolidation is continued for another decade, the office could secure reports for two-thirds of that number and still cover the entire trackage. The term company or establishment is rapidly losing its significance in important industries. It is of no statistical value in the report on electric railways. If the word "system" could have been used to designate the number of separate holdings it would probably have conveyed a more exact meaning, but this was impossible because in some instances separate reports were made for constituent companies. The two systems in the District of Columbia insisted on making eight reports, and would not be satisfied until they were counted eight times. There were nine companies operated by regular steam railroads as an auxiliary of the railroad business. Eleven companies operated incline planes exclusively and, therefore, cannot be strictly classed as street railways. There were also 53 companies operated exclusively by animal power, 2 by cable, and 3 by steam. Eliminating these and the 170 lessor or non-operating companies, there remain 739 companies, with 18,730.20 miles of single track, to which the standard system of accounting could be considered as applicable. But a large number of these companies have complicating features that are difficult to overcome in the application of such accounting. For instance, 252 companies generate electric current for sale, and the business was of much importance that separate reports were secured for the light and power plants of 118 companies, in which the revenue from the sale of current amounted to $6,469,726. The present Association form of account does not take sufficient cognizance of this feature of the industry. It is a feature that appears to be developing very rapidly and should be recognized in any system that is to be made of universal application. After deducting the 252 companies that generate electric current for sale, there were 487 companies, and of these, 50 operate gas plants, waterworks, or some other industry that has no connection with the railway business. There are, therefore, only 437 companies to which the standard form of accounting is strictly adaptable.

Mr. Steuart urged, therefore, the adoption of accounting forms that would cover light and power and all other branches of the present comprehensive corporations; and he proceeded also to speak of the later interurban developments. He stated that it had been found that making a separation of the roads, it is found that about 300 companies can be considered as operating interurban lines. Their total single track amounted to 8,853.53 miles, and their total earnings from operation for the year to $41,099,987; total operating expenses were $26,135,031, the net earnings being $14,964,856. The single track of these companies forms 39 per cent of the total for all companies, and their operating earnings 17 per cent of the total earnings from operation. The interurban traffic, therefore, forms still only a very small proportion of the total electric railway business. There are about 56 companies, with 3,212.75 miles of single track, that operate what may be classed as fast long distance interurban lines. Each of these companies operates at least 20 miles of road, the average length of single track per company being 57.37 miles. The maximum running speed outside city limits was at least 25 miles per hour. The total operating earnings amounted to $13,657,021, and the operating expenses $7,924,568, the net earnings being $5,732,453. These roads have some features which are distinctive, and the Census Office is now preparing an analysis of their statistics which will be included in the final report.

As to the horse car line, Mr. Steuart remarked that it had been electrocuted in almost every city where it was in a flourishing condition a few years ago. While there were 67 companies using animal power and 259.1 miles of track operated by such power, the greater proportion of the track was owned by companies which used other motive power on a portion of the line. There were only 53 companies which used animal power exclusively, and their single track amounted to 158.12 miles, being an average of about three miles for each company. It is strange that the Metropolitan District, in which the most advanced electrical appliances are in use on the street railways, is also the home of the antiquated horse car. Almost half of the trackage operated by animal power is located in Manhattan, and the Dry Dock, East Broadway and Battery Railway is the largest road operated by a company using animal power exclusively. With the exception of New York, the following cities are the only places in which more than five miles of track were operated by animal power in 1902: Hutchinson, Kansas, 7.83 miles; Santa Rosa, Cal., 7.33 miles; Chicago, Ill., 6.76 miles; San Francisco, Cal., 5.65 miles; Arkansas City, Kansas, 5.50 miles, and Tucson, Arizona, 5.10 miles. The cable, which fifteen years ago had such bright prospects, is now antiquated. There are only two street railways operated exclusively by cable power. From the Census Bulletin there appeared to be twelve roads of this character, but ten of them are inclined planes.

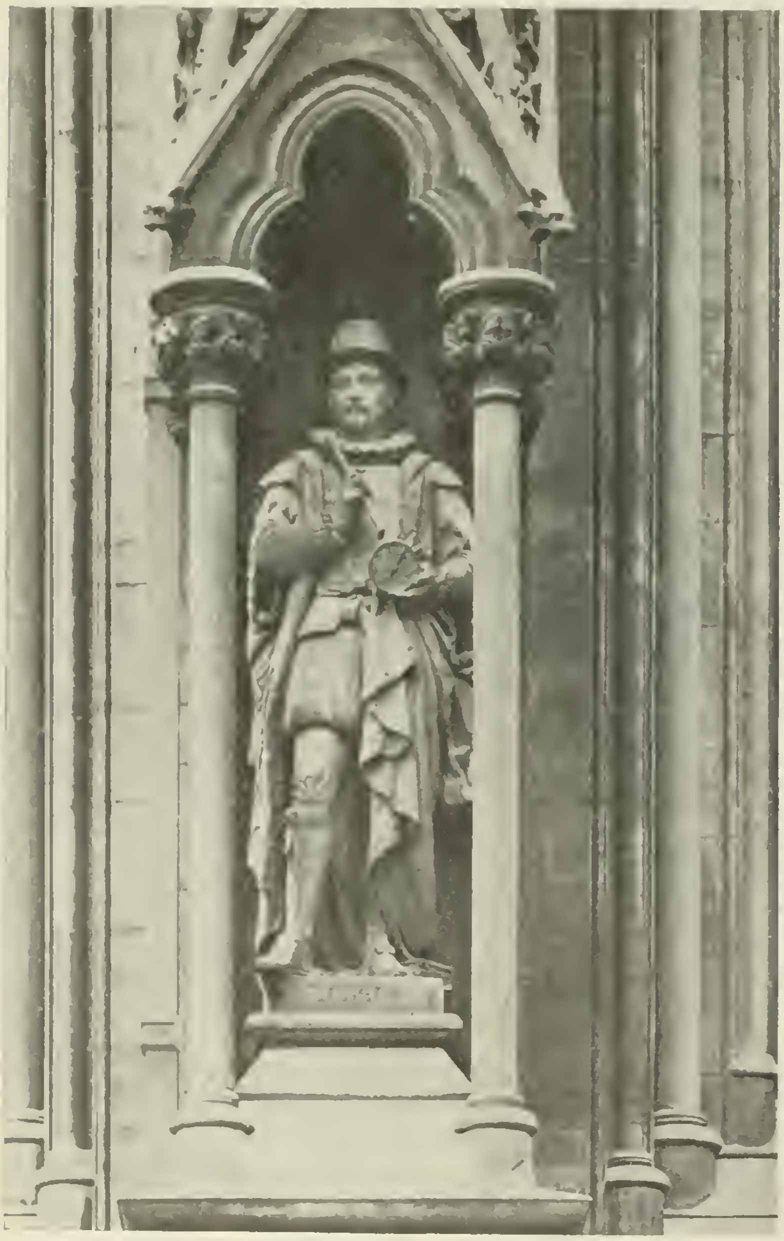
Mr. Steuart then presented some financial criteria, remarking that the tendency in most lines of industry is toward over-capitalization, and the conditions prevailing in the electric railway business seem to have been especially conducive to this result. The par value of the common and preferred stock on which no dividends were paid during the year amounted to $667,878,624, or about 50 per cent of the total issued. The practice of some companies to equalize the cost of construction with the amount of capital stock and bonds, and the apparent inability of others to furnish definite information concerning the cost of construction, with the amount of capital stock and bonds, and the apparent inability of others to furnish definite information concerning the cost of construction, made it impossible to compare the actual cost with the stock and bonds issued. Accepting the figures as reported, it appears that the stock issued and the funded debt outstanding for all roads, exceeded the cost of construction by $140,648,022.

With regard to the adoption of the Association form of accounting, Mr. Steuart stated that the Census Office immediately ascertained to what extent it had been used by the State Railroad Commissions. The commissions in New York, Massachusetts, Connecticut, Maine and New Hampshire were using schedules that followed the form almost exactly. These five States contain 6,386.92 miles of single track, or 23.30 per cent of the total trackage in the United

States. This fact alone would have justified the office in using the standard form, but it was also found that a number of other States had collected information from which the schedule could be partially prepared. Pennsylvania is one of the most important States that had not adopted the standard form, but the Commissioner informed Mr. Steuart that it was his intention to do so. The adoption of this form by the officers in all States would aid greatly in its uniform application, and it seems that the Association should endeavor to accomplish this by persistent work with the State Commissioners. In this manner the burden resting upon the companies of making reports that are in part repetitional or duplicates would be greatly alleviated. Mr. Steuart then cited a number of amusing and interesting instances of crude bookkeeping encountered in different sections of the country, and devoted the final portion of his paper to an elaborate discussion of the technical features involved in existing and improved methods of accounting.

William Gilbert of Colchester.

The accompanying reproduction is made from a photograph expressly taken for reproduction here of the statue of Gilbert, still standing at this day in one of the niches of the Chapel of St. John's College, Cambridge, and is believed not to have before appeared in print. The great father of experimental philosophy is here shown in manner different from that exhibited, either in the well-known portrait said to have been engraved by Clamp in 1796, "from an original picture in the Bodleian Library, Oxford," or in the painting which, upon the occasion of the tercentenary celebration of Queen Elizabeth, was made by Mr. Frank Daniell for Mr. Benham, who gave it to the new Town Hall at Colchester, where it now hangs in the Mayor's parlor.



STATUE OF WILLIAM GILBERT.

The original portrait which Gilbert is said to have left to the University of Oxford, and which was "placed in the Gallery over the Schools," is reported to have been consumed in the great London fire of 1666, although Anthony A Wood speaks of it as "decayed and removed" ("Hist. and Antiq. . . . ," 1796, Vol. II, p. 96). The writer in Ninth Encyl. Britann., speaking of this portrait, says that Gilbert therein appears as standing in his doctor's robes, "holding *in* his hand a globe inscribed *terrella*, whilst over his head is the inscription, '1591, aetatis 48,' and a little below his left shoulder the words, 'Magneticarum virtutum, primus indagator Gilbertus.'" The Clamp picture lacks the inscriptions and represents Gilbert resting his hand *upon* an ordinary globe. We may add that it was the central portion of this picture which was utilized by Mr. Arthur Ackland Hunt for his well-known historical painting, representing Gilbert making an experimental demonstration in electricity before Queen Elizabeth.

In the Daniell painting above alluded to, the inscriptions have also been omitted. Gilbert is resting his right hand upon a globe whilst in his left he carries a rolled manuscript bearing in Elizabethan characters the words *De Magnete*. The painting itself bears a plate inscribed as follows: "William Gilbert, of Colchester, Physician to Queen Elizabeth and King James I, author of *De Magnete* and founder of the Science of Magnetism. Born 1540, died 1603. Presented by Charles E. Benham."

The reproduction of the statue herein made is the first one we know of showing the full figure and costume of Gilbert. The pose, the arrangement of the beard, the style of the ruffle, are altogether original, and, for the first time, he is seen holding a bar magnet in one hand and a mariner's compass in the other. The statue bears out Dr. Fuller's description of Gilbert. "His stature was tall, complexion chearful, and Happiness not ordinary in so hard a student and retired a person," and shows likewise "the keen, straightforward, searching glance, the twinkling play of good-humoured sarcasm, ready to vent itself on all 'old wives gossip' and 'foolish vanities,' the frank, fearless, open countenance, intolerant only of shams and fraud," as expressed by Mr. Benham in the "Sketch of Gilbert's Magnetic Philosophy," which he published at Colchester during the past year.

In this connection it may be said that the inscription on Gilbert's tomb in Trinity Church, Colchester, reproduced in the last-named work, indicates that Gilbert was 63 at the time of his death. Prof. Silvanus P. Thompson's latest researches, however, show that Gilbert was *certainly* not born in 1540, but in 1544, and that, contrary to the generally accepted belief, he was only 59 years of age when he died. Inquiries now being actively instituted abroad in several directions will soon set this question at rest.

The first signature of Gilbert discovered came to light some five years ago attached to a medical certificate in Her Majesty's Record Office. Up to that period, not one example of his handwriting was known, but in the meantime several signatures have been found in books of St. John's College, where Gilbert matriculated during May, 1558, and Prof. Thompson mentions the fact that he has recently found a volume of Aristotle bearing Gilbert's own marginal notes, some of which will no doubt be reproduced at an early date.

Tunnel Under Washington.

The Commissioners of the District of Columbia have granted a formal permit to the Philadelphia, Washington & Baltimore Railroad (the Pennsylvania road) to construct the twin tunnel under the United States Capitol and the adjacent blocks and streets. The permit had been held up for several weeks because of a difference between Major Biddle, the engineer commissioner, and the railroad engineers in regard to the motive power to be used to propel cars in the tunnel. Major Biddle insisted that electricity should be used, and the railroad men wanted to be allowed to use steam. Electricity was finally agreed on. The tunnel will be 3,000 ft. long, beginning at the intersection of Massachusetts Avenue and First Street, N. E., going under Capitol Hill to New Jersey Avenue and D Street, S. E. The total cost of the work will be approximately $800,000. There will be two branch tunnels connecting with yards and tracks of the Pennsylvania road in South Washington.

The Value of Radium, Roentgen Rays and Ultra-Violet Radiations in Mineralogical Determinations.

With the advent of Kunzite, the newly-discovered gem, and its remarkable behavior when subjected to the action of radio-active substances and electromagnetic radiations as observed by Dr. George Frederic Kunz, late president of the New York Mineralogical Club, and Prof. Charles Baskerville, head of the chemical department of the University of North Carolina, fresh stimulus has been given to the study of the new properties of minerals acquired in a radio-active field.

Before presenting these remarkable phenomena a brief history of the stone named in honor of Dr. Kunz will be given. A gem believed by mineralogists to be extinct was noted by Dr. Kunz in his treatise on precious stones[1] some ten years ago, the data being obtained from spodumene, a mineral generally found in large, opaque whitish crystals, but which sometimes appears as highly colored transparent specimens of very small size.

These are the clear yellow gem-spodumene of Brazil[2], the green variety known as hiddenite or lithia emerald of North Carolina, and the lilac or amethystine specimens found occasionally at Branchville, Conn.[4] These minute crystals are plainly remnants of what must have once been elegant specimens,[5] but this special spodumene was extremely susceptible to alteration, and the finer properties of the larger specimens have been destroyed through their environments and their transparency and beauty of tint eliminated.

From these remaining fragments the doctor was enabled to approximate their appearance when in the perfect state and classified as precious stones. Nearly nine months ago spodumene crystals, unaltered, transparent and of a rich lilac color were discovered near Pala, California, and specimens were sent to Dr. Kunz for classification, and it was ascertained by him that these were not only different from all other minerals heretofore examined, but also fulfilled to a nicety the conditions exacted by the extinct stone previously described in his work.

These newly-discovered crystals of spodumene measured 10 x 20 x 4 centimeters and are not only of extraordinary size, but are of exceeding beauty and transparency as well; in color they vary from a rich deep rosy lilac to pale and almost colorless crystals, depending on the depth from which they are obtained, the striking colors being found at considerable depths and the colorless varieties near the surface of the earth.

Up to a very recent date this new gem was without a name, but while Dr. Kunz was on his vacation Prof. Baskerville, in view of the acute observations of the eminent mineralogist, cleverly proposed the name of Kunzite, which was heartily received by scientists both at home and abroad.

Fig. 1 illustrates photographically crystals of Kunzite, the size being relatively indicated. The dimensions and weights of six of the largest crystals are here appended.

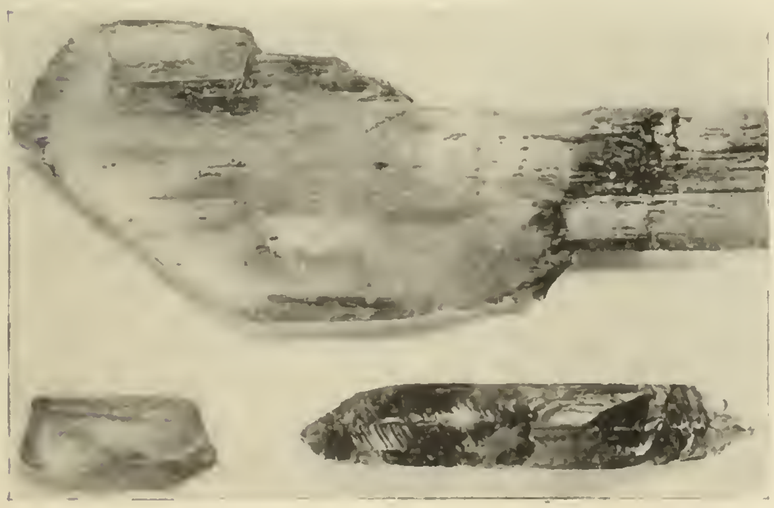


FIG. 1.—CRYSTALS OF KUNZITE.

	Weight, grains.	Weight, troy.	Dimensions, centimeters.
No. 1	528.7	17.1	17x11x1
No. 2	528.7	17.1	22x8x1.5
No. 3	597	9.55	19x5.5x1.5
No. 4	256.6	8.25	23x4x2
No. 5	340.5	10.95	13x6x2.53
No. 6	239.5	7.70	18x4x2

Dr. Kunz and Prof. Baskerville have subjected these magnificent crystals to the bombardment of the Röntgen rays having high penetrative powers, yet on examining the stone in a dark room they emitted a white light for as long a period as twenty minutes, whereas with all other specimens of altered and unaltered spodumene obtained from Brazil, North Carolina and Connecticut included in all the private and public collections available, none was found to produce a similar effect.

Again, it was found that a crystal 2x4x10 centimeters, excited by a stream of Röntgen rays for a few minutes, set up a secondary radiation by which a radiograph of the crystal itself was easily made on a sensitized paper by its own emanations, and even when thin paper was interposed between the radio-active crystal and the light sensitive paper the radiation still was active. These savants have shown that this phosphorescent property is not confined merely to the surface of the crystal but persists throughout its mass. Fig. 2 is a radiograph of Kunzite crystal made with a 12-in. spark coil and a self-regulating tube, with an exposure of 60 seconds. Oppositely disposed, ultra-violet radiation does not produce the slightest indication of fluorescence or phosphorescence when Kunzite is subjected to its action.

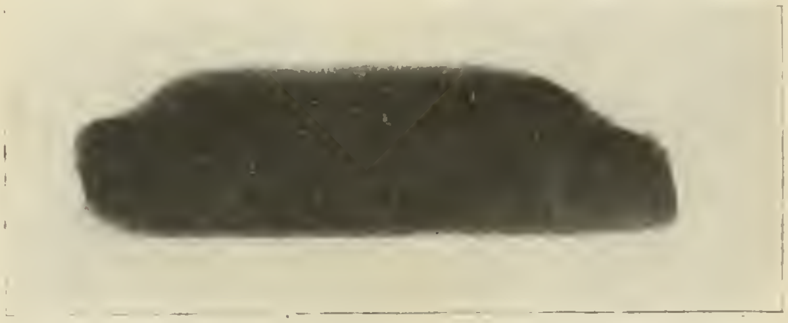


FIG. 2.—RADIOGRAPH OF KUNZITE CRYSTAL.

The Kunzite is highly dichroic in the darker specimens, and with the dichroscope the darker specimens show a rich, deep purple for ordinary rays, and a pink for the extraordinary rays. For a lighter crystal, almost like pink topaz in color, the ordinary ray is transformed into pink, and the extraordinary ray showed almost no color, having an approximately white appearance.

A small quantity of radium of 300,000 radio-activity and the purest yet received in this country reached the American Museum of Natural History (New York City) a few days ago, sealed in a small glass tube with an outer casing of lead-foil, the total diameter being about 3 centimetres. This, as well as a quantity of 7,000 activity was employed by Dr. Kunz and his colleague, Prof. Baskerville, in the examination of the hitherto unrevealed properties inherent in gems. Not only was Kunzite subjected to its searching influence, but the entire Bement-Morgan collection—over 13,000 specimens in number—and the Morgan-Tiffany collection of gems containing several thousand specimens, together with some thousands of different diamonds and a large number of gems and minerals, were investigated.

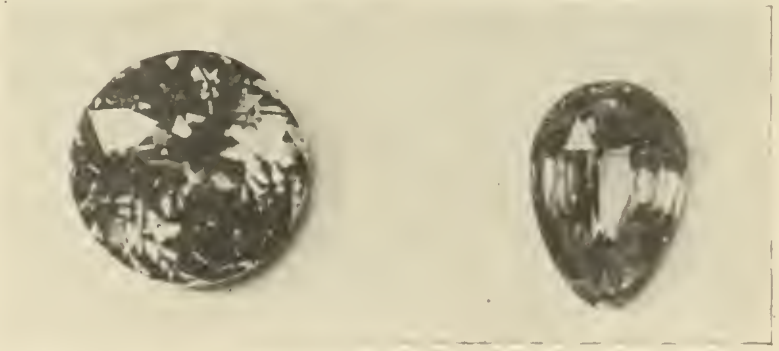


FIG. 3.—GEMS CUT AND POLISHED.

Fig. 3 shows two forms of Kunzite gems cut and polished, and it was ascertained that after these specimens were influenced by the radium they emitted a wonderful phosphorescence. Figs. 4 and 5 illustrate how the experimenters protected themselves from the untoward effects of the radium such as it may possess. Two corks with a piece of lead foil inserted between them was securely fastened together with the tube of radium suspended over it, as shown in Fig. 4, which is a top elevation. Fig. 5 shows the lead foil projecting forward and the little apparatus in position so that the radium will emit its corpuscles directly on the gem held under it. The tube is snugly tucked away, not only that it may not sustain damage to itself but so, too, it may not accidentally sear the flesh or destroy the vision of those in whose keeping it is entrusted.

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[1] Gems and Precious Stones of North America, Kunz, third edition, 1892, page 150.

[2] Pigani, Comptes Rendus, 84, 1509, 1887.

[3] J. L. Smith, Am. Journal of Science, 21, 128, 1881.

[4] Penfield, *id* 20, 259, 1880.

[5] Kunz, Science, 452, 280, Aug. 23, 1903.

The radium, now the property of the Museum, was acquired through the courteous gift of Edward D. Adams, Esq., for the especial purpose of the researches recited above. By its aid diamonds exhibit a marked phosphorescent property, which they retained for a time after the stones are removed; other diamonds, on the other hand, do not phosphoresce at all; this striking example was most notable in a cut gem weighing 15½ carats, of a beautiful white color and from an unknown Brazilian locality; others of the same class were uncut gems found in British Guiana, and a large diamond weighing 16 carats found at Eagle, Wis. The mineral Willemite exhibited a fluorescence and phosphorescence, and Wollastonite a marvelous phosphorescence, but the new gem, Kunzite, phosphoresced with a greater brilliancy than any other substance examined with radium. When the radio-active matter was held under the entire gem, which measured an inch in diameter, an inch in depth and weighing 55 5-16 carats, it glowed with an orange-red color, and its phosphorescent emissions penetrated from three to six sheets of paper.

FIGS. 4 AND 5.—RADIUM TUBE OF 300,000 RADIO-ACTIVITY.

It is pleasing to note that this work has been taken up by men so remarkably well qualified as Dr. Kunz and Prof. Baskerville. The latter is a graduate of the University of Virginia and is Professor of Chemistry in the University of North Carolina, Chapel Hill, N. C., and has made extensive researches in what is known as rare earths, which have attracted so much attention in recent years, as it is the incandescence of these earthly minerals that has been the subject of so much experimenting in gas and electric lighting.

Dr. George F. Kunz first gave his attention to the subject of phosphorescence about 1875, and in April, 1876, he read a paper before the New York Lyceum of Natural History on the phosphorescence of pectolite by attrition as a distinguishing characteristic between it and the fibrous zeolites. He next made a series of experiments on the phosphorescence of the diamond at the Paris Exposition of 1889 jointly with Prof. E. Mascart, the well-known electrician. Prof. Kunz continued his researches on his returnn to America, and finally deduced the sweeping law that all diamonds phosphoresce by attrition. He published a statement to the effect that certain diamonds from Brazil absorbed sunlight and some of them ultra-violet radiation, which they emitted in the dark in the form of light waves, and that this effect was due to the presence of some substance, possibly a hydro-carbon, to which he gave the name of Tiffanyite. This phenomenon was shown in an electrical exhibition at Grand Central Palace, New York, in 1896, for an entire month, where it was viewed by thousands of spectators. The experiment was conducted in a specially constructed room, where the diamonds were shown in white light and under ultra-violet radiation, and then allowed to phosphoresce in the dark.

Dr. Kunz discovered as early as 1887 that chlorophane, a mineral from Amelia County, Va., emitted light by attrition, and that it phosphoresced by the glow of the hand, which proved to be a distinguishing characteristic between it and other varieties of fluorites. He has also made an exhaustive study of fireflies and glow worms, both in the United States and Europe and Asiatic Russia.

With this wide experience in testing gems, together with the subtle aid which X rays, ultra-violet radiation and radio-active substances will give in the exploration of regions hitherto inaccessible through the medium of microscopy, spectrum analysis and chemical analysis, we must not be surprised if phenomena even more noteworthy be presented for our consideration.

For twenty-one years Dr. Kunz has been a special agent in charge of precious stones for the United States Geological Survey; received the honorary degree of Ph.D. from University of Marburg, Germany, and A. M., Columbia University.

Recent Electrochemical Developments.

BATTERY INVENTION.

All electrochemical patents issued on September 8 relate to battery inventions. Three of these were granted to Mr. Oliver P. Fritchle, of Denver, Colo., for a process and apparatus for producing the active material of lead storage battery plates. Particles of finely-divided lead are produced by spraying molten lead by means of a blast through a hot cleaning solution, such as a hot dilute solution of hydrochloric acid; by this means the particles are claimed to obtain a peculiar cohesive property, so that they may be welded together into a rigid but highly porous mass, by subjecting the material to light pressure. The treatment with acid causes a slight evolution of gas, which prevents the particles of lead from settling into a dense compact mass. The porosity thus produced is said to be sufficient to allow easy diffusion of the electrolyte, which is after all the fundamental condition to be fulfilled in an efficient storage battery plate.

A patent, granted to Mr. George E. Hatch, of Quincy, Mass., refers to the type of lead accumulator which has been developed in recent years by this inventor. Each positive-pole electrode is composed of a rigid porous support plate of kaolin, corrugated in one direction. In this way a number of parallel grooves are provided which are filled on one side of the plate with active material. For the negative-pole electrode he employs thin porous plates of light wood. Each plate has the form of a shallow tray, with a profusion of holes piercing its bottom; the active material is filled into this tray, which serves to support and give form to the active mass during the process of formation; but as by the formation the active mass becomes a firm, coherent and durable mass of spongy metallic lead which will not crumble, the trays may be very thin and light, and not nearly as rigid as the support plates of the positive-pole electrode. The conducting plates are thin sheets of lead. One of these sheets is placed in contact with the active material in a support plate of the positive-pole electrode; against this support plate is placed a tray containing the active material of the negative-pole electrode, and this active material is then placed against another conducting sheet of lead; this combination represents a couple which may be held together by any suitable means.

The advantages which a commercial lead-zinc cell would have over the lead accumulator—higher e.m.f. and lighter weight—are so evident that the long series of commercial failures of various forms of the lead-zinc cell does not prevent new inventors from taking up the old problem. In two patents granted to Mr. Lothar Fiedler, of London, a new modification of the lead-zinc cell is described. The one electrode is the ordinary peroxide plate, while the other has an active surface of cyanide of zinc and mercury and is made as follows: A plate of zinc or carbon is treated as cathode in an electrolyte made of 1,000 grams zinc sulphate, 50 grams mercuric sulphate, 10 grams potassium cyanide and diluted with water to a density of 30° Baume. The anode is zinc and during electrolysis the density of the electrolyte is kept constant. On the cathode cyanide-zinc amalgam is deposited in a firm, even and porous condition, so that when used in the lead-zinc cell it has no disposition to become detached from its support. The electrolyte used in the inventor's lead-zinc cell is a gelatinous mass, made up of 1,000 grams of a solution of 24° Baume of sodium silicate, of 3,000 grams of a solution of 33° Baume of sulphuric acid, and of 50 grams of mercuric sulphate. After this solution is compounded it is at once poured into the cell and in a little time it solidifies into a jelly-like mass.

New Telephone Patents.

INDUCTION COMPENSATION.

There are always at hand two ways of increasing the volume of transmission over a line, the one the use of a more sensitive receiver and the other the adoption of a more powerful transmitter. The first is always attended by additional disturbance from line induction, while the latter means more wear and tear on both batteries and transmitter. As a happy medium Messrs. William Condon and Albert Barrett, of Kansas City, have adopted and protected by two patents what they term an "Anti-Induction" system, comprising arrangements such that the receiving efficiency may be reduced and the transmitter power correspondingly and simultaneously at will. When too increased much noise appears at the receiver, the number of battery cells in use with the transmitter is increased until the voice currents overpower the disturbing currents on the line. The receiving efficiency, however, being reduced simultaneously with the connection of additional battery, approximately constant volume of speech appears at the receiver.

LOADING COILS.

Two patents have been granted describing self-inductive loading coils of odd construction. These coils are both of the open magnetic circuit type and are the inventions of G. A. Campbell and W. L. Richards, who have assigned them to the American Telephone & Telegraph Company. Fig. 3 shows views of both coils. In each it will be seen that the magnetic iron wire is disposed about the outside of the coil, the stray field threading the coil and therefore much confined. The result is a coil which should be rather free from disturbing effects upon other coils, which, in the loading of cables, must be located near it.

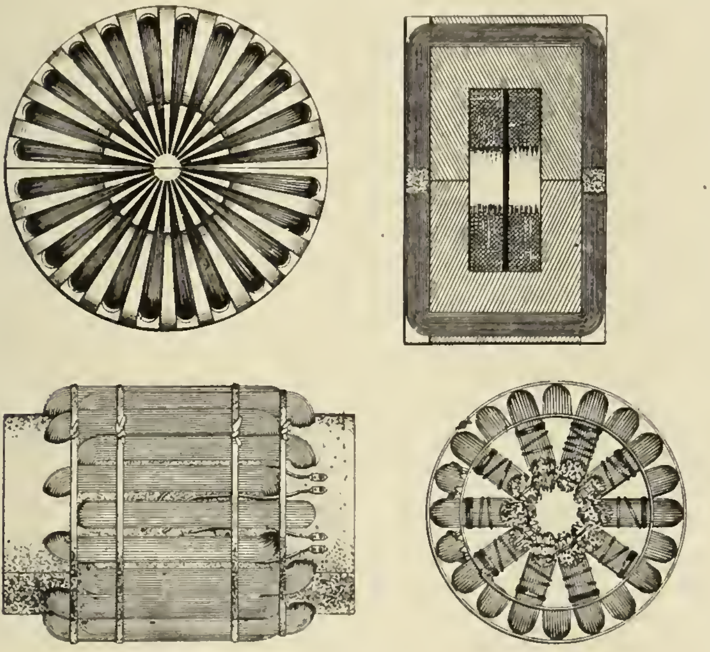

FIG. 1.—CAMPBELL AND RICHARDS LOADING COILS.

A FEW SUBSCRIBER'S AIDS.

The receiver holder again appears in a patent issued to E. Bass, of New York. This time it is a simple bent wire at the end of which the receiver is held. A wall bracket and a spring to force the receiver toward the head of the user complete the device proper. The inventor thoughtfully suggests a plug to be forced into the escutcheon plate of the regular hook switch when it is desired to hold this latter in its normal depressed position.

Another aid is a tell-tale for a magneto bell to assist one who has more than a single telephone to answer. This tell-tale is a piece of sheet material peculiarly perforated and slotted, so that it may be hooked over the bell hammer rod and there remain supported in an elevated position until the rod is vibrated, when the tell-tale will fall and indicate which bell has rung. Charles E. Monroe, of New York, is the patentee of this device, which has been assigned to the Ericsson Telephone Company.

Still another attachment is an extension bell switch, which is held open by engagement with the magneto bell hammer rod. Being released as was the preceding device, the switch falls, closing a battery bell circuit. George L. Gulliford, of Bloomington, Ill., is the inventor of this device.

A memorandum paper holder constitutes the fourth subscriber's aid. This is a bent wire holder, which will clamp itself to a wall set back board and shelf to support and provide a guide and tearing edge for a roll of scratch paper. The patent for this paper holder has been issued to W. H. Sherman, of Newport, R. I.

AN IMPROVED COIL TERMINAL.

All those who have had much work about relays appreciate the annoyances of loose coil terminals, and yet heretofore no cheap and satisfactory terminal has been devised. The application of heat from a soldering iron to the insulating coil head causes this latter to soften and become distorted by the terminal piece owing to the side pressure of the iron. Fig. 4 shows a terminal designed to be readily tightened in case it becomes loose. As will be seen, the metal strip is bent up like a McGill fastener and slipped into a radial slot in the spool head. After being pulled down into the transverse slot, one clip is bent over and the other given a quarter turn to hold the whole together. If the terminal loosens at any time an additional twist will tend to tighten it. Mr. James Duncan, of Boston, has patented this new terminal, his patent being assigned to the American Telephone & Telegraph Company.

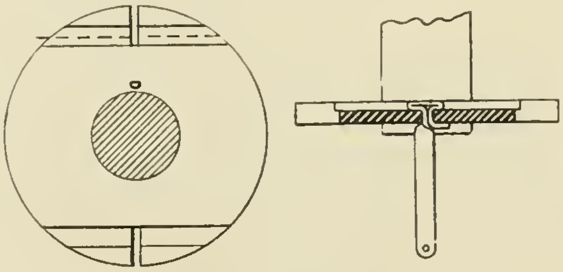

FIG. 2.—DUNCAN ELECTROMAGNET.

TRUNK CALLING SIGNAL CIRCUIT.

An automatic trunk signal circuit has been devised by W. M. Davis, of Chicago. This circuit is more particularly adapted to work in connection with the switchboard circuits of the same inventor and operates to notify automatically the operator at the receiving end of a trunk wire by the lighting of a lamp that a subscriber has been connected to the other end of that trunk and awaits attention. A ring back signal is provided for emergency use, and the common batteries of the two central offices involved are kept distinct by condensers and repeating coils.

SENSITIVE DROP AND RELAY.

Mr. Davis has also invented a magneto drop signal with a battery auxiliary for use with very long lines, where the hand magnetos fail to send sufficient current for the ordinary drop. The line drop has two armatures swung before the same core. One merely controls a battery connection, while the other actuates the shutter hook. The contact armature responding to a weak current comes up to its contact and thereby closes the battery circuit through the coil. The additional pull caused by the battery current causes the hook armature to operate until such time as a contact in the line jack again opens the battery circuit and releases both armatures. The corresponding clearing-out signal is double-wound, one winding being for the battery and one for the line. In this case a socket switch associated with the plug socket reopens the battery circuit. To Mr. Davis is also due a new relay. In this the armature pivoted to a pole-piece at one end of the core swings toward a second pole-piece at the other end, and through the agency of an insulating rod controls contact springs secured to the spool on the side opposite to the armature. All three of Mr. Davis's patents have been assigned to the Stromberg-Carlson Company.

ONE-WIRE TRANSMISSION.

From time to time brief mention has been made in these columns of various ones of a series of patents for multi-induction coil systems, of which Mr. C. G. Burke is the inventor. These earlier systems all provide a number of induction coils of differing electrical properties having the primaries in the line and the secondaries in a local circuit with the receiver. With such systems it has been claimed that but one wire is necessary to satisfactorily transmit speech. Some time ago in reviewing this claim we suggested that the action was probably due to the capacity effects of the additional induction coils. That such is the case is evidenced by two later patents bearing on this subject, the one granted to Mr. Burke and the second to R. A. Ripley. Both relate solely to the transmission of speech along a single wire, a "capacity body" such as a condenser, a battery, the human body or an induction coil with a short circuited low resistance winding being connected to line beyond the telephone receiving apparatus. It seems incredible that such an arrangement could compete with modern two wire transmission, especially as with the single wire it is impossible to neutralize extraneous inductive effects.

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The Edison Convention.

As predicted in our report last week of the opening of the convention of the Edison Illuminating Association at the Hotel Fontenac, Thousand Isles, the meeting was a very successful one in attendance and in the character of the papers read and the discussions they brought forth. Our report gave a complete programme of the technical proceedings, which was carried out in its entirety. On Thursday night Mr. C. P. Steinmetz gave an interesting lecture on "Illumination," and during the week there were a number of social features, including golf and bowling contests, a croquet tournament, a progressive card party and a "mixed foursome" tournament.

Following are the officers elected for the ensuing year: President, Mr. J. B. McCall, of Philadelphia; vice-president, Mr. C. C. Perry, of Indianapolis; secretary, Mr. W. S. Barstow, of Portland, Ore.; treasurer, Mr. Alex. Dow, of Detroit. Executive Committee—C. L. Edgar, Boston; Samuel Insull, Chicago; J. W. Lieb, Jr., New York; L. A. Ferguson, Chicago, and T. E. Murray, Brooklyn.

Among the papers read was one by Mr. E. A. Leslie on "The Development of Summer Lighting," which gave an account of the result of extending the service of the Brooklyn Edison Company to Coney Island. The project for this extension at first met with some opposition, but the result is indicated by the fact that the lighting load of Coney Island and other summer resorts to which the lines were subsequently extended, has brought up the load curve of the middle of the summer to an equality with that of the heaviest days of the winter. A most significant feature of the curve is that it shows that more machinery is required to handle the summer load than is required for the winter load. Aside from the influence of these extensions on the company's business, has been the effect in increasing the popularity of the summer resorts, the brilliancy of the lighting not only bringing greater crowds, but retaining them to a later hour in the night. Owing to the excellent results produced at Coney Island, the service has been extended to other resorts on Long Island, some of which undoubtedly owe their success to the fact that they were thus enabled to obtain the brilliant illumination which draws and holds the populace. With the paper was submitted a copy of the *Brooklyn Edison*, in which journal many views are given, showing how the old Coney Island has been transformed through the introduction of the Edison lighting service.

With the title "Overhead Pole Line Construction and Operation for Central Stations," Mr. A. H. Manwaring and Mr. J. T. Hutchinson read a paper giving the latest practice in overhead and pole line construction. Specifications are included for poles and cross arms for various kinds of service, illustrations of types being included. The subject is covered under the heads of poles, junction poles, cross arms, braces, pins, insulators, lightning arresters, fuse boxes, location and insulation of transformers on pole lines, location and construction of main or trunk lines, grounding of secondaries, complaints and rules. The paper advises that all secondary mains supplied by transformers should have the neutral of the three-wire system or one wire of the two-wire system grounded, the object being to prevent high-tension current from reaching the secondary wires. No wires smaller in size than No. 6 B. & S. gauge should be used for either primary or secondary work, and no fuse box or transformer should be placed upon a junction pole or arc lamp pole, except where absolutely necessary. Poles should be spaced from 40 to 45 yards apart, depending on circumstances, and in long lines every tenth pole should be guyed, the wire being carried from the top of one pole and about six feet from the base of the next. Iron poles, generally speaking, should be avoided on account of the liability of shock to linemen working on live wires. Poles of southern cedar lack mechanical strength and pine poles are short-lived, chestnut poles being preferable to either.

Mr. E. W. Lloyd, read a paper entitled "Purchased Electric Power in Factories," in which detailed information is given for determining the cost of power in the case of a customer who is thinking of replacing steam by electric power. For this purpose a tabulation is offered, and in another table are given the costs as determined in the case of a machine, carpenter and pattern shop, and a foundry. It is recommended that payment for motors be spread over long periods with good allowance in case they be taken back. The paper includes a table showing the annual variation in cost of current, caused by variation in percentage of efficiency of electric motors. In the case of a 10 hp motor, a one per cent. deficiency amounts to $11.65 per year, or $58.25 for 5 per cent. deficiency.

Mr. L. L. Eldon read a paper on the "Selection and Insulation of High Tension Switch Apparatus," which subject was considered under the heads of switches, switchboard locations, bus-bar arrangement, generator switchboards, feeder switches, operating means for switches, construction and general recommendations. The author attaches a great importance to simplicity for a central station switch board, and his recommendations are in line towards securing the greatest possible simplicity.

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Bell Telephone Work in Wisconsin.

The Wisconsin Telephone Company, licensee of the Bell system in that State, is making extensive improvements throughout the entire system. The facilities of this company represent an investment of three and one-half million dollars, and one million more is provided for developments in 1903 and 1904. Thirty thousand subscribers and eight hundred toll stations are being furnished with service. Over twenty thousand miles of toll circuits are in operation within the State, exclusive of the interstate connections with the American Telephone-Telegraph Company.

A handsome new office and exchange building has recently been completed by the company in the city of Eau Claire, which is admirably arranged to suit the needs of the rapidly growing business. The first floor contains, on one side of the entrance hall, a public lobby, and connected with this a general office and the local manager's office. On the opposite side of the hall is the general office of the division superintendent and his private office. In the rear part of the first floor is the apparatus room, in which the underground cables enter through a terminal room in the basement. The entire second floor contains retiring and locker rooms for the operators and the main operating room, in which the very latest type of common battery board, of 2,000-circuit capacity, is being installed, by the Western Electric Company, of Chicago. The work is rapidly progressing, and it is anticipated that the building will be occupied by September 25. The entire aerial plant will be practically rebuilt and approximately 35,000 ft. of cable will be employed in the work, exclusive of the 10,000 ft. employed in the underground work.

Improvements of the same kind are being made at Chippewa Falls and Stevens Point, as well as in other points throughout the State. Copper circuits are being added to the several existing toll line routes and new territory is being opened up from Ashland to Chippewa Falls and Eau Claire, along the Wisconsin Central Railroad, connecting all the intermediate towns, not at present enjoying long-distance facilities.

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Old-Time Telegraphers.

The twenty-third annual reunion of the Old-Time Telegraphers and the Society of the United States Military Telegraph Corps will be held at Milwaukee, Wis., on September 23, 24 and 25. The headquarters will be at the St. Charles Hotel, but the meetings of the two bodies will be held in the rooms of the Merchants' and Manufacturers' Association in the University Building. The business meetings will be held during the morning of September 23. The rest of the time will be taken up by excursions, etc. On the evening of September 24 there will be a banquet at the Hotel Pfister, and on Friday the entertainment will consist of a street car ride to Whitefish Bay.

Militia Electricians at Fort Terry, N. Y.

During the recent mobilization of the militia at Fort Terry, N. Y., for instruction under the officers of the regular army, the Thirteenth Regiment, H. A., N. G. N. Y., formed a detachment of forty men for the purpose of drilling them in the installation, operation and maintenance of artillery electrical apparatus. Owing to the variety of devices and the extensive use of electricity in these works, a splendid opportunity for instruction presented itself to the personnel of the detachment, as well as an object lesson to the militia body and all interested in coast defence, of the importance of electricity in its relation to heavy artillery operations. The electrical outfit of the fort, consisting of several separate generating plants, with both steam and oil engines, and having storage batteries as auxiliaries, furnishes current for motors used in ammunition hoisting, searchlights, lighting gun batteries, lights for fire and battery commanders' stations, garrison lighting, lights for night range finding, telephones, telautographs, electric clocks, and the submarine mine service.

From the above it may be seen that in order to successfully operate a fort, skilled electricians are a necessary part of the force. The skill of the men must excell that required for similar work in civil pursuits; for, although the engineering conditions under which electricity is applied in the artillery service are practically the same as in ordinary life, the requirements are of necessity much more exacting and difficult.

The detachment consisted of men picked from the entire regiment with reference to their aptitude for electricity. The examination consisted of questions aimed at determining knowledge, experience and how acquired of steam boilers, steam engines, oil engines, dynamos, motors, storage batteries, searchlights, wiring, telephone switchboards, telephone instruments, telephone lines, electric bells and signals or any special experience a man may have had that would not come under these heads.

Previous to the arrival of the regiment at Fort Terry the only knowledge the detachment had of the purely military end of the subject was derived from correspondence in connection with the arrangements for the encampment and from Major Anderson's handbook for artillery electricians, which suggested a set of rules for the individual instruction and guidance of all concerned.

All operations were carried out with the idea that the men were already conversant with the fundamental principles of the subject. They were told they were expected to exercise every endeavor to acquire as much knowledge as possible of the fortification electrical equipment. It was not necessary to mention the important part it played in its defensive strength, for this was obvious.

From the experience gained at the encampment, the first experiment of the kind since the militia were reorganized, it seems where men have had such training in handling electrical machinery as naturally comes to those who follow electrical work as a vocation, it will be comparatively easy to organize them so as to be of valuable service to the regular establishment in any emergency calling into action the seacoast defences. As the electrical part of fortifications consists mainly of devices which have become standard in the industrial world very little training would be required to make the men efficient. In those cases where the electrical apparatus is purely military in character, for instance the submarine mine system, of which civilians are not likely to have much practical knowledge and less experience, if the men are thoroughly grounded in the underlying principles of the subject, the intricacies of such work can be quickly mastered.

If this country should find itself involved in a war with a first-class power the immediate execution of a large mass of electrical work would be an imperative necessity, especially in connection with the seacoast defences. A very large number of trained men would necessarily be required to execute such work promptly, and these men must be drawn either from the enlisted forces of the regular army or must be raised as volunteer troops after the emergency has arisen. Unfortunately for efficiency, the electrical corps of our army is entirely too small for the amount of work it has to do. Army officers are making efforts to improve this condition, and will probably succeed, but as it is not likely that any force such as would be required in time of war will ever be available from the regular army, it follows that the bulk of our electrical work will have to be done by the electrician volunteer. Any arrangement, resulting in the organization of skilled electricians who at a moment's notice may be called on for duty as an auxiliary to the regular army in case of need is an addition to the defensive strength of the country.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY ON LAND.—According to a recent dispatch from Boston, J. S. Stone, lecturer in the electrical department of the Massachusetts Institute of Technology, recently succeeded in sending wireless messages from Cambridge to Lynn, Mass., a distance of about twelve miles, under conditions that have hitherto been deemed impossible.

ELECTRICAL ENGINEERING IN THE NAVY.—According to the *New York Herald*, Secretary Moody is considering the abolishment of the Navy Bureau of Equipment, and the distribution of its present functions among the remaining bureaus. In this event electrical engineering would come under the cognizance of one of the engineering bureaus of the navy.

MOSQUITOES UNDER THE RAY.—It is stated from Newark, N. J., that Dr. Frank Irving, chief of the X-ray department of the Newark City Hospital, has exploded the story to the effect that the X-ray would slaughter mosquitoes and other insects, and as a result of which Dr. Irving has received a number of letters asking for information. The X-ray, the doctor says, has a tendency to make the insects sprightlier and more inclined to bite.

WIRELESS TELEGRAPHY IN THE BRITISH NAVY.—In Montreal a few days ago Signor Marconi stated to a newspaper representative that he had just signed a contract with the British Navy Department for the use of his system of wireless telegraphy on all the ships of the British navy. This contract gives him permission to use all the British coaling stations in all parts of the world for the erection of land stations. Signor Marconi is on his way to Ottawa to confer with the government in reference to the erection of stations in different parts of Canada for a land system of wireless telegraphy from the Atlantic to the Pacific.

HEAVY STORM IN ENGLAND.—An unusually severe storm swept over the English and Irish coasts last week Friday doing an immense amount of damage to telegraph lines. The Western Union and Direct United States Cable Companies, according to a cable dispatch, were heavy sufferers, the land lines connecting London with the two cable terminals being blown down. Communication by these routes was cut off for several hours. The Commercial Cable Company's service, it is stated, was not quite so badly impaired, and at no time, so New York authorities assert, was its business completely suspended.

MILAN TRANSPORTATION EXHIBITION.—To celebrate the inauguration of the Simplon Pass tunnel an exhibition will be held in Milan in 1905 devoted to means of transportation. Of the ten divisions, one will comprise automobilism, another electric transportation and the third telegraphs and telephones. In the second mentioned the exhibits will be under the heads of generating plants, electric lines and equipment of roads, rolling stock, various applications of electric traction, literature relating to plans, designs and statistics. In the division of telegraphs and telephones, line and station material and apparatus will be exhibited, and an exhibition will also be made of the Marconi system of wireless telegraphy.

POWER FROM MISSISSIPPI.—It is announced from St. Louis that a dam across the Mississippi River is projected at the foot of Des Moines Rapids, at Keokuk, to produce 50,000 or 60,000 hp, which can be used for industrial purposes in all the cities and towns in that vicinity, and at the same time furnish deep water navigation for more than forty miles between Keokuk and Burlington. Engineers who have studied the plan regard it as not only feasible, but as promising great advantages to that section of the country. They predict the construction of other dams up and down the river for similar purposes in the future until the entire upper Mississippi is harnessed to electric plants and distributes its power over wires through the States which lie upon its banks.

WESTERN UNION AND PENNSYLVANIA.—It is stated that the Western Union Telegraph Company has a large force of engineers at work along the lines of the Pennsylvania Railroad Company east of Pittsburg marking the boundaries of the Pennsylvania's right-of-way and compiling an estimate of damages which the telegraph company sustained by the cutting down of its poles and wires some months ago by the railroad company. This information is to be the basis of a suit for heavy damages.

ACCIDENTS TO ELECTRICIANS.—Referring to a note which appeared in the issue of August 29, referring to accidents in Omaha to two electricians, the New Omaha Thomson Houston Company writes us that as far as the accident occurring at its plant in which James Corr was injured, the item is correct, but that W. C. Gould, who was also injured, is an employee of the Omaha & Council Bluffs Street Railway Company, and while at work on the bridge between Omaha and Council Bluffs met with the accident noted.

THE NEW NIAGARA TUNNEL.—The shaft of the Toronto & Niagara Power Company, at Niagara Falls, has been sunk by A. C. Douglass to its full depth of about 140 ft., and a start of about 40 ft. made on the temporary tunnel in the direction of the line of the real power tunnel. The time consumed in sinking the shaft was little more than a month, and the work is regarded as a record-breaking feat. At the beginning many weeks were spent by Mr. Douglass in getting the cofferdams securely fixed in the loose rock and shale; but once ready for the start, with the bedrock exposed, the shaft went down with astonishing swiftness.

MARCONI'S TRANSATLANTIC WORK.—In a recent interview, Mr. Marconi stated that transatlantic communication by his system of wireless telegraphy would not be delayed beyond three months. Referring to his work in developing the system, he said that in the beginning he was willing that any scientists should examine his apparatus and should know the principles under which he had been operating, but persons have seen fit to take an unfair advantage of this to the extent of adopting his ideas, and it is now the policy of the company to observe the utmost secrecy about every improvement that has been adopted. His latest inventions, he stated, have not as yet been patented in the United States, and he could, therefore, give no description of them nor permit the public to know much about them until the patents have been obtained.

GATHMANN AIRSHIP.—The inventor of the Gathmann shell, which was tested at Sandy Hook, has invented a mechanical automobile airship. The ordinary electric fan, inverted so that the fan revolves horizontally, is the basis of Gathmann's idea. He has worked out a machine with huge fans, measuring 36 ft. from tip to tip, which revolve at a speed of 260 r.p.m., and, pushing the air from underneath, cause the car to rise from the earth and ascend into the air. Apparently either electricity or gasoline is used. The gasoline engines are planned to weigh 5 pounds per horse-power. As each engine has 500 hp, both, therefore, weigh 5,000 pounds. The inventor has provided that each horse-power shall have a lifting power of 33 pounds. Thus the two engines can carry together 33,000 pounds, or 22,000 pounds more than the actual weight of the ship.

BUILDING LONDON UNDERGROUND.—A cable dispatch from London of September 12 says: "Under the management of a young American named Huntingdon the London Metropolitan Railroad's new electric power station is raising its fine proportions at Neasden in rapid fashion. It is all being done with British workmen, too, whom Mr. Huntingdon says only need proper handling to work as hard as Americans. The bricklayers struck this week because Mr. Huntingdon demanded that they be at the top instead of the bottom of the ladder when the hooter gave the signal to begin work. Mr. Huntingdon offered them one cent per hour less if they preferred to begin at the bottom of the ladder and they accepted it. Men who thought it a good day's work to lay 500 bricks now lay 1,500 and even 2,000 under the stimulus of bonuses and with American labor-saving devices."

MONT BLANC TROLLEY.—M. H. Duportal, the French Inspector General des Ponts et Chaussees, has selected St. Gervais as the starting point for the railway which, it is hoped, in a few years, will reach the summit of Mont Blanc. The project is identified with the name of M. Vallot, the director of the Mont Blanc Observatory, and is for a railway starting from Les Houches. The idea seems to be to get the shortest possible and most sheltered line, enabling the summit to be reached in all seasons; and it is conceded that M. Vallot's survey is the best possible for the purpose. M. Duportal's scheme does not supersede its predecessor, however; rather it will prepare the way for it; and it has the great merit of serving the immediate and practical necessities of the district. The first section of the proposed electric line reaches the Aiguille du Gouter almost direct from Fayet by way of the Bionnassay Valley, which faces full south, and consequently is always free from snow early in the year, at any rate as far as the Tête Rousse. An open-air line by this route is, therefore, feasible; and this is important, as tourists naturally desire to see the perspectives of the mountains, which would be impossible if the line should be tunneled all the way.

AMERICAN ELECTROCHEMICAL SOCIETY.—The final programme of the meeting of the American Electrochemical Society to be held at Niagara September 17-19, comprises sixteen papers, as follows: "Some Theoretical Considerations of Resistance Furnaces," by F. A. Fitzgerald; "Manufacture of Ferro-Alloys in the Electric Furnace," by Geo. P. Scholl; "Advances in Electrometallurgy of Iron Production," by Marcus Ruthenburg; "An Experiment on the Electrolytic Determination of the Basicity of Acids," by I. J. Moltkehausen; "Electrolytic Copper Refining," by W. D. Bancroft, with written discussion by L. Addicks and B. Magnus; "Electrometallurgy of Gold," by W. H. Walker; "Efficiency of the Nickel-Plating Tank," by O. W. Brown; "A New Type of Electrolytic Cell," by P. G. Salom; "Electrolysis of Iodium Hydroxide by Alternating Current," by C. Hambuechen; "A Practical Utilization of the Passive State of Iron," by C. F. Burgess; "Electrolysis of Water," by Jos. W. Richards and W. S. Landis; "On the Supposed Electrolysis of Water Vapor," by F. Austin Lidbury; "Buthelot's Law Relative of E.M.F. of Cells Based on the Reciprocal Action of Saline Solutions and Soluble Electrolytes," by C. J. Reed; "The Thermo-Chemistry of the Dissociation Theory," by Jos. W. Richards; "Theoretical Properties of Free Ions in Solution," by E. F. Roeber; "Discussion of the Theory of Electrolytic Dissociation," opened by W. D. Bancroft. The programme also includes visits to Niagara power houses and electrochemical works, the usual sight-seeing trips and a dance and reception at the Cataract House. The local committee consists of Mr. E. G. Acheson, chairman, and Messrs. Collins, Hall, Acker, Haskell, Rankine, Mauran, Brindley and Lovejoy.

LETTER TO THE EDITORS.

The Nernst Lamp.

To the Editors of Electrical World and Engineer:

SIRS:—Referring to the claim that the introduction of the Nernst lamp in Buckingham Palace effected a saving of 50 per cent. in current over incandescent lamps, it may surprise a great many to know that the real efficiency of this lamp in practical service in this country is no greater than that of the ordinary incandescent lamp, and yet such is the fact. The candle-power value given to the Nernst lamp appears to be that obtained in a restricted zone beneath the lamp and is largely due to the reflected light from the porcelain frame of the lamp. Place an ordinary tin shade over a 16-cp. 50-watt incandescent lamp, and by the same method of measurement we get 50 cp with an efficiency of 1 watt per candle.

All this serves to show that the only true method of comparing different illuminants as to candle-power and efficiency is on a basis of spherical candle-power. When the Nernst lamp is so measured its efficiency in commercial service to-day will be found practically the same as the ordinary incandescent lamp. It is true that the Nernst lamp may be operated at a very high efficiency, and so also may the incandescent lamp, but the penalty of shortened life to the filament in both cases, makes it uncommercial to do so. It is also true that the Nernst glower operates at a higher temperature than an incandescent lamp filament (rendered possible by the more refractory character of the Nernst glower material), but it does not follow therefrom that the efficiency of the Nernst lamp is higher.

A higher temperature does not mean a higher efficiency except where we compare the same kind of filament at different temperatures. Investigation shows that the Nernst lamp glower requires a much higher temperature to give equal efficiency with the carbon filament. The higher temperature, therefore, of the Nernst glower, far from making it of higher efficiency than the carbon filament, is necessary to bring it to the same efficiency, so that the advantage resulting from the greater refractoriness (that is, greater durability under higher temperatures) of the Nernst glower, is in a large measure lost by the fact that it requires to be burned at so much higher temperature in order to give the same efficiency. In contrast, and illustrating this point, we find the newly-discovered osmium filament to be far superior to the carbon filament, because it can be burned at a lower temperature for a given efficiency; and were the Nernst glower with its greater refractoriness possessed of the qualities of the osmium filament, it would be placed well in the lead of all other known filament materials because of the enormously high efficiency that it would have at its present high temperature.

It is possible, of course, that time and improvements may correct the shortcomings of the Nernst glower, but at present we must deal with the facts as they are. These facts are that the high efficiency credited to the Nernst lamp is not realized in commercial practice, and that the claims of the gain in efficiency over the incandescent lamp, as well as the methods of comparison, are misleading.

Harrison, N. J. F. W. Willcox.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Measurement and Separation of the Losses of Asynchronous Polyphase Motors.—Peukert.—An article illustrated by tables and curves, in which the author gives the results of a number of measurements made with several motors, in order to determine whether the method given by Benischke, previously described in the Digest, gave only the frictional losses or a value including hysteresis losses in the rotor. Benischke had always used the same magnetic induction, and the author, therefore, wanted to determine whether the method is correct at different inductions. Instead of a Prony brake he used an electromagnetic or eddy-current brake. The slip of the motors was measured by the stroboscopical method. The author states that the results give an experimental proof of the fact, that in an induction motor at very small loads, the slip varies proportionally to the load, as the slip in such a motor, near to synchronism, is directly proportional to the resistance of the rotor and the power. He finds the friction and air losses are independent of the hysteresis loss in the rotor, and therefore concludes that the method of Benischke is suitable for the purpose. Only one motor of those with which he experimented, gave more work absorbed in friction with higher induction. The author explains this by an eccentricity of the rotor, on account of which an eccentric pull takes place due to the different densities of the lines of force, and he regards this as a simple means to test the centric disposition of the rotor by a determination of the friction losses. The experiments further show that the no-load slip becomes smaller with the increase of potential, the decrease of slip at no load being nearly inversely proportional to the square of the potential. When the friction losses are determined by this method, a further separation of the losses can be effected by subtracting them from the watt values with consideration of the copper losses, and thus obtaining the iron losses.—*Elek. Zeit.*, August 20.

Ohmic Loss in the Brushes of Direct-Current Dynamos.—Latour.—A mathematical article in which the author proposes to show that the ohmic loss in the brushes varies, for the same current strength, with the conditions of commutation in such a sense, that it decreases, becomes zero and becomes negative when the reverse e.m.f. increases, while it grows when the reverse e.m.f. decreases or changes its sign. —*L'Eclairage Elec.*, August 22.

REFERENCES.

Exact Diagram of the Asynchronous Polyphase Motor.—Lehmann.—A mathematical article, illustrated by several large diagrams, which are calculated by the author. Curves of tests are also given, which were obtained with an Oerlikon motor of 360 hp at 6,000 volts and 25 cycles and a triphase 8-pole, 720-hp motor of 6,000 volts and 25 cycles.—*L'Eclairage Elec.*, August 22.

Testing of Electric Machines and Transformers.—Dettmar.—The author gives a number of explanations, designed to clear up points in the standard rules adopted by the German Electrotechnical Society on the valuation and testing of electric machines and transformers.—*Elek. Zeit.*, August 20.

2,000-Kw Transformer.—A popular illustrated description of a 2,000-kw transformer built for the Pittsburg Reduction Company at Niagara Falls.—*Scient. Am.*, September 5.

POWER.

Steam and Electrically-Driven Auxiliaries.—Taite and Downe.—An abstract of a paper read before the Manchester Local Section of the I. E. E. on the comparison between steam and electrically-driven auxiliaries in central stations. The authors point out that the efficiency of a generating station as a whole depends to a very appreciable extent on the efficiency of the auxiliary plant, such as air pumps for condensers, cranes, feed pumps, mechanical stokers, economizers, coal elevators, ash conveyors and workshop. They state that during recent years it has become the practice to use electric motors almost exclusively for driving cranes, stokers, economizers, coal elevators, ash conveyors and the workshops, but that condenser air pumps and also feed-water pumps are still driven to a large extent by steam power. It is, however, becoming recognized that the loss from condensation in long steam pipes compares badly with the small amount of electric power absorbed in the cables. The authors give some interesting figures of the percentage of power absorbed by the electrically-driven auxiliaries in a large new central station. This was 8.3 to 6.5 per cent. of the total power generated, according to the state of the load factor and was distributed as follows: Condensing plant, 4.67 per cent.; boiler feed pumps, 1.18 per cent.; mechanical stokers, 0.37 per cent.; ash conveyor, 0.07 per cent.; economizer scrapers (1,600 pipes), 0.11 per cent.; coal elevators, 0.05 per cent., and workshop, 0.05 per cent. The power taken by the mechanical stokers represented 1.04 units per boiler-hour, while the economizers required 0.33 unit per hour for driving the scrapers for each battery of 400 pipes; the coal elevator absorbed 0.22 unit per ton of coal raised 40 ft. and deposited in the bunkers. The authors give a comparison carried out with steam and electrically-driven pumps, the average of the test for the steam pumps being 49.1 pounds of water delivered per pound of steam. An electrically-driven, 4,000-gallon pump furnished 108 to 147 pounds of water per pound of steam. Where any electrically-driven auxiliary plant is extensively adopted, the authors consider that a battery of accumulators is a practical necessity, as in the event of a total break-down of the generating plant from any cause, the supply of water to the boilers and the lighting of the works would not be interrupted. The authors then deal with the condensing plant and give figures obtained in practical running with single-phase, alternating-current motors driving centrifugal pumps for raising water for a Koerting evaporative condenser.—Lond. *Elec.*, August 21.

Electrical Pumps.—An illustrated note on a recent installation at Sydney, Australia, of a 500-hp engine and dynamo, and a 345-hp motor direct-coupled to a high-lift pump, which is designed to deliver 2,800 gallons of water per minute to a height of 265 ft. The engine is of the double-acting, compound-condensing type; the compound-wound, eight-pole generator gives 500 amp. at 550 volts. The shunt and series windings are wound on aluminum spools. The motor is of similar design, with only four poles. The voltage at the terminals is 500, and the speed is 720 r.p.m.—Lond. *Elec. Rev.*, August 21.

REFERENCES.

Electric Rock Drills.—MUNBY.—The author discusses the advantages of the electric drill as compared with the air drills, in doing the work cheaper, requiring less horse-power, occupying less floor space, having less weight, etc. The construction of the electrical drills is then briefly taken up, and the difficulties pointed out which are still experienced with them.—*Stevens Inst. Indicator*, July; reprinted in *Eng'ing News*, September 3.

Electric Power Appliances in the Mines of Europe.—GUARINI.—A well-illustrated article. The author describes a number of installations in mines, dealing with pumping and ventilating machinery, the driving of drills and drilling machines, the electric firing of shots, locomotives and tramming, hauling and hoisting machinery and the applications of electricity to the treatment of the ore after extraction in stamp mills, crushers, screens, etc.—*Eng'ing Mag.*, September.

Electricity in Mines.—CAMPBELL FUTERS.—The first part of an article, reviewing in a general way the conditions which have to be conformed to by electrical installations in mines.—Lond. *Elec. Rev.*, August 21.

Motor Driven Machine Tools.—An illustrated article, describing some recent practice in the application of the electric drive to drilling machinery.—*Am. Eng. & Railroad Jour.*, September.

TRACTION.

Electric Railroads.—BORK.—An abstract of a paper read before the Verein fuer Eisenbahnkunde, Berlin. The author gives the results obtained on the experimental road Berlin-Lichterfelde, repeatedly noted in the Digest. The consumption was on an average 22 watt hours per ton kilometer in summer and 23.3 in winter. For 1 kilometer of feeder and return conductor the resistance was in the beginning 0.0449 ohms, which was afterwards brought down to 0.04 ohms. The smallest observed insulation resistance for 1 kilometer single track was 16,000 ohms, the average being 500,000 ohms; the insulation loss with 25 kilometer length and 700 volts pressure was therefore 0.035 amperes or 22.5 watts. The conductors, storage batteries and the electric train equipment has been satisfactory. The current collectors have come up to expectations. The construction of the motor cars has been satisfactory. The motors, which are directly on the axles, produced only an insignificant wear and tear of the wheel tires. There was less jarring in running and starting than with steam locomotives. Electric heating proved to be too costly; electric braking had to be abandoned also, as being no more effective and more expensive than air-braking. The electric lighting showed considerable variation in intensity when the train started and gas lighting has replaced it. The cost of running was found to be for 1,000 effective train kilometers $266.45, while for steam traction under the same circumstances it was $266.35. Steam is therefore only a trifle cheaper. As advantages of electric traction are cited the better and easier adaptability to the conditions of traffic, the doing-away with smoke and soot, the considerable increase of the adhesive weight, the greater acceleration in starting and the lesser wear and tear of the permanent way.—*Glaser's Annalen.*, No. 622; abstracted in *Dingler's Polyt. Jour.*, August 22.

Power Stations for Large City Roads.—An article giving a brief summary of the practice in power station construction, although not limited to those of recent construction. Three tables show, first, the total capacity of power stations supplying city lines, the total capacity per mile of track, the total capacity per car operated at times of greatest traffic, and the kilowatt-hours per car-mile for the last year. The second table gives statistics relating to the recent generating stations erected by the different companies. The third table gives particulars of some of the largest engines in use. Although direct current is used for the greater part of the power employed in these cities, alternating-current distribution is employed to a limited extent, and most of the companies are now introducing alternating-current distribution. Diagrams show plans of the stations. In the new stations, special precautions are being taken to procure the separation of boilers, generators and engines into groups, so that accidents to one group will not affect the others, both in the steam and the electrical portion of the equipment. The generators are usually of 5,000-kw or larger. Electrically operating steam valves are being introduced. Ample facilities are being supplied for storing coal and handling it rapidly. The stations are designed so that extensions can be made very easily.—*St. R'y Jour.*, August 29.

Standard Overhead Construction in City Streets.—An illustrated article, giving particulars of the practice of fourteen prominent city railway companies in overhead construction, from which it appears that there are many points of difference. Centre pole construction has become practically obsolete for city work; the objections to its use are enumerated in detail. There has been an increase in the weight and strength of the poles and also in the insulation between the trolley wire and the pole. In some cities three insulators are used between a trolley wire and the steel pole. In Milwaukee, however, the insulation at the trolley hanger has been done away with and the company uses only two strain insulators in the span wire. This construction makes the span wire alive, but this has not much practical importance. Practice is fairly well divided between two-section steel poles and three-section steel poles. Aluminum for feeders is not used to any extent. Figure 8 trolley wire has not met with much favor, but some companies are using it with satisfaction. St. Louis uses wood entirely for trolley wire insulators.—*St. R'y. Jour.*, August 20.

The Third Rail System.—GOULD.—An article reviewing the advantages of the third rail system for the construction and operation of interurban railroads. The author states that a third rail distribution system having an equivalent copper cross sectional area about 10 per cent. greater than with trolley can be built for the same cost per mile, the estimate including the crossing cables and connectors. He then discussed the type of third rail and says that the standard T rail has many advantages over all the rest. The third rail should be built of as highly conductive material as is permissible, of soft steel rails containing a very low percentage of carbon, the conductivity of which to copper is as about 1 to 7.5, while it is as 1 to 12 with higher carbon track steel. The question of third rail insulators is then taken up and a type of insulator mentioned which the author has found satisfactory. Third rails, cables and contact shoes are also discussed.—*St. R'y. Jour.*, August 20.

Electric Trolley Omnibuses.—An illustrated note on recent German designs and equipments of electric trolley omnibuses. The line Kœnigswald-Dresden is described, which has a double trolley wire, 30 cm. apart, one of them acting as positive and the other as negative conductor. The current collector, which is of a peculiar construction for preventing the trolley carriage from coming off the wire, is illustrated. It has four wheels, two of which rest on the positive and two on the negative wire. Omnibus and trolley carriage are electrically-connected by a flexible two-core cable, which is fastened to the pole on the car by means of a plug arrangement, which when two cars pass each other are simply exchanged, thus avoiding the necessity of having passing places. The length of the cable may be varied to suit requirements when passing other vehicles. The cars, of 2,850 kg. weight, are driven by two series motors of 15 B.hp maximum output, the consumption of energy, when the roads were dry and hard, being given as varying from 130 to 220 watt-hours per ton-mile, the former figure relating to level roads and the latter to gradients of 1 : 25. The cost of the overhead construction per mile is given as $2,000 to $2,800, and the cost of upkeep of the omnibuses at about 1 cent per mile. A short description of the Biela line is also given.—Lond. *Elec.*, August 21.

London United Electric Tramways.—A long, illustrated, descriptive article, dealing in detail with the Chiswick power station. This station contains two vertical cross-compound engines, each coupled to two 250-kw traction generators, one on each side of the fly-wheel. The generators are eight-pole machines, giving 500 amp. at 500 to 550 volts. There is also a 500-kw, three-phase alternator driven by an engine of the same size as above, giving 98 amp. per phase, at 5,000 volts, 25 cycles, and two 100-kw, 5,000-volt, three-phase alternators, coupled to two cross-compound vertical engines. The auxiliary plant comprises one 500-kw rotary converter, supplied with three-phase current by six 100-kw static transformers, and two negative boosters, 15 kw, giving 300 amp. at 50 volts on the generator side and driven by direct-coupled 500-volt motors. The generator field is excited by the current passing through the positive feeder of the district to which the negative cable of the booster is connected. The switchboard connections are illustrated. From the power station three-phase current at 5,000 volts is supplied to the sub-stations over three-core, lead-covered, paper-insulated cables laid in stoneware conduits. The equipment of the sub-stations is briefly described. A diagram of the car controller connections and the car wiring is given.—Lond. *Elec. Eng.*, August 21.

Fonda, Johnstown & Gloversville Railway.—An illustrated description. The equipment of the new power station at Tribes Hill on the Mohawk River, one of the largest and most up-to-date interurban stations in this part of the country, consists of three engines, of the vertical cross-compound condensing type, developing 1,700 hp at 94 r.p.m. The generating station contains three main units of 1,000 kw each. Three sub-stations are located about ten miles apart. The high-tension line voltage chosen is 13,220 volts. One of the special features of the transmission system is the line between the generating station and the Amsterdam sub-station, which is in operation all day for railway and all night for lighting service. On this account the use of four transmission wires for a three-phase circuit was adopted, one of the four being a spare line with suitable knife switches at each end, for insuring continuous service.—*St. R'y Jour.*, August 29.

REFERENCES.

Modern Electric Railway Repair Shop Methods.—McCulloch.—The author discusses in detail the results secured in the repair shops of the Chicago City Railway. A statement is given of the machine tools used in these car houses, and the number of men employed with their duties. A table shows the classification of the operating expense accounts used in charging up shop time; another shows the division of the pay roll for the year 1902, according to occupation. It is interesting to note that the machine shop, car repairing and painting departments are about equal and are the largest items, being each more than 15 per cent. of the total. Other tables give the labor accounts for the shop and car houses, an itemization of the repair accounts, and the cost of performing some of the usual operations in the repair shop. He then gives some conclusions deduced from the practice followed in Chicago. He dwells on the importance of the standardization of apparatus. He believes it advisable only for the largest companies to attempt to manufacture apparatus for their own use. He then sums up what he considers the eleven important requirements in repair shop practice.—*St. R'y Jour.*, August 29.

Intramural Railway for the St. Louis Exposition.—Weston.—An article containing a discussion of the original design of this railway, with a detailed statement of the proposed equipment and cost.—*St. R'y Rev.*, August 20.

Electric Railways in Europe.—A note reviewing the situation in Switzerland, Sweden and especially Germany. Special attention is drawn to several projects for the application of the Langen system of suspended electric railways, repeatedly noted in the Digest.—Lond. *Elec. Rev.*, August 14.

Automatic Coupling for Electric Railways.—An illustrated article, describing a new coupling designed by Mr. Westinghouse.—Lond. *Elec.*, August 21.

Standard Tramway Rules.—An article giving the most important provisions for "British Standard Tramway Rails and Fishplates," just issued by the Engineering Standards Committee.—Lond. *Elec.*, August 21.

Closing of Railroad Compartment Doors by Electricity.—Vitoux.—An illustrated article, containing a description of the Gime system of simultaneously closing all compartment doors on a train by electricity to prevent accidents.—*L'Eclairage Elec.*, August 15.

Wires, Wiring and Conduits.

Aluminum Conductors for Electric Transmission Lines.—Adams.—A popular article, in which the author compares aluminum with copper as regards its mechanical qualities, and discusses the conditions under which it can replace copper for transmission lines. Attention is drawn to the fact that on account of the larger diameter of the aluminum wires for a given current, the inductance is less than with copper wires. The loss of energy is, therefore, decreased, and the radius of transmission for large powers extended.—*Eng'ing Mag.*, September.

REFERENCES.

Locating Faults in Cables.—Northrup.—An article describing two methods for locating faults in cables: the first is for the case that at least one good wire is available and the second when two good wires can be had.—*Elec. Rev.*, August 29.

Tests on Broken Cables.—Raymond-Barker.—An article in the first part of which the authors point out various inconsistencies in the localization formulas given by several text-books. In the second part he gives a synopsis of localization formulas with uniform nomenclature, exemplified by the calculation of several problems.—Lond. *Elec. Rev.*, August 14 and 21.

Electro-Physics and Magnetism.

Production of Helium from Radium.—Ramsay and Soddy.—A paper presented before the Royal Society, England. The authors conveyed the maximum amount of the emanation obtained from 50 mgms. of radium bromide by means of oxygen into a U tube cooled in liquid air, and the latter was then extracted by the pump. It was then washed out with a little fresh oxygen, which was again pumped off. The vacuum tube sealed on to the U tube, after removing the liquid air, showed no trace of helium. After standing for four days the helium spectrum appeared and the characteristic lines were observed identical in position with those of a helium tube thrown into the field of vision at the same time.—Reprinted in *Scien. Am. Suppl.*, September 5.

Method of Showing Penetrating Powers of Radium Rays.—Black.—An article in which the author describes a simple method for showing the great penetrating powers of certain radium rays. His arrangement consisted of two large Leyden jars, which had their interior coatings joined to the two sides of a Wimshurst machine, while their exterior coatings were joined to two small exactly similar spark-gaps arranged in parallel, to form alternative paths for the secondary discharge when the primary discharge took place on the machine. The secondary discharge will then pass at the gap which is exposed to the radioactive substance. The author has shown by this arrangement that 1 cgm. of radium bromide sends some rays through 8.5 cm. of lead. The presence of 1 cgm. of radium bromide even at a distance of 2 meters, may be detected definitely. To obtain these results the terminals at the spark-gaps ought to be small spheres about 1 or 2 cm. diameter, the gaps should be small and carefully shielded from all discharge of the machine. Thick lead shields, about 25 cm. thick, should be arranged to hinder any action of the radium on the gap which is not exposed to the radiation, and the Leyden jars should be of considerable capacity. He gives a table containing the results of some experiments, and shows that the radioactivity, induced by radium, produces some penetrating rays. After the radium bromide had been in an ebonite box for 18 hours, when the empty box was put on a sheet of zinc 0.5 mm. thick, which was placed over one of the gaps, the sparks passed readily through that gap.—Lond. *Elec.*, August 21.

Ionization in Air at Different Temperatures and Pressures.—Patterson.—The author gives the results of his investigations with description and diagrammatic sketch of the apparatus used by him. The results show that the ionization varied but slightly with the temperature (pressure constant) up to 450° C., but above this it increased very rapidly, due to ions being given off by the walls of the vessel, and the current being much greater when the cylinder was charged negative than when positive. The observations were carried up to a temperature of 520° C. The author also measured the ionization of the air at pressures varying from 765 to 27 mm. of mercury, and of hydrogen varying from 116 to 790 mm. of mercury. The results indicate that the current varies very slowly with the pressure down to 130 mm., and below 80 mm. the current is proportional to the pressure, while above 300 mm. the current is almost independent of the pressure. In hydrogen the current varies rapidly with the pressure, but not proportionally. The author attributes this partly to the hydrogen not being pure, and as the vessel was not quite air-tight there would be a greater proportion of air at the lower pressures than at the higher. The average of a large number of observations gave to the author 61 as the number of ions produced per c. cm. per second in the iron cylinder, which he used for the experiments, 3.4 × 10 to the $^{-10th}$ power E. S. units as the charge on one ion, the volume of the cylinder being 12,800 c. cm. Wilson found 36, Rutherford 27 and Harms 53 to 63, the difference being most probably due to the different materials used by these investigators.—*Phil. Mag.*, August.

Rotation of Liquids in the Magnetic Field.—Drude.—The author made some further experiments on the rotation of liquids in a magnetic field, in connection with the results obtained by Urbasch, previously noted in the Digest. He carefully poured a layer of water on sulphuric acid contained in a glass vessel, and on bringing the north pole of an electromagnet with a strong magnetic field about ½ cm over the liquid, he obtained a rotation of the latter. At the wall of the vessel the liquid rotated counter clockwise, but when the vessel was heated around the rim the sense of rotation became reversed. He attributes the result to thermoelectric currents between the dilute and the concentrated liquids, when the temperature of the diffusion layer is not constant, which currents produce the rotation in the magnetic field. He concludes that a mixture of diffusing liquids will only in that case rotate in a magnetic field, when the phenomenon of diffusion is accompanied by an electric current, due to thermal differences or other reasons.—*Zeit. f. Electrochem.*, August 13.

Theory of the Coherer.—Hurn.—An article containing a description of the author's experiments on the action of coherers composed of nickel filings subjected to the influence of a direct current. The filings were kept in constant motion by tapping the coherer. The dielectric was air and paraffin oil. The coherers showed in both cases the phenomenon of fatigue, which proves that this phenomenon also takes place with direct current, which has been denied by others. The paraffin oil coherer showed an automatic regeneration after 12 hours' rest. The author explains the function of the dielectric in the coherer effect, as follows: The electric waves, or the constant differences of potential acting at the coherer electrodes, the magnitude of which is increased gradually, produce an ionization of the dielectric and, therefore, its higher conductivity. The forces necessary for this are relatively small, owing to the smallness of the insulating layers. After the dielectric strength of the intervening medium is destroyed, an equalization of the potentials at the coherer electrodes takes place, which is accompanied, in consequence of the comparatively large resistance to be overcome thereby, by mechanical and thermal effects, and which breaks through the oxidized layer and welds the particles to each other. This explanation accounts for the phenomena without assuming the existence of sparks, as has been done by others.—*Phys. Zeit.*, August 15.

Properties of Periodic Currents of any Wave Form.—Swyngedauw.—A highly mathematical article in which the author extends the properties of sinusoidal energy currents and wattless currents to periodic currents of any wave form. He deduces that the law of Kirchhoff applies at every instant to the energy currents as well as to the wattless currents, which arrive at or depart from the two points of intersection between which there are several circuits. He then takes up Boucherot's theorem for sine currents, viz.: "In a network of alternating-current circuits, comprising neither collectors, turning commutators or resistances varying during the period, the sum of the magnetizing powers is zero, as well as the sum of the real powers." The author arrives at the conclusion that it is possible to apply the general propositions obtained for sine currents to the energy currents and the wattless currents of any wave form.—*L'Eclairage Elec.*, August 15.

Assymmetry of the Mercury Break.—Ives.—An article describing experiments which show that the capacity of the shunted condenser necessary to stop the sparking at the break of an inductive circuit, depends upon the direction in which the current is flowing through the break. The least amount of capacity which must be inserted in shunt around the break to reduce the spark from a large to a small one, was shown to be much greater when the breaking pole was connected to the negative side of the battery than when connected to the positive side. In the author's experiments the break was produced by an amalgamated copper wire 1 mm. in diameter, dipped by hand in and out of a small test tube containing mercury covered with water. The phenomenon also appeared when the mercury was not covered with water, and then the wire was of iron or platinum. Curves plotted from the observations are given. The author thinks that this remarkable assymmetry may be due to some selective action of the mercury vapor generated when the spark passes, of the same nature as in the recently-discovered Cooper Hewitt effect, or it may possibly be due to some capacity effect, such as is found in the Wehnelt interrupter.—*Phys. Rev.*, September.

REFERENCE.

Specific Resistance of Non-Metallic Conductors of the First Class.—Ferchland.—The author gives the results of an investigation of the specific electrical resistance of non-metallic conductors of the first class and especially peroxide of lead. He obtained the peroxide by electrolysis and subjected it to compression. The decrease of resistance with increasing pressure was measured. The results obtained are given.—*Zeit. f. Elektrochem.*, August 13.

Electro-Chemistry and Batteries.

Electrolysis with Alternating Currents.—Le Blanc.—A paper read before the recent International Congress of Chemistry at Berlin. The author first discusses the electrolysis of a sodium hyposulphite solution between cadmium electrodes, for the purpose of making sulphide of cadmium. He found that with 1,000 reversals per minute and a current density of 4.6 amp. per sq. dm. nearly no yield is obtained. With a lesser number of changes the yield increases, but it reaches only about 75 per cent. with one reversal per minute, and this only when the solution is stirred very briskly. He deduces from these observations that the sulphide of cadmium is reduced cathodically, and that at a low number of reversals the yield is only reached by removing the sulphide from the cathode by stirring. The author then carried out experiments with copper electrodes in potassium cyanide solutions, in order to arrive at some idea of reaction velocities, based upon the idea that if at a certain number of current reversals the copper electrodes in potassium cyanide solution were dissolved according to Faraday's law, that the time during one current impulse was sufficient for the accomplishment of the reaction of combination of copper with cyanogen; if, on the other hand, no copper was dissolved, the time was not sufficient for the reaction to take place. He found that with a 4 normal potassium cyanide solution and 4.6 amp. per sq. dm. current density, 90 per cent. of the copper went into solutioin at 3,400 reversals of the current, 58 per cent. at 17,600 reversals, and 33 per cent. at 38,600 reversals. He concludes, therefore, that the velocity with which the copper ions react is very great, but still conceivable; and he finds by extrapolation that with 80,000 reversals per minute no copper would go into solution. The velocity of reaction does not seem to be influenced to any extent by the temperature, as was shown by an experiment at 0° C.—*Zeit. f. Elektrochem.*, August 6.

Silicide of Ruthenium.—Moissan and Manchot.—A paper read before the French Academy of Sciences, describing the authors' method of preparation in the electric furnace of a new compound, silicide of ruthenium. It is obtained by acting with a current of 600 amp. at 120 volts for about two or three minutes on a mixture of powdered ruthenium and crystalline silicon, put into a carbon boat inside of a tube of the same substance. A well-fused metallic regulus is obtained, which when treated with various solvents, gives a residue of brilliant white crystals. The yield is about 80 per cent. of the ruthenium used.—*Comptes Rendues*, Tome 137, p. 229; abstracted in *L'Eclairage Elec.*, August 22.

Double-Carbide of Chromium and Tungsten.—Moissan and Kouznetzow.—The authors have obtained this new double carbide by heating in the electric furnace, in a carbon crucible, a mixture of 100 grams sesquioxide of chromium, 45 grams of tungstic acid and 30 grams petroleum coke or sugar carbon. The current must not be of too great intensity, 400 amp. at 75 volts for five minutes being sufficient. Another method of obtaining the double carbide consists in fusing in the electric furnace a mixture of metallic chromium, tungsten and a small quantity of sugar carbon in the presence of a large excess of copper, always avoiding as much as possible the carbon vapor of the arc. The mass is melted rapidly in a carbon crucible and the copper is maintained in ebullition for one to two minutes. After pulverizing and treating the regulus thus obtained with various solvents, small crystalline clusters of the double carbide are obtained.—*L'Eclairage Elec.*, August 22.

Leeds Copper Works.—A short description of the works and its installations for carrying out the Elmore electrolytic process for the manufacture of copper tubes. The plant is capable of turning out 75 tons per week. The depositing department contains 216 acid sulphate depositing tanks, in 24 lines of nine tanks, placed end to end. The copper used for depositing is 96 per cent. pure, and is treated for the removal of the arsenic and other impurities in three twelveton refining furnaces, from which it is cast into trough-shaped molds 13 ft. long, which form the anodes for the electrolytic bath. The mandrels, around which the copper is deposited, are turned by electric motors, and up to 4 in. diameter are made of brass, and above that of cast iron with brass ends. Before being used in the depositing tanks where the tubes are made, the mandrels are treated in the alkaline electrolytic bath containing copper anodes, so that they become coated with a thin layer of copper. The tubes are formed in the acid sulphate solution, lead conductors bringing the current to the copper anodes, while the mandrel cathodes are connected to the negative terminal by copper conductors and flexible brushes. The tubes are withdrawn by revolving them between friction rollers after which the mandrel is withdrawn. Tubes up to 4 ft. diameter and 13 ft. length can be produced in this way. There are four pairs of 250-hp, cross-compound condensing Corliss engines for driving the depositing dynamos, each pair driving a 1,700-kw, direct-current dynamo. For power purposes there are three pairs of 400-hp engines of a similar nature, each pair driving a 425-hp dynamo.—Lond. *Eng'ing*, August 14.

Voltametric Balance.—Pfanhauser.—Descriptions of some improvements in his voltametric balance, which is intended for use in electroplating baths, and serves to control the amount of deposit obtained on the articles to be plated.—*Zeit. f. Elektrochem.*, August 13.

Manufacture of Electric Accumulators.—A reprint of the regulations issued by the British Home Office, applying to all factories where electric accumulators are manufactured, prescribing the sanitary conditions to which employer and employees have to conform. The regulations will come in force October 1, 1903.—Lond. *Elec.*, August 21.

Units, Measurements and Instruments.

Direct-Registering Ohmmeter.—Sack.—An article giving an illustrated description of an instrument for practical use in which the resistance values can be read off directly. The apparatus consists essentially of a milliamperemeter with a moving coil, connected in series with several storage cells and the unknown resistance to be measured. The apparatus has a scale with approximately even divisions, and the pointer is adjusted so that it rests at the high end of the scale when the instrument is not in use. When no resistance is in the circuit, only the battery and instrument being included, the pointer should be at zero, thus showing its maximum deflection. As resistance is inserted the deflection becomes smaller and, therefore, the reading from the zero point becomes greater. Suitable provision is made to prevent a too strong recoil of the pointer and a possible damage to the instrument, by connecting a resistance in shunt, which is inserted automatically, when the contact key which is pressed down for the purpose of taking readings, is released. An arrangement is also included which permits changing the magnetic field of the instrument 15 per cent., thus adapting it to the varying voltages of the storage battery. Before using the instrument, it is tested with the battery and the instrument only in the circuit, in which case the pointer should be deflected to the zero point; if it does not do so, the magnetic shunt is varied by turning a screw head, until this position is obtained. Contacts are arranged for using the instrument for several ranges of measurements.—*Elek. Zeit.*, August 20.

Miscellaneous.

references.

Annual Meeting of the German Electrotechnical Society.—A long report, with details of the reports of the various committees and the discussions of the papers read before the meeting. The following rules and regulations are given in full: namely, on the construction and maintenance of wooden poles for high-voltage installations; on the construction and testing of installation material, such as box cut-outs, plug contacts, plug fuses, lamp holders with and without switch; on the testing of iron sheets; on the valuation and testing of electric machines and transformers, comprising the output rise of temperature, insulation, overload, efficiency and methods of determining it, and tabulated values for the frequency, number of revolutions and potential; on standard values for copper; on standards for wires and cables of various construction for high and low pressures; on the protection of metallic pipe lines against the earth currents of electric railroads.—*Elek. Zeit.*, August 13 and 20.

Necessary Practical Safeguards Against Fires Caused by Lightning.—Hands.—An abstract of a paper read before the recent International Fire Prevention Congress in London. The author reviews the phenomenon of lightning and gives his views on the question of earthing the conductor. He draws attention to the fact that a side flash or spark will occur between the conductor which is struck and other metals sufficiently near it; the latter should, therefore, be at a safe distance or connections should be made to them. He then discusses the cases of failures of conductors. The conditions under which a maximum of safety can be obtained are discussed in conclusion.—Lond. *Elec. Rev.*, August 21.

Treatment of Malignant Diseases by Electrical Methods.—Jones.—A paper read before the British Medical Association, with discussion. It is devoted to the use of the X-rays for cancerous diseases and the proper way of procedure.—Lond. *Elec.*, August 21.

Electro-Magnetic Gun.—An illustrated description of a gun composed of a series of short coils in which the current is interrupted successively as the forward pole of the iron projectile has passed the coils.—*Elektroteknisk Tidsskrift;* abstracted in *L'Eclairage Elec.*, August 15.

Continental Electrical Engineering Industry.—An article discussing in a general way the financial situation of the principal German, Swiss and Russian enterprises, based upon their published annual reports.—Lond. *Elec. Rev.*, August 21.

New Books.

Die Telegraphie Ohne Draht. By Augusto Righi and Bernhard Dessau. Braunschweig: Friedrich Vieweg & Son. 478 pages, 258 illustrations. Price, 13 marks.

This volume forms one of the most complete treatises on wireless telegraphy that has appeared. It is divided into four parts. The first part or chapter deals only with the general laws of electricity, and while apropos, of course, to the subject of wireless telegraphy, it is no more attractive than similar matter which may be found in hundreds of treatises on electricity. The second part is devoted to the earlier experiments in wireless signalling, particularly those of Hertz, whose researches it fully details. The latter portion of the second part is devoted particularly to radioconductors or conductors which are employed to emit energy in the form of Hertzian waves, and is a valuable collection of existing knowledge upon this subject.

The third part comprises matter bearing particularly upon wireless signalling. It details the various experiments which have been made with inductive systems such as that invented by Sir Wm. Preece, and with various attempts to telephone from moving trains. Then the various systems now specifically known as wireless telegraph methods are taken up and fully and completely illustrated. The volume is particularly valuable in containing detailed drawings of all of the circuits which have been employed, together with the designs used for the various coherers, induction coils and decohering apparatus.

The last chapter deals with such miscellaneous systems of signalling without wires as are comprised in the various photophonic experiments which are perhaps somewhat more interesting than practicable. The work is entirely descriptive in character and non-mathematical, but, as both a historical and descriptive account of the art of wireless signalling it is very complete.

Das Elektrische Light und die Elektrische Heizung. By Dr. Alfred Ritter v. Urbanitzky. Leipzig: A. Hartleben. 226 pages, 103 illustrations. Price, 4 marks.

This little pamphlet is a somewhat popular exposition of electric lighting and heating. It commences with a general description of the electric arc and the elementary principles of arc lighting. The effect of the magnet upon the arc is shown and data are given as to the temperatures of the carbons. A historical description of incandescent lighting follows which is chiefly interesting in presenting the various mechanical details of glow lamps. In order to be up to the times Mr. Cooper Hewitt's mercury arc experiments are briefly described. Next follows a chapter upon arc lamp mechanism that is somewhat trite in presenting for the reader's consideration the old Duboscq regulator and other antiquated types. In order to justify its title the last very short chapter gives a brief resumé of electric heating. The work is non-mathematic in character and popular in style.

Kurzes Lehrnbuch der Electrotechnik. By Adolf Thomalen. Berlin: Julius Springer. 515 pages, 277 illustrations. Price, 12 marks.

A condensed manual of electrotechnics would be almost a literal translation of the title of this volume and expresses its purpose perhaps better than a more elaborate description. It is not a pocket compendium of rules and tables like those of Foster, Monro and Jameson, nor is it a general treatise on the laws of electricity, but it is something midway between the two that has no analogy in English literature. There are 19 parts or chapters, each of which is devoted to a particular branch of electrotechnics and is intended to be a working digest giving both the principles and data most frequently desired in relation to each of the topics. The first chapter touches only elementary principles, the second deals with the storage battery and the third with elements of magnetism. It is only when chapter IV is reached that the volume becomes interesting to any one but an elementary student of electricity, and excepting for the sake of completeness, the first three chapters might well have been omitted. In the succeeding ones, however, the book amply redeems itself, for in the following parts, describing the various forms of dynamo machines and in elucidating the principles which govern their operation and their design the book rises to a high level.

The author makes an exceedingly extensive use of vector diagrams, and his explanations are some of the most lucid that we have ever met with. The pages on polyphase systems will be a material aid to many students who have been perplexed at the voltage and current rules, which are here explained in the most satisfactory manner by the aid of diagrams which are novel in their arrangement. The latter part of the work is devoted to alternating-current motors and then closes with some pages upon vectorial algebra and an exceedingly complete table, embracing a very wide range of electrical equations. To the working electrician the volume will probably prove so valuable an aid that many American engineers will regret that it only appears in German.

Descriptive Geometry. With Numerous Problems and Practical Applications, and a Quarto Atlas of 18 Plates. By William S. Hall, C.E., E.M., M.S. New York: D. Van Nostrand Company. 76 pages and portfolio of 18 plates. Price, $3.50.

This is a well-arranged work on the subject and contains much instructive matter. The author quotes Auguste Comte to show that descriptive geometry is valuable, both for mental discipline and for its industrial utility. Perhaps the same may be said of some other branches of mathematics, but not in the same degree. For example, it is safe to say that most persons do not know that the form of the ordinary locomotive cow-catcher is a hyperbolic paraboloid, but that such is the case becomes apparent as soon as the method of construction is studied. A further study of the book shows that several other surfaces and curves of complex nature are used in the arts, some by design and some as accidental results.

A machinist of the more intelligent class knows that in turning a taper by the usual method he must keep the point of his tool on a level with the point of the lathe center—that is, the axis of the work—or the taper will be hollow instead of straight, but he does not know, unless he happens to be a mathematician, that when the tool is "off the center" he is turning a hyperboloid of revolution of one nappe. Descriptive geometry would tell him this; the information, however, would be of no importance to the ordinary workman, but the man who has work to lay out ought to know it. Descriptive geometry is a study of importance to all who aim at acquiring a technical education, and deserving of more attention than it receives in some courses. The work before us is a good exposition of the subject, considering the limitations of one small volume. It is not, of course, a complete treatise, but it gives a good deal of information on a wide range of subjects.

The Chemical Publishing Company, of Easton, Pa., will print English translations of the series of monographs on applied electrochemistry, written by authorities on the electrochemical industry, and edited by Victor Engelhardt, chief engineer of the Siemens-Halske Company, Vienna. So far the following volumes have been issued in the German language: "The Electrolysis of Water," by Victor Engelhardt; "The Electro-Metallurgy of Chromium," by Max Le Blanc; "The Arrangement of Electrochemical Laboratories," by H. Nissenson; "The Manufacture of Metallic Objects Electrolytically," by Dr. W. Pfanhauser; "The Electro-Metallurgy of Nickel," by Dr. W. Borchers. The translations will be made by Prof. J. W. Richards, of Lehigh University, president of the American Electrochemical Society.

Power Equipment of Portland Mill in Colorado Springs.

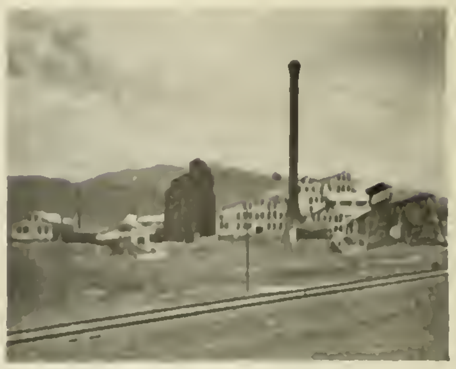


FIG. 1.—CHLORINATION MILL.

Large users of electric power in Colorado are the mills or plants for the reduction of the gold ore mined in the Cripple Creek and other mining districts of the State. There are three such mills in the immediate vicinity of Colorado Springs and the installation in the Portland chlorination mill may be taken as typical for a plant of that character. The mill is located on Bear Creek, about one mile west of Colorado Springs. It is owned by the Portland Gold Mining Company and is used for the reduction of the low-grade gold ore coming from the famous Portland mine at Victor, 45 miles distant. The ore is hauled to the mill over the line of the Colorado Springs & Cripple Creek District Railway, whose track is seen in the accompanying general view of the works.

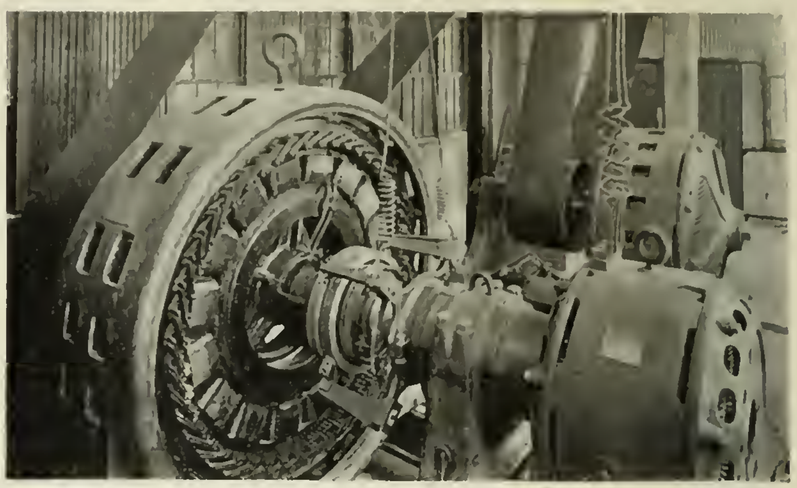


FIG. 2.—SYNCHRONOUS AND INDUCTION MOTORS.

The present capacity of the mill is three 100-ton Pierce roasters, but another 100-ton roaster is about to be added. All the machinery in the mill is run by electric power, purchased from the Colorado Springs Light & Power Company. A six-mile transmission line carries the power from that company's steam power plant north of Colorado Springs, to a substantial brick sub-station building at the mill. Here the 6,200-volt, 60-cycle, three-phase current passes through oil-break switches to the high-potential switchboard. General Electric lightning arresters are used to protect the line. Four 250-kw General Electric oil-cooled transformers (one being held in reserve) step the potential down to 460 volts for the power work in the mill. Both primary and secondary circuits are delta-connected.

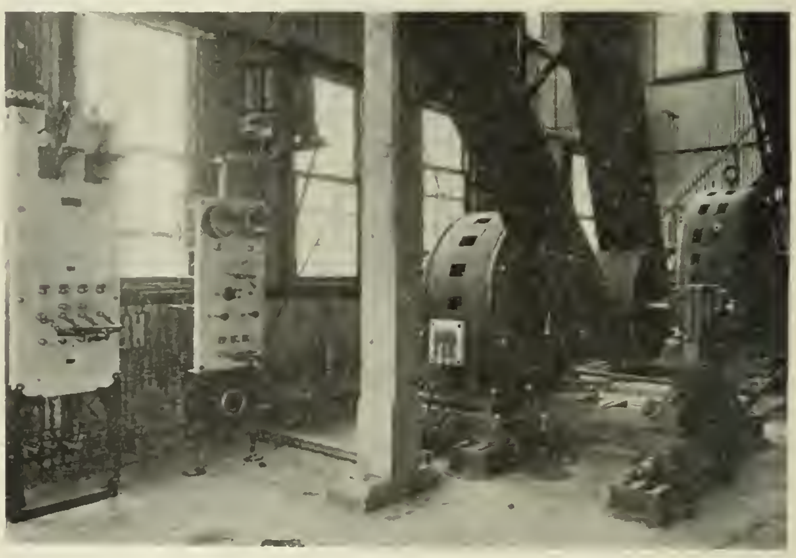


FIG. 3.—SYNCHRONOUS AND INDUCTION MOTORS.

The three power panels of the low-potential gray marble switchboard each control two power circuits. On the center panel are an indicating wattmeter and an indicating voltmeter, while on each of the two outside panels is a recording wattmeter for registering the power of the main three-phase power circuit before it is distributed to the individual feeders.

There is a total motor installation of over 1,500 hp. With the exception of two revolving field synchronous motors and two variable-speed motors all the motors are three-phase induction type, and were all supplied by the Westinghouse Electric & Manufacturing Company. The motors operate on 440 volts at 7,200 alternations. In one of the accompanying illustrations are shown a 300-hp synchronous motor, the largest in the mill, and a 75-hp induction motor. The synchronous motor has mounted on its extended shaft a 25-hp induction starting motor. It is used to drive the rolls by means of a belted shaft, while the 75-hp machine drives in a similar manner the three 100-ton roasters. The other synchronous motor is of 200-hp capacity and is used to drive the chlorination barrels. For exciting the fields of the synchronous motors, two 115-volt direct-current generators driven by 15-hp induction motors are located in the sub-station.

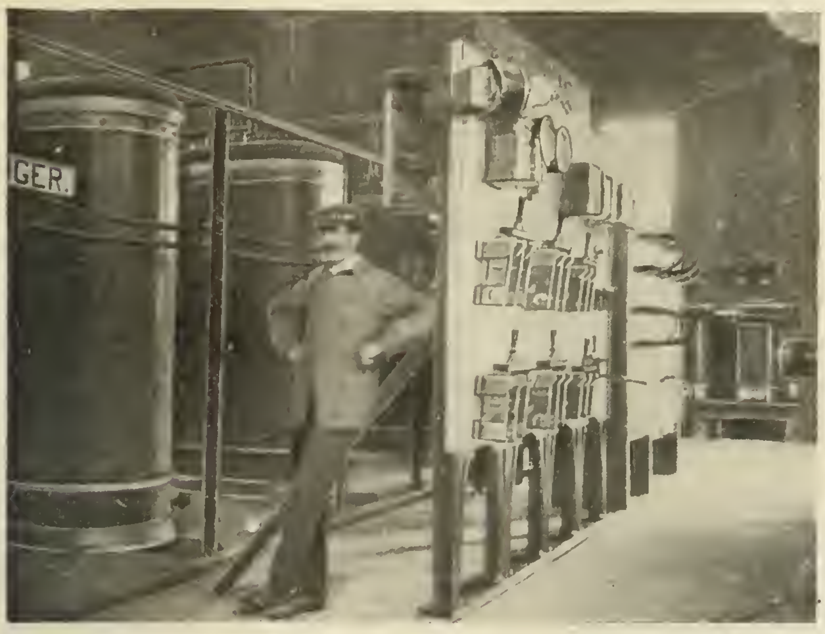


FIG. 4.—SWITCHBOARD, TRANSFORMER HOUSE.

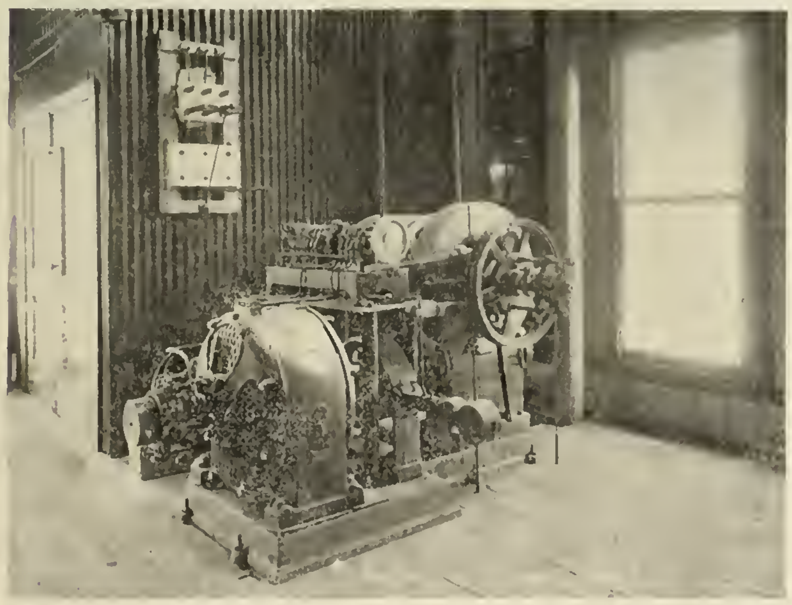


FIG. 5.—MOTOR ON FREIGHT ELEVATOR.

The other induction motors in the plant are distributed as follows: A 200-hp motor driving the crushing department; 40-hp driving the fans for cooling the hearths on the roasters; 75-hp for the fans in the barrel house; 75-hp for operating an air compressor; 75-hp for driving the concentrating tables; two 40-hp motors operating upright Deane pumps; 50-hp for driving the machine shop and carpenter and blacksmith shops; 10-hp for a roll in the melting room; 50-hp for rolls in the sampling department; 10-hp on the bedding floor for driving conveyors; 75-hp for dust-collector and screens. A 25-hp variable-speed motor is used for box car handling apparatus on a trestle. A 30-hp variable-speed motor has been used for operating a freight elevator at a speed of 300 ft. a minute, the equipment being of the latest Westinghouse pattern, with automatic elevator controller.

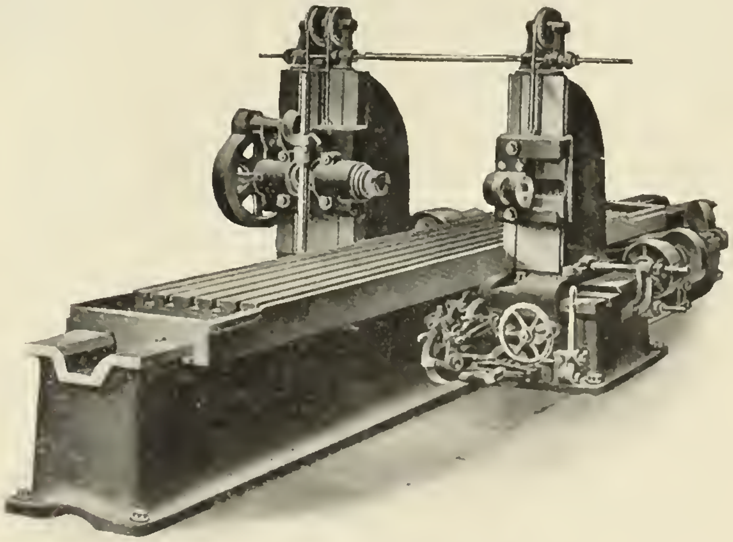
Water for the boilers and other purposes is obtained from Bear Creek, a short distance below the mill. There are three pumping stations, the largest one containing two Deane pumps driven by 75-hp induction motors. The other two stations are operated respectively by 40 and 15-hp motors.

For lighting the mill a separate 1,100-volt, single-phase circuit is used, this being split up into two 110-volt circuits through two 25-kw transformers connected in multiple. There are three incandescent circuits supplying about 500 lamps and one arc circuit carrying Manhattan enclosed arcs. Arc lighting has not proved a success in the mill, as the dust and gas affect the lamps so that they soon get out of order. The lighting circuits are controlled by one panel on the power switchboard.

The electrical plant has run continuously, or practically so, since it was started up over a year ago. When any shut-down has occurred, it has generally been on account of accident to the mill machinery rather than any fault of the electrical apparatus. The consumption of power varies from 5,000 to 6,000 kw-hours a day, the peak load being about 300 kw and the minimum load 150 kw. The sub-station and electrical equipment are under the management of S. J. Connolly.

Planer-Type Milling Machine.

The Brainard-Becker Milling Machine Company, Jamaica Plain Station, is introducing a new 10-ft. planer type milling machine, shown herewith. This machine is built from new designs and new patterns and is of very heavy construction for strength, rigidity and power, with special provisions for ease of operation and the demands of modern milling machine practice. The spindle is made of hammered crucible steel, 5 in. in diameter, has a threaded nose and runs in self-centering bronze boxes, with nut and check nut to compensate for wear. The spindle carrier is very heavy and is held firmly to the upright by long gibs. It is elevated by a screw with adjustable dials graduated to thousandths of an inch, and has a counterbalance for ease of operation. There are 20 changes of speed for the cutter spindle obtained by gearing in the main driving cone, operated by clutch and lever, so that all changes can be made instantly. The table is very heavy and is regularly built with five T slots lengthwise and an oil channel the full length and at each end. It travels on flat ways securely gibbed and has a quick return operated by power from a separate countershaft. It can also be moved by the usual hand wheel. The feed of the table is directly operated through gearing from the spindle at ratios of 13½ and 27 to 1 by 5-in. belt on a 5-step cone, the diameter of which is 23 in. on the largest step and 13 in. on the smallest, giving a range of feed through eight changes, from 3/64 to ⅜ in. These changes of feed can be made instantly by means of a lever, without stopping the machine. The head may be adjusted from either side of the machine, so that it is not necessary to take the cutters off the arbor in order to change their position in relation to the work. The bed extends to the floor and makes a solid foundation.



PLANER TYPE MILLING MACHINES.

Evershed Testing Set.

It has come to be recognized that the requirements as to methods and apparatus for insulation testing work are different from those employed in the past for testing in connection with submarine cable and similar work. The apparatus illustrated in Fig. 2 and widely known in Europe as Evershed's testing set was designed to meet those requirements, and in the course of the past few years its specialized function have received very general recognition among electrical men all the world over.

The Evershed set is an adaptation of the two coil ohmmeter combined with a portable hand dynamo yielding a continuous current at any voltage that may be desired. The electrical principle is indicated in Fig. 1. The current from the dynamo *D* divides at the ohmmeter into two parts, of which one flows through the pressure coil *P*, and constant resistance *R* and tends to turn the magnetized needle *N S* and index towards the infinity point on the scale, while the other fraction of the current traverses the windings of the current coil *M* and the leakage path *X* through the insulation which is under test.

When there is no leakage the current coil has no field and the needle is free to lie in the magnetic axis of the pressure coil. The index then stands at the last division on the scale, which is accordingly marked "infinity." If the insulation resistance is so low as to be negligible, the current flowing through the current coil will depend only on the volts and the resistance of the current coil itself. The current coil will now deflect the needle away from "infinity" to a position in which the turning moments of the two coils are balances. This point on the scale is marked "zero." Obviously, for any given resistance in the leakage path the index will come to rest at a definite point between zero and infinity. Moreover, if the resistance is constant and independent of the voltage, the position of the index will not be changed by increasing or decreasing the volts, for if the volts are doubled, for example, the currents in both coils will be doubled and their ratio remains unchanged. Hence the angular position of the needle and index indicate resistance quite apart from voltage.

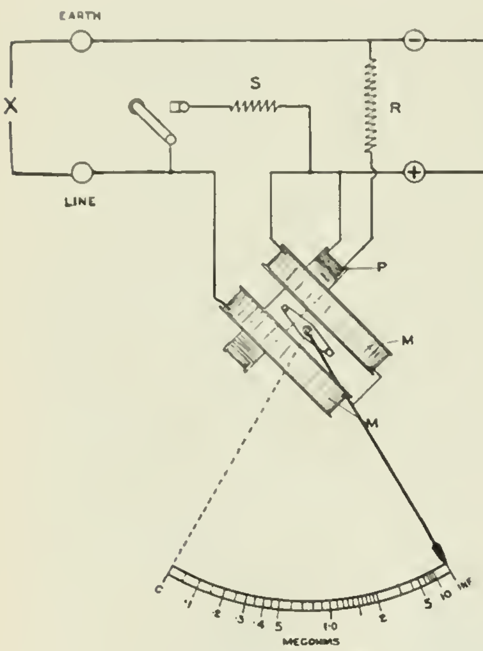


FIG. 1.—DIAGRAM ILLUSTRATING PRINCIPLE OF TESTING SET.

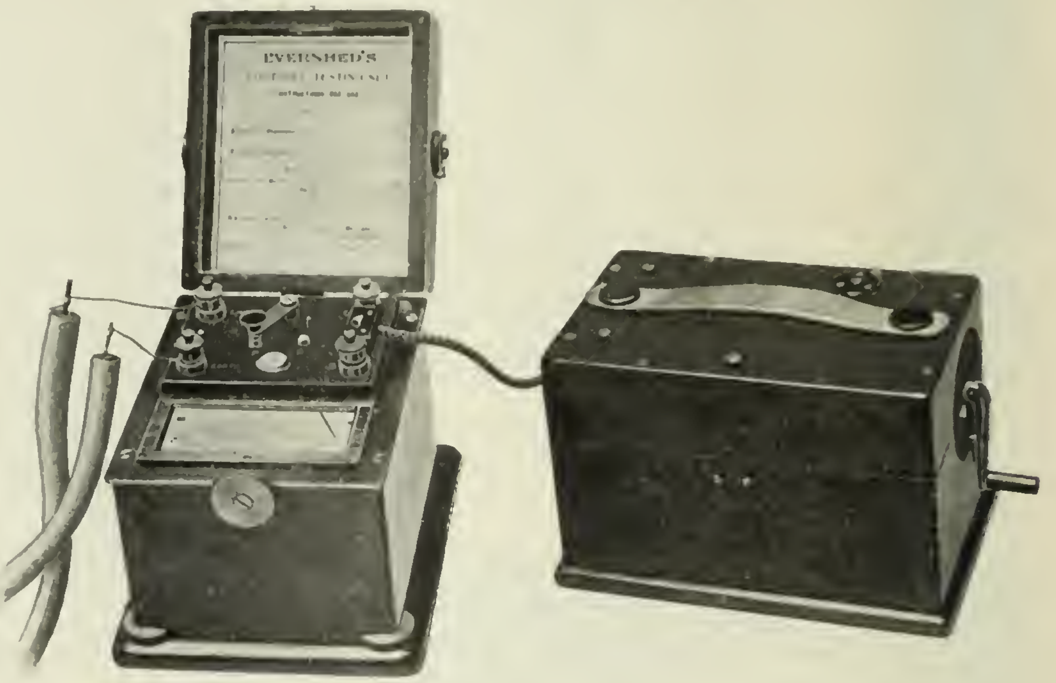


FIG. 2.—GENERAL VIEW OF TESTING SET.

It should be noticed here that this instrument is a true ohmmeter in that it directly indicates the value of the resistance under test by means of a pointer which ranges over a scale of ohms and megohms, just as an amperemeter indicates amperes, a voltmeter volts, and so on. The word ohmmeter is sometimes applied, quite illegitimately, to apparatus based upon the Wheatstone bridge principle; an application of the name which is entirely misleading, and about equivalent to calling a potentiometer a "voltmeter."

In the present and latest pattern of Evershed testing set, the hand dynamo is built after the fashion of a modern continuous current generator. It has a tunnel wound armature, a finely laminated core built from stampings of best iron of "transformer" quality, a special form of commutator with elastic roller brushes and roller bearings for the armature axle. It is driven by double gearing, all the gears having machine cut involute teeth. The winch handle is hinged so that it may be turned down into a recess in the box when not in use. A convenient flexible connector is provided for coupling the dynamo to the ohmmeter.

The ohmmeter has a very finely pivoted astatic needle system, magnetized by the dynamo current and, therefore, free from all the troubles incidental to permanently magnetized astatic needles. The needle system is automatically lifted off the jewel bearing and securely clamped by the action of shutting the lid of the box. The current coil is wound with an enormous number of turns of the finest wire so as to secure the maximum sensibility. A one-ninth shunt is provided so as to reduce the sensibility ten times when low insulation resistances are being tested. There are four terminals on the ohmmeter. Two of these serve for the connections to the dynamo, and the other two are marked "line" and "earth," respectively, and to these the circuit which is to be tested must be connected.

To use the apparatus successfully calls for no more than a hand to drive the dynamo and an eye to watch the index of the ohmmeter. There is not a single adjustment of any kind to be made beyond screwing two leveling on the ohmmeter until the bubble of a circular spirit level stands central. There are no calculations to be made, for the scale reads in megohms.

A complete insulation test may be had in less than a minute from the start, and this without any knowledge of scientific testing. An example drawn from every-day experience will best illustrate the utility and convenience of the apparatus. A shunt-motor armature has been rewound and replaced in the machine. While coupling up preparatory to running a bad leak to frame is felt. The shop testing set being at hand, the ohmmeter is coupled to one terminal of the motor and to the frame. Half a dozen turns of the hand dynamo are sufficient to show up an insulation resistance of about 16,000 ohms. On lifting the motor brushes the insulation runs up to several megohms, showing that the ground was not in the brush gear nor in the field windings. The "line" connection of the ohmmeter is now lifted on to the commutator and on turning the hand dynamo very slowly the ohmmeter reads about 30,000 ohms; on gradually speeding up the dynamo to a high voltage—150 volts or so—the insulation steadily falls to 12,000 ohms, a result that pointed clearly to moisture in the freshly varnished armature coils. This test, as actually made, occupied less than two minutes, and in that time the leak had been located, its extent measured and its cause ascertained with a certainty that enabled the motor to be started at once on load, in full confidence that the leak was not a local defect on the point of breaking down, but a widely diffused leakage due to traces of moisture which would dry out as the armature warmed up.

The Evershed testing set is being manufactured in this country by Messrs. Queen & Co., of Philadelphia and New York, who have placed on the market a handy series of ohmmeters ranging up to 50 megohms, together with a standard line of hand dynamos wound for 100, 200, 500 and 1,000 volts.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Speculative conditions were dull and prices had a lower tendency, notwithstanding the easier conditions of the money market and the favorable crop outlook. The only conspicuous movement of the week was the heavy decline in United States Steel shares, which appeared to be mainly due to manipulative efforts to depress that security. The common stock fell to 20⅞, which is the lowest figure on record. This extreme drop naturally exercised an unfavorable influence on the market at large. Apart from the drop in steel shares, the market was practically featureless. Metropolitan Securities and Metropolitan Street Railway were marked up on very limited transactions, whereas Brooklyn Rapid Transit was raided similarly with the steel stocks and sold off. Brooklyn Rapid Transit closed at 40½, being ¼ point above the lowest of the week—the highest being 45¼. Thirty-nine thousand two hundred and twenty five shares of this stock were sold. Metropolitan closed at 114¼, which is a net gain of 1½ points, the sale aggregating 5,120 shares. General Electric fell to 162½ and closed at that figure, which represents a net loss of ½ point, the sales aggregating 1,150 shares. The two issues of Westinghouse showed decided weakness, both closing with net losses of 4 points, the quotation of the common being 166 and that of the preferred 171. Western Union made a net gain of ⅜, closing at 83½. American Telegraph & Cable closed at 18½, being a net gain of 1¾ points. Following are the closing quotations of September 15:

NEW YORK.

	Sept. 8	Sept. 15		Sept. 8	Sept. 15
American Tel. & Cable......	79	78¾	General Electric.	162	160
American Tel. & Tel........	132	130	Hudson River Tel...........	..	..
American Dist. Tel....	24	24	Metropolitan St. Ry.........	112½	113¾
Brooklyn Rapid Transit ...	43¾	38¾	N. E. Elec. Veh. Trns........	..	..
Commercial Cable.	..	145	N. Y. & N. J. Tel............	..	..
Electric Boat.	13	13	Marconi Tel................	1⅞	1⅞
Electric Boat pfd...........	38	38	Western Union Tel...... ...	83	83
Electric Lead Reduction.. .	1¼	1¼	Westinghouse com....	165	155
Electric Vehicle...........	4½	5⅛	Westinghouse pfd..........	170	160
Electric Vehicle pfd.......	7½	8			

BOSTON.

	Sept. 8	Sept. 15		Sept. 8	Sept. 15
American Tel. & Tel	132½	131	Western Tel. & Tel. pfd....	81¼	80
Cumberland Telephone....	..	..	Mexican Telephone.........	1⅜	1¼
Edison Elec. Illum..........	..	..	New England Telephone...	124	124
General Electric............		..	Mass. Elec. Ry..	21½	20
Western Tel. & Tel	13	12	Mass. Elec Ry. pfd.... . .	79½	78½

PHILADELPHIA.

	Sept. 8	Sept. 15		Sept. 8	Sept. 15
American Railways.........	..	44½	Phila. Traction..	95½	95½
Elec. Storage Battery	56½	55	Phila. Electric	6¼	6
Elec. Storage Battery pfd.	56⅛	55	Phila. Rapid Trans..........	..	13¾
Elec. Co. of America.	8⅝	8¼			

CHICAGO.

	Sept. 8	Sept. 15		Sept. 8	Sept. 15
Central Uuion Tel.	..	..	National Carbon pfd........	88	89
Chicago Edison........	..	..	Metropolitan Elev. com.....	..	..
Chicago City Ry....	170	170	Union Traction	4½	5
Chicago Tel. Co	..	..	Union Traction pfd.........	..	30
National Carbon	20	20			

BROOKLYN RAPID TRANSIT.—The annual report of the Brooklyn Rapid Transit Company for the year ended June 30 shows a surplus for the year of $796,783—or about 1¾ per cent. on the capital stock. Gross earnings were $13,280,321 and net $5,349,242—an increase in the former case of $769,699 and in the latter of $1,022,517. The net returns would have been greater had it not been for unusual expenditures under the heading "operation of power plant," these including $109,337 paid for hired power and $283,979 increase in the cost of coal due to the coal strike. The mileage of the system is 251 miles, of which 242 is double-track. In addition there are 35 miles of siding and turn-outs, making a total trackage of 530 miles. The passenger earnings are divided as follows: Surface, $9,284,157, an increase of $234,928; elevated and bridge, $3,802,683, an increase of $530,647. During the year there was added to car equipment 120 open elevated cars, 16 open surface cars, 34 combination surface cars, 10 freight gondola cars and 2 snowplows. In his report President Winter says, among other things: "The new central power station is progressing toward completion and is expected to be fully in operation with its equipment of eight 4,000-hp engines in the spring of 1904. The causes of extraordinary delays in work of this character during the year last past, and still existing, are too well known to need explanation. Four of the eight engines are in service and work is generally well advanced, with the exception of boiler and steam fitting work, which is much behind the time set for completion. There were installed and are in operation in the eastern power station one new 4,000-hp engine, with 2,700-kw generator, and at various sub-stations six 1,000-kw rotary converters and eighteen static transformers. Sub-stations in Essex Street and Halsey Street were completed and put in operation, and Sands Street sub-station well advanced."

BELL TELEPHONE OUTLOOK.—The following is from a Boston financial source: "The fact that New England investors have been obliged to take practically all of the $22,000,000 new stock of the American Telephone & Telegraph Company after having absorbed about $15,000,000 of the stock from New York holders, including the Morgan holdings, makes the present market for American Telephone shares somewhat limited. The American Telephone & Telegraph Company is now passing through the most prosperous period in its history and the aggressive and efficient management of Mr. F. P. Fish has permeated every department of the business. It is unfortunate that the stock should sell at the lowest price for years, but it is generally recognized that present prices are the result of general financial conditions entirely foreign to intrinsic values. That the stock sold at 127, however, was no surprise to some leading interests in the company. When the question of the new stock issue came before the board of directors there was considerable difference of opinion among the members of the board as to the advisability of the issue this summer, some taking the position that as the company had $8,000,000 of cash on hand it could have borrowed sufficient money for construction needs to have carried it through this year, while other members took the position that the Telephone Company should divorce itself from stock market conditions. At that time one of the influential directors stated to the board that if a stock issue was made this year the stock would sell at 125, and it did decline from above 150 to 127. Leading interests in the Telephone Company, however, were never stronger in their faith in the property than at the present. The stock at 133 returns 5.3 per cent. upon the investment."

CONDUIT ENTERPRISES EMBARRASSED.—A number of companies engaged in the clay brick and conduit industry have been embarrassed by the financial difficulties of Mr. Raymond C. Penfield, of New York City. The companies are the Brooklyn Brick & Sewer Pipe Company, the Standard Fire-Proofing Company, the Great Eastern Clay Manufacturing Company, the Standard Vitrified Conduit Company, the National Clay Manufacturing Company, and the Manhattan Brick & Terra Cotta Company. It has been ascertained that, in addition to other liabilities, Mr. Penfield put out notes to the extent of about $1,200,000 for the purpose of raising "working capital," and no provision was ready to meet them when they began falling due on September 8. All the companies here and three companies in Cleveland are involved as endorsers of the notes. Several of the concerns are doing a large business and the assets are considerable. The Continental Trust Company has been appointed receiver. We are glad to learn from the Standard Conduit Company that its business is intrinsically in splendid condition, and President Barnard informs us that it will go right forward in spite of these difficulties arising outside its own direct affairs.

WESTERN UNION FINANCES.—The Western Union Telegraph Company issues the usual statement for the quarter ended September 30, 1903 (partly estimated):

	1903.	1902.	1901.	1900.
Net revenue	$2,400,000	$2,247,174	$1,949,316	$1,705,756
Bond interest	286,300	252,550	239,040	239,040
Balance	$2,113,700	$1,994,624	$1,710,276	$1,466,716
Dividends	1,217,015	1,217,010	1,217,005	1,217,001
Surplus	$896,685	$777,614	$493,271	$249,715
Previous surplus	13,019,724	10,751,003	9,319,285	8,352,450
Total surplus	$13,916,409	$11,528,617	$9,812,556	$8,602,165

The actual returns for the June 30 quarter were: Net revenue, $2,007,698; bond interest, $286,300; balance, $1,721,398; dividends, $1,217,015; surplus, $504,383; previous surplus, $12,515,341; total surplus, $13,019,724.

GENERAL ELECTRIC ACTIVITY.—A financial dispatch from Boston says: "While there has been a falling off in the booking of new business by the General Electric Company, leading officials of that company look upon the depression as but temporary. They think it is due to monetary conditions rather than to timidity on the part of consumers fearing a general depression in business. They believe that with the crop movement well under way monetary conditions will ease and business conditions improve. The General Electric Company is at the present time handling a record-breaking business. In July and August the company did a gross business of over $7,500,000. In the last annual report of the General Electric Company it was shown that net manufacturing profits amounted to 20 per cent of the gross. Upon this basis the General Electric Company must have done a net business in July and August of about $1,500,000, not including income from securities it owns."

DIVIDENDS.—The directors of the United Traction & Electric Company of New Jersey have declared the regular quarterly dividend of 1¼ per cent on the capital stock, payable October 1. The Savannah Electric Company has declared a regular semi-annual dividend of 3 per cent on the preferred stock, payable October 1, to stockholders of record September 17. The Seattle Electric Company has declared a regular semi-annual dividend of 3 per cent. on the preferred stock to stockholders of record September 17. Directors of the Otis Elevator Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable October 15. The General Electric Company has declared a dividend of $2 per share, payable October 15. The Commercial Cable Company has declared a quarterly dividend of 2 per cent. payable October 1.

MISSOURI EDISON.—The Missouri Edison, of St. Louis, and Union Electric Companies have been consolidated, taking the name of the former. The capital is $10,000,000. An injunction to prevent the merger was served too late.

Commercial Intelligence.

THE WEEK IN TRADE.—There was a general improvement in trade conditions, yet some irregularity still exists. A better feeling prevails with reference to the outlook for the corn crop, the conditions in most States having improved during the last week. There is less activity in the East, as indicated by advices from that section, but there are signs of improvement in the cotton mill situation. In the West lumber and building materials of all kinds are active and firm, but at the East the resumption of building operations at strike centers has not been sufficient to keep those markets strong. Iron trade is rather pessimistic, buyers persisting in holding off, but the reported declines in Northern and Western irons are largely sympathetic—the result of the reported additional cuts in the Southern product. Other metals, notably tin and copper, have eased off. In copper there was nothing of interest, the business transactions being of rather ordinary proportions. The ruling quotations were 13⅜ to 13⅝c. for Lake, 13¼ to 13½c. for electrolytic, 12⅝ to 12⅞c. for casting stock. Railway earnings continue good, the increases for August being fully 8 per cent. over the best previous years. *Bradstreet's* notes that collections showed a slight improvement, the result probably of the crops moving to market. Owing to the lateness of the crops, there is little complaint of traffic congestion. The business failures remain about normal, as indicated by *Bradstreet's* figures. The number for the week ending September 10 aggregated 165, against 162 the week previous, and 197 the corresponding week last year.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, through its Eastern District office, Keystone Telephone Building, Philadelphia, Mr. Paul W. Bossart, manager, reports recent sales as follows: Dallas, Pa., 200-line switchboard and telephones; Tunkhannock, Pa., 100-line switchboard and telephones; New Albany, Pa., 25-line switchboard and telephones; Waterside, Pa., 25-line switchboard and telephones; Alexandria, Va., 350-line switchboard and telephones; Frenchtown, N. J., 150-line switchboard and telephones; Perth Amboy, N. J., 200-line switchboard and telephones; Lambertville, N. J., 150-line switchboard and telephones; Flemington, N. J., 150-line switchboard and telephones; New Egypt, N. J., 100-line switchboard and telephones; New Lisbon, N. J., 100-line switchboard and telephones. In addition to the foregoing list of sales, the Kellogg Company has just secured orders for substantial additions to the "Main" and "Race" exchanges of the Keystone Telephone Company in Philadelphia, amounting to five sections for each exchange, making the total present equipment of each of the above exchanges 5,200 lines. The Kellogg Switchboard & Supply Company has also been awarded the contract for a switchboard and telephones for Linton, Ind. The contract calls for an 800-line switchboard with ultimate capacity of 3,000, and telephones. The directors of the New Home Company, of Linton, compose part of the board of directors of the Knox County Telephone Company, of Vincennes, Ind. On account of the satisfactory results from Vincennes they ordered an exact duplicate of the board for Linton.

WESTINGHOUSE ELECTRIC SALES DEPARTMENT.—The New York offices of the sales organization of the Westinghouse Electric & Manufacturing Company, consisting of the New York Sales Department, Department "I," the Export Department and the General Agent's office, have been removed to the new Hanover Bank Building, corner of Nassau and Pine Streets. The new offices occupy the entire seventeenth floor of this building, one of the finest and best equipped office buildings in the country, and where every facility will be provided, both for the representatives of the company and for the public with whom they do business. The mail address of the several departments of the Sales Organization in New York will be No. 11 Pine Street. The telephone number, 6131 Cortlandt, remains unchanged. The executive, financial and stock transfer offices will remain on the fourth floor of the Equitable Building. The present organization of the Westinghouse Electric & Manufacturing Company has been quartered in the Equitable Building since 1889, but the rapid and material increase of business has made the above move necessary.

CHICAGO CONTRACT FOR TROLLEY CARS.—The contracts for 100 new cars at a cost of $493,500 have been let by the receivers for the Union Traction Company. General Manager Roach states that he will at once apply to the city for permits to substitute the overhead trolley for cables in certain streets on the north and west sides. Without the new trolleys the new cars would be nearly useless, and out of this application for change of power may come a clash between the city and Judge Grosscup, involving the interpretation of the "99-year act." The new cars contracted for are to be 40 ft. long, equipped with air brakes, reversible seats, large windows, which practically make them open cars in the summer, and push buttons to signal conductors. They are to cost $4,935 each, the contracts for the cars being let to the St. Louis Car Company for $2,535 each, and for the electric motors to the General Electric Company for $2,400 each equipment. They are to be delivered in Chicago before December 31.

NOBLESVILLE, IND., POWER PLANT.—The Noblesville (Ind.) Hydraulic Company is carrying out an important enterprise in power transmission and is already making contracts for apparatus. It is utilizing a fall on the White River and creating a reservoir of about 100 acres. The power thus developed will operate six turbines of 350 hp each, for which an order has already been given. The National Electric Company, of Milwaukee, has the contract for generators, etc., at $18,500 for the initial equipment. It is expected to use the plant ten months in the year, and to furnish current for lighting as well as for industrial purposes. The transmission is about two miles.

ELECTRIC CAR TRUCKS.—Mr. R. R. Frazier, United States Consul at Copenhagen, Denmark, writes as follows: "A well-known firm of agents in Copenhagen desire to correspond with a firm in the United States who are in position to furnish trucks for street cars and steam cars in a country foreign to both Denmark and the United States, where the government will undertake the construction of new lines of railway, electric and steam. Trucks for passenger cars will be required for the electric lines and trucks for passenger and freight cars for the steam railways. Letters forwarded to this office in reply to the above request will be promptly delivered."

BALL ENGINE ORDERS.—The Smith Premier Typewriter Company, of Syracuse, N. Y., has recently purchased a 500-hp cross-compound engine, direct-connected to an alternator from the Ball Engine Company, Erie, Pa. The power plant for the First National Bank Building, of Chicago, is now being installed. The engines, of which there are four, are of the vertical cross-compound type, arranged for direct-connection to generators, and are 300 hp each. The engines were built by the Ball Engine Company.

ELECTRIC TRAIN LIGHTING.—It is stated that electric lighting is to be substituted for gas on all passenger coaches on the Pennsylvania Railroad. Every passenger coach now being built in the shops of the company in Philadelphia, Jersey City, Altoona and Pittsburg is wired in addition to having the illuminating gas installation. Several of the Pennsylvania coaches have storage battery lighting now.

ELECTRIC POWER IN BOSTON.—The Boston Edison Company reports 1,838 power contracts, representing 13,693 hp connected and 9,129 hp demanded. There are also on the system motors equal to 6,107 hp on "commercial rates." The motors are employed on an endless variety of service.

J. W. O'BRIEN & CO., Journal Building, Boston, are installing the underground work at the Woman's Insane Hospital, Dorchester, Mass. They have also been awarded the contract for underground installation in conduit and cable by the Auxiliary Fire Alarm Company, Boston.

General News.

THE TELEPHONE.

SONORA, CAL.—The Sonora Telephone Company has been incorporated with a capital stock of $50,000. Among the directors is W. E. Bristol.

ATLANTA, GA.—An independent long-distance telephone line from Atlanta to Asheville, N. C., is to be constructed at once by the Gainesville Co-operative Telephone & Telegraph Company.

BRADFORD, ILL.—The Milo & Bradford Telephone Company has increased its capital stock from $5,000 to $20,000.

DAHLGREN, ILL.—The Dahlgren People's Telephone Company has increased its capital from $2,500 to $5,000.

WARREN, ILL.—The Pitcher Telephone Company, with a capital stock of $7,500, has been incorporated by L. B. Pitcher and others.

STREATOR, ILL.—The Independent Telephone Company of this city will extend its lines to Aurora and Ransom, and will spend about $30,000 in extending and improving the lines in this city.

WABASH, IND.—The franchise of the Central Union Telephone Company in this city recently expired, and no renewal has so far been asked.

INDIANAPOLIS, IND.—A summary of the tax returns for telephone companies show a valuation of $11,966,172 in the state. This is exclusive of real estate and office fixtures. The tax board at its final session sustained the appeals of the South Bend Home Telephone Company and reduced its assessment from $100 to $90 a mile; the Steuben County Farmers' Telephone Company from $30 to $20 a mile; the Home Telephone Company of Elkhart from $170 to $160 per mile. A reduction was also made in the assessment of the Merchants' Mutual Telephone Company of Michigan City, and of the Delaware & Madison Counties Telephone Company from $100 to $80 a mile. The appeal of the Citizens' Company of Kokomo; the Crown Point Telephone Company; the United States Telephone Company; the Chicago Telephone Company and the Home Telephone Company of Crawfordsville were not sustained.

BURLINGTON, IA.—The Iowa Telephone Company will erect a line direct from this city to Omaha.

WHAT CHEER, IA.—The What Cheer Telephone Company has been incorporated with a capital stock of $5,000.

DES MOINES, IA.—The New Montana Telephone Company has been incorporated with a capital stock of $100,000.

DES MOINES, IA.—The Des Moines Mutual Telephone Company directors have decided to purchase a switchboard costing $95,000.

DECORAH, IA.—The Summer Telephone Company, capitalized at $30,000, and owning about 150 miles of lines and large exchanges at New Hampton and West Union, besides several smaller ones, will pass under the control of Vic. Stevens, who controls the Standard, Interstate and Dubuque lines. Mr. Stevens bought of the two chief stockholders of the company $18,000 worth of the stock, paying eighty cents on the dollar.

COUNCIL BLUFFS, IA.—The Nebraska (Bell) Telephone Company has a large force of workmen constructing the underground conduit system and expects to have the work completed by the latter part of the month. Plans have been made for a new exchange building and contracts for its construction will probably be let shortly. A new switchboard will be installed with a capacity of 1,200 lines. The company expects to expend about $135,000 for the proposed improvements. The central energy system will be adopted.

WHITEWATER, KAN.—The Whitewater Telephone Company has been incorporated with a capital stock of $2,500 to establish a local exchange here.

TOPEKA, KAN.—The Missouri & Kansas Telephone Company has absorbed the Kansas Long Distance Telephone & Telegraph Company, which tried unsuccessfully to get a franchise in Topeka a year ago, and is now building an extension in North Topeka to connect with a new Kansas City toll line which will be in operation in a few months.

MAYBURG, KY.—A telephone line will be built between Whitesburg and Stonega, Va.

OWENSBORO, KY.—The Rural Home Telephone Company, of Davies County has been formed; capital $25,000. Directors: H. K. Cole and others.

MIER, MEX.—A telephone line is being constructed between this place and the town of Doctor Arroyo.

HOMER, MICH.—The Homer Telephone Company has been incorporated with $15,000 capital. The principal stockholders are B. F. Woodbury, Raymond C. Smith, E. D. Woodbury and Roy D. Gardner. Extensive improvements are contemplated in the plant involving the addition of about fifteen miles of rural lines and the use of metallic circuits throughout.

DETROIT, MICH.—It is announced that the plant of the People's Telephone Company, representing an investment of approximately $400,000, has been sold to a syndicate associated with the Stromberg-Carlson Company, now operating independent telephone systems throughout the country. The new organization embraces six prominent men in other cities as follows: Eugene H. Satterlee, president of the Rochester Home Telephone Company, Rochester, N. Y.; Thomas W. Finucan, general manager of the Stromberg-Carlson Telephone Manufacturing Company; Alfred Stromberg, president of the Stromberg-Carlson Telephone Manufacturing Company of Chicago; Arnold Kalman, capitalist, of St. Paul, Minn., and John J. Heim, president of the Kansas City Home Telephone Company, of Kansas City, Mo. The company has petitioned the Common Council for a new franchise for the purpose of operating its lines in the city and connecting with other independent telephone lines throughout the state.

WRIGHTSTOWN, MINN.—The Hewitt Wrightstown Telephone Company has been incorporated and will extend its line in several directions.

GLENCOE, MINN.—The McLeod County Telephone Company has been incorporated with a capital stock of $50,000. J. J. Greaves and E. B. Greaves are among the directors.

ST. LOUIS, MO.—The Kinloch Telephone Company has closed negotiations for a right of way for a line from Alton to Springfield, having procured franchises in almost every town along the way.

ST. LOUIS, MO.—By a deal which has been closed between the Kinloch Long Distance Telephone Company of Missouri and the Buffum Telephone Company of Louisiana, Mo., St. Louis will receive long distance connections with a large number of northeast Missouri towns which have not been in reach of telephone communications before. Before the end of September the Kinloch Company will have its wires into Jefferson City, and the extension will be pushed West and South as rapidly as possible until Kansas City, Joplin and Carthage are reached. Wherever it is practicable, connections are being made with local branches.

BEAVER CROSSING, NEB.—The Beaver Crossing Telephone Company has changed its name to the Seward County Telephone Company. It has a capital stock of $50,000 and the incorporators are C. W. Doty, H. C. Johnson and others.

FILLEY, NEB.—The Home Independent Telephone Company has been incorporated with a capital stock of $3,000. The incorporators are Charles Hughes, S. R. Smith, C. R. Burbank, Edward Hughes and J. A. Barnard, all residents of Filley.

TAMORA, NEB.—The People's Mutual Telephone Company has made great progress since its incorporation in February. It has arranged with the Stromberg-Carlson Company to connect with Seward, where the plant will cost not less than $15,000 and will be ready for service about the first of January, 1904.

FREMONT, NEB.—The Fremont Telephone Company has asked the City Council, through a communication from the Commercial Club Committee, for permission to raise the company's rates, stating that it is not possible for it to continue business at the present rates for service. The Council appointed a committee of three to investigate the matter and report.

NEWARK, N. J.—The Central New Jersey Telephone Company has applied to the Springfield Township Committee for a franchise to operate a telephone line in that place. Similar applications have been made in the counties of Union, Morris, Hunterdon and Middlesex. The representatives of the company, which is a new concern, claim that the rates will be one-half the patrons of the present company are now paying.

TRENTON, N. J.—Articles were filed with the Secretary of State on Sept. 5 merging the American Telephone & Telegraph Company of New Jersey, the New York & Philadelphia Telephone & Telegraph Company and the Midland Telephone & Telegraph Company into the American Telephone & Telegraph Company of New Jersey. The new company has an authorized capital of $130,000 and is a long distance branch of the Bell telephone system. The officers are Edward J. Hall, Morris Township, president; Edward P. Meaney, Newark, vice-president; Melville Egleston, Elizabeth, secretary; James P. Vail, New York, treasurer.

WATERLOO, N. Y.—The Home Telephone Company will extend its lines to Bridgeport.

HEMPSTEAD, L. I., N. Y.—All the wires of the New York and New Jersey Telephone Company, from the city line of Queens, and along Fulton Avenue to the Bethpage Turnpike in the village of Hempstead and so on to Babylon Turnpike, will be placed underground. A subway is now being built.

FRANKFORT, OHIO.—The Hickman Telephone Company has been incorporated with a capital stock of $5,000.

JOHNSTOWN, OHIO.—The Johnstown & Croton Telephone Company has increased its capital stock from $30,000 to $50,000.

CINCINNATI, OHIO.—The Butler County Western Telephone Company has increased its capital stock from $5,000 to $12,000.

PEEBLES, OHIO.—The Adams County Telephone Company has been incorporated, capital $10,000. Directors: E. Humphreys and others.

LIGHTSVILLE, OHIO.—The Lightsville Telephone Company has been organized by J. L. String and others, the capital stock being $5,000.

GERMANTOWN, OHIO.—The Germantown Independent Telephone Company, Germantown, has increased its capital from $2,500 to $10,000.

NEW LEXINGTON, OHIO.—The Sunday Creek Valley Telephone Company has been incorporated with a capital stock of $50,000. Mr. DesAntle was chosen president.

FORTVILLE, OHIO.—The Fortville Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are P. A. Randall, F. E. Brown, J. H. Haskell.

CINCINNATI, OHIO.—W. Gilbert Thompson, of Lebanon, a heavy stockholder in independent telephone companies in Ohio, says that an independent telephone system will be in operation in Cincinnati as soon as mechanical arrangements can be completed.

SPRINGFIELD, OHIO.—The Central Union Telephone Company will install an exchange at Yellow Springs. Heretofore that village has been served exclusively by the Springfield & Xenia Telephone Company.

ST. MARY'S, OHIO.—The St. Mary's Telephone Company has adopted the automatic telephone system for its new plant, now in course of construction. As far as known Dayton and Columbus are the only two cities in the state where the automatic system is being installed.

MEDFORD, OKLA.—The Oklahoma & Kansas Telephone Company has increased its capital stock to $300,000.

SOUTH SHORE, S. D.—W. C. Cralle has been granted a franchise to install a local telephone system here.

PLATTE, S. D.—The Charles Mix County Telephone Company has been formed to take over the local mutual exchange and improve it.

MEHERRIN, VA.—The Lunenburg Telephone Company has been organized here with Mr. A. M. Bruce, president; L. P. Wallace, vice-president; M. E. Gee, secretary; L. F. Staples, treasurer; E. A. Owen, manager.

CLARKSBURG, W. VA.—The Consolidated Telephone Company of Clarksburg and Fairmont has decided to extend its lines in Wheeling, Uniontown and Pittsburg, and will at once install a long-distance service.

ALMA CENTER, WIS.—The Central Wisconsin Telephone Company will build a new line to Fairchild at once.

MAIDEN ROCK, WIS.—The Maiden Rock & Esdaile Telephone Company has completed its organization and elected officers as follows: President, Beverly White; secretary, Otto Holverson, treasurer, G. Bangton.

WAUSAU, WIS.—The Wausau Telephone Company will modernize its plant and improve it generally.

AVOCA, WIS.—The Avoca Telephone Company has sold its lines to the Union Consolidated Telephone Company and gave possession Sept. 1. This company owns and controls over 500 miles of lines and is acquiring more by buying and building.

LARAMIE, WYO.—A telephone line will be built to connect Laramie and Hanna. It will be about 75 miles long and run via Rock River. A large number of ranches will be connected by the line.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CAL.—The South Yuba Water Company, which controls the Central California Electric Company, operating three electric power stations for transmission of electricity to Sacramento and other points, has purchased of the Pioneer Pulp Company a large additional water supply. The Towle & Bros. Company also sold its share of the property, which consists of the large lakes of the Pulp Company in Lake Valley, in Six Mile Valley and near the Alta station. Also the water rights and canals from the north fork of the American River, Canyon Creek and Little Bear River. The South Yuba Water Company, which already had one of the largest water systems in California, will now have an increased supply of power water for the plants in Placer County. Plans were recently announced for a large bond issue to provide money to extend the electric power and water system. The Van Norden Trust Company of New York will take the bonds. Dr. Charles Van Norden, of Sacramento, is manager of the Central California Electric Company. The South Yuba Company can use its water several times over by running it through electric power plants and then utilizing it for irrigating and furnishing power water for mining plants.

SANTIAGO, CUBA.—Eduardo J. Chibas, Enramadas baja 14, Santiago, has organized a syndicate to build a central lighting plant.

WASHINGTON, D. C.—Gen. Oliver, Acting Secretary of War, has issued a revocable license to the Great Falls Power Company to construct a dam across the Potomac River at Great Falls, to connect with the government dam at that point near the Maryland shore.

HIGH FALLS, GA.—S. Grantland, president of the Towaliga Falls Power Company, states that improvements are contemplated to the extent of about $300,000. W. C. Whitner, Richmond, Va., is engineer in charge.

COLUMBUS, GA.—The Rankin Realty Company, recently incorporated with a capital of $150,000, will erect an electric plant to furnish light, power, etc.

HONOLULU, H. T.—An electric lighting plant will be installed in Honolulu, H. I., and operated in connection with a new ice making plant by the City Market Company, which has been incorporated by Wong Leong and other Oriental business men.

EAST ST. LOUIS, ILL.—At a meeting of the stockholders of the Citizens' Electric Light & Power Company of East St. Louis, it was decided to spend $50,000 in improving the present plant.

CRAWFORDSVILLE, IND.—At the first meeting of the new board of electric light trustees the rates were fixed as follows: City street lighting $66 per light per annum; commercial rate 12½ cents per kw-hour. The street lighting rate is an advance of $6 per year over the old; the commercial rate is the same. The board discussed ways and means whereby the plant might be placed on a paying basis. Superintendent Thomas has resigned and his successor will be selected from applicants passing the highest examination. The questions will be prepared by a competent electrician or professor of an electrical school.

MADRID, IA.—It is reported that the Madrid Light & Power Company intends erecting an addition to its power house.

DES MOINES, IA.—It is stated that the Edison Light Company proposes to install an automatic stoker and a chain grate at the power station; also erect a 200-foot steel smokestack, brick lined; extend the power dam 400 feet; install six new steel boilers of 420-hp each. Cost, complete, $60,000.

COLDWELL, KY.—The Young Electric & Gas Company, of Coldwell, has been incorporated; capital $100,000. Incorporators: E. Young, John C. Gates and M. J. Groom.

SPRINGFIELD, MASS.—We are informed that the Boston & Albany R. R. intends installing an electric power plant in its West Springfield shops. A. Ames, Jr., is electrical engineer.

PORTLAND, ME.—The Boston Phoenix Lighting Company, of Portland, has been incorporated to make and deal in gas and electric appliances; capital $200,000, of which nothing is paid in. President, C. M. Drummond; treasurer, W. G. Chapman. Directors: C. M. Drummond, W. G. Chapman and J. H. Drummond, Jr., of Portland; Chas. W. Hulman and B. J. Noyes, of Boston, Mass.

BUCHANAN, MICH.—Mayor Geo. H. Black is reported interested in the installing of a municipal plant.

LAKE CITY, MICH.—Chas. Ostrander has secured a 10-year franchise to install an electric light plant here.

WADENA, MINN.—It is stated that the Council is considering the installing of meters for its electric light consumers.

STILLWATER, MINN.—The Stillwater Gas & Electric Light Company, according to reports, contemplates issuing $350,000 bonds to improve the local plant and to bring power from Apple River Falls.

TAYLORS FALLS, MINN.—It is stated that the St. Croix Improvement Company has about completed arrangements for the purchase of the power at Taylors Falls and expects to start work for the development of power there.

TWO HARBORS, MINN.—It is reported that the Crowley Electric Company, of Duluth, has secured the contract for the new machinery to be installed at the new village electric light station here. Probable cost, $16,000.

FORSYTH, MONT.—Crocket & Blum will install an electric light plant here.

FT. ASSINNIBOINE, MONT.—Plans are about to be prepared for a 300-hp electric light plant to be installed at this post.

HELENA, MONT.—The Butte & Anaconda Power Company has been incorporated, with a capital of $100,000, to build a power plant on the Missouri River, near Helena. It is hoped to develop 25,000 hp and it is the plan of the company to furnish power to Helena, Butte, Anaconda and all intermediate points.

HELENA, MONT.—J. F. Wegner, of Craig, has filed a notice of appropriation of 1,500,000 inches of the water of the Missouri River at Ox Bend canyon, near Hilger's. It is stated that he intends building a dam and erecting a generating station to furgish power for refining, smelting and other purposes.

OMAHA, NEB.—The city has contracted with the electric light company for special street illuminations for the Carnival of the Knights of Ak-Sar-Ben, to be held October 1 to 10. Two thousand five hundred dollars will be expended for this purpose. The Knights of Ak-Sar-Ben pride themselves in being the originators of electrically lighted floats and the annual carnival brings thousands of visitors to the city. The electric parade is a most gorgeous display and is unsurpassed. A floral decked automobile parade will be one of the attractions of the carnival week this year.

NIOBRARA, NEB.—New York parties are making plans and specifications for a water power electric plant at Niobrara. A franchise has been secured and the plans call for the construction of a wing dam to divert a portion of the river around the West side of Niobrara Island. A large amount of power is estimated to be available and will be transmitted long distances at high potential. The company back of the enterprise is known as the Niobrara River Power Company. Two other companies are making application to the State Irrigation Board for the use of the river at this same point.

TRENTON, N. J.—The Stuyvesant Company has been incorporated to construct and operate electric light plants, etc. Capital, $25,000. Incorporators: Saml. N. Lever, Rye, N. Y.; Albert C. Watson, N. Y. City, and H. A. Bingham, Oradell, N. J.

DANSVILLE, N. Y.—It is reported that the Dansville Gas & Electric Company has sold its plant to the Mill Creek Electric Light & Power Company and that the new company will install additional machinery.

CAMERON, TEX.—The Cameron Water, Power & Light Company has increased its capital stock from $50,000 to $100,000. It is understood that its plant is to be enlarged.

AMARILLO, TEX.—The Amarillo Water, Light & Power Company has been incorporated, with a capital of $100,000. Incorporators: W. F. Ramsey, John K. Brydes and L. W. Chase.

WACO, TEX.—Bids are wanted Oct. 1 for electric lighting for a term of 5, 10 and 15 years, consisting of not less than 150 arc lamps of 9.6 amperes each, enclosed lamps 6.6 amperes each. Allan D. Sanford is Mayor.

BEAUMONT, TEX.—It is stated that the plant of the Beaumont Ice, Light & Refrigerator Company is about to be sold to Walter A. Myrick, of this city, and associates. If the deal is consummated the new owners will enlarge the electric light plant.

RICHMOND, VA.—Bids will be received Oct. 5 by Sol. L. Bloomberg, President Common Council, for a franchise to erect poles and run wires on the streets and alleys of the city, and to construct conduits or subways thereunder for the purpose of furnishing electric light and power.

MANCHESTER, VA.—The Committee of William and Mary College is reported to have rejected all bids received for installing a lighting plant in the college. The appropriation therefor is $5,000. Prof. Randolph, of the Virginia Polytechnic Institute, of Blacksburg, is reported to be a member of the committee.

OLYMPIA, WASH.—The Capitol Commission has awarded the contract for the power and lighting plant for the annex to Kilbourne, Clark & Company, of Seattle, for $10,500.

WALLA WALLA, WASH.—Saml. Storrow, engineer, Los Angeles, Cal., is preparing estimates for constructing a power plant on the Walla Walla River, in Walla Walla. Philadelphia parties are interested.

SEATTLE, WASH.—Contracts for furnishing material for installing a municipal power plant have been awarded as follows: To the Standard Underground Cable Company, of Pittsburg, Pa., wire and cables, at $29,856. To the Pelton Water Wheel Company, of San Francisco, Cal., contract for the water wheels and equipment, at $13,080. The contracts for insulators, generators, transformers and switchboards are still to be awarded.

RICHLAND CENTER, WIS.—A special election is to be held to vote on the question of issuing $20,000 electric light bonds.

ABBOTSFORD, WIS.—It is stated that C. W. Newberry, of Crookston, Minn., is preparing to install an electric light plant and a telephone system.

THE ELECTRIC RAILWAY.

COLLEGE HILL, ARK.—The College Hill Light & Traction Company has been chartered, with $195,000 capital; E. K. Smith, president; J. D. Sanderson, vice-president; E. J. Spencer, secretary; J. L. Chatfield, treasurer, and F. W. Offenhauser, assistant secretary.

PALO ALTO, CAL.—The Town Trustees have granted a franchise for an electric railway to J. F. Parkinson, of Palo Alto.

SANTA ROSA, CAL.—The Supervisors of Sonoma County have sold to Burke Corbett an electric franchise over the county roads leading from Petaluma to Sebastopol and then through Green Valley to Forestville.

LOS ANGELES, CAL.—The end of August marked a decided reduction in the construction force of the Pacific Electric Railway Company, as most of the interurban lines planned by the company for the present have been completed. The line to Whittier is all completed, except the laying of rails, which are late in arriving. The poles are up, the trolley wire is strung and the roadbed is ready for the steel.

SAN FRANCISCO, CAL.—Representatives of the Standard Oil Company propose to build an electric railway to connect Point Richmond with West Berkeley. The franchise, for which application has been made, calls for a road from San Pablo via Richmond, Barrett Station and Steege to West Berkeley, where connections can be made with other steam and electric lines for San Francisco. At Point Richmond the Pacific Coast Oil Company, which is a branch of the Standard Oil Company, has large petroleum refineries, the oil being pumped through a 300-mile pipe line from Bakersfield. Among the promoters of the enterprise are John C. Black, superintendent of construction of the refineries of the Pacific Coast Oil Company; E. A. Gowe, of the same company; C. Kinney, an electrical contractor, and L. D. Dimm, a manufacturer of lubricating oils. Some of the stock has already been paid in. The passenger business will be taken care of with high-class equipment, and there will also be a light freight and express service. The electric power for the operation of the road can be supplied from the Bay Counties transmission lines. The route will be through a growing manufacturing district along the bay shores of Contra Costa and Alameda counties.

APALACHICOLA, FLA.—The Apalachicola Street Railway Company has been granted a franchise by the City Council to build a street railway on various streets. The incorporators are H. W. Grady, John M. Fowler, Andrew L. Wing and Domingo Cattanetti.

TIFTON, GA.—The Tifton & Valdosta Railroad Company has given notice of application to the Secretary of State for incorporation. The road will run from Ocilla, in Irwin County, to Valdosta, in Lowndes County, a distance of 80 miles. It is also proposed to build an extension from Ocilla to Helena, in Wilcox County, connecting there with the Southern Railway. It is proposed to issue capital stock in the road to the amount of $10,000 per mile, or a total of $800,000 for the 80 miles. The general offices will be in Ocilla.

MARSEILLES, ILL.—The Illinois Valley Traction Company proposes to extend its line from Marseilles through to Morris and Joliet as soon as the road between LaSalle and Marseilles is completed and in operation.

JERSEYVILLE, ILL.—The Union Traction Company, of Jerseyville, has been incorporated with a capital stock of $2,500. The object of the corporation is to build an electric railway and furnish light and power. The incorporators are A. O. Auten, June M. Rhoades and Joseph W. Becker.

EAST ST. LOUIS, ILL.—Incorporation papers have been filed by the Municipal Traction Company, of East St. Louis. The new company proposes to build electric railways through the southeastern part of the city. The capital stock is $100,000. The officers of the company are C. O. McCasland, president; C. G. Derleth, vice-president; P. J. Soucy, treasurer, and D. H. Morrell, secretary.

GALESBURG, ILL.—The Galesburg, Monmouth & Rock Island Railway Company has awarded part of the contracts for constructing its proposed line between Galesburg, Monmouth and Rock Island, and construction work will be begun at once. About 70 miles of line are to be built. Fourteen motor cars and ten trailers will be operated. The general contractors are the Arbuckle-Ryan Company. The power station will be equipped with three 500-kw alternating-current direct-connected generators, Corliss engines and Sterling boilers. The officers of the company are G. F. Duncan, president; E. Woodman, secretary and treasurer; S. L. Nelson, manager and purchasing agent.

INDIANAPOLIS, IND.—A new company, organized to engage in building steam and electric railroads, has been incorporated with the Secretary of State. The title of the company is the Southern Construction & Equipment Company. The capital stock is $50,000. The directors are Frederick Cline, Frank N. Fitzgerald, William H. Lacey and others. The principal offices of the new company will be in this city.

PRINCETON, IND.—The Evansville & Princeton Traction Company has elected these officers: Joseph Hestone, president; Jonah Legrange, vice-president; William Sontag, general manager; E. J. Baldwin, secretary and general passenger and freight agent; Sam Weston, treasurer. The officers were elected as a board of directors. Perry Freeman, of Indianapolis, who is a heavy stockholder, is not represented. The capital stock is placed at $600,000, of which $50,000 has been sold. The road is completed from Princeton to Darmstadt, a suburb of Evansville.

BURLINGTON, IA.—Plans have been made for the construction of an interurban electric line from Burlington to Keosauqua. Corporate articles have been filed by the Burlington Interurban Company, with $200,000 capital stock. Carl Liepold is president, and J. W. Topping, secretary.

CEDAR RAPIDS, IA.—R. A. Wallace, A. T. Averhill, John T. Hamilton and John M. Redmond, well-known capitalists of this city, have made application to the City Council for a franchise permitting them to construct and operate an entirely new street car system in Cedar Rapids.

COUNCIL BLUFFS, IA.—The Council Bluffs, Tabor & Southern Railway Company is projecting an electric line to run from St. Joseph, Mo., to Rockport, Mo., thence north to Sidney, Ia., from Sidney to Tabor, from Tabor to Hillside, from Hillside to Glenwood, from Glenwood to Pacific Junction and from Pacific Junction to Council Bluffs.

BURLINGTON, IA.—The organization of the Burlington & Interurban Railway Company has been completed by the filing of articles of incorporation with the Secretary of State. The articles state that Burlington shall be the principal place of business, and that the authorized capital stock shall be $200,000. Carl Leopold, is president; W. W. Copeland, first vice-president; Charles Blaul, second vice-president; Charles Armknecht, treasurer; J. W. Topping, secretary, of Burlington, Ia.

OTTUMWA, IA.—The business men of this city are considering plans for the construction and operation of a railroad from Ottumwa, in a southwesterly direction through Moravia and Corydon to Allerton, to a point on the Southern Iowa division of the Rock Island in Wayne County. The name of the company will be Corydon, Moravia & Kansas City Railroad Company. The promoters have not yet decided whether to use steam or electricity as motive power. The line will be about 45 miles in length.

HUTCHINSON, KAN.—The Commercial Club has taken up the matter of an interurban electric railway from Hutchinson to Sterling, through Nickerson. President Charles Williams spoke of the proposition as being a feasible one.

FRANKFORT, KY.—The Frankfort Street Railway Company is preparing to extend the line to Versailles, and has had a new route surveyed.

PADUCAH, KY.—Ground for the power house and transfer station for the proposed electric railway between Paducah and Cairo, Ill., has been bought at Bandana, the central point on the proposed line. While full facts have never been given out regarding this line, it is known that the promoters are Paducah, Louisville and other outside capitalists. Mr. Pall, of Louisville, is interested.

MERIDIAN, MISS.—The Meridian Light & Railway Company has just completed an extension to the new Meridian Female College and the Meridian Male College. The company is about to rebuild its system entirely and has ordered new equipment. It is also building a new power house which will be provided with double equipment. These improvements will cost about $200,000. They will include the building of new electric light lines to the new college and the extension of the East End trolley line.

ST. LOUIS, MO.—The St. Louis & Valley Park Railroad Company has filed a petition in the St. Louis County Court, asking for a franchise to construct and operate an electric railway from St. Louis to Valley Park by way of Fenton.

JEFFERSON CITY, MO.—The Excelsior Springs & Missouri City Electric Railway Company has been granted a certificate of incorporation by the Secretary of State. The new company is capitalized at $200,000. The incorporators are John W. Creech, of Harrington, Kan.; Charles S. Curry, Sidney P. Allen, Elmore S. Truitt and Willard E. Winner, of Kansas City, and Maurice A. Wogan, of St. Joseph, Mo.

DECATUR, NEB.—The survey of the first section of the Omaha, Decatur & Northern Electric Railway Company from Decatur to Tekamah has been completed.

OMAHA, NEB.—The promoters of the Omaha, Lincoln and Beatrice Electric Railway say that construction of the road will be commenced within thirty days. The road will run through some of the choicest farm districts of Eastern Nebraska. An almost complete right of way for the entire road has been obtained.

TRENTON, N. J.—The Delaware Traction Company has received a franchise from the Ewing Township Committee, and will build from Trenton to Lambertville.

NEWARK, N. J.—It is announced that the Public Service Corporation had leased the South Orange and Maplewood Street Railway. It is said that $250,000 was paid for the line. The deal has been under consideration for some time.

HACKENSACK, N. J.—The Newark & Hackensack Traction Company which operates from Hackensack to Arlington, a distance of about 12 miles, is now owned by the New York & New Jersey Railroad & Ferry Company, whose tracks run from Fort Lee through Hackensack to Paterson, with a branch to Englewood.

MINEOLA, N. Y.—A mortgage for $1,000,000 has been entered to the Savings & Trust Company, of Cleveland, Ohio, by the Mineola, Hempstead & Freeport Traction Company, now the New York & Long Island Traction Company. The loan is for the purpose of extending the company's lines. The company now operates from Mineola to Freeport, and will soon have the extension from Rockville Centre to the New York City line finished. It also operates a line to Queens and contemplates lines to Babylon from Freeport; also routes on the north, central and southerly sections of the island into the city of New York, through traffic agreement with other lines or its own.

YOUNGSTOWN, OHIO.—Local interests are talking over the advisability of building an electric railway from Youngstown to Niles.

YOUNGSTOWN, OHIO.—The Youngstown, Park & Falls Street Railway Company has amended its charter so as to be permitted to construct and operate an electric railway from Central Square in Youngstown to Idora Park, in Youngstown Township, with lineal or lateral extensions, as the owners see fit.

NEWARK, OHIO.—Officers elected by the Newark, Martinsburg & Mount Vernon Traction Company are Edward H. Everett, president; Dr. J. F. Sprontz, vice-president; John Chilcote, treasurer; Frank Elliott, secretary; Edward Kibler, counsel. The company intends to build immediately. This road will complete the Cincinnati-Cleveland line.

GENEVA, OHIO.—Surveys have been made here for the electric railway between Geneva and Meadville. The line, as surveyed, comes into the county east of Pierpont and to Jefferson through the center of Denmark. The road will be over private right of way, except through the villages and Jefferson, where it will run the length of Jefferson Street, and on to Geneva.

COLUMBUS, OHIO.—The Southeastern Ohio Railway, Light & Power Company, of Zanesville, has been incorporated, with a capital stock of $10,000, by M. W. Hissey, L. R. Meyer, W. W. Harris, N. P. Shurtz and E. M. Ramsbottom. The company proposes to build an electric railway from Zanesville through Roseville, Crooksville and Sayre to New Lexington, and to develop and sell electricity for light and power.

CLEVELAND, OHIO.—W. J. Stanley, vice-president of the Pennsylvania & Ohio Traction Company, is said to be interested in a plan to build an electric railway from Cleveland to Pittsburg. Mr. Stanley wants a private right of way into the heart of the city, although the proposed line will use the public streets for a short distance and will reach the Public Square. It is said that two routes have been suggested and surveyed. One of them goes to Akron, passes across to the Mahoning Valley, and then down to Pittsburg over some lines which are already in process of construction or which are projected in that territory. The other plan is to have the road built on a private right of way direct from Cleveland to the Mahoning Valley points.

STRATFORD, ONT.—The Council is prepared to negotiate with parties who would be willing to establish an electric railway here.

KANE, PA.—The Kane Electric Street Railway Company, Kane, Pa., has been incorporated with a capital stock of $24,000. President, Thomas S. Cunningham, Kane.

HARRISBURG, PA.—The control of the West Fairview & Marysville Electric Railway has passed into the hands of the Harrisburg & Mechanicsburg Railway. The stock amounts to $110,000 all told, and there is an equal amount of bonds. The acquisition of this line gives the Harrisburg & Mechanicsburg Railway control of the roads between Mechanicsburg, Camp Hill, White Hill, New Cumberland, Marysville and Harrisburg.

WESTERLY, R. I.—The directors of the Groton-Westerly Street Railway Company have decided to offer $200,000 of preferred stock to the public and to engage counsel to present the matter of public convenience and necessity before a judge of the Superior Court. Senator Hamilton, of Groton, president of the company, states that the company is not yet ready to consider contracts for the construction of the road. A committee consisting of President Hamilton, A. H. Chappell, Charles B. Noyes and B. F. Williams has been appointed to secure locations for a power plant and obtain the right of way where needed.

MEMPHIS, TENN.—The railroad committee of the City Council has decided to recommend that a franchise for a street railway be granted Fletcher R. Harris and associates, of St. Louis, for $150,000.

SAN ANTONIO, TEX.—The San Antonio Traction Company contemplates building a new branch line. The route of the proposed line is through the heart of the residence part of the city which is now without electric railway transportation facilities.

SALT LAKE CITY, UTAH.—The County Court has under consideration the petition of D. R. Roberts for an electric railway franchise. Mr. Roberts wants the right to build from Richmond to Wellsville, thus traversing the county from end to end. It is understood that he will next apply for a franchise in Logan City.

NEWPORT NEWS, VA.—The route of the projected Jamestown, Youngstown & Old Point Electric Railway has been determined upon. The line will have terminals at Newport News and Old Point.

RICHMOND, VA.—A charter has been granted to the Nelson & Albemarle Railway Company to build and operate an electric line from the soapstone quarry to the Southern Railway, a distance of six miles to eight miles. The capital stock is $250,000. The incorporators are J. W. Foster, H. L. Lane, D. J. Carroll, F. V. Elsom, D. H. Pitts, J. G. Hopkins and George W. Bostwick.

TACOMA, WASH.—The Tacoma Railway & Power Company contemplates building an interurban line to Sumner and Puyallup.

SPOKANE, WASH.—A 60-mile electric railway to run from Spokane via Newman Lake to Rathdrum, then looping back to Cœur d'Alene City and Liberty Lake, with a spur to Steamboat Landing, on the Pend d'Oreille River, and a branch to Harrison, is proposed. Eastern capital is behind the enterprise. James Edwards, a civil engineer, formerly with the Northern Pacific, is preparing data to be submitted to the promoters.

WHEELING, W. VA.—It is stated that in the near future the Wheeling & Elm Grove Traction Company will build another power house.

MILTON JUNCTION, WIS.—Three hundred citizens have petitioned the Rockford, Beloit & Janesville Railroad Company to extend its road to Milton Junction.

NEW INDUSTRIAL COMPANIES.

THE WOLD ELECTRIC MOTOR COMPANY has been incorporated in New York City to manufacture electric motors; capital, $50,000. Incorporators: David Wold, Louis Nashley, Otto C. Britseh, all New York City.

THE ERNEST J. WILLIS COMPANY, of Manhattan Borough, New York City, has been incorporated to deal in automobiles and electric and other vehicles; capital $75,000. Directors: Ernest J. Willis, Caroline M. Willis, Manhattan; William W. Myers, Brooklyn.

THE BETTINI PHONOGRAPH COMPANY, Manhattan Borough, New York City, has been incorporated to continue the business of G. Bettini; capital $20,000. Directors: Gianni Bettini, Paris, France, William A. Abbott, Stamford, Conn., Daniel P. Mitchell, New York.

THE J. WARREN GAY ELECTRIC COMPANY, of New London, Conn., has been incorporated with a capital stock of $2,400. It is organized for the sale of electrical supplies, the construction, repairing and installing of electrical machinery and equipment and the business of locksmithing.

LEGAL.

INJURIES FROM POLES.—The full bench of the supreme court, Judge Lathrop dissenting, has decided in the case of Jeremiah Riley vs. The New England Telephone & Telegraph Company, that corporations having poles in the street are liable for injuries caused by their existence provided the injured person exercises due care. The fact that the companies are entitled by reason of municipal franchises to maintain such poles does not exempt them from liability.

TELEPHONE LINES IN FREMONT, NEB.—At Fremont, Neb., on August 27, Judge Grimison rendered a decision in the case of Nebraska Telephone Company vs. the City of Fremont, adverse to the city. The city had attempted to stop the Nebraska (Bell) Company from further extension of its lines in the city, contending that the company had no franchise. The telephone company secured a temporary injunction and by this decision the injunction has been made perpetual. The company tried to show in the trial that it had succeeded to the plant and franchise of the old Fremont Telephone Company. The decision of the court is chiefly on the grounds that the company had been allowed use of the streets without objection for eighteen years. An appeal to the Supreme Court will be made by the city.

BREAKING OF TELEPHONE CROSS ARM.—In an appeal to the Court of Appeals of Maryland, in Maryland Tel. & Tel. Co. vs. Cloman, where in the first suit the plaintiff, an experienced lineman, was injured by the breaking of a cross arm at the top of a telephone pole, the lower court's decision in favor of the plaintiff was reversed. The arm broke while plaintiff was straining certain wires upon it, by reason of the existence of a knot in the arm near where one of the pins inserted to hold the insulators was placed. The defect was obscured by paint and could not have been discovered by ordinary inspection. The arm was of the kind ordinarily used, and purchased by defendant after being painted. It was held by the Court of Appeals that such facts were insufficient to establish negligence of defendant in furnishing such defective arm for use, and that the court's refusal to direct a verdict for defendant was therefore an error. In another appeal case of the same company, in an action for injuries to plaintiff by tripping over a telephone wire lying concealed in the grass in the street, the evidence was reviewed and was held to be insufficient to justify a finding that defendants owned or were in control of the wire at the time of the accident.

PERSONAL.

MR. JOHN H. BARKER, for several years with H. B. Coho & Co., has accepted the position of General Sales Agent for the Mechanical Appliance Company for all territory east of Pittsburg and Buffalo.

MR. C. O. BAKER, JR., the well-known platinum merchant, has just returned from a summer vacation in Europe, greatly benefited by the change. He met many old electrical friends while on the other side.

MR. SETH H. DYER has resigned his position of electrical engineer with the Guanajuato Consolidated Mining & Milling Company, to accept the managership of the Alumbrado Electrico (electric lighting company) of Morelia, Mexico.

MR. W. S. BARSTOW, the consulting electrical engineer, has removed his offices in New York City to suite 1100-1103 56 Pine Street. He is about to make a trip to the Pacific slope, where he has some important consultation work on hand.

PROF. C. P. MATHEWS will not resume his duties at Purdue University owing to trouble with his eyes. The injury is largely the result of the work of Prof. Mathews in arc light testing, the results of which appeared in the admirable reports on this subject made to the National Electric Light Association.

MR. CALVIN W. RICE, who went abroad a few months ago broken in health has just returned home from Europe in excellent trim, greatly benefited by the change. He pushed his travels as far as Venice, and while in England had the honor of being entertained by Lord Kelvin and Andrew Carnegie.

MR. S. HENRY BLAKE has recently been made engineer of arc lighting for the General Incandescent Arc Light Company, with headquarters at its works, Pittsfield, Mass., succeeding Mr. J. Henry Hallberg, resigned, whose assistant he has been for over four years. His most recent work has been the superintendence of the installation of 4,500 4 ampere G. I. lamps in the city of Cincinnati, Ohio.

MR. GEORGE F. DURANT and his pioneer work in the development of telephony in St. Louis come in for appreciative treatment in the *Republic* of that city. It was there that the old Law system received recognition and was long used. Mr. Durant was and is the general manager of the Bell Telephone Company of Missouri, formed as far back as 1879 with a capital of $400,000. In 1878 it had 15 subscribers. To-day it has 15,000.

MR. L. F. MAHLER, formerly district manager of the DeLaval Steam Turbine Company, at Chicago, has assumed a like position with the Bullock Electric Manufacturing Company, with offices at 1505 Chemical Building, St.

Louis. Mr. Mahler has under his supervision the following territory: The southern half of Illinois, Missouri, Kansas, Arkansas, Indian Territory, Oklahoma, Nebraska, the Dakotas, and the northern half of Texas.

THORBURN-PAINTER.—The many friends in the electrical field of the late Uriah H. Painter, of Washington, who was prominent in many of the early electric light and motor developments, are interested to note the marriage of his daughter, Miss Alice Elise Hunt Painter to Mr. D. Scott Thorburn, son of Sir Walter Thorburn, M. P., of Peebles, Scotland. The wedding took place last week at Elberon, N. J., and was a very fashionable affair.

MR. WILLIAM HENGERER, president of the William Hengerer Company, which is building the largest department store in Buffalo and one of the largest in the world, arrived from Europe last week on the *Deutschland*, and this week is in New York getting estimates on his plans for the complete electrical plant and equipment for the new Buffalo store. The plans for the electrical plant were furnished by a local electrical engineering firm, and the contracts will be placed for delivery in time for installing during January next.

SIR HIRAM MAXIM.—A cable dispatch from London says: Sir Hiram Maxim stated at a meeting of the Maxim Electrical & Engineering Company of London that he will shortly announce an important invention which will bring forth more money than anything he has ever done, not excepting his automatic gun. He added that he was putting thousands of pounds into the invention, the character of which he will not divulge until all the patents are secured. The president of the company announced that the company had the patent for a new boiler, made entirely of steel, which was more economical in working and cheaper than anything of the kind now on the market.

PROF. BYRON BRIGGS BRACKETT, A.M., PH.D., has been appointed to the chair of Physics and Electrical Engineering at the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y. Prof. Brackett is a graduate of Syracuse University and received his doctor's degree from Johns Hopkins University. His teaching experience has been in Dickinson Seminary, Williamsport, Pa.; Adelphi Academy, Brooklyn, N. Y.; Eastern High School, Washington, D. C.; Electrical Engineering Laboratory, Johns Hopkins University, Baltimore, Md.; Union College, Schenectady, N. Y.; Rutgers College, New Brunswick, N. J., with which institution he was last connected previous to appointment to the Clarkson School of Technology. His practical electrical engineering experience comprises the inspection and testing of all the cable manufactured for the U. S. Army during the Spanish-American war by the General Electric Company, at Schenectady, N. Y.; a year's work with the late Prof. Henry A. Rowland, of Johns Hopkins University in the development of the Rowland Printing Telegraph, with considerable experience in commercial electrical testing at various times.

EDUCATIONAL.

OMAHA Y. M. C. A.—The Educational Committee of the Omaha Young Men's Christian Association has issued an announcement for its night school for men which will open October 5 and be conducted through six months. Twenty-three subjects and twenty-one instructors are announced. Mechanical Drawing, Architectural Drawing, Steam Engineering, Electricity and Telegraphy will be included in the course of studies. Mr. A. J. Collett, draftsman at the Union Pacific railway shops at Omaha, will instrust the classes in drawing; Mr. A. H. Fetters, assistant mechanical engineer at the Union Pacific shops, will be instructor in steam engineering; Mr. T. H. McGrath, chief dispatcher for the F. E. & M. V. Ry. Co., the class in telegraphy, and Mr. John Hay Kuhns, electricity.

Trade Notes.

NERNST LAMP.—The New York sales offices of the Nernst Lamp Company have recently been removed from the Equitable Building to the new Hanover Bank Building, No. 11 Pine Street.

STANLEY WATTMETER.—The September bulletin of the Stanley Instrument Company, of Great Barrington, Mass., is devoted to the Stanley recording wattmeter for alternating current circuits, which is illustrated and described in minute detail.

WM. ROCHE, manufacturer of the New Standard dry battery, has recently been compelled to enlarge his plant owing to the constantly increasing demand for his product. Mr. Roche reports the most successful season he has experienced since his start in business.

"MICHIGAN WHITE CEDAR," a story in two chapters, is the title of a booklet that the Maltby Lumber Company, of Bay City, Mich., cedar dealers, is sending out to all its customers. Considerable information and some rather instructive pictures are contained in the folder, which it will be glad to send to any one interested in the purchase of cedar ties or poles.

SPRINGS.—The Wallace Barnes Company, Bristol, Conn., has recently issued a new catalogue of the very extensive line of small springs manufactured by it. The list includes springs for motors, phonographs, clocks, etc., and spiral, hinged, tapered and many other forms. Some very clear illustrations show the many kinds of springs produced by this company. The catalogue is accompanied by a new stock sheet.

THE H. T. PAISTE COMPANY, of 3101 Ludlow Street, Philadelphia, has about completed the general distribution of its new catalogue No. 10. Therein it has listed besides its line of general supplies, all of its most recent specialties, exclusively "P-K." It particularly desires that none of the trade be without a copy of its catalogue, which it considers practically a "Directory of Electrical Supplies." The copies, of course, are free and a postal will bring one.

INTERCOMMUNICATING TELEPHONES.—The Stromberg-Carlson Telephone Manufacturing Company has just issued a neatly gotten-up pamphlet on its central energy intercommunicating telephone systems. It includes some fine illustrations of the apparatus comprising these systems, and tells some of their features and advantages. On the front cover is the significant statement that "With a telephone at your right hand your department's at your command."

WAGNER POLYPHASE WATTMETER.—The Wagner Electric Mfg. Company, of St. Louis, Mo., is placing on the market a polyphase wattmeter in two forms—portable and switchboard. The same company is also manufacturing a portable alternating current ammeter, which is particularly applicable for determining the loads carried by transformers. It is supplied with a series transformer having leads 30 feet long, and so arranged that the small transformer can be slipped over the lighting transformer leads without disturbing them in any way.

STURGESS WATER WHEEL GOVERNORS.—The Sturgess Governor Engineering Company, of West Troy, N. Y., has just issued a new edition of its catalogue on water wheel governors, which have lately been brought to the attention of the public through the columns of the technical press. All the movements in this governor are produced by fluid pressure, which may be either oil or water, the former for low heads and the latter for heads of more than 100 feet. The pamphlet is well illustrated and there is a great amount of interesting data in it.

THE AVA CHEMICAL COMPANY.—Announcement has been made at the business office of the Ava Chemical Company, of New York, that arrangements will be made with local druggists for the sale of certain of the products of the Chemical Company at once. Preparations for the opening of a large number of laboratories have been steadily in progress and within ten days the first outside of New York will be opened. Others will be opened thereafter as soon as possible. The factory to be built by the Ava Chemical Company at Niagara Falls in the near future will be among the earliest completed.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, announces that owing to the constant growth of the business during the past ten years it has found it advisable to increase its cash capital and divide its business into two parts. That portion of the business relating to electrical supplies and its good will and stock of goods has been sold to the Wesco Supply Company. The other part of the business, that of railway supplies and the building of electric light plants and electric railways, will be retained and will hereafter restrict itself to this branch of the business. Note of this change has already been made in these columns.

ELECTRIC APPLIANCE COMPANY.—The general supply catalogue No. 20 is just from the press of the Electric Appliance Company, Chicago. This catalogue is a most attractive one in appearance and in completeness and arrangement is fully up to the standard of others issued by this hustling house. It lists many new articles never before shown in a supply catalogue and all out-of-date items have been eliminated. This large volume with the loose leaf discount book accompanying it should be in the hands of every electrical buyer. The company will take pleasure in sending a copy by prepaid express to anyone in the trade who has been overlooked in the distribution.

RAILWAY SHOP EQUIPMENT.—The Crocker-Wheeler Company, of Ampere, N. J., has just issued in handsome pamphlet form of 32 quarto pages and cover the illustrated description of the new shops at Collinwood, Ohio, of the Lake Shore & Michigan Southern Railway. In these shops there is a very complete Crocker-Wheeler lighting and power plant of about 1,200-hp. The motor equipment is large. Individual direct-connected motors were installed on about three-fourths of the machine tools, and the others were put into seventeen groups, each with its line shaft driven by a separate constant speed motor. The Crocker-Wheeler system of multiple-voltage speed control is used. The pamphlet is full of interesting power data as furnished from this ideal plant.

WOOLLEY FOUNDRY & MACHINE WORKS, Anderson, Ind., issue a neat descriptive and illustrative catalogue in regard to their Burger gas and gasoline engines. These are of simple, durable form. The igniter is a removable plug fitted to a hole communicating to the upper part of the cylinder where the richest gases locate, thus ensuring perfect ignition. The plug is seated at its inner end, and current is derived usually from a magneto on the engine bed. One type of the engine, the Hit or Miss, has a centrifugal governor, and the automatic type is equipped with the Rites inertia governor of the single weight type. All the Burger engines are equipped with a pump attached to the engine bed, operated by the engine, with which the gasoline is drawn from the distant storage tank. The indicator cards shown are excellent.

PIPE JOINT COMPOUND.—In a neat booklet issued by the Joseph Dixon Crucible Company is told an interesting little story about an attempt to remove a plug from a steam pipe which refused to budge because Dixon's graphite pipe joint compound had not been used, the old-fashioned red lead compound having been applied instead. Dixon's compound, it is stated, makes joints absolutely tight, and they can be easily separated at any time. This graphite compound is highly recommended for use on surfaces that are in contact, and where it is necessary that they shall not stick. Besides that the compound, it is stated, prevents rusting. Gaskets rubbed with the compound can be easily removed and used over again. Every one interested in steam fitting and engineering can get a copy of this booklet by addressing the company at Jersey City, N. J.

ELECTROMAGNETS.—The Varley Duplex Magnet Company, Providence, R. I., has issued a very interesting catalogue which contains illustrations of many of the different varieties of electromagnets manufactured by it. Among the magnets shown are spark coils, solenoids, medical coils, switchboard magnets, field magnets, ringer magnets, induction coils for telephones, fan motor coils, etc. An interesting illustration is that showing the automatic winding machines for the manufacture of telephone magnets made of either bare or insulated wire. These machines have a capacity of 50,000 per day. Views of other machines are shown. Besides the illustrations above referred to there are a couple of curves showing the relations of ampere-turns and air gap to the pulling force. The company manufactures magnets for every purpose to which electromagnets are applied. The catalogue is neatly designed and is printed in black and orange.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 8, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

737,997. ELECTRIC CONDUCTOR MOLDING, Sidney M. Buck, Philadelphia, Pa. App. filed April 8, 1903. The grooves in the molding are made undercut or dovetailed, so that when the wire is placed therein in a zigzag direction, it will engage with the sides of the groove and be held therein even when the molding is applied to the ceiling. (Dated Sept. 1.)

738,167. AUTOMOBILE CONTROLLING MECHANISM; George H. Day, Hartford, Conn. App. filed Jan. 16, 1903. A locking device for the brake co-operates with a cut-out switch whereby the locking of the brake in its applied position prevents the application of power to the motor.

738,1[illegible]. MOTOR CONTROLLING MECHANISM; Charles E. Eames, Chicago, Ill. App. filed Sept. 22, 1902. A fluid medium under the control of electrically operated mechanism is used to actuate the controlling switches.

738,188. SECONDARY BATTERY; George L. Hatch, Quincy, Mass. App. filed Feb. 13, 1899. (See page 482.)

738,201. LAMP SOCKET, Walter A. Church, Binghamton, N. Y. App. filed Oct. 18, 1902. The parts of the socket are of peculiar shape and housed within a solid block of insulating material made in two parts.

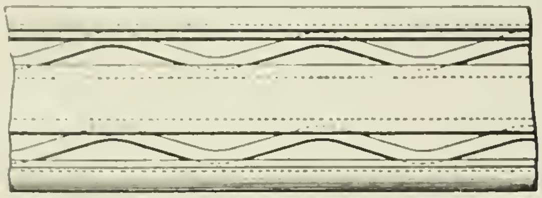
738,302. SIGNAL TRANSMITTING SYSTEM; Edward B. Elliott, Chicago, Ill. App. filed Jan. 13, 1902. A master circuit contains a transmitting key and a series of magnets, each of which operates a key in a signal circuit. By a suitable device any of the signal magnets can be made inoperative.

738,305. TROLLEY FOR ELECTRIC RAILWAYS HAVING OVERHEAD WIRES FOR SUPPLY OF CURRENT; Amedee Fayol, Bordeaux, France. App. filed June 28, 1902. A fork is pivoted near the trolley wheel and can be thrown upward by pulling on the rope, to help guide the wire into the groove of the wheel.

738,313. PROCESS OF PRODUCING ACTIVE MATERIAL AND ELECTRODES FOR STORAGE BATTERIES AND PRODUCTS THEREOF; Oliver P. Fritchle, Denver, Colo. App. filed Jan. 7, 1903. (See page 482.)

738,314. APPARATUS FOR PRODUCING ACTIVE MATERIAL AND ELECTRODES FOR STORAGE BATTERIES; Oliver P. Fritchle, Denver, Colo. App. filed Jan. 7, 1903. (See page 482.)

738,331. ORE SEPARATOR; Conrad F. Lancaster, East Liverpool, Ohio. App. filed Oct. 20, 1902. A device for removing iron particles from fire clay. The pulverized clay is passed between magnetized corrugated plates and the metal particles adhere in the re-entrant angles of the plates.


737,997.—Electric Conductor Molding.

738,333. CONTACT MAKER FOR ELECTRICAL SIGNS; Conrad F. Lancaster, East Liverpool, Ohio. App. filed Oct. 20, 1902. Details.

738,392. RHEOSTAT; Walter V. Ash, Perth Amboy, N. J. App. filed Jan. 2, 1903. A rheostat containing controllable resistances for both the armature and field of a shunt motor.

738,393. APPARATUS FOR REMOTE CONTROL OF ELECTRIC MOTORS; Walter V. Ash, Perth Amboy, N. J. App. filed Jan. 2, 1903. Solenoids arranged each side of the controlling arm can be energized from a distance to move the arm either to the right or left.

738,426. ELECTRIC ARC LAMP; Charles E. Foster, Streatham, England. App. filed July 5, 1902. Details.

738,427. PROCESS OF PRODUCING ACTIVE MATERIAL AND ELECTRODES FOR STORAGE BATTERIES AND PRODUCT THEREOF; Oliver P. Fritchle, Denver, Colo. App. filed March 18, 1903. (See page 482.)

738,437. APPARATUS FOR CHANGING CHARACTER OF ELECTRIC CURRENTS; Noah S. Harter, Cherokee, Ia. App. filed May 27, 1903. Details of a pole changing switch for sending rapid changes of polarity or pulsations from a continuous current generator.

738,442. BOILER ALARM; William C. Heitkamp, Pleasantridge, Ohio. App. filed June 23, 1902. A float in the boiler carries a rack engaging with a gear wheel which moves an external indicator to show the level of the water. The index of the indicator closes an alarm circuit at predetermined points in its travel.

738,468. LOCOMOTIVE ENGINEER'S ALARM; Edward McClintock, Merrian Park, Minn. App. filed Feb. 5, 1903. Signal rails are arranged in blocks along the main rails and co-operate with special trucks carried by the trains, so as to afford intercommunication between signal mechanisms on the trains.

738,478. BRUSH FOR ELECTRIC MACHINES; Cornelius R. Phillips, Philadelphia, Pa. App. filed June 12, 1903. A carbon brush having chambers for a lubricating material, the latter percolating through the pores of the material to the working face of the brush.

738,480. REGISTERING APPARATUS; Anton Pollak, Budapest, Austria-Hungary. App. filed July 2, 1902. A ray of light projected to the indicator from the original source of light is projected from a moving point so that the movements of the ray from the indicator may be recorded in successive lines like an ordinary written page. The apparatus is used in rapid telegraphy where the record is made on a sensitized strip.

738,489. ELECTRIC SIGN; Bert E. Salisbury, Syracuse, N. Y. App. filed Dec. 30, 1902. The receptacles are cylindrical and occupy circular holes in the face of the sign, the back of each receptacle having binding screws so that the two wires of the circuit can be readily attached.

738,519. ELECTRIC SWITCHBOARD; William F. Bossert, Utica, N. Y. App. filed July 17, 1903. The cross-connecting bars have sockets adapted to receive an ordinary screw-threaded fuse plug which fits therein to afford a low resistance contact.

738,525. TELEGRAPHIC TRANSMITTER; Joseph P. Conway, Los Angeles, Cal. App. filed Aug. 15, 1902. A series of key levers each of which carries notches that are arranged to make and break the circuit in accordance with Morse characters when the lever is pressed by the finger.

738,545. CORD TIP; William Kaisling, Chicago, Ill. App. filed June 6, 1902. A metal sleeve clamps the covering of the wire and is then inserted in a tubular portion of the tip where it is held by solder.

738,594. AUTOMATIC SWITCH HANDLE FOR ELECTRICAL TOOLS, James J. Ayer, Cambridge, Mass. App. filed April 14, 1903. A quick acting switch in the handle of a soldering iron or similar tool, so constructed that the operator is not compelled to retain a tight grip of the handle to prevent the switch from opening.

738,601. CROSS FOR CHURCH TOWERS, Joseph A. Blenke, Covington, Ky. App. filed May 16, 1903. The lamps which illuminate the cross are mounted on endless belts so that an impaired lamp can be moved from a remote part of the cross to the base portion and replaced, thus avoiding the necessity of reaching or climbing to the extremities of the structure.

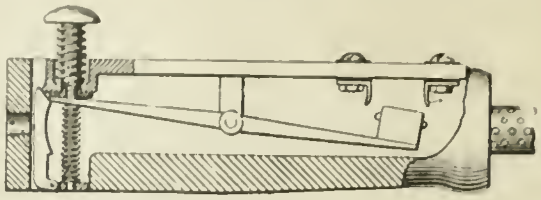
738,602. TROLLEY STAND; John J. Bouchard and William F. Ensor, Bradford, Pa. App. filed Dec. 18, 1902. Details of the horizontal pivot of the pole to avoid friction and exclude dust and dirt.

738,607. ELECTRIC WATER HEATER; John W. Ewart, Wendover, England. App. filed Jan. 3, 1903. Pipes through which the water leads have a heating resistance wrapped around them and are located in a vacuum chamber to enable the temperature of the wires to be raised higher than could be done if the wires were exposed to the air.

738,6[illegible]. ELECTRIC IGNITING DEVICE; Harry B. McNulty, Washington, D. C. App. filed Feb. 13, 1903. Details.

738,648. INCANDESCENT LAMP SOCKET; Joseph L. Yost and Owen E. Kenney, Toledo, Ohio. App. filed June 12, 1903. Details.

738,649. CONTACT SHOE FOR ELECTRIC RAILWAYS, Walter D. Young, Baltimore, Md. App. filed Jan. 21, 1903. A mounting for the shoe enabling it to constantly maintain a square contact with a third rail.


738,594.—Automatic Switch Handle for Electrical Tools.

738,651. PREVENTING LEAKAGE OF CURRENT TO STUDS IN SURFACE CONTACT SYSTEMS OF ELECTRIC TRACTION; Benjamin H. Bedell, London, England. App. filed March 17, 1903. A conducting shield is interposed between the live rail or wire and the surface stud, so that any leakage current will be grounded before it reaches the stud.

738,676. TROLLEY RETRACTOR; Richard H. Ham, Stockport, N. Y. App. filed Jan. 16, 1903. Details.

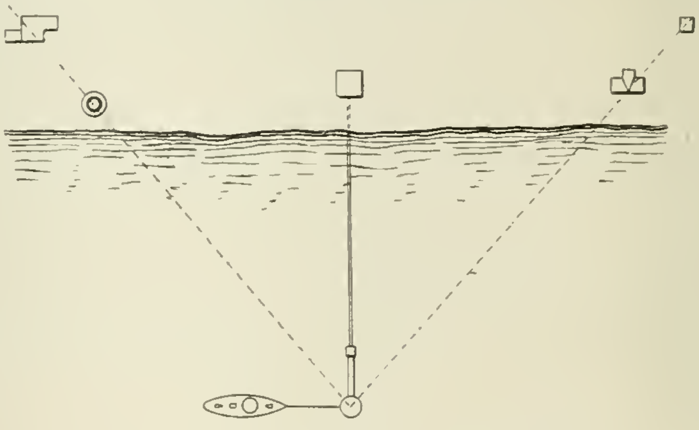
738,688. FLOOR BOX; Hubert Krantz, Brooklyn, N. Y. App. filed May 14, 1903. The box is set into the floor below the floor level and a water-tight cover screws into place until it is flush with the level of the floor, a plug carrying the terminals fitting a central opening in the cover.

738,717. LAMP SOCKET; Leonard Erikson, Malden, Mass. App. filed July 2, 1902. An elongated block having a lamp socket at each end and adapted to fit into and engage with a curved elongated reflector.

738,718 and 738,719. GALVANIC CELL; Lothar Fiedler, London, England. App. filed Dec. 22, 1902. (See page 482.)

738,721. THIRD RAIL SYSTEM; John H. Hughes, Greenwich, Conn. App. filed April 30, 1903. The third rail is supported on angle brackets which are clamped between, but insulated from, two inverted T-rails.

738,725. SYSTEM OF SUBMARINE COMMUNICATION; Simon Lake, Bridgeport, Conn. App. filed June 23, 1902. A system of wiring laid upon the bed of a body of water and connecting together various stations under water and on land and provided with means whereby a submarine vessel can make connections at a station and communicate with the other stations.


738,725.—System of Submarine Communication.

738,734. ELECTRIC HEATER OR RADIATOR; Edward G. Rivers, Richmond, England. App. filed Nov. 21, 1902. The heater units consists of enamelled metal plates having powdered and compressed carbon confined between them.

12,151. APPARATUS FOR AMPLIFYING ELECTROMAGNETIC SIGNAL WAVES; John S. Stone, Boston, Mass. App. filed Aug. 18, 1903. This patent and the one following relates to a method of developing high-frequency simple harmonic electromagnetic signal waves consisting in producing oscillations of corresponding frequency in a primary circuit and causing the same to be inductively reproduced at an increased amplitude in the elevated conductor.

12,152. METHOD OF AMPLIFYING ELECTROMAGNETIC SIGNAL WAVES; John S. Stone, Boston, Mass. App. filed Aug. 18, 1903. See preceding patent.

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NIAGARA MEETING OF THE AMERICAN ELECTROCHEMICAL SOCIETY.

The meeting at Niagara last week of the American Electrochemical Society again demonstrated the great value of this youngest of the technical societies to the profession and the industry which it represents. Not the least of its claims to the highest consideration is that its founding made known what until then the world had ignored, namely, that there existed in this country a body of workers in the field of electrochemistry who in ability and zeal rank second to none in the world; and the members of this body the society has, in the short space of less than two years, firmly united in professional solidarity and imbued with an esprit du corps equal to that of any of the older professional societies. The fact that the attendance at Niagara and the number of papers there read were somewhat below the average of the former meetings, is not to be taken as indicating that interest in the body is slackening, but rather merely as repeating the sometime experience of almost all similar bodies that two general meetings a year are one too many.

Of the papers read, that by Prof. Bancroft on "Electrolytic Copper Refining," was without doubt the most important presented at the meeting. The investigation which the paper records was equally excellent in scope and in method. The data obtained show conclusively the relation under definite conditions between current efficiency, current density and temperature in four different electrolytic solutions, three of the solutions being those in commercial use, and the fourth one for which a claim of superiority has been made. The admirable feature of the paper is that the data were determined under such conditions that any given refinery can by simply supplying the further data relating to the particular conditions of operation of its plant, determine if the economy which the experiments indicate can be realized in that particular case. In the discussion this feature of the plan of investigation appears not to have been fully realized, some of the speakers criticizing the conclusions of the paper through misunderstanding that these conclusions were not offered as general in their scope, but rested on assumptions representing only a portion of the factors entering into the commercial problem, the other factors being known in the case of any plant, and easily combined with those given for the solution of the economic problem as a whole.

Another valuable paper presented was that of Mr. Brown on "Nickel Plating." Heretofore, in this industry knowledge of the processes appears to have been almost entirely empirical, based upon experience alone without reference to the underlying principles. The paper discusses the fundamental principles and sets forth data by the aid of which the nickel plater can carry out his processes in a much more intelligent manner than in the past has been done, and, moreover, extend them successfully to meet exceptional conditions. An interesting paper was that by Prof. Burgess on the "Passive State of Iron," in which he showed how the passive electrical state which iron assumes under certain conditions has been taken advantage of industrially in electrolytically removing from steel tubing the brass left on the outside as a superfluous material during a brazing process. The discussion on the dissociation theory was a disappointment to those who expected it to be, par excellence, the enlivening feature of the meeting, its opponents being much more moderate in their tone on an occasion when specific criticism rather than general denunciation was called for. It was pointed out by those who have remained neutral in the controversy that instead of a theory, the generalization is, properly speaking, only a hypothesis, and that independently of its validity as a whole, it has been of much service in the development of modern electrochemical science.

The National Bureau of Standards.

Elsewhere we reprint that part of a recent report of the National Bureau of Standards which refers more particularly to what has been accomplished in getting into working condition the departments of the Bureau dealing with electricity, thermometry and pyrometry. As will be seen, the electrical standards equipment of the Bureau is already quite creditable in several branches, and work is progressing satisfactorily in the remaining ones. At present there are facilities for the comparison of resistances covering a wide range, and for the calibration of direct current ammeters up to 600 amperes and direct current voltmeters up to 300 volts, as well as for the calibration of direct-current wattmeters, presumably for the same limits of current and voltage. The equipment for the testing and calibration of condensers and the measurement of inductances is also quite complete. When the alternating-current department, which is now in hand, is similarly developed, the Bureau will be able to meet any demand likely to be made upon its service by the electrical industry, as well as by the various laboratories of the country. During the campaign for the establishment of the Bureau, perhaps the most effective aid was that which was lent by the electrical interests; and it is a great pleasure to know that Dr. Stratton and his able corps of assistants are making every effort to render the Bureau of the highest service to the electrical arts and to experimental electrical science.

Overhead Pole Line Construction for Central Stations.

At the recent convention of the Association of Edison Illuminating Companies this topic was discussed in a paper that we have reprinted in part on page 510. The subject is of great and increasing practical importance. Many power transmission circuits already stretch across the country, and more are destined soon to appear. The average length of these lines increases from year to year, as the voltage of transmission increases. Ten years ago five kilovolts would have been considered a high pressure. At the present time a high pressure would be from forty to sixty kilovolts, while at no very remote period in the future we may expect to see even these pressures largely increased. It is not only that high-pressure lines are appearing in greater numbers and in greater lengths, but also that low-pressure wires and signaling wires are being erected in increasing numbers. In telegraphy, on this continent, there is practically no machine transmission. Nearly every wire is worked on the Morse system by hand. When the traffic increases beyond the capacity of a single wire, the managers put up another wire. Similarly, in telephony, every new long-distance circuit calls for two more overhead copper wires, in the open country. Then the trolley feeders have to be carried overhead in interurban districts. The result is that overhead wires parallel to each other and overhead wires running at intersection, increase and multiply from year to year. There are already places in this country where six separate lines of poles run parallel and side by side only a few yards apart from each other. Some of these places, moreover, are not in the immediate neighborhood of cities.

The danger of accidental crosses between high-pressure wires and signaling wires is, therefore, constantly on the increase, unless steps are taken to lessen the danger, by special precaution, as fast as the growing multiplicity tends to increase it. While there can be no doubt about the increase of the danger through increase in the number of wires crossing each other's paths, yet there can also be no doubt that adequate construction will minimise the risk. The suggestion of the casual citizen, unversed in the subject, is to bury the wires underground. This plan is very satisfactory within city limits, but outside cities it becomes quite impracticable, the expense alone being prohibitive. Besides, long-distance telegraph and telephone wires must go overhead in order to be workable. The long-distance transmission wires must go overhead, in order to maintain their insulation. Every line of reasoning, therefore, returns to improvement in line construction. This means systematizing and standardizing the construction, in such a manner as to secure the most uniform and most reliable disposition commercially possible.

As pointed out in the paper, the principal objection to pole lines on the part of the public is their ragged and unpleasing appearance. This disregard of æsthetic appearance has often been specially charged to American overhead lines by European electrical engineers, who are accustomed to see and to construct trim and handsome lines at a considerable additional expenditure of care and money. The charge is to a great extent condoned by the great length of telegraph and telephone lines that have to be erected over uncultivated lands, in order to connect cities that lie remote from one another, and where any extra care expended upon appearances would be thrown away to the wild woods. The denser and older civilization of Europe has rendered more care necessary upon the appearance of its pole lines, as well as upon the appearance of its railroads. The same influences are, however, steadily at work on this continent tending to improve the appearance of pole line construction in suburban districts. There can be no doubt that a smart and trim pole line becomes an ornament to a landscape; or, at least, escapes being an eyesore. Moreover, such pole lines are apt to require the least expenditure in repairs, and are the least likely to get into trouble by falling upon other wires at intersections.

The paper discusses the details of pole line construction as modeled upon experience in the strenuous suburbs of Philadelphia, and contains a number of excellent suggestions. Complete specifications are offered for the uniform safe support and connection of transformers on individual poles, so as to provide immunity from accidental crossing between primary and secondary wires on the pole, as well as safeguarding the lineman who may have to change the fuses of the transformer during a time when the high-pressure wires are alive. In conformity with the best practice, the paper recommends the grounding of secondary circuits. Every year of experience with increasing primary pressures emphasize the importance of permanently grounding secondary circuits in order to prevent the possibility of bringing the secondary circuit to primary potential through any accidental cross, inside or outside of the transformer. With only low-pressure grounded electric light wires or properly protected telephone wires entering consumer's premises, the risk of accidental shock, or of danger from fire consequent upon accidental crosses outside, may be practically eliminated; while if standard line construction is everywhere followed, the chance of accidental crosses becomes itself remote.

It is to be hoped that all the electric lighting and power companies will unite their influences in maintaining the character of suburban overhead construction. The danger of accidental crosses is greatest with careless, wastefully cheap and slip-shod construction, while a single bad accident due to a cross between an overhead high-pressure and telephone wire may bring discredit in the public indiscriminating eye upon the carefully and the carelessly engineered company alike. Experience has hitherto indicated that there is considerably more chance of a cross between telephone wires and alternating-current distribution wires at one kilovolt or two kilovolts pressure, than between telephone wires and transmission wires at many kilovolts pressure. This may be due in part to the greater prevalence of distribution circuits; but it is also due, in part, to the greater care and more substantial construction which is exercised in the erection of long-distance high-pressure transmission lines. The high-pressure wires mean a great gain to the community supplied by them. They are destined to spread. It is, therefore, necessary to see that they are safely erected.

ONS AND IONS.

The communication elsewhere in this issue from Mr. Bowker sets forth an interesting hypothesis covering a great range of natural law. It seeks to cover the leading properties of ether, matter, chemical affinity, cathode rays, Röentgen rays and spectrum analysis. In the natural history of scientific discovery there is first a period during which facts are being collected. This is the purely analytical period, in which all the energies of investigators are being directed towards the collection of new material or fact discovery without any attempt to coordinate the facts or assimilate them. After the expiration of this period comes the second or synthetic period, in which effort is made to collate the data as distinguished from collecting them. In this period the laws controlling the phenomena are discovered and reduced to the form of theories. A theory, if competent, is therefore the crowning arch over columns of observations. The completed structure is grander and more imposing according to the amount of fact material which the arches span. In the natural history of ions and the science connected with them, the most recent analytical development has been so rapid, and so rich has been the harvest of fact material open to the scythe of investigation, that there has been but little opportunity for the second and synthetic period to inaugurate the theory that may aggregate and collocate all these new facts. Nevertheless, some synthetic propositions have been already brought forward, and Mr. Bowker's proposals are on the welcome list.

It has already been suggested that, in view of recent developments in ionic investigation, all matter may be composed of a single mother-substance—protyle. This protyle is supposed to be manufactured by destructive processes from concrete matter in the Crookes tube. Protyle is regarded as being composed of corpuscles, or the chips of matter which may go to build up atoms. According to that hypothesis, there are about one thousand chips of protyle in a single atom of hydrogen, and, therefore, about two hundred thousand chips of protyle in an atom of mercury. All chips of protyle are alike and indistinguishable. One particular structure of chips builds up a stable structure which may be known as an atom of nitrogen, and another particular structure having a different number of chips, differently organized, may be known as an atom of uranium. Concerning the forces which hold together the chips of protyle inside any atom, the existing hypothesis, itself a speculation, becomes yet more speculative. It has been supposed that the chips are themselves inherently electrically charged, or are corpuscular electric charges, and that they gyrate in orbits like lilliputian asteroids, with frequencies which correspond to the frequencies of spectrum analysis requirements. The internal energy of an atom, part of which may be released by rearrangement under chemical synthesis in the formation of new molecular structures, has been supposed to come from the energy of planetary movement of the chips within the atom. The presence of these protyle chips, with their relatively large independent electrical charges in an atom, seems to offer as satisfactory explanation for mechanical inertia, as observed in masses of matter. Gravitation has also been accounted for in a less satisfactory manner. Electrolytic conduction, gaseous conduction, and solid conduction, have all been explained by the existing proposals to a greater or less extent. But while all this theory has already been suggested, it comes rather from different persons at different times than from any single paper or text-book with which we are familiar.

Mr. Bowker's paper contains an independent effort to develop the most recent ionic theory, and is largely consonant with the speculations already offered. Mr. Bowker goes a step further, however, than the speculations we have seen. The chemistry of ancient times postulated the molecule of matter under the title of atom, as the minimum divisible, or smallest thinkable piece of matter. The chemistry of ten years ago regarded the atom, or component part of a molecule, as the smallest thinkable, or smallest postulable part. The recent ionic chemistry regards the ion, electron, corpuscle or chip (using these terms synonymously) as the smallest postulable piece of matter and builds atoms out of protyle, just as molecules are built of atoms. Mr. Bowker carries us yet another step, and regards the corpuscle as distinct from the passive "on." According to his view, the universal ether is made of motes of passive material called "ons." Some particular energization of an on or of "ons" makes up a corpuscle, if we apprehend his view correctly, and then corpuscles become atoms, and atoms molecules, which we might finally distinguish, if we could catch them and hold them quiet in the field of an enormously powerful microscope not yet designed or conceived. The essential difference, therefore, as we understand it, between Mr. Bowker's hypothesis and the existing hypotheses, lies in the fact that he builds the ether out of the same stuff as he builds corpuscles, and this mother stuff is "ons." The ons which lie helter-skelter in myriads to form his universal ether are energized here and there into material corpuscles or ions. What the process is that prefixes an i to an *on*, to convert it into an *ion*, or what is the difference between an *on* and an *ion*, is not suggested. An existing hypothesis, however, regards the corpuscle or ion as an energized piece of ether, just in the same way that a vortex-ring, or smoke-ring in air, is an entity derived from air by a particular energy-differentiation. On this theory, the ether, alone and quiescent, is a sort of universal fluid, and the material elements or ions are, say, vortex spirals floating in it. On this view, matter and ether are the same except that the latter is energetically inert, while the former is active or energized.

This speculation differs only then from Mr. Bowker's in that it leaves the nature of the ether in the tacit shade of mystery, and starts with ether as filling all space somehow; whereas Mr. Bowker, more conscientiously, starts with complete emptiness in space, and then fills it with separate similar ons like myriads of micrococci in order to make the universal ether. In either case the transition from ether to matter takes place through the portals of energy. Assuming that all this were true, the hypotheses would naturally converge to the expectations that not only matter might be transmuted through protyle from one form to another, say, from lead to gold—the old dream of the alchemists—but that also matter, as protyle, might be created out of ether by discovering the particular method used by nature in the past or present for blowing soap-bubbles, or generating vortex-rings, out of the ether. It is not only perfectly conceivable, on such a hypothesis, that matter might be created, destroyed, or exchanged, but it is even to be expected that the process might some day be discovered of doing deliberately and artificially that which the forces of nature may have done sporadically and automatically in the unending past. All this, however, is merely speculation, and without the limitations imposed by the existence of facts, the number of such speculations may be multiplied ad infinitum.

Report of the National Bureau of Standards.

With regard to the work of the National Bureau of Standards, Dr. S. W. Stratton, its director, gives some interesting details in relation to electrical matters. The electrical work of the bureau during the year was divided into two parts, the first including the construction and verification of resistance standards and standards of electromotive force, the calibration of resistance boxes, Wheatstone bridges, potentiometers and other resistance apparatus, direct-current measuring instruments, etc., and the second embracing the verification of photometric standards. This work has been subdivided into the following subjects: 1. Primary and secondary mercurial standards and resistance standards of precision. 2. Resistance boxes. 3. Standards of electromotive force. 4. Ammeter and voltmeter testing, and verification of resistance standards for current measurement. 5. Photometry.

Dr. Stratton says:

"At present resistance measurements of the bureau are referred to a number of 1-ohm manganin standards, reverified from time to time at the Physikalisch-Technische Reichsanstalt, which are, therefore, known in terms of the primary mercurial standards of that institution. The construction of secondary mercurial standards is now under way.

"The set of resistance standards of the bureau has now been completed and consists of ten 1-ohm coils and four coils of each of the following denominations: 10, 100, 1,000, 10,000, 100,000, 0.1, 0.01, 0.001 and 0.0001 ohms, together with two 2-ohm, three 3-ohm, two 5-ohm coils and two megohm boxes, so that there are on hand in most cases two reference standards and two working standards of the same denomination. Two 0.00001-ohm standards are under construction.

"The materials for a new lot of standard cells have been purchased from a number of leading manufacturers. The cells are to be set up in the immediate future. Arrangements have been made with the Weston Electrical Instrument Company for the loan of a dozen cells of the portable type, to be used in determining the relation between the standard cells of the bureau and those of the English and German institutions.

"A laboratory has been equipped for the calibration of direct-current ammeters, voltmeters and wattmeters, and the verification of resistance standards for the measurement of very large currents. The present range is 600 amp. and 300 volts, but will be considerably extended in the near future. The resistance standard of lowest value of the bureau is 0.0001 ohm. Standards of considerably smaller resistance can, however, be accurately calibrated. The double-bridge method is employed.

"Facilities are now provided for the verification of resistance standards of precision and standard cells, the calibration of resistance boxes and other resistance apparatus, ammeters, voltmeters, wattmeters, watt-hour meters, the verification of resistance standards for current measurement, the determination of the electrical conductivity and the temperature coefficients of materials.

"The second part of the electrical work has included the measurement of electrical inductances and capacities, and the testing of inductance coils and condensers, and the preparation for alternating-current measurements of a wider range.

"The bureau is now prepared to measure the capacity of condensers by various methods, expressing it in terms of the standards of the bureau, and to test condensers for leakage, absorption and temperature coefficient. The bureau is also prepared to measure inductances in terms of its standards, and will shortly be prepared to measure both inductances and capacities in absolute measure.

"The calibration of alternating-current voltmeters and ammeters will begin in the near future, as well as the testing of alternating wattmeters and watt-hour meters, frequency indicators, phase indicators and other alternating-current apparatus."

In regard to thermometry and pyrometry, the report says: "For scientific work requiring the highest attainable accuracy in the measurement of temperatures in the interval 0° to 100°, this bureau is now in the possession of five Baudin thermometers of the highest perfection of workmanship, and eight Tonnelot thermometers, all of which have been carefully studied at the International Bureau of Weights and Measures, and thus serve to define the connection of the temperature scale used by this bureau with the international scale of temperature of the hydrogen gas thermometer. The bureau has further prepared specifications and is now having constructed by Richter, of Berlin, a number of primary standard mercurial thermometers that are to be carefully studied at and compared with the standards of the Physikalisch-Technische Reichsanstalt.

"Specifications have been prepared and primary standard mercurial thermometers are now being constructed by Niehle, of Berlin, and by Baudin, of Paris, for work in the interval 100° to 550°. The specially designed platinum resistance thermometers have been constructed by the Cambridge Scientific Instrument Company, and have just been received by this bureau. A special Wheatstone bridge resistance box has been designed for use with these platinum thermometers and is now nearly completed. The comparison baths for work in the interval 100° to 550° are now being designed and the necessary parts assembled, so that the bureau will be in a position in the course of several months to certify thermometers up to 550° C.

"For the testing of pyrometers in the interval 500° to 1500° C. much of the necessary apparatus is now in hand. As standards the bureau is in the possession of several platinum and platinum-rhodium thermo-couples, which have been compared with the standards of the Reichsanstalt, in addition to a number of thermo-couples from other sources, and as soon as these have been recalibrated and intercompared the bureau will be in a position to certify pyrometers for the public. The platinum thermometers will also serve as standards up to 1000° C. For the testing of pyrometers the bureau has available several small gas furnaces, several electric furnaces with necessary regulating rheostats, two radiation pyrometers with an electrically-heated "black body" for the calibration of radiation pyrometers, a specially-designed potentiometer suitable for thermo-electric work, a Callendar recording pyrometer, etc. A very thorough digest of the most important work done in the field of high temperature measurement from 1830 to the present time has been prepared.

"The bureau is at present prepared to certify clinical thermometer mercurial thermometers in the interval —30° C. (—22° F.) to + 100° C. (212° F.), and thermo-couples in the interval 0° to 1500° C. (2700° F.)."

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Trains for the New York Subway.

Tests have been made lately on the Manhattan Elevated road with a five-car train of the style intended by the Interborough Railway Company for the underground road. Some details of the fireproof features have already been given in these columns. Mr. Frank J. Hedley, the general superintendent of the Interborough Company, himself explained the automatic brake system on the cars, as follows:

"The cars carry two lines of air pipes, known as a main reservoir and a train-line pipe. When the train is in motion the main reservoir line is charged with 90 pounds of compressed air to the square inch. The air is compressed by means of electrically-driven compressors, which are installed under each motor car. When the train is in motion the train-line pressure is so regulated that 70 pounds pressure to the square inch is carried, and any reduction in the train-line pressure causes the brakes on the entire train to set automatically and simultaneously. The train-line pressure is coupled with the electric controller, and if at any time while the current is being fed into the motors the motorman should for any reason take his hand off the controller when the train is in motion, the brakes are at once set on the entire train. Just before the brake is automatically set the current is cut off from the motors on the entire train. This also is done automatically.

"The cars are also equipped with what is known as the conductor valves. These valves are provided with cords which run through the trains and upon the platforms, so that any conductor anywhere on the train can set the brakes immediately. In addition there is an automatic stop valve on each truck. Should any motorman at any time run past a danger signal the brake will immediately set and his current be cut off, thus making it impossible for him to run far beyond a danger signal.

"There are no gates on the cars, but sliding doors in the vestibules. They are opened and closed by means of levers. The windows open from the top, instead of the bottom, as on the elevated cars. Each train will have eight cars, five of them motor cars, and three trailers. Five hundred cars are at present being built. They will all be run on the Second Avenue elevated line during the winter, and the cars now running on that road will be distributed over all the lines." Mr. Hedley also repeated what has already been set forth as to the steps that have been taken to protect the cars from fire and the passengers from any fire due to short-circuits, collision, etc.

A Theory of Ons: In Reconciliation of the Undulatory Theory of Electricity With Ionization and the Electron Hypothesis.

By R. R. Bowker.

After study of the most recent data on ionization and of the hypothesis of the electron as developed by Prof. J. J. Thomson, Sir Oliver Lodge and others, I venture to propose the following hypothesis, based on a homogeneous unit of primordial matter, which may best be called the "on" (from Greek ὤν, and as a logical primitive of *ion* and *electron*), in support of the undulatory theory of electricity and in reconciliation with it of the observed corpuscular phenomena.

It is now admitted and asserted by investigators that the "atoms" of "elements" are structures of component particles. The latest investigations confirm the indications of the Frauenhofer lines, which have always seemed to suggest, indeed to prove, that the elemental atom is composed of parts, whose frequencies of tonic and perhaps harmonic vibration produce the distinctive lines.

It is now also asserted that in all electrical conductors the constituent molecules, supposedly neutral or balanced electrically, are in part or in whole dissociated into electrically charged particles, which may be atoms or combinations of atoms, called by Clausius and Faraday, "ions."

It has long been proven that the most diverse physical properties may result from differences solely of arrangement of the same constituent particles, as is sufficiently illustrated by the fact that fifty-five allotropic compounds of $C_9H_{10}O_3$ have diverse and distinctive properties.

I state the proposed theory synthetically instead of analytically for greater clearness in statement.

It may be supposed that homogeneous ons, so infinitesimal as to be practically imponderable (which when passive and uncombined may constitute the space-medium or ether, responsive to and transmitting vibrations of all wave lengths) constitute when energized and combined ponderable matter, generating or transmitting vibrations of distinctive wave lengths selectively according to the nature of the combination.

It may be supposed that these ons constitute distinctively the "atoms" of the several "elements" by differences of numbers or of systems of arrangement. The distinctive groups or systems within the atom, like the strings of the piano, would give, by their different lengths or masses and thus distinctive tonalities, the characteristic spectrum lines. It is conceivable that the ons within the atom might be associated cohesively in inert groups as rods, plates or other solid figures, or in active vortex whirls, or in orbital rotation like the solar and stellar systems of astronomy, linking the infinitely great with the infinitely little.

It may be supposed that the distinctive elemental atoms are variants of one of these systems, or that the different orders of elements may have their atoms built on different orders of systems. It is conceivable, for instance, that the inert gases of the argon group may be inert combinations of ons, while the more active elements might be rotating orbital systems. It is claimed that rotating planes would give the doublets and triplets recently discovered among the Frauenhofer lines. It would seem probable that atoms of a small number of ons, therefore, or low atomic weight and comparatively simple structure, would occur most largely—as is actually the case.

It may be supposed that differences of energy would be shown in energized ons, atoms and molecules, either by excess or lack of normal energy, or by difference of vortex or orbital direction, thus manifesting positive and negative electric character. Thus atoms, and consequently molecules, having more positively electric ons, or "posons" than negatively electric ons, or "negons" (the original electron), would have positive electric character and would be satisfied or electrically neutralized only by combination with a substance having negatively electric ons in excess. Thus hydrogen and the other metallic elements would as a class have an excess of positive ons, or positive motion, and the non-metallic elements an excess of negative ons, or negative motion. It is conceivable that electric intensity might vary with the rapidity of the vortex or orbital motions.

It may be supposed that under conditions of extreme excitation, caused by vibrations of great intensity (as by extreme heat) or of high frequency (as in the case of ultra-violet, Röntgen and like rays), ons are separable from the atom, the degree or conditions of separability varying with the structure of the several elements and their physical relations. A like condition of an explosive separation of ons from the atom, and incidentally a breaking up of the molecule, partial or complete, might be developed under the exhaustion conditions of a Crookes tube under the influence of electric vibration, making the gas a conductor, producing the "fourth state of matter," and causing the cathode rays.

It may be supposed that the propulsive energy separating the ons from the atom would give the ons a high rate of speed, possibly in an orbit about the atom, in one direction, giving negative electricity, and that the reaction would give the larger atom a repulsion or rotation at a speed lower in inverse proportion to the larger mass, in the opposite direction, giving positive electricity. This suggestion seems to parallel the conditions of the supposed electron, while in accord with the undulatory theory and the conservation of energy.

It may be supposed that the degree of separability of the on from the atom differs with the atomic structure of the several elements. Thus the high atomic weights, indicating a large number of ons and correspondingly increased complexity of structure, of the new radioactive elements suggest that these may be of comparatively unstable structure or of unstable equilibrium, comprising ons or groups of ons easily separable as permanent emanations, either by the stored propulsive energy or by the conversion of energy from cosmic sources into this radioactivity. On this supposition three classes of radiations would be distinctively accounted for: one of actual corpuscles, the repelled ons, two of waves proper, arising respectively from the quick pulsations of the repelled ons and from the slower pulsations from the residual atoms. The separation of the ons might be in so small a proportion of the substance as to alter its physical properties comparatively little, producing possibly, however, such changes as have supposedly been noted in thorium. If the separable ons had a tendency to come to the physical surface of the substance, this might account for the resumption of radioactivity noted in thorium. The emanations of ons might constitute an inert gas, identifiable with the gases of the argon group.

It may be supposed that the conditions of separability of the on from the atom differ with the physical relations of the same substance, as in solid, liquid or gas. Thus the separation may be limited and temporary in the case of solid conductors, as copper, producing ionization during the passage of a current, while in liquid electrolytes, ons set free or repelled may transport with them in the process of convection as ions less active particles which, when the on surrenders its energy, appear at the odes again as atoms or molecules of the element or compound, the degree of decomposition depending upon whether the elements in a compound are electrically balanced, as in the case of some compounds, or are electrically unsatisfied. This suggestion is also in conformity with the observation that the negative ions of all gases are the same, and the view that the negative corpuscle (or electron) is perhaps a thousandth part of the atom.

To put this theory briefly, it suggests that the several elements may be constituted of different systems of homogeneous ons, whose relations of vibration within the atom produce electrical energy positive or negative according to the direction or other quality of the motion. I venture this hypothesis for the consideration and cross-fire of investigators.

Telephony in Abyssinia.

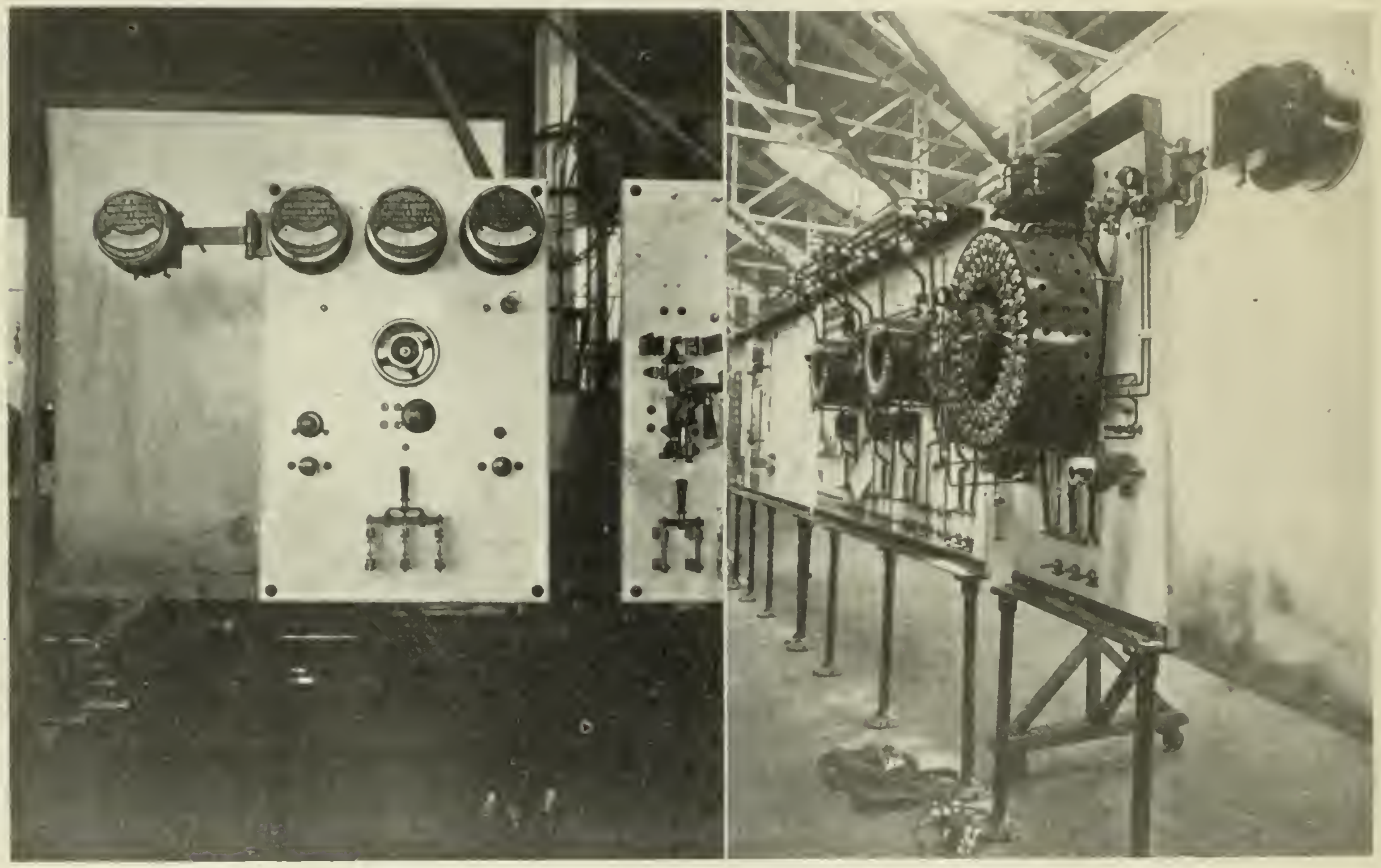
Emperor Menelek, of Abyssinia, it is stated, is establishing a complete telegraphic and telephonic system in that country. Both have been in operation for some years between the towns of Harar and Addis Abeba, and recently the seat of Government has been connected by telegraph with Jibuti, on the Gulf of Aden. There are thus more than 500 miles of telegraph line already at work in the empire, and recent extensions will increase the total length of line in use to about 1,200 miles. A telephone system now connects Asmara with Barromedia by way of Adowa, and Addis Abeba with Ankober. The Emperor has given permission to Italians to construct the line from Massowah on condition that it passes by Ankober, where political prisoners are detained. He receives daily reports by telephone from all parts of his empire. The southern frontier is not yet included in the system, but he has given orders that a telephone line 400 miles long shall be constructed there. The necessary material has already arrived in the country, and the work of construction will be carried on as rapidly as the conditions will permit.

Alternating Current Switchboards—I.

By Stephen Q. Hayes.

ONE of the most important, but often least noticed parts of an electrical installation is the switchboard, which has been described as the brain of an electrical system. This description is a very apt one, for a switchboard performs all the functions of controlling, protecting, measuring and regulating an electrical system that the brain performs for the human system.

The devices used for controlling are the switches which connect the various sources of power, such as generators, transformers, batteries, etc., feeding into the switchboard, and the feeders, etc., feeding out. Protective devices such as fuses, circuit breakers, etc., are to protect the various apparatus from damage due to excessive current, etc. Measuring devices comprise the various ammeters, voltmeters, wattmeters, etc., used to indicate and record the output of the various circuits. Regulating devices cover rheostats and regulators of various kinds. In the design of switchboards, as in the design of everything else, there are three points always to be borne in mind: 1st. Work to be done. 2nd. Method of doing the work. 3rd. Cost of doing the work.



Figs. 1 and 2.—Front and Rear Views of 100-250-Volt Switchboard.

In any given case the work to be done is usually clearly understood and definitely known, but the method of doing the work and its cost is subject to many possible variations.

One man may want the cheapest switchboard that will do the work while another wants the best irrespective of price. Between these two limits there is a very wide range, and it is part of the duties of a designer to be able to meet all conditions and supply a board that will be satisfactory as regards cost and completeness.

With this end in view standard lines of switchboard panels have been designed to meet all conditions liable to be met with in actual service. While the question of cost has not been lost sight of, more attention has been paid to secure completeness, reliability and good appearance than to keep down the cost to a minimum. Panels have been designed for direct-current plants, and for alternating, the latter ones being the subject of this paper, the boards being those made by the Westinghouse Company.

The type of switchboard shown in Fig. 1 is for 100-250 volts, and consists of polished marble panels placed side by side and supported on a suitable iron frame. The instruments, switches, etc., for the generator and feeder circuits are mounted on and form a part of these panels. In general these panels are intended for small installations and should not be used for plants having many multiple running generators. One panel should be installed for each generator and one for each set of feeders. Additional generators and feeders may be provided for at any time by adding the proper panels.

Blue Vermont marble, 1½ in. thick, ⅛ in. bevels, is standard, but panels are supplied of white Italian marble or black enamelled slate if desired. The framework consists of a piece of 3 in. x 2 in. x ¼ in. angle iron running the length of the board at the top of the panels, and a similar one at the bottom. A gas pipe leg at each end and one at every junction supports the marble 28⅜ in. from the floor line. The top angle iron, and, occasionally the bottom one, should be braced to the floor, the ceiling or the wall, and for small boards of five panels or less, where the bus-bars are not too heavy, this type of construction is entirely satisfactory. For boards of a greater number of panels or with heavy bus-bars a construction described later, should be used.

The controlling apparatus for an exciter consists of an exciter field rheostat and plug switches in the alternating-current circuit. When ammeters and voltmeters are wanted in the exciter circuits, it is necessary to provide exciter panels. The voltmeter is connected to the lines by means of a plug and receptacle, so that the voltage of any phase can be read. Knife switches with 250-volt spacing are used for these panels and at the time this line was laid out it was not intended to use these panels above that voltage. Since that time the Board of Fire Underwriters have authorized the use of these switches up to 440 volts alternating current, so that these panels can be used up to that voltage. These switches are described at some length farther on.

Both the alternating-current field and direct-current exciter rheostats are mounted on the back of the generator panels. The latter rheostat is placed inside the alternating-current rheostat frame and both are operated independently by concentric handwheels on the front of the board.

Fig. 2 is a rear view of this board and shows clearly the type of framework, the concentric rheostats for the generator and exciter, the shunt transformer with its fuse block and the plug switches in the field circuit of the alternating-current generators. It also shows the swinging bracket on which the voltmeter is mounted and the method of locating the voltmeter resistance on this same bracket.

Fig. 3 is a diagram of connections for a board of this type and shows how the ground detector, voltmeter and synchronizer are connected. The ground detector consists essentially of a transformer with a three-point receptacle for three-phase work and a four-point for two-phase, with a plug, lamps and push button. If there is no ground on the circuit, the lamps will not light up, no matter in what receptacle the ground detector plug is placed. If there is a ground, the lamps will light up when the plug is placed in any receptacle except that one connected to the grounded leg.

The object of having the ground detector push button "double-contact," i. e., forming single-pole, double-throw switch is to allow the circuit to be normally closed across one phase by placing the ground plug in the receptacles marked with red fibre. This allows the lamps to be used for illuminating purposes, etc., as the push button is held by a spring in the closed position until it is desired to test for ground.

The diagram illustrates the method by which the voltmeter is connected across any phase and shows the connection for synchronizing. The instant of synchronism is indicated by the lamps being dark.

The two-phase generator panels have two ammeters, one in each phase, two two-pole switches or one four-pole, one combination rheostat, one voltmeter with six-point receptacle and plug and two field plugs. One type of panel has a synchronizing and ground detector outfit and is used for the first machine installed; a second type has the ground detector outfit omitted, and is used for the second and succeeding generators; a third type has the synchronizing outfit omitted and is used where there is only one machine and no additions are expected.

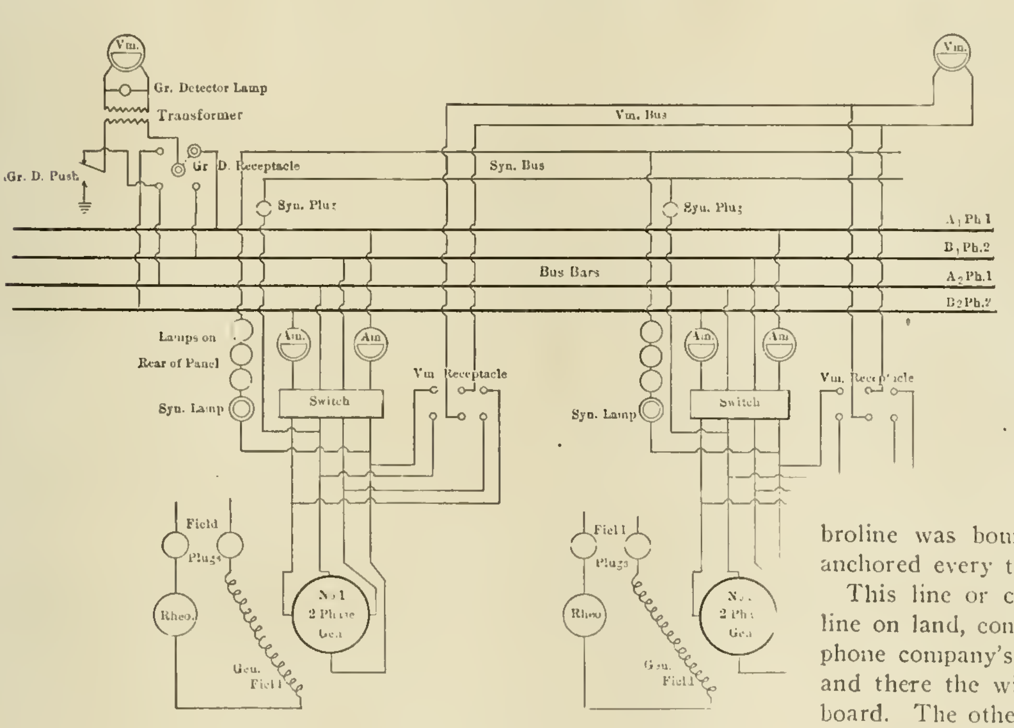


FIG. 3.—DIAGRAM OF CONNECTIONS.

The two-phase feeder panels are built both with and without ammeters and as a rule two or more feeder switches are placed on a panel. Where ammeters are used, only one per feeder and not one per phase is the rule. The three-phase panels are similar to the two-phase except that the generator panels have three ammeters instead of two and both generator and feeder panels have three-pole switches.

It is a rule to recommend against the use of fuses or other automatic protection in generator circuits where the machines run in multiple. The reason for this is that generators of the sizes used with these boards should have sufficient armature reaction to prevent the current increasing to a dangerous amount, even on a dead short-circuit, so that fuses are not needed to protect the generators. At the instant of synchronizing two generators, if they are not exactly in step when thrown together, there will be a rather heavy flow of current from the leading to the lagging machine, which will pull the two machines together without damage to either. If there is a fuse or automatic circuit-breaker in the generator circuit it is very liable to blow at this time, making it necessary to replace the fuse or breaker and start again to synchronize.

Fuses, when ordered for the feeder circuits, are usually supplied for separate mounting, for on these panels there is rarely room enough for them to be mounted either on the front or on the rear.

This type of board is built with switches of 100, 200, 300, 400 and 600-amp. capacity, and, therefore, should not be used for larger machines than the following: Two-phase, 440 volts, 500 kw; three-phase, 440 volts, 450 kw; two-phase, 220 volts, 250 kw; three-phase, 220 volts, 225 kw.

The above are limiting sizes and wherever possible for machines near the limit in size, panels of another type should be used as being mechanically stronger and being better arranged for heavy bus-bar work.

The Telephone at the International Yacht Races.

In connection with the recent yacht races an interesting application of the telephone has come to notice. The application in question was the equipping of the steamer *Sunbeam*, tender to the *Reliance*, with a complete set of telephone instruments, placing them in connection with the entire Bell system throughout the United States. As is well known, the mooring ground of the *Shamrock I* and *Shamrock III*, the *Reliance* and their tenders, was inside the Horseshoe at Sandy Hook. There each day the *Sunbeam* came to anchor during the races and for some time previously.

In order to place a telephone on the *Sunbeam* it was necessary for the New York & New Jersey Telephone Company to utilize their pole line running to the Hook, which carries the telephone line to the instruments leased by the government. From the last pole of the company additional temporary poles made of iron pipe were set upon the government dock to the nearest point from which the *Sunbeam* came to anchor. From the last pole an insulated pair of wires was run under the water to a temporary buoy placed by the telephone company. This pair of wires was covered with rubber and braid and served with hambroline to form an armor to resist the chafing of shells on the bottom of the bay. The hambroline was bound every sixteen inches and the cable thus made anchored every twenty feet with twenty-pound iron weights.

This line or cable was attached to a pair of wires on the pole line on land, connecting with a pair of wires extending to the telephone company's exchange at Atlantic Highlands, 14 miles distant, and there the wires terminated in a drop and jack in the switchboard. The other end of this twisted pair wire or cable terminated on a cork buoy in a detachable coupling placed in the vicinity of the point of anchorage of the *Sunbeam*. From the other side of the coupling a twisted pair wire was run (not served in this case, however, with hambroline) through a large sheave block rove to the masthead and extending to an ordinary set of telephone instruments placed on the steamer. Five hundred feet of slack was allowed for the swaying of the boat and the variation in its anchorage.

TELEPHONIC CONNECTION WITH TENDER "SUNBEAM."

When the connection was made to the instrument on the steamer, communication was established with Atlantic Highlands exchange and thence through the entire telephone system, precisely similar to any other subscriber in the Atlantic Highlands exchange. When the *Sunbeam* left her moorings the coupling was opened, slack wire coiled on top of the boat's pilot house, the steamer then proceeding on her way. On the boat's return the coupling was united and telephonic communication established. In this way Mr. Iselin and his guests on board the boat communicated with many New York and New Jersey points.

The accompanying engraving shows the tender *Sunbeam* just after the boat had come to anchor and the connection had been established to the temporary buoy. The pair of wires running from the mast head to the buoy and the buoy itself are plainly visible.

Overhead Pole Line Construction and Operation for Central Stations.*

By A. H. Manwaring and J. T. Hutchings.

When the generation of electric current for light and power purposes had been commercially attained, and the necessary lamps and motors had reached a stage of development which promised successful operation, the problem of the distribution of the current claimed the attention of the electrical engineer. The presence of the large number of overhead telegraph lines served as a precedent and the central station distributing wires were, therefore, carried overhead on poles, and the line fittings patterned after existing telegraph construction. These fittings, however, failed to entirely meet the conditions of electric light distribution; and while some effort was made towards improvement, yet in the main the pole lines were greatly neglected. This was probably due to the expense involved, and also to the disposition of the station manager to concentrate his energies on the apparatus giving immediate trouble and his tendency to unconsciously postpone the improvement of the general construction until some opportune occasion, which unfortunately never presents itself.

The original construction was usually light and cheaply erected, and the lack of proper maintenance increased the number of accidents, which, together with the unsightly appearance of the poles, strongly agitated public opinion against the entire construction; and in many cities legislation was adopted to compel all wires for electric lighting purposes to be placed underground. On account of the limitations of the art, however, the installation of underground wires was not entirely successful. In recent years the improvements in construction have, in a large measure, overcome the original difficulties, and many lines which originally were overhead have been placed underground with entire success, especially in the more congested districts of large cities where the volume of business warranted the expense.

In suburban districts and small towns where a comparatively few consumers are scattered over a large territory, the cost of underground construction is prohibitive; and the cheaper pole line construction is the only alternative. For high-tension transmission lines carrying currents of 20,000 volts and over, pole line construction has been found the most feasible on account of the great distances covered and the cost of other forms of construction.

There is an impression existing among many engineers that an overhead pole line supplying electricity for light and power cannot furnish as satisfactory service as an underground system. While in many instances the results have, perhaps, justified their impression, yet it must be borne in mind that the most careful attention to all details is given to underground systems and no expense spared to make them satisfactory and reliable. If one-half the attention were paid to the details of overhead lines that is now given to underground lines, the system would be quite as satisfactory and reliable for continuous service to individual consumers as the underground system and much more cheaply maintained.

This paper treats of some of the important points to be considered in successful pole line construction for a plant supplying current for series arc lighting and alternating current for light and power; and refers especially to the methods in vogue in those sections of Philadelphia where business at the present time is not sufficient to warrant the installation of underground wires.

POLES AND CROSS ARMS.

The poles most frequently used are chestnut, Southern cedar, pine and iron. Chestnut poles when well seasoned are preferable for general line use, and are purchased to conform to the following specifications:

The poles must be straight, live white chestnut, having all bark removed and knots trimmed flush with the surface. The poles must not be less than 8½ in. in diameter at the top and have the following dimensions six feet from the butt: 35-ft. poles, 13 in. diameter; 40-ft. poles, 14 in. diameter; 45 ft. poles, 15 in. diameter; 50 ft. poles, 16 in. diameter; 55 ft. poles, 17 in. diameter; 60 ft. poles, 18 in. diameter.

The poles should be well shaved with a draw knife, except the part to enter the ground, which varies in length from 5 to 7 ft., as follows: 35 and 40 ft. poles, 5 ft.; 45 and 50-ft. poles, 6 ft.; 55 and 60 ft. poles, 7 ft.

Poles are roofed at the top to form a right angle. The poles are "gained" to form a flat of about 5 in. for the attachment of the cross arms, which are spaced 24 in. between centers, the top of the first arm being 1 ft. from the top of the pole.

All poles upon which are located devices requiring regular inspection, should be provided with steps in order to facilitate this work. The standard step is made of galvanized iron ½ in. diameter by 9 in. long, having 3 in. of thread. These are preferably placed 15 in. apart, the distance between two steps on the same side of the pole being 30 in., and the first step is placed 6 ft. from the ground.

Poles are spaced from 40 to 45 yards apart, depending on circumstances, and all end and corner poles are guyed with ¼ in. or ⅜-in. stranded galvanized wire. In long lines every tenth pole is also guyed, the wire being carried from the top of one pole to about 6 ft. from the base of the next. Poles are periodically inspected to determine if they are in good condition and perfectly safe.

Iron poles, generally speaking, should be avoided on account of the liability of shock to the linemen when working on live wires. The use of these poles, however, cannot always be dispensed with, and when used for street arc lighting, the lamp should be so arranged that it can be lowered and trimmed and from a stepladder, thus protecting the trimmer. If it is found necessary to suspend the lamp from a bracket attached directly to an iron pole, thus necessitating trimming from the pole itself, a portable grounding wire should be furnished which can be attached to the lamp, thus grounding the circuit and making it perfectly safe for the trimmer. This arrangement has been found to work very satisfactorily in actual service, although some trouble has been caused by the trimmer neglecting to remove the grounding wire after trimming the lamp. This, however, has been overcome by imposing a nominal fine for each and every offense. The safety of the trimmers is also considerably increased by grounding both wires of the circuit in the station during the time that the current is off.

Poles of Southern cedar lack mechanical strength, and pine is short-lived. These poles are, therefore, inferior to chestnut and should not be used when the latter is obtainable.

Junction poles in the past have caused considerable trouble, principally due to the manner in which branch lines at right angles to the main line were connected, and further, to the placing of fuse boxes on these poles. It is of the utmost importance that the wiring of junction poles should be made as simple as possible. Branch wires should be attached to reverse arms and the connections from the main to the branch circuit be made by vertical taps. Under these conditions the junction pole will be safe and accessible to linemen.

Cross arms should be made of selected yellow pine, free from knots and sap, finished on all four sides and having the upper corners chamfered, except where the arm bears against the pole. Cross arms should always be purchased unpainted in order to permit of rigid inspection, and immediately upon acceptance they should be covered with three coats of good white lead and oil. They should be attached to the poles with ⅝-in. through bolts with nuts and washers.

BRACES, PINS AND INSULATORS.

The braces are made of galvanized iron 28 in. long, 1¼ in. wide, 3/16 in. thick, having a hole 2 in. from each end, one 7/16 in. and the other 9/16 in. in diameter. Carriage bolts ⅜ in. x 4 in. are used for attaching the braces to the cross arms, and ½ in. x 4 in. lag screws for attaching them to the poles.

Locust pins 1½ in. x 9 in. well boiled in linseed oil are preferable for lines of 5,000 volts and under.

Double petticoat glass insulators are used for all series arc wires and secondary distributing wires. For alternating-current lines of 2,000 volts and over a special porcelain insulator is used in Philadelphia.

LIGHTNING ARRESTERS AND FUSE BOXES.

Lightning arresters are required primarily for the protection of transformers on the line and of apparatus in the station. The arrester installation for the station should be the best obtainable, and should be so placed as to be under continual supervision by the switchboard attendant. With the exception of these no lightning arresters should be placed on the main line.

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* A paper read at the Thousand Islands Meeting of the Association of Edison Illuminating Companies.

Each branch line should be protected with at least one set of lightning arresters, and in some instances several should be used, depending on the length of the branch line, location of the transformers, and the nature of the territory covered. All lightning arresters should be most carefully grounded, and it should be borne in mind that one set of arresters properly installed is superior to a number of arresters with poor ground connections.

Lightning arresters should not be directly protected by fuses, but they should be arranged with suitable devices to easily cut them out of circuit for inspection. This can be accomplished by the use of suitable fuse boxes having copper wire substituted in place of the fuses, or line switches having carrying capacities equal to that of the lines. After every heavy electrical storm, lightning arresters should be inspected to see that they are not damaged, and periodic inspections should be regularly made to see that the gaps are clear from dirt or dust.

The following are a few of the necessary requirements of a satisfactory fuse box on alternating-current circuits having voltages of from 2,200 to 2,500 volts:

1st. The fuse should be capable of opening the circuit under any and all conditions of short-circuit or overload.

2nd. The fuse box should be designed to prevent any leakage of current from the metal parts in circuit to the case of the box, under any and all conditions of weather. In fact, the insulation should be such that the box would operate with perfect satisfaction if mounted upon an iron cross arm.

3rd. The break distance should be sufficient to allow of the opening of the box under an inductive load of at least 30 amperes, without causing trouble.

4th. The box should be arranged to be easily and securely attached to standard cross arms in such a position as to be easily and safely opened for inspection and for the replacing of fuses.

5th. The box should be so arranged for the introduction of wires as to render contact with them unnecessary when the linemen open the box.

6th. The design should be such that when a fuse is replaced the lineman is in no danger of being burned by the arc or hot metal, or of receiving an electric shock.

At the present time there is no fuse box on the market that entirely meets all of these requirements, although several fulfil many of them. Fuses which were formerly perfectly satisfactory on 2,200-volt circuits, supplied by small generators, operated singly, will no longer break the circuit in case of short-circuit on the larger generators now generally used. When short-circuits occurred under the old system, the engines slowed down and the generator voltage dropped practically to zero, and almost any of the fuse devices on the market would open the circuit. At present large generating units frequently operate in parallel, and a fuse to be satisfactory should be capable of being blown directly across the bus-bars at the station without maintaining an arc. In Philadelphia we have instituted a rule to install no fuses of a greater capacity than 30 amperes on our alternating-current distributing lines. With a circuit-breaker at the station set for 125 amperes, these fuses will then open the branch circuit with little or no indication at the station.

The cut-outs protecting transformers should be so located as to be easily and safely reached for inspecting and replacing fuses.

The connecting wires to the fuse boxes should be insulated with at least 5/32-in. rubber, covered with a double saturated braid, and secured in such a manner that it is impossible for them to come in contact with other lines.

LOCATION AND INSTALLATION OF TRANSFORMERS.

Transformers should be attached to cross arms entirely independent of those carrying high-tension lines and should be so located as to be easily inspected. If the transformers are of large sizes, the arms to which they are attached should be reinforced in such manner as to insure their security under all conditions, and if necessary an additional arm should be placed below them to facilitate the climbing of the linemen to the upper part of the pole. Under no condition should the transformer be erected in such a position on the pole as to interfere with the regular work of the linemen.

LOCATION AND CONSTRUCTION OF TRUNK LINES.

The territory to be supplied should be divided into sections having as far as possible definite boundaries, both for series-arc and alternating-current circuits, in order that the power house, switchboard and line attendants and the office force also may be conversant with the exact district covered by each circuit.

The number of wires leading from the power house should be reduced to the least possible number. This can be best accomplished by increasing the size of the circuits and operating at high voltages. For this reason and also for the betterment of the service, all 1,000-volt alternating-current circuits should be increased to 1,100 volts, and series arc circuits to 125 lights each. With such a system the number of wires leading from any station can be kept within satisfactory limits. There should be, however, not less than two main trunk lines leading from the power house, and these should be run in as direct a line as possible to the centers of the various sections. However, care should be exercised that these lines are run in streets having the least number of telegraph and telephone wires, and also where they will be least objectionable to the public. In fact, it is preferable to increase the length of a line 1,000, or even 2,000 ft., than to select a more direct route at the expense of public good will.

Series circuits for both arc and incandescent street lighting should, as far as possible, be laid out in compact blocks, and so arranged that with the exception of the main lines there will be but one line on a street; in other words, a circuit should run out on one street and return on another.

Each series-arc circuit of 125 lamps should be subdivided into at least three loops, so arranged that any one can be separately cut out by a switch. This will be found of great assistance in locating open circuits and grounds; and in case of fire the section affected can be easily and safely cut out without interfering with the rest of the circuit.

All wires on the main or trunk lines should be well drawn up in order to prevent crosses. All series circuits from the power house to the point where the circuit branches, should be carried on pins occupying the same relative positions counting from the top of the pole. This would also apply to alternating-current circuits, unless the distances covered are such as to require transposition. No cut-out boxes, transformers or lightning arresters should be erected upon the main or trunk lines as previously mentioned. The wires for the circuits which first branch off from the main line should be carried on the lower cross arms, and wires supplying the more distant sections should be carried above; the reason being that wires which require least attention should be placed out of the way of the linemen, whose services are generally most needed on those wires which supply the business in the immediate neighborhood.

Where series-arc or series-incandescent lines for street lighting are erected on the same poles with alternating-current lines they should be carried below the latter since they are out of circuit during the day; in other words, all high-tension lines which are in circuit continuously, should be located on the top cross arms, thus obviating the necessity of linemen when working on the series lines from coming in contact with them. For the same reason the secondary lines being safely handled, should preferably be placed on the lower arms. Secondary wires should not be attached to the same cross arms with high-tension lines, unless on opposite sides of the pole.

It is advantageous to erect alternating-current lines which are in circuit 24 hours daily, on a distinct type of insulator, in order that linemen will know at a glance what circuits are alive. This can readily be accomplished by using porcelain insulators for alternating-current and glass insulators for series circuits, the latter being in use only at night. This is also of assistance in tracing out the circuits.

All branch circuits should lead from reverse arms, except in the case of single series-arc loops, which may be attached to an iron break arm on the outside or end pin. If alternating-current branch circuits lead in both directions at cross streets, the wires should be carried straight across and a common connection made to the main line.

The necessary fuse boxes to protect the mains should be placed on the first pole each side of the trunk line.

Where numerous telephone or telegraph wires cross above electric light wires, a separate six-pin cross arm should be attached at the top of the pole for supporting two No. 10 galvanized iron wires (one at each end of the cross arm) stretched from pole to pole as guard wires.

GROUNDING OF SECONDARIES.

All secondary mains supplied by transformers should have the neutral wire of the three-wire system or one wire of the two-wire system grounded. It is also necessary that a suitable ground be furnished at the premises of each consumer, in addition to the regular installed grounds upon the system. In case of a number of transformers being connected in multiple there should be a ground for each transformer.

It might be mentioned incidentally that in connecting two-wire meters the field coils of the meter must not be connected to the grounded side of the system, as otherwise there may be a loss of revenue, due to the meter being shunted by grounds in the building, etc. When conducting a periodic test of the meters, the condition of the ground connections in the building should be examined and repaired if defective.

We have found it quite advantageous to have certain of the regular day force of linemen detailed alternately to look after the complaints at night. Each man naturally gives more attention to the character of his work when he appreciates that his duties when on the night shift are more or less arduous in proportion to the manner in which he and his companions have performed their work during the day.

RULES.

If the plant is of sufficient size to require division into sections or districts for successful operation, a uniform system of rules and diagrams should be used in order that all work of the same character shall be performed in a uniform manner. This enables a lineman to be transferred from one division to another, and still be perfectly familiar with his work.

The following are a few of the general rules to line foremen:

1. No wire of smaller size than No. 6 B. & S. gauge shall be used for either primary or secondary work.

2. All alternating-current primary line wire shall be erected on porcelain insulators upon adjacent pins.

3. All arc line wire shall be erected on double petticoat glass insulators.

4. Alternating-current and arc line wires shall in no case be placed upon the same cross arm unless the pole is between.

5. All joints shall be well soldered and taped.

6. Secondary lines shall at all points be at least 18 in. from primary or arc lines unless covered with heavy porcelain tubes.

7. Fuse boxes shall be placed upon all branch circuits.

8. The main circuits shall not be fused as long as the wires are maintained of the same size as at the station.

9. Fuse boxes for branch circuits shall in all cases be fused 25 per cent. smaller than the main fuse at switchboard; and in no case shall branch fuse boxes be fused with copper wire.

10. Fuse boxes for branch circuits shall be placed upon the first pole from the junction pole.

11. Transformers shall not be placed on the exterior of buildings, sheds or other property belonging to the consumer.

12. All poles having transformers or fuse boxes upon them shall be stepped.

13. No fuse box or transformer shall be placed upon a junction pole or lamp pole, except where absolutely necessary, in which case the office shall be notified and permission obtained.

14. Transformer poles shall in all cases have full six-pin arms.

15. In placing transformers for motors, 1 kw should be allowed for each horse-power up to 30 hp, except where a number of motors are installed upon one group of transformers, in which case the capacity may be reduced in accordance with the condition of load.

16. All consumers having 200 lights or over, who are not regular in their hours of burning, such as churches, lodge rooms, public halls, etc., shall be placed upon two-phase wherever possible.

17. In connecting two-wire consumers upon three-wire secondary circuits, care should be taken that the load is evenly balanced, as to location and time of burning.

18. Wherever practicable, consumers should be grouped upon one transformer, or system of transformers and secondary wires.

19. The object in grounding a secondary wire of transformers is to prevent high-tension current from reaching the secondary wires. The neutral wire of all three-wire secondary circuits must be grounded, and also one side of all two-wire secondary circuits.

20. It is of the utmost importance that the primary fuses protecting each transformer shall be of a size proportionate to the capacity of the transformer. When a transformer is fused excessively heavy, or with fuses of dissimilar sizes, one fuse only is liable to blow, thus leaving current on the defective transformer.

21. It is essential that, when a primary fuse on the transformer is blown through any cause, the secondaries should be disconnected from the transformer and the latter tested to full line voltage between the primary and secondary coils, so as to determine that there is no breakdown in the insulation between these coils.

22. All alternating current circuits should be tested daily for grounds.

23. All series lighting circuits should be tested for grounds within ten minutes after the circuits are taken off, and for open circuits, crosses and grounds at 12:10 P. M. and 3:10 P. M., and also one hour before starting time.

Throughout the country are hundreds of localities and small towns which would be deprived of the advantages of electric light and power, were overhead lines abolished and all wires compelled by law to be placed underground. The cost of the latter system, as previously mentioned, is often prohibitive and the cheaper pole line construction is, therefore, a necessity and will maintain its supremacy in many districts for years to come.

It should be the duty of every station manager to see that all work on overhead lines is performed in a permanent manner, whether erected for continuous or temporary service. Temporary repairs must of necessity be made if trouble is located and cleared at night or during stormy weather, but these temporary repairs should be reported and become the first work on the following day.

The station manager is, no doubt, frequently tempted to use the cheaper telephone and telegraph construction for light and power purposes, especially when appropriations are inadequate for thoroughly substantial work. He should, however, refuse to employ such construction under all conditions, and should be as particular and as firm in rejecting such material as he would be in refusing to employ light tubing for high-pressure steam lines.

The station manager must appreciate that the vital point in overhead construction and operation is attention to details, and if he will see that all work is erected in a thoroughly permanent manner, he will accomplish much towards the prevention of complaints from the general public and from the consumers of his own company.

Purchased Electric Power in Factories.*

By E. W. Lloyd.

The growth of electric power loads in central stations during the past ten years has been no less than marvellous. There is scarcely a member of this association who does not remember the time when the installation of a ten horse-power motor on the Edison system was an event known to every employee of the company, and commented upon fully as much as the connecting of a five hundred horse-power installation at the present time. There is scarcely a doubt but that the connected central station power load in large cities will equal the connected light load at a very early day, as the removal of large isolated plants in office buildings and mercantile houses has increased our power loads with leaps and bounds. The time has come, however, when we must look to large individual motor installations in factories if our present rate of growth is to be maintained.

The small power customer in large cities comes with little or no solicitation, and need not be considered here. It is of the installation of motors, and the cost of power from central stations for large factories, in comparison with isolated plant costs, that this paper will endeavor to treat.

It seems to be the policy of some companies to offer power rates at almost the cost of production, and in some cases, to go even lower in order to build up a day load.

The experience of one company demonstrates that in a great number of cases factory plant costs per kw-hour were much in excess of what we now sell them current for at a profit.

Low power rates are a detriment to central station business, as these rates are published by customers from place to place, and often business is lost because the prospective customer hears of an extremely low price in another city, where the local conditions, or more often the anxiety of the company to get a power load, prompt them to give a low rate without learning what it actually costs to operate the isolated plant. Before giving a prospective customer a price per kw-hour, it is well to know what his factory plant costs are. In ascertaining these costs you will probably meet with difficulties. The manufacturer with engineering training, or having a mechanical or electrical engineer as manager, thinks he can generate power just as cheaply as we can sell it. We find, however, that a large portion of the customers with whom we ultimately do business, know little of their actual plant costs, and if their estimate of costs is taken, we would find a cost per kw-hour with which it would be impossible for us to compete. A careful investigation of the plant will determine whether their figures are correct. If their system of keeping costs is wrong, it is necessary that the information be estimated from data obtained by going over every detail of the driving machinery, plenty of allowance being made for large coal consumption when the apparatus is over five years old.

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An important point is the examination of all the pumping machinery. It has been our experience that the steam pump is one of our best friends. Frequently the decision as to whether a plant be operated from central station service, or an isolated plant be installed, is determined by the large steam consumption of the pumps per horse-power per hour.

The items enumerated below are those which should be considered in making up the total cost of operating an isolated plant:

Salary of engineers; salary of firemen; salary of electrician; fuel; removal of ashes; water; oil; repairs to boilers; repairs to engines and dynamos; lamps; carbons; tool account; miscellaneous expense and supplies, waste, packing, etc.; general expense; depreciation; interest on investment; insurance; rental value of space; damage resulting from heat and vibration; risk to employees and the public through accidents and boiler explosions; taxes.

In addition to the above plant costs it is often necessary to add the following: Maintenance of rope or belt transmission lines; unnecessary investment in shafting and hangers; salary of millwrights.

Our experience has been that it will generally be necessary to estimate most of the above items, as the customer has not kept these costs separate from other similar accounts. Such items as salaries, supplies, coal and water, are about the only ones that can be accurately obtained over a period of years.

In estimating the kw-hour output of an isolated plant, we have to take into consideration not only the power consumed by the machines themselves, but the friction load of the heavy transmission shafting, and the wastes in the generating machinery. It is also essential that we be familiar with the customers' output, and have a knowledge of the workings of different kinds of machinery, and know the power required to drive each machine, together with the number of hours per day each runs. An estimate made on this basis can be checked by indicator cards taken every fifteen minutes during the day for several days. A one-day test is, as a rule, very inaccurate, as the machinery varies in its operation from day to day. These tests are necessary only in large factories, as a proper estimate of the kw-hour consumption may be made of a small installation without this expense.

Engine tests are very often deceiving, it being extremely difficult to separate the friction load present in all engine-driven plants from the actual power delivered to the machines. It is therefore, much more accurate to estimate the kw-hour consumption for each machine or group of machines. These estimates can be made quite accurately by an engineer who is trained to the work.

Instances have come to my notice of cases where there was under 5 per cent. variance between the bills and the estimate. Having the plant costs and the kw-hour output of the plant, their kw-hour rate can be compared with the central station rates with gratifying results.

In addition to the favorable comparison of rates, we have the advantage afforded by the lower kilowatt consumption of the machinery after the removal of waste caused by the constant running of generating machinery, shafting, steam pumps, pulleys, belts, etc. These changes in most cases turn the tide in our favor, as, in the majority of factories, the percentage of lost energy is very large.

One of the most difficult tasks we have is convincing a customer that his average load is not equivalent to his connected load, nor is his maximum load the average. It is surprising what a large number of people there are who persist in these views. When a customer is asked how much power he will require, he invariably mentions the horse-power of his engine, and when you give him a rate per kw-hour immediately proceeds to multiply this by his hours of running and finds an enormous cost per month.

Besides the ordinary causes of waste above mentioned, there are generally numerous changes that can be made in plants, which will reduce the current consumption materially. If air is used for hoisting and drilling, these machines can be replaced with electric hoists and motor-driven drills. Of course, if the plant uses hammers or riveters, the air compressors cannot be removed, but they can be changed to motor drive with an automatic controlling device arranged to start and stop the compressor, as the conditions of operation require. Where it is necessary to have shafting of any length, a saving on the friction load can be effected by the use of light line shafting and three-point bearings.

In order to substantiate the argument that central station charges are cheaper, the table given below shows costs per month taken from a customers' books for one year previous to the removal of their plant, that are higher than their present current bills from us:

Salary of engineer, $90; salary of fireman, $60; fuel, $577; removal of ashes, $8; water, $20; oil, $2; repairs $15; tool account $2; miscellaneous expense supplies, $15; depreciation, $83; interest on investment, $49; insurance, $6; rent value of space, $25; interest on unnecessary investment in shafting, $5; total, $956.

This customer is running about the most difficult class of machinery to which we are called upon to supply power. They carry on a structural steel business operating punches, shears, traveling cranes, a fully equipped machine shop, carpenter and pattern shop, foundry, a 75-hp beam saw, and a 75-hp air compressor, having a total of 400 horse-power in motors. With a 4c. rate per kw-hour running ten hours a day, their bills run about $800 per month. We expect to run them for considerably less money by replacing a number of their air hoists by electric, as their air hoists takes about five times the energy after all wastes are calculated.

The only way we were able to save this firm money was by the elimination of all wastes throughout the plant. Most of the machines have a motor directly connected to them, the exception being the carpenter and machine shops, which are group driven.

These facts demonstrate that proper motor installation is the large factor in reducing the cost of power from central station service. I do not believe it is necessary to follow the advice of some manufacturers of motors in order to have an efficient installation, such as specifying the very large motors necessary for multiple voltage control, where the motor in some cases is 50 to 75 per cent. larger than need be; but on such machines as pumps, air compressors, punches, large machine tools, large wood-working machines, beam saws, hoists, printing presses and the like, it is essential that a motor be installed for each in order that the average load be as small as possible.

The two voltages supplied by the Edison three-wire system, together with the use of any of the numerous mechanical methods of speed changing, will efficiently supply all the range in speed required by any tool with which I am acquainted.

The first cost of a motor installation often militates against us when figuring with a prospective customer for current, but this prejudice is rapidly disappearing as the numerous advantages in favor of motor drive are becoming widely known, and up-to-date factory managers are making changes whether they use central station current or generate their own.

I believe it good policy to be extremely liberal when quoting costs to install motors, as their sale is really a secondary consideration in connection with central station business. Spread the payments for motors over long periods, with good allowance in case they be taken back. Make a guarantee on the bills per connected horse-power per month for a short period; in fact, force the customer to do business when the negotiations get to a point where you are apt to lose him.

I do not mean to take the position that it is necessary to cut rates in order to close a contract, because making a stipulated price per horse-power per month does not make the rate. Keep up your rates, but use every possible expedient to get power business by a liberal policy. Some people are afraid of central station charges, and it is necessary to make concessions to sufficiently interest them to make the trial.

In figuring on motors with our customers, we frequently find that we are underbid very materially by makers of inferior apparatus, and the customer is inclined to buy the cheaper machine on account of the saving in the first cost. This is frequently very poor policy on his part, we find there are often machines which are defective in design and therefore take more current than they should. It is sometimes hard, however, to convince a customer that a slight difference of efficiency makes any particular difference. We have figured out the difference in the Edison bills which would be made by a difference of efficiency, from 1 per cent. to 10 per cent., in order that the customer may see in dollars and cents what it means to him on a year's bills.

By studying the table it will be readily seen that a slight disadvantage in efficiency will make what appears to be a cheap motor by far the most expensive in the long run, e. g., assume two motors of 10 hp capacity each, one selling at $250 and the other at $225. Let us assume that the motor will average 3 horse power ten hours a day the year around. Assume that the average efficiency of the cheaper motor is 3 per cent. less than that of the $250 one. The annual cost for current would be $20.94 greater. Capitalizing this annual difference on the basis of 5 per cent., we find that the cheaper motor costs $225 plus $104.70, or $329.70 as compared with the $250 machine.

The following table shows annual variation in cost of current caused by variation in percentage of efficiency. Table based on motor running at full load ten hours per day for 312 days. Current based on 5c. per kw-hour. When the hours running per day of motors is determined, the actual loss can be easily figured:

PER CENT. VARIATION IN EFFICIENCY.

H.P.	1 per cent.	2 per cent.	3 per cent.	4 per cent.	5 per cent.	6 per cent.	7 per cent.	8 per cent.	9 per cent.	10 per cent.
1	1.17	2.27	3.49	4.65	5.83	6.91	8.15	9.32	10.48	11.67
2	2.32	4.65	6.98	9.30	11.65	13.93	16.31	18.64	21.00	23.00
3	3.49	7.00	10.47	13.95	17.60	20.92	24.50	28.00	31.40	34.50
5	5.82	11.73	17.45	22.75	29.25	34.50	41.00	46.50	52.00	58.00
7½	8.74	16.50	26.15	34.00	44.00	53.00	61.00	70.00	78.50	87.00
10	11.65	23.15	34.90	46.50	58.25	69.50	81.50	93.00	104.50	116.50
15	17.48	35.00	52.00	62.00	88.00	104.00	122.50	140.00	156.00	174.50
20	23.30	46.50	70.00	83.00	116.50	139.50	163.00	186.00	208.00	233.00
25	29.00	58.00	87.00	104.00	146.50	174.00	204.00	232.50	260.00	290.00
30	35.00	70.00	104.00	124.50	176.00	209.00	245.00	280.00	314.00	350.00
35	40.75	86.50	126.50	145.00	205.00	243.00	286.00	326.00	365.00	407.50
40	46.00	93.00	139.00	165.00	235.00	278.00	325.50	374.00	417.50	466.00
50	58.25	117.50	174.00	207.50	279.00	348.00	412.50	467.50	500.00	582.50

My company makes a practice of buying plants, and often the difference between the salvage allowed and the cost of the motor installation is very small.

When there is a plant to be removed we find it to our interest to offer good prices for the second-hand machinery. Often a customer is agreeably surprised at what is offered for his plant and will sign a contract at good figures where he would become dissatisfied and refuse were we to appraise his plant too low. We find a good market for all the apparatus we remove at very good prices, and there is no doubt about the value of the second-hand machinery department. We have a gang of expert wreckers who place the machinery in the warehouse in good shape, where it is cleaned up and put in presentable condition for sale. A few well-placed advertisements in trade papers bring plenty of inquiries, and we rarely carry any of the machinery over a year.

Besides the removal of wastes in plants above enumerated, there are other savings which should receive consideration in case the factory where motors are to be installed in a new building. Such as, less investment in line shafting, smaller foundations for the building, lighter roof supports owing to the decreased weight of the shafting and the absence of belts, which allows of the installation of traveling cranes, thereby increasing the handling facilities of the factory, and reducing the cost of the output.

There are also a great many reasons in addition to the actual cost of current, why central station service should be used, and before presenting our estimate it is always a wise precaution to bring these points to the attention of a customer. Following are a few of the reasons: Constant smoking, causing the manufacturer annoyance and trouble with the city authorities, who force him to use a high grade of smokeless coal at great cost, or the installation of costly smoke consumers or furnaces. Strikes of engineers, firemen or teamsters; inability to get coal; break-down of transmission shafting, belts, engines or boiler plant, together with the liability of accident in operating a plant where trouble is being had with the employees. Also the large losses suffered by the manufacturer when accidents occur causing the closing of the whole factory. With reference to accidents: We have a customer who had been operating a plant for the supply of power and light for twenty years. One night about six o'clock the battery of boilers burst, killing nine people and maiming many others. They called on us for temporary service, which we were able to give them by 7.30 next morning, having a construction gang of sixty-five men working all night. After running them temporarily for a time, an estimate was made for permanent service, with the result that they are now on our system. Their losses, including claims exceeded the total cost of the operation of the plant for over ten years. It is needless to say that they will not install a new plant.

Further advantages are: the reliability of the service from the central station at any time during the twenty four hours, with possibility of running any one tool or group of tools if necessary, without starting a large engine and paying a night engineer and fireman; the privilege of using two voltages from the three wire system, insuring large speed variation, especially for individual motors, and a corresponding increase in the output of the plant. Flexibility of the motor installation, allowing an increase in the motive power at very little cost with the additional advantage of a better rate the more power used. Furthermore, the increased cleanliness in the factory; the absence of belts, vibrations, heat, and the increased output (which is a very important point) due to the absence of belt slippage.

I have tried to bring out the point that proper motor installation is the important one to consider when figuring on new business. I wish to emphasize this by saying that it is far better to refuse business when the customer refuses to install motors in accordance with the best engineering practice, as a customer invariably fails to renew his contract when he finds his bills running a great deal higher than he expected. In addition, he publishes his high costs and stops many prospective customers by his talk of robbery by the Edison Company.

It is safe to say generally that we can handle economically any business when the average load does not exceed 35 per cent. of the connected load. In one large plant an installation of 2,800 connected horse-power in individual motors is driven by a 500-kw generator, the average power required being but 15 per cent. of the connected load.

I believe we are just entering the power field, and that in a very few years the furnishing of power from central station service will be quite as important as the distribution of light. The recent developments in steam turbines and high-class generators, promise to open up a vast field for power and light stations. There is no reason why central station power cannot be sold cheaper than it can be made by any isolated plant, and our experience is grounding us more firmly in this belief every day, as we only recently took out the largest isolated plant in the city of Chicago, which approximated 8,000 horse-power, and connected the business to our system, saving them money, and giving them better service than they ever had from their own plant.

Altogether, we have removed over fifty isolated plants in Chicago during the past three years, and connected them to our system.

The removal of the isolated power plant is a natural evolution, and the supply of power from central stations is merely another example of the consolidation of all interests both from a business and an engineering standpoint.

The solution of the smoke problem, and freedom from labor troubles, lies in the furnishing of power from central station service.

Boys on Radium.

One of the most interesting lectures delivered at the meeting of the British Association, which was recently held at Southport, was by Mr. Vernon Boys, president of the mathematics and physics section, relative to radium. Mr. Boys suggested a connection between radioactivity, as now observed, and the stock marvel of the comet and its tail. "What is a comet and of what does its tail consist?" asked Mr. Boys. It was impossible not to be struck by the similarity of the language used in describing comets and that used in any paper written on radium. He knew that mere superficial similarity was worth very little, if anything, but for centuries the sky had shown us phenomena still not entirely understood, and inability to remove all difficulty by the aid of radium or similar material was no reason for dismissing the idea of any connection without further thought. He added that Sir William Crookes has devised an experiment in which a particle of radium keeps a screen bombarded forever, so it seems, each collision producing a microscopic flash of dancing light, the multitude of which forcibly compels the imagination to follow the reasoning faculties and realize the existence of atomic tumult. Radium in some respects, he said, behaved in a manner contrary to that of all proper chemical thorium or uranium, which acted in the same kind of way as did radium, but with far less vigor, and would last a million years before there was nothing left, or at least before they were worn out, while radium, preferring a short life and a merry one, could not expect to exist for more than a few thousand years. In that time one gram of radium would evolve one thousand million heat units, sufficient, if converted into work, to raise 500 tons a mile high, whereas a gram of hydrogen, our best fuel, burned in oxygen, yielded only 34,000 heat units, or one thirty-thousandth part of the output of radium.

An Object Lesson in Telephone Receivers.—II.

By Arthur V. Abbott, C. E.

THE STROMBERG-CARLSON RECEIVER.

THIS receiver is a highly developed instrument and of great interest and value in the study of receiver design. The assembled receiver is shown in Fig. 42 and a sectional view in Fig. 43. In Fig. 44 the magnetic system is removed from its case, while in Fig. 48 the receiver is completely dissected into its component parts. The case shown at *A* in Figs. 43, 44 and 45 is composed of a single piece of hard rubber, on one end of which a screw thread is cut, while at the rear the case is reinforced and the cord passes through a hole in the center to reach the terminals of the line coils. On the front end of the case a brass cap, *B*, is secured by means of a screw thread. This brass cap is made very solid and substantial and carries in its center a projection, *X* (Fig. 45), to which the pole pieces and magnetic system are bolted as shown in Fig. 43, by means of a bolt which passes directly through both of the poles and the projection upon the brass cap, so that this cap forms a solid foundation for the whole instrument to which the magnetic system is secured in the strongest manner. On the outside this brass cap is threaded and a circular brass ring, *C*, is cut to engage with this thread. The diaphragm is placed on the inside of this ring and

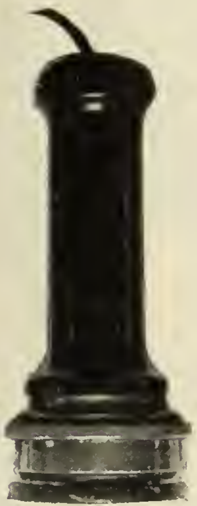
FIG. 42.—RECEIVER ASSEMBLED.

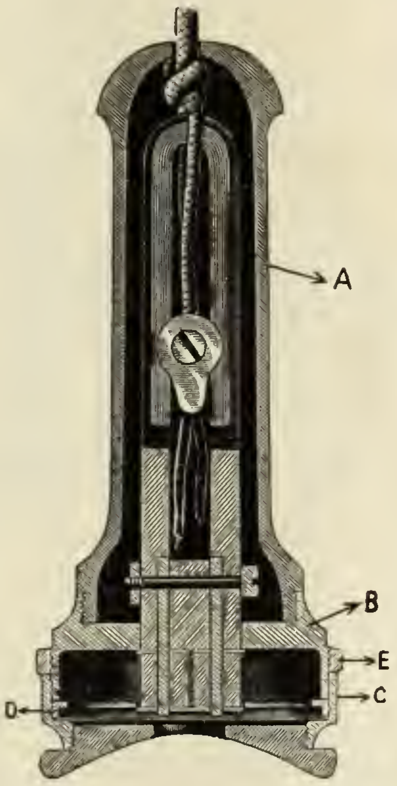

FIG. 43.—SECTIONAL VIEW OF RECEIVER.

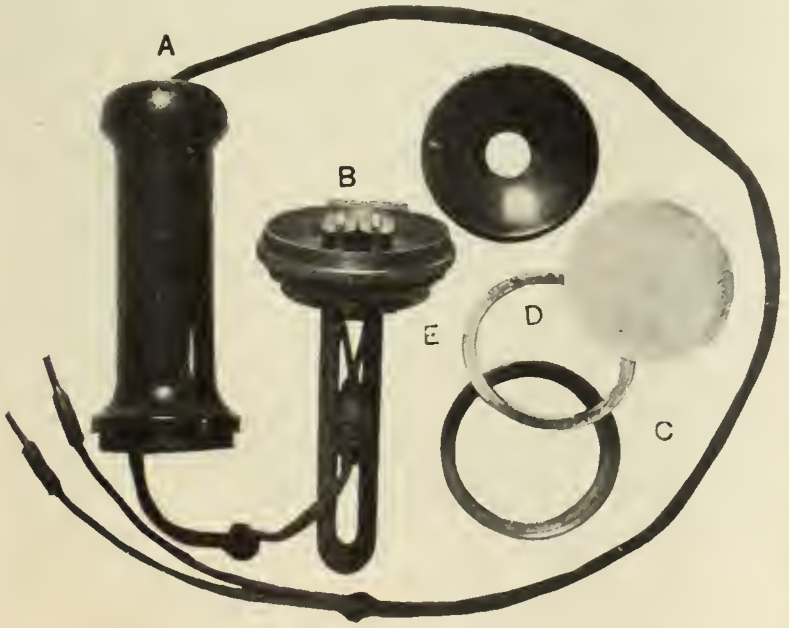

FIG. 44.—RECEIVER PARTLY DISSECTED.

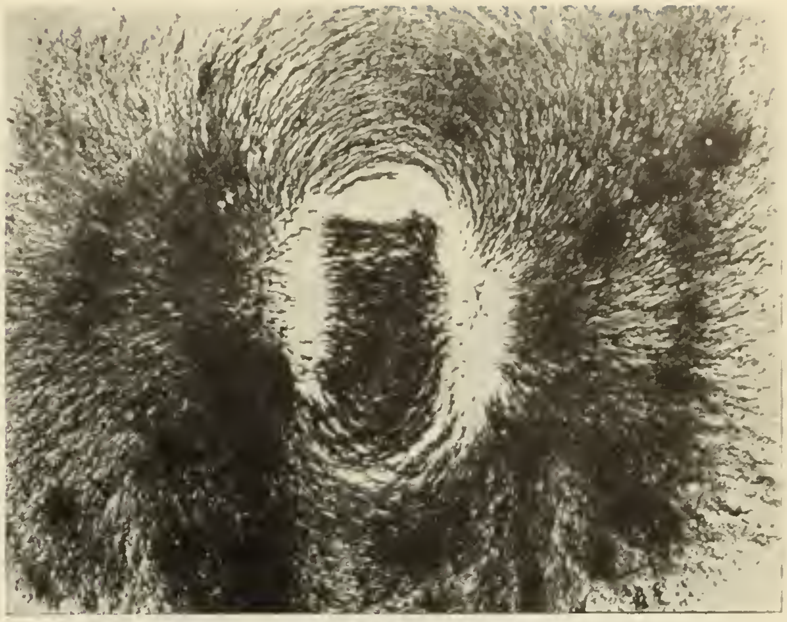
FIG. 46.—PHANTOM WITH DIAPHRAGM REMOVED.

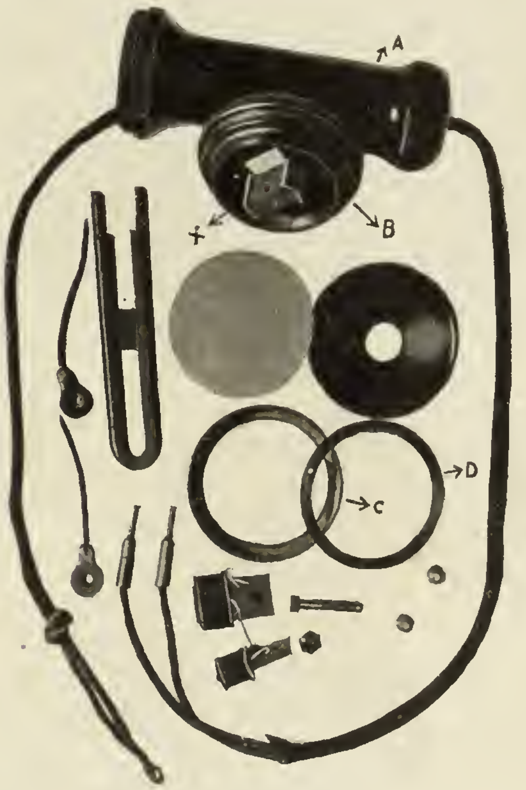

FIG. 45.—RECEIVER COMPLETELY DISSECTED.

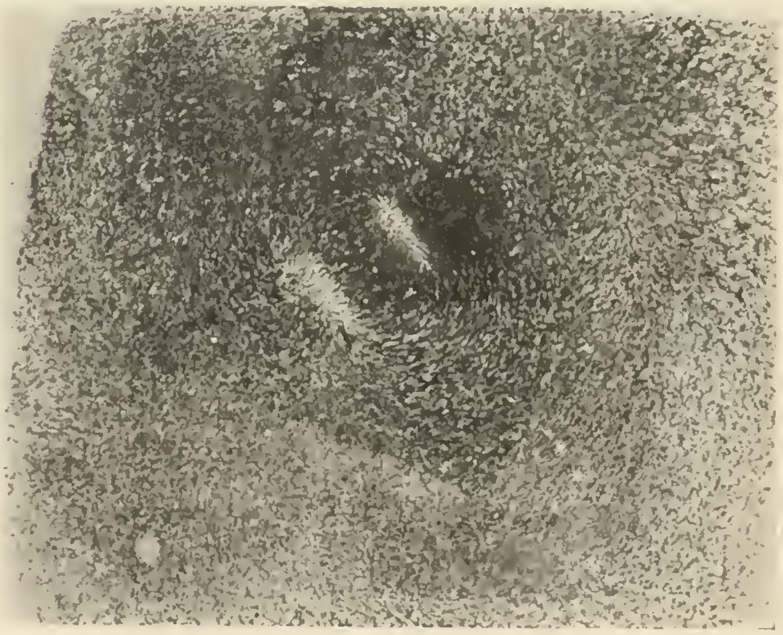
FIG. 47.—PHANTOM WITH DIAPHRAGM IN NORMAL POSITION.

secured against a shoulder by means of a follower ring, *D*, which is threaded into the inside of the cap, *C*. By this means the diaphragm is clamped very firmly between two sharp circular brass rims, and it is evident that as the ring, *C*, is threaded on the exterior of the brass cap, *B*, the adjustment of the diaphragm with reference to the pole pieces can be made with the utmost nicety and exactness. Finally, in order to secure the cap, *C*, in its place, a follower ring, *E*, which acts as a lock nut, is screwed up against the cap when it is in its final position. The diaphragm is of sheet iron tinned .01 in. thick, 2.19 in. in diameter over all with a free diameter of 2.12 in. The magnetic system consists of one U-shaped bar of steel .625 in. wide and .24 in. thick, with its outside edges slightly chamfered. There is a distance of .35 in. between the sides of the U, while the magnet is 4.60 in. in length. The pole pieces are of soft iron .590 in. wide, .10 in. thick and 1.18 in. long. The coil spools are of fibre .44 in. wide, .860 in. long and .50 in. deep. The winding of the local battery instruments is of No. 38 wire, having a resistance of from 90 to 100 ohms, with about 1,200 turns, the line coils being connected in series. The tractive effort is 2.940 pounds (1,332 grams). This corresponds with tractive effort per sq. cm. of 1,755 grams, giving an induction in the pole pieces of 13,100 gausses, corresponding to a remanance in the permanent magnet of 5,800 gausses. The receiver cord passes through a hole in the rear of the case. On the inside a large and heavy knot is tied in the cord, which forms a very flexible stop, and prevents the weight of the receiver from producing any strain upon the terminals. Between the faces of the magnet a fibre block is placed to which the line wire terminals are carried by means of two pieces of okonite wire that pass through the cap, *B*. These terminal wires carry two brass terminal pieces that are secured to the fibre block by means of screws, to which the cord tinsel is connected. This receiver is very substantial and will bear a great amount of abuse without injury to any of its parts. Figs. 46, 47 and 48 are phantoms from this model. Fig. 46 is the phantom with the diaphragm removed, exhibiting plainly a most powerful field. Fig. 47 is the phantom with the diaphragm in place, showing that in this receiver the diaphragm is fully saturated, while Fig. 48 is a phantom taken with the diaphragm removed ⅛ in. away from the pole pieces, and strikingly illustrates the effect of changing the adjustment of the diaphragms with reference to the pole pieces, for in this phantom there is hardly a trace of magnetism exterior to the diaphragm itself.

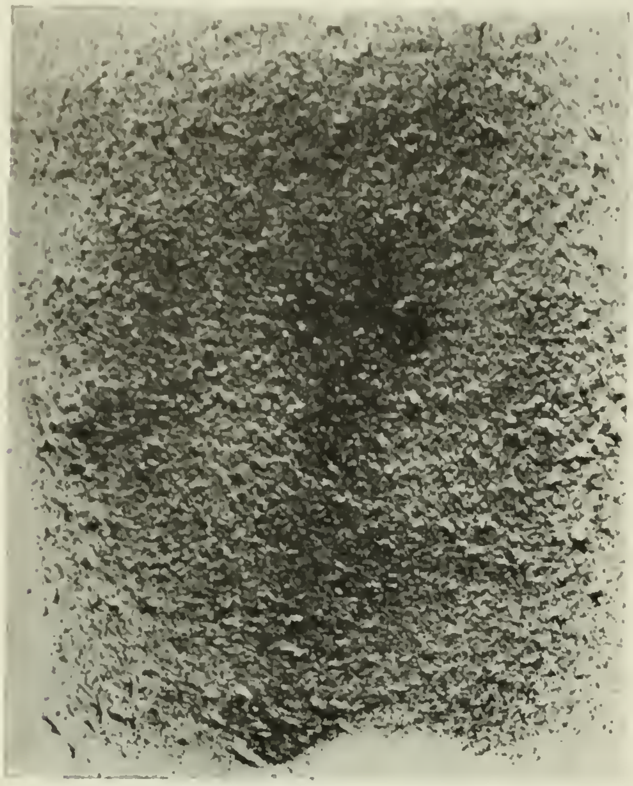
FIG. 48.—PHANTOM WITH DIAPHRAGM ⅛ IN. FROM POLE-PIECE.

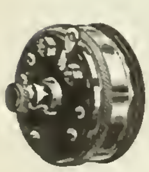
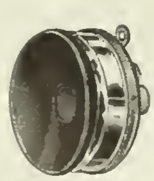
FIG. 49.—WATCH CASE RECEIVER.

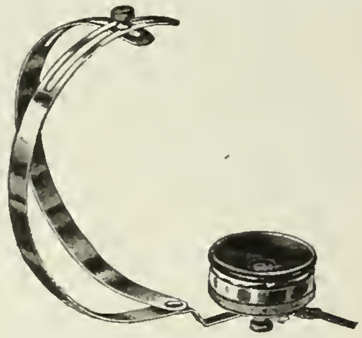
FIG. 50.—WATCH CASE RECEIVER WITH HEAD BAND.

Figs. 49 and 50 illustrate the Stromberg Carlson watch case receiver. In general design this receiver adopts as far as practical the model and the principles in the hand telephone, departing therefrom only in so far as necessary to secure the requisite lightness to enable the receiver to be worn upon the head. In Fig. 50 the assembled receiver includes a band, whereby it may be supported from the head, is shown.

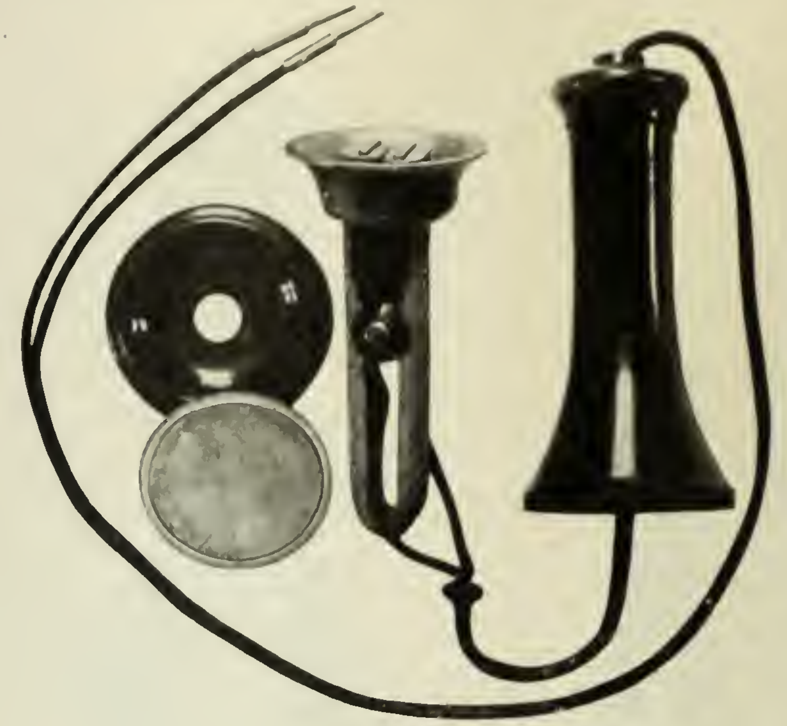
FIG. 51.—RECEIVER DISSECTED.

THE AMERICAN RECEIVER.

The American receiver exhibits another method of securing an adjustment between the pole pieces and the diaphragm. Fig. 51 shows this receiver dissected. The case consists of two pieces of composition. Upon the front the diaphragm cap is threaded, while the receiver cord passes through a hole in the rear. The magnetic system consists of a U bar .655 in. wide, .25 in. thick and 4.25 in. long, the U being formed so that there is .32 in. between the parallel phases. The pole pieces are .61 in. wide, .10 in. thick and 1.5 in. long, and are recessed in the top of the U bar. Before the pole

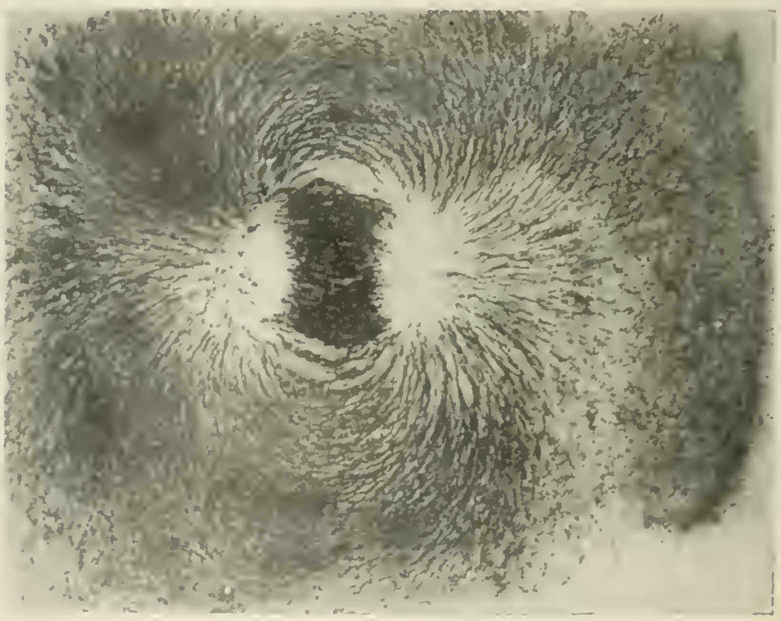
FIG. 52.—PHANTOM OF RECEIVER WITH DIAPHRAGM REMOVED.

pieces are put in place a wash dish-shaped piece of brass is set under the pole pieces and on top of the U. This wash dish piece is pressed in a die and after it is in position the face of the dish and the face of the pole pieces are grounded on a lap so as to be exactly in line. The diaphragm is of sheet iron tinned and as is shown in Fig. 51 is dished, the dishing being sufficient to carry the center of the diaphragm about .03 in. away from the pole pieces. The edge of the diaphragm rests upon the face of the brass dish that is secured between the pole pieces and the magnet. The receiver is assembled by slipping the magnet placing the diaphragm on the piece of the dish, and clamping the whole with the diaphragm cap. It is evident from this mode of construction that there is no means of making any adjustment of the distance between the diaphragm and the pole pieces after the process of manufacture is once completed. The receiver cord enters the instrument through a hole in the rear of the case and is then knotted after the fashion of the Stromberg-Carlson model. The terminals pass to a block placed between the parallel faces of the magnet and are there connected to the leading-in wires. From this block the leading-in wires of heavy copper pass through holes drilled in the brass dish to the line spools. The line spools are made of brass .40 in. wide, .90 in. long and .62 in. deep. The winding is of No. 36 wire and the resistance about 125 ohms. The tractive effort is 2.170 pounds (964 grams). This corresponds to a tractive effort of 1,240 grams per sq. cm., indicating an inductance of 10,900 gausses in the pole piece. The remanance is 4,750 gausses. Fig. 52 is a phantom of the American receiver with the diaphragm removed.

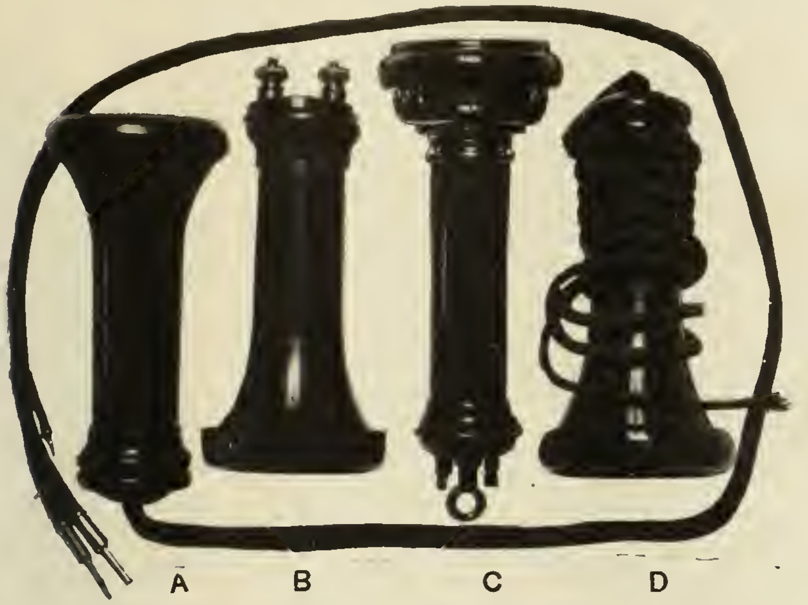

FIG. 53.—DIFFERENT TYPES OF RECEIVERS.

A—KELLOGG RECEIVER. B—MANHATTAN RECEIVER. C—ERICSSON RECEIVER D—WESTERN TELEPHONE COMPANY RECEIVER.

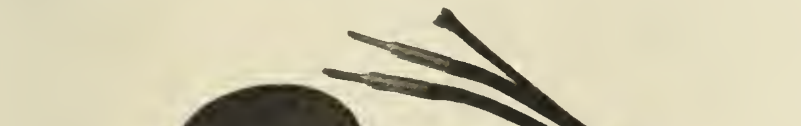

FIG. 54.—A—KELLOGG RECEIVER DISSECTED. B—MANHATTAN WATCH CASE RECEIVER ASSEMBLED.

RECEIVER OF THE KELLOGG SWITCHBOARD & SUPPLY COMPANY.

The characteristics of the receiver of the Kellogg Switchboard & Supply Company are illustrated in Figs. 53 and 58, inclusive. At *A*, Fig. 53, the assembled receiver is shown. In Fig. 54 it is dissected into its component parts. In Fig. 55 and 56 is a sectional drawing. In one model the case consists of three pieces: the diaphragm cap, the case body and the tail piece, as shown in the sectional drawing (Fig. 56). In the model of Fig. 54 there are only two parts: a body and diaphragm cap. The magnetic system (Fig. 54) consists of two bars .630 in. wide, .24 in. thick and 3½ in. long. These bars are secured by means of a bolt and non-magnetic block at the pole piece end and iron screw and magnetic filling piece at the rear. The diaphragm is of ferrotype .011 in. thick, 2.18 in. over all in diameter, with a free diameter 1.93 in., and is perfectly flat. The line coils are wound upon brass spools .41 in. wide, .90 in. long and .62 in. deep; the wire is No. 30 and the resistance from 65 to 70 ohms. The pole pieces are .54 in. wide, .10 in. thick and 1.25 in. long; they are secured to the magnet by recessing the ends of magnet bars and by bolting the pole pieces with the same bolt that secures the ends of the magnet. In order that the receiver may be heavy enough to hold the switch hook in its proper place a lead weight is cast between the magnet bars, as is seen in Fig. 54. The tractive effort is 2.437 pounds (1,170 grams). This corresponds to a tractive effort 1,620 grams per sq. cm., indicating an induction in the pole pieces of 12,300 gausses, and a remanance in the magnets of 5,400 gausses. The case is faced off perpendicular to the axis of the magnet and the diaphragm secured by clamping it to the face of the case and the underside and the inside of the cap. In Figs. 54 and 55 it will be noticed that between the pole pieces and the magnet bars a round disc of non-magnetic metal is placed, which is parallel with the face of the pole pieces. As is shown in Fig. 55, the inside of the case carries a shoulder which is machined to be parallel with the face of the case. When the magnetic system is dropped into place the disc bears against this shoulder and the whole magnetic system is secured in place by four screws, which pass through the disc and into the case. Thus, in this model the diaphragm and the magnetic system are supported by the case, but as the points of support are quite close together there is little danger of loss of adjustment.

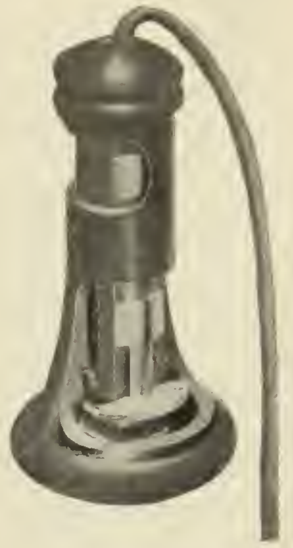

FIG. 55.—SECTION OF KELLOGG RECEIVER.

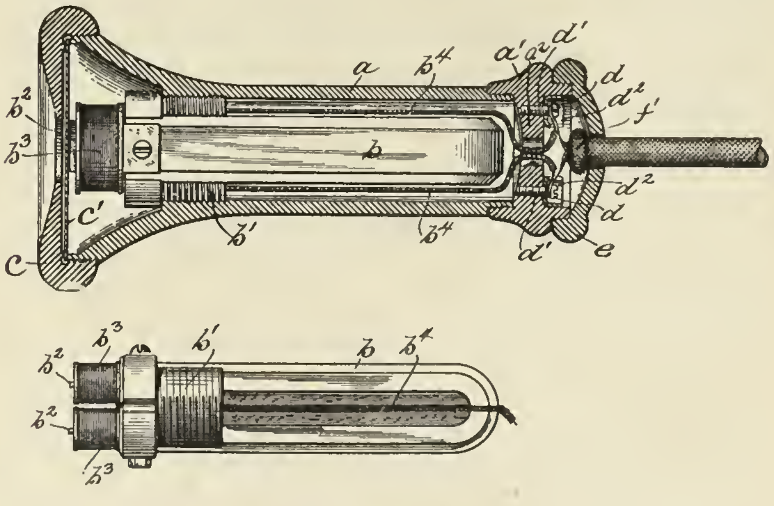

FIG. 56.—ANOTHER MODEL OF THE KELLOGG RECEIVER.

Niagara Falls Meeting of the American Electrochemical Society.

THE fourth general meeting of the American Electrochemical Society, held at Niagara Falls last week, had a registered attendance of 138 members and guests. On each morning a session was held, devoted to the reading and discussion of papers, while on the afternoons excursions and visits to electrochemical plants and other points of interest were made. A smoker with an enjoyable vaudeville program on Thursday evening and a reception with dancing on Friday evening were well attended by the members and guests, while for Saturday an excursion by boat and trolley was arranged along the gorge to Fort Niagara. Upon the whole, the meeting was a very enjoyable affair, for which credit is due to the activity of the local committee and especially its indefatigable secretary, Mr. Clarence L. Collins, 2nd.

The plants which invited the Society as a whole to visits were the several Niagara power plants, the Niagara Research Laboratories, and the National Battery Company, in Buffalo. The storage battery made by the latter company is well known to our readers, one of its special features being Mr. Sperry's pyroxyline envelope. The Niagara Research Laboratories are a new departure in the development of electrochemistry. The company was founded to maintain a research laboratory for scientific investigation in the field of chemistry, electrochemistry and electrometallurgy, to do analytical and experimental work for the general public and to act as consulting engineers in perfecting or improving existing processes. They also rent space and power for chemical and electrochemical investigations. The three-story building contains, on the main floor, a transformer and motor-dynamo plant; the electric furnace room with furnaces of various sizes for experimental purposes; machine shop; and various rooms for rent. The second story contains offices, library, the electrolytic room with a nicely equipped electrolytic bench, and the analytical laboratory.

Several of the electrochemical plants had extended invitations to groups of individual members. Among them were the Acker Process Company, the Electrical Lead Reduction Company, and the promoters of Mr. Ruthenburg's experimental iron furnace plant. The process of the Acker Company, which has already been described at length in these columns, has been in continuous and successful operation since 1901, and is the only commercial process in which fused salt is electrolysed. The Electrical Lead Reduction Company has installed an entirely new form of apparatus which will be described below in the abstract of Mr. Salom's paper. Mr. Ruthenburg's iron furnace is installed in the works of the Cowles Company at Lockport, near Niagara, and will be referred to in the abstract of Mr. Ruthenburg's paper. Below are given condensed abstracts of all the papers presented at the meeting.

On Thursday morning the meeting was opened by the reading of the reports of the secretary and treasurer. The membership list has now passed the 600 mark, and the treasurer reported a surplus of $2,000. The establishment of local sections has been taken into consideration and the first local section will be founded at Madison, Wis.

THEORETICAL CONSIDERATIONS IN THE CONSTRUCTION OF RESISTANCE FURNACES.

Mr. Francis A. J. Fitzgerald presented a note on some theoretical considerations in the construction of resistance furnaces, a reprint of a portion of which appears elsewhere.

The author gave several formulas as of use as a guide in the design of a resistance furnace, although they cannot be rigorously applied, because several factors are neglected in the assumptions.

In the discussion Prof. Burgess asked what is the power factor in such furnaces: Mr. Fitzgerald replied that in the early types of furnaces there was considerable self-induction, with a correspondingly low power factor; but by special arrangements, like interlacing the bus bars, the conditions were improved. Mr. A. H. Cowles spoke of some early experiments made by him with carborundum; he claims that the current passes not only through the core, but also through the carborundum; Mr. Fitzgerald denied the correctness of the latter statement and Prof. Burgess said he had found carborundum to be an extremely poor conductor compared with carbon.

ELECTROMETALLURGY OF IRON.

Mr. Marcus Ruthenburg, of Lockport, N. Y., presented a paper on advances in electrometallurgy of iron production and stated that while in a paper presented last year he asserted that the work of his electric furnace was performed upon a ton of ore with something less than 500 kw hours, he is now prepared to say that he does now the same, but better work, with an expenditure of about 250 kw hours. The energy is used only for melting the iron ore, but not for its reduction. In his present form of furnace the powder of magnetic ore which has been previously concentrated by means of magnetic separation, falls into a magnetic zone between two slowly revolving rolls, here the material forms a bridge, due to the action of the magnetic field. When the material forming the bridge is electrically smelted, it becomes non-magnetic and drops down into the soaking pit, while new material forms a new bridge and so on.

The electric current serves only for melting the material and agglomerating it so as to be in a form ready for reduction. The reduction itself takes place in the soaking pit below through which CO or hydrocarbons are passed. The three principal points of the process were first the power required for agglomerating and sufficiently treating the material for subsequent reduction; second the regulation of the size of the agglomerated particles; third, the reduction of the agglomerated particles. The present status of these three problems is said to be, first, that 250 kw-hours are required for the agglomeration of one ton of ore; second, that the size of the product is under perfect control; third, that the reduction of the mass in the soaking pit by means of hydrocarbons is complete. Inasmuch as the only function of the electric current is to agglomerate the dusky particles into coherent masses without binder or flux, and to convey a sufficient quantity of heat to the ore in the soaking pit, to permit the reducing agents to perform their function, it is evident that the heat and current losses due to maintaining a molten mass are lacking which are present in other furnace processes.

In the discussion Dr. Scholl, having asked for analysis of the material, Mr. Ruthenburg said that phosphorus is controlled by the preliminary magnetic treatment, but if phosphorus should be in the charge supplied to the furnace it is not eliminated; sulphur is said to be eliminated, and magnetic ore is itself low in sulphur. Mr. Cowles said he had seen the furnace in a run lasting for several days; the finest point is that the only material which drops into the soaking pit is iron oxide after it is fused. When accumulated in the soaking pit one has a heated mass in a retort through which heated hydrocarbon gases may be passed to produce reduction; he also gave some theoretical figures on the process.

THE PASSIVE STATE OF IRON.

Prof. C. F. Burgess presented a paper on a practical utilization of the passive state of iron. It has long been known that iron and steel assumes that peculiar condition known as the passive state by employing the material as an anode in sodium nitrate or various other soluble nitrates. Upon assuming the passive condition, the iron no longer becomes attacked by the anode products, and behaves like a platinum anode. Some years ago he developed in his laboratory a process for removing brass from steel tubing, the brass having been left on the outside of the tubing as a superfluous material during the brazing process. It was tried to employ an electrolytic stripping process for removing the brass, but in a great many electrolytes the iron tended to corrode much more readily than did the copper which enters into the constitution of the brazing spelter. Iron has a position considerably above copper in the electrochemical series of elements, and where two different metals are in contact, the natural tendency is for the more electropositive one to go into solution with the greater ease. The idea presented itself of making the iron more electronegative than the copper by causing it to assume the passive state, and upon using the sodium nitrate solution in which this state could be developed it was found that the brass could be completely removed and the iron left intact. This method of electrolytic stripping was installed and operated with success in various factories, and is now an important adjunct to the dip-brazing method. This same electrolytic stripping process may be applied equally well in removing silver, lead, tin and other metals more electronegative than iron from an iron surface. Nickel cannot be removed in this way, since it assumes itself the passive state.

The author gave some measurements of the single potential of iron, with the use of the calomel standard electrode. The single potential of iron immersed in a sodium nitrate solution before the current is passed, is in the neighborhood of + 0.2 volt; by causing the current to pass from the iron anode, however, the potential quickly becomes negative and increases rapidly in negative value up to — 2.0 volts under certain conditions.

ELECTROLYTIC DETERMINATION OF THE BASCILITY OF ACIDS.

Mr. Ivar Juel Moltkehansen presented a paper on an experiment on the electrolytic determination of the bascility of acids. One of the most difficult problems of inorganic chemistry is the constitution of metaphosphoric acids, which can only be determined by analysis of their double salts. A decision as to the constitution of the metaphosphates, soluble in water, is possible from measurements of their electric conductivity, in combination with Ostwald's dilution law. This method is applied by the author for ammonium metaphosphoric acid. His results speak for the existence of dimetaphosphoric acid of the ammonium salt, with two molecules of water of crystallization, according to the formula $(NH_4PO_3)_2\ 2H_2O$.

ELECTROMETALLURGY OF GOLD.

A paper on this subject was presented by Dr. W. H. Walker, of Boston, Mass., giving a review of the present commercial situation in this field. The electric current is used both for dissolving gold in potassium cyanide and for precipitating it from the solution. For the first purpose, the effect of the current is to produce oxygen, as it was early discovered that the presence of oxygen is necessary for the dissolution of the gold. The processes for recovering gold electrolytically from cyanide solutions may be divided into two classes. The first class comprises the processes in which the gold is first dissolved in a tank and afterwards recovered electrolytically. The Siemens & Halske process belongs to this class, and is used on a large scale in South Africa. The other class comprises those processes in which the solution and precipitation of gold are carried on simultaneously. The Pelatan-Clerici, the Riecken and the Aurex-Sluice processes belong to this latter class, and have not been found to be commercially successful, the reason for their failure probably being due to the fact that large quantities of ore are required to recover a small quantity of gold, and that these large quantities of ore must be continually moved. The author then gave an account of some experiments made by him with a telluride gold ore and explained why some processes which worked well in the laboratory have not been successful on a large scale. The fact is that to recover the gold by cathodic precipitation, the ions containing gold must be continually in contact with the cathode; this was not appreciated by the early experimenters.

In the discussion Mr. Bancroft said that the Siemens & Halske people are not using the Siemens & Halske process in South Africa, but the Andreoli process. Dr. Richards remarked that the efficiency of the electrolytic gold recovery is very small, but that the cost of power does not cut any figure in the economical production of gold from ores.

ELECTROLYTIC COPPER REFINING.

Dr. Wilder D. Bancroft presented a paper on electrolytic copper refining, in which he gave an account of a series of tests made in Cornell University to find the most economical conditions. The principal factors varied in these experiments were the temperature and the current density. Two sets of curves were plotted, one showing the relation between the cost to precipitate a ton of copper and the temperature of operation; the second set showing the relation between the cost to precipitate a ton of copper and the operating current density. From these curves it appears that a temperature of 70° is most satisfactory. Although the cost runs very high at this temperature for a current density of 1 amp. per sq. dm., it begins to drop off very rapidly as the current density increases, until it assumes a practically constant value at the higher current densities. Between 3.5 and 3.75 am. per sq. dm. would be the best current density for obtaining economical results, for at this density no extra power would be required to heat the solution. Operating at this current density, and with covered tanks, in order to prevent the heavy radiation losses, the current alone would be sufficient to heat the electrolyte to over 80°. In order to secure a good circulation, essential for a good deposit with high current densities, the present method of pumping could be retained. If the gutters leading to and from the pump were properly insulated the solution would not drop below 70° before returning to the tanks. Moreover, running at this high current density, there would be a considerable saving in the first cost of the plant, inasmuch as fewer tanks are needed for the precipitation of a given amount of copper in a given time. The lower the cost of heating, the greater the advantage of a high temperature. The author sums up the results of the investigation by recommending, first, covered tanks; second, a current density of 3.5 amp. per sq. dm.; third, a temperature of 70° C.

The paper of Dr. Bancroft was discussed by various copper refining engineers. Mr. Lawrence Addicks, of the Raritan Copper Works, said in a communicated discussion that electrolytic refining consists, from the standpoint of economy, in a very nice balance of a number of conditions, and that Dr. Bancroft has considered some, but has overlooked others, for instance, labor cost. The idea of covered tanks would be greeted with much hesitation by most refiners, for it is hard enough to get thorough inspection with an open tank. Every refinery is charged with interest and depreciation of plant, and these are not considered by Dr. Bancroft; he thinks that these charges would revolutionize Bancroft's cost tables. He sums up his criticism by saying that current density and temperature bear vital relations to the cost of refining, and that Dr. Bancroft has furnished valuable data concerning these items; for some refineries his conclusions may be correct, but not for all.

Mr. Benjamin Magnus, of the Anaconda works, gave as a result of his experience that the ampere-hour efficiency depends entirely on mechanical conditions. He seriously objects to covered plants and refers to the conditions used by the Anaconda refinery, where the current density is 10.5 amp. per sq. ft., the temperature of the electrolyte is 100° F. and the circulation of the electrolyte 3 gallons per minute. Under these conditions the chemical action in the tank is 1 per cent. greater than the electrolytic action, and the voltage per tank is 0.23 volt. In order to keep the solution constant day by day, the extra copper taken up by the solution is taken out by means of a tank with insoluble anodes. The cost of operating this tank in which the voltage is 2, is at least 8 times the cost of operating a regular depositing tank. If a temperature of 70° C. should be used and the current density be raised to 31.5 amp. per sq. ft., the excess chemical action would be so great that to free the electrolyte from copper by means of tanks with insoluble anodes, would cost so much that the saving of power due to warmer solutions would be more than offset.

Mr. Woolsey McA. Johnson said he had plotted for nickel curves similar to those of Dr. Bancroft for copper, and pointed out that the results of such curves must be translated freely into practice. He also criticised some special assumptions of Bancroft which he considered as unwarranted.

Dr. Bancroft, in his reply, said that in his paper he had clearly stated all assumptions which he had made, and that he had intended to give exact figures concerning current efficiency and temperature; this he has done and every refinery is now enabled to make the calculations of cost for its own case, taking their own figures for the other factors, purposely not taken into account, in his paper. He considered that the difficulty of covered tanks was greatly overstated. If the covers are so arranged that they will swing or lift open easily, the only difference will be the slight extra time necessary to raise the covers. The fact that by means of covered tanks, nothing else being changed in the present arrangements, a saving of 30 per cent. in power may be accomplished, should certainly be of interest.

EFFICIENCY OF THE NICKEL-PLATING TANK.

Prof. Oliver W. Brown presented a paper on this subject, which in the absence of the author was read by Mr. W. McA. Johnson. The design of the present nickel-plating solution has been the result of the "cut-and-try" process, and few attempts have been made to give a good scientific explanation of why some solutions give better results than do others. Platers have also turned their attention mostly to the cathode and less to the anode, although a high current efficiency can only be attained if the anode corrodes at the same rate as the metal is deposited at the cathode. The nickel-plating cell is notably inefficient from this point of view; there is not only the resistance of the electrolyte to be overcome by the applied voltage, but an additional counter e.m.f., amounting in some cases to over two volts. To study the problem, the author has determined the single potentials of anode and cathode separately, by means of a standard electrode.

His results show that electrolytic nickel anodes corrode very poorly as compared with cast nickel anodes; pure rolled anodes are no better than electrolytic. The cathode efficiency is affected to a marked degree by the anode efficiency. The satisfactory operation of a nickel-plating solution depends to a large extent on the character of the anode employed. The purest anode material is not the best; presence of copper is advantageous to a certain extent, and it is quite likely that certain other impurities which are usually present in cast nickel may be equally advantageous. The reason that cast nickel anodes show a superiority may be due to the impurities or to a different physical structure which gives rise to a great porosity and roughness of the surface, and thereby a greater actual surface area. The electroplater can obtain an efficiency of 90 per cent. or more if cast anodes are used, with an anode density of about 5 amp per sq ft.

In the discussion Mr. W. McA. Johnson recommended to electoplaters the author's method of studying the anode and cathode potentials separately by means of a standard electrode, but he thought that for the average plater the cost of standard electrodes and potentiometer would be too high. Prof. Burgess did not consider the cost to be excessive and referred to the great convenience of using the Ostwald mercury standard electrode. There was also some discussion between Messrs. Gahl, Reed and Richards concerning overvoltage.

A NEW TYPE OF ELECTROLYTIC CELL.

A paper on this subject was presented by Mr. Pedro G. Salom. His process of reducing galena to lead consists, as is well known, in the use of galena as cathode in sulphuric acid, the sulphur going off as hydrogen sulphide. In his early experiments with this process, the chief difficulty encountered was the incompleteness of the reduction. It was found that this was due to the use of too thick a layer of ore, by diminishing the thickness of the layer, the reduction becomes more and more complete. At the same time the use of a much higher current density than formerly used becomes thoroughly feasible. But these improvements would have been impracticable with his old type of cell; he has, therefore, devised a new type of cell which has another important advantage, namely, that the process now becomes continuous.

The cell looks somewhat like a wheel in horizontal position; it consists of an annular body of a trough-shaped cross-section made of antimonial lead and being used as cathode. The anode consists of a series of segmental plates, supported by a spider frame and bridging the spaces between seven of the eight arms of the spider frame, the space between the seventh and eighth arm being left open. The anode is rotated and the gases developed are led off through a pipe. A box filled with crushed galena is arranged in the open space between the seventh and eighth arms of the spider frame, and is provided with a feeding slot through which the galena is supplied to the bottom of the cell. A scraper plate sweeps the spongy mass out of the apparatus while the anode rotates. The author states that this cell should be also useful for other electrolytic processes than the reduction of galena.

ELECTROLYSIS OF SODIUM HYDROXIDE BY ALTERNATING CURRENT.

In a paper with this title, Mr. Carl Hambuechen, of Madison, Wis., described a method for producing electrolysis by connecting an electrolytic cell directly to a source of alternating pressure. As alternating current is largely used for transmission of power, its conversion into an undirectional current is a matter of moment to electrochemists; it is possible to avoid rotary converters or motor-generators, if aluminum is used as one of the electrodes in a cell in which electrolytic decomposition is to be effected. This follows from the well-known property of an aluminum electrode to permit the passage of current in one direction, but not in the other. The author applied this principle successfully to the electrolytic production of sodium from fused sodium hydroxide, the efficiency of the process being high.

ELECTROLYSIS OF WATER.

A paper presented by Messrs. J. W. Richards and Walter S. Landis was an account of a continuation of the researches of the authors on this subject, a first paper having been presented by them at the last meeting of the society. In their former paper they have shown the application of Ohm's law to dilute sulphuric acid for voltages up to 3.5 volts. In the course of their new experiments with somewhat modified apparatus, they found that there are two very important factors to be taken into account, viz.: the current used and the size of the electrodes. The current must be kept within the limit of that which can be completely depolarized by the gases in solution in the electrolyte. The electrode surface must be large enough to allow this depolarization to take place simultaneously with the decomposition. The smaller the electrodes used, the greater the polarization.

An interesting fact ascertained by the authors is that an evolution of gas can be obtained at about 1.1 volt at a small electrode, if opposed to a large one, and that this is true for oxygen as well as hydrogen. At the larger electrode there is enough dissolved gas in the solution to act as depolarizer. The results obtained by the authors concerning the diffusion current agree well with those of Bigelow.

In the discussion Mr. Reed said the evolution of gas at a small electrode, opposed to a large electrode, may be explained by the assumption that the latter forms a compound with the ions and acts as depolarizer. Mr. Hering thought that in the measurements of the authors there was an ambiguity concerning the time when the readings were taken. Dr. Gahl spoke on overvoltage. Dr. Richards, in his reply, said that the readings were taken seven seconds after closing the circuit, because this was the time required for letting the needle of the measuring instrument come to rest. They could not find any chemical effect on the platinum, nor did the current depend on the condition of the platinum.

ELECTROLYSIS OF WATER VAPOR.

Mr. F. Austin Lidbury, of Niagara Falls, presented a paper on the supposed electrolysis of water vapor, due to a discharge of electricity through steam. In experiments which the author has made in conjunction with Mr. D. L. Chapman, he made the interesting observation that in the partial decomposition of water vapor by the electric discharge the hydrogen and oxygen liberated tend to separate and to take up different positions in the tube, the hydrogen collecting at both anode and cathode and the oxygen in the middle of the tube. It appears that the process cannot be entirely analogous to ordinary electrolytic action, and further investigations are required in order to give a satisfactory explanation.

METALLIC DIAPHRAGMS.

A note on metallic diaphragms, by Dr. Eugene A. Byrnes, of Washington, D. C., was read in the absence of the author by Mr. C. P. Townsend. Various conducting materials become poor conductors when in finely-powdered form, and may then be used for metallic diaphragms. For instance, finely-divided lead may be used. Various mechanical arrangements for the construction of the diaphragm are possible; for instance, the finely-crushed material may be included between perforated iron plates, etc. For further particulars the reader may be referred to a recent patent of Dr. Byrnes, an account of which was given in ELECTRICAL WORLD AND ENGINEER under "Recent Electrochemical Developments."

GENERAL DISCUSSION OF THE ELECTROLYTIC DISSOCIATION THEORY.

As an introduction to this discussion a paper was read by Dr. E. F. Roeber on the theoretical properties of free ions in solution. The author discussed the use of physical analogies and mechanical models, as introduced by Maxwell in the theory of electricity, and said that the electrolytic dissociation theory should be considered from a similar point of view, electrolytic phenomena being illustrated by the model of traveling ions. The author gave a sketch of the facts of electrolysis and showed what properties must be attributed to the ions to suit the facts. In an "infinitely dilute" solution of uniform concentrations these properties are the electric charges, according to Faraday's law, and the specific mobilities of the ions, according to Kohlrausch; if there are differences of concentration in the solution no new properties are attributed to the ion, but it is assumed that only two kinds of forces are acting on the same—the electric forces due to the electrostatic charges, and the osmetic forces due to the concentration differences. These are all the suppositions made in Nernst's theory of diffusion and theory of concentration cells. For infinitely dilute solutions this model of ions has been found to represent the facts completely and correctly. For more concentrated solutions, Arrhenius has made the assumption that only a part of the dissolved molecules is ionized and active, while the non-ionized molecules are inactive. But here the fundamental difficulty is encountered that we have not yet an absolutely certain method for determining the degrees of dissociation, because the different methods applied for this purpose have, in numerous cases, given results which are not in agreement with each other. Nevertheless, the dissociation theory represents even for more concentrated solutions an approximation to the truth. A theory is a tool for scientific progress, and a tool should not be depreciated because it is not perfect.

Dr. Wilder D. Bancroft opened the general discussion and said that in recent years the dissociation theory has developed along two different lines. One class of workers have applied the theory to more and more new facts, and they have been very successful; the other in which Kahlenberg is a leader has looked for limitations of the theory, and they have also been very successful. Dr. Bancroft emphasized that the electrolytic dissociation theory really applies only to infinitely dilute solutions. He also called attention to the fact that it has not yet been exactly proven that there are really abnormal molecular weights in solutions, so that the fundamental facts on which the thermodynamical support of the theory is based are not certain; we do not yet know whether the heat of vaporization of pure water is equal to the heat of evaporization of sodium chloride.

Mr. C. J. Reed gave a long list of those points in which he believes the dissociation theory to be a failure. He thinks that electric charges are always sources of energy and must evolve energy where they discharge; the change of an ion into an atom should, therefore, evolve energy, while in reality energy must be supplied from the outside. Another point raised by Mr. Reed against the dissociation theory is that it does not account for the electrolysis of fused salts. Mr. F. A. Lidbury answered some of the objections raised by Mr. Reed. Dr. W. Lash Miller spoke of an investigation in which he used Ostwald's dilution law to determine which are the ions of acetic acid, and then wanted to calculate the transport numbers: but the results were not in accordance with the facts, and he does not know yet how to explain them. Prof. Henry S. Carhart said that the dissociation theory has been a very successful working hypothesis, but there are very serious objections. He considered the term dissociation to be not good. We have to expect modifications of the theory.

Dr. J. W. Richards presented, as a contribution to the discussion, a paper on the thermochemistry of the dissociation theory. The paper was highly theoretical and cannot be briefly extracted. He considers the ionized state as a "combined state" and assumes the heat of neutralization of an acid and a base to correspond to the passage of water from steam to liquid. The calculation of the ionization heat, based upon his view, is in good agreement with the facts. As a further contribution to the discussion, Mr. C. J. Reed presented a paper on Berthelot's law relative to the electromotive forces of cells, based on the reciprocal action of saline solutions and soluble electrolytes. He showed that Berthelot's alleged proofs of this law were no proofs. He assumes the e.m.f. at the junction of two electrolytes to be zero.

Dr. H. M. Goodwin said that when investigations go on, one must expect disarrangements between facts and an established theory; this is the only way to perfect a theory. He spoke of the applications of the dissociation theory to the colors of solutions; he thinks that the view of the theory which considers the neutralization heat to correspond to the formation of a molecule of water from a hydrogen and a hydroxyl ion is simpler than Dr. Richards' view. Dr. Richards replied that his view is preferable because it enables him to calculate the neutralization heat, and the result agrees with the facts.

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The Bell Telephone System in Philadelphia.

The recent merger of telephone interests in Philadelphia, with the policy of putting at the head of the system Mr. U. N. Bethell, general manager of the New York Bell system and head of the Washington system, gives interest to the affairs of the Bell Telephone Company, of Philadelphia. Its capitalization has been increased rapidly by successive issues of stock, from $3,500,000 at the beginning of 1900 and $2,500,000 in 1898, due to the extensive growth of the business, the number of city subscribers alone having recently been given as 42,000, as compared with 13,000 so recently as the beginning of 1900, when the company had less than $4,000,000 capital.

The successive increases and stock allotments are given by Philadelphia financial authorities in the following table:

Year.	Stock Outstanding.	Allotment.	Increased.
1898	$2,500,000	20%	500,000
1899	3,000,000	16 2-3%	500,000
1900	3,500,000	14 2-7%	500,000
1900	4,000,000	25%	1,000,000
1900	5,000,000	20%	....
1900	6,000,000	16 2-3%	1,000,000
1901	7,000,000	14 2-3%	1,000,000
1902	8,000,000	25%	2,000,000
1902	10,000,000	20%	2,000,000
1903	12,000,000	....	....

The market for the stock is a narrow one. The quotation has ranged from 70 to about 78 in the last three years, varying as the rights came off and regaining the high figure, substantially, each time. The highest price touched was 94, in 1899. The stock sold at 75 last June, and a few weeks ago an odd lot changed hands at 67. The company has continued to pay 8 per cent. dividends along with each increase of stock, and it is expected that the current year's earnings will exceed those of 1902, when the costs of maintenance, on account of some severe storms, were unusually heavy.

The development of the business is now particularly in the districts outside the city, which are covered by the Delaware & Atlantic Company, whose stock is owned by the Bell Telephone Company, of Philadelphia, and this company's published figures showed decided gains in number of subscribers. The Delaware & Atlantic territory covers all of New Jersey south of Trenton, the Counties of Berks, Montgomery, Chester and Delaware around Philadelphia, and the State of Delaware. The placing of the main arteries for the suburban lines underground has been accomplished at some points by the Delaware & Atlantic Company, at Wayne, Media, Ogontz and Norristown.

The American Telephone & Telegraph Company has always taken its proportion of stock in the Philadelphia Bell Telephone Company, 83 per cent. with each new issue, and holds over $9,600,000 of the $12,000,000 outstanding. Four financiers in Philadelphia hold about $1,000.000 more and another $1.000,000 or so is owned by the New York and Boston trust companies.

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Westinghouse Electric Status.

A favorable analysis is made by financial authorities of the Westinghouse Electric figures just made available. The last balance sheet submitted by the Westinghouse Electric Company to stockholders was dated March 31, 1897. A comparison of the statement with the one recently published in connection with the application for listing new stock shows a remarkable gain in financial strength Working capital, or the balance of current assets over current liabilities, is now $12,134,395, compared with $2,093,146 in 1897, an increase of $10,041,249. This does not include stocks and bonds in the treasury, which have increased from $5,964,879 in 1897 to $7,251,385 in 1903. These securities are carried at cost.

The company's fixed assets, including property and patents, have increased from $7,816,089 in 1897, to $13,577,701 in 1903, a gain o $5,761,612. Besides this, there has been written off, according to one of the reports, $2,786,719, indicating a total expenditure of $8,548,331.

In 1901 $3,000,000 stock (par $50) was issued at $55 a share; and now $4,500,000 is being issued at $80 a share. When the new stock will have been issued total capital increase in the six years will have amounted to $10,853,000 (par value), and $3,865,000 proceeds from stock to issue is still to be added to working capital.

The surplus after dividends for the six years may be figured as follows:

Gain in working capital	$10,041,249
Gain in stocks and bonds owned	1,286,504
Gain in fixed assets	8,548,084
Total gain in assets	$19,876,084
Stocks and bonds issued (less retired) par value	6,353,711
Balance	$13,522,373
Less premium on stock sold	1,551,000
Balance, surplus earnings	$11,971,373

This amount is probably not far from the actual amount of earnings after dividends and interest since 1897.

The gain in working capital is a reflection of the rapid growth in the company's business. This growth may be seen in the following figures of gross sales for the years ending March 31: 1898, $4,378,060; 1899, $6,901,760; 1900, $11,963,646; 1901, $15,853,481; 1902, $19,975,958; 1903, $23.899,492; total sales, six years, $82,972,397.

Twenty per cent. of the above total gross sales would be about $16,500,000, which is probably the amount of net earnings before dividends and interest.

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Telegraphers' Mutual Benefit Association.

The annual meeting of the Telegraphers' Mutual Benefit Association will be held at 195 Broadway, New York, on Wednesday, November 18, next.

Westinghouse Turret System of Electro-Pneumatic Car Control.

A few details and one or two illustrations have already been presented to the readers of this journal with regard to the new Westinghouse turret system of electro-pneumatic car control, and we are now able to supplement that matter by a number of interesting particulars entering more fully into the construction and modus operandi of this important advance in the field of electric traction. The data, as here given, are based upon an interesting exhibit made by the Westinghouse Company at the Saratoga meeting of the American Street Railway Association, to which reference was made at the time in these columns. As a matter of fact, however, the control has already entered into practical adoption, and is now being placed on several cars on the Manhattan Elevated Railroad, while 264 control equipments have also been purchased for the Brooklyn Rapid Transit System. In the turret control, which derives its name from the external appearance of the organism, the actuating mechanism is not directly connected to the main source of current supply, and the connections for the low-voltage control circuits are the only ones which have to be considered in the train operation. There are only seven battery wires required for the train cable, and the train cable carries only a pressure of 14 volts, thus doing away with high-voltage wires on trail cars and high-voltage couplings anywhere in the system. It follows that from the use of a separate electrical circuit the controlling apparatus can be worked even when the main current is cut off, from any of the familiar causes, so that even when the third rail is dead the motors can be reversed and used for braking.

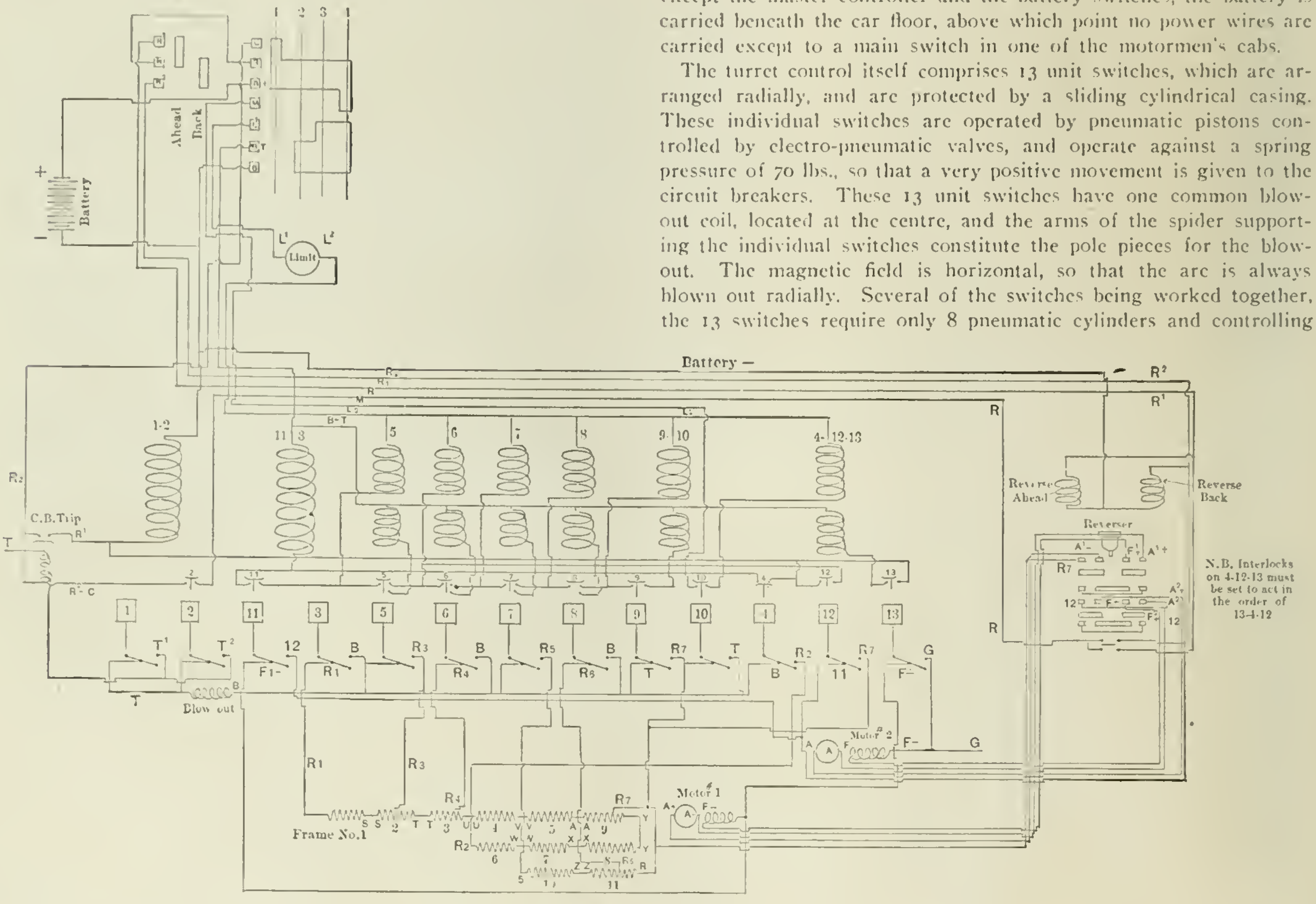

Fig. 1.—Diagram of Working Circuits.

To take the system step by step, attention is called first to the master controller and the air-brake operating valve, which are shown mounted on the inside end panel of the motorman's cab on an elevated car. When the apparatus is not in use the door of this compartment shuts against the end panel, so as to enclose the apparatus. The master controller is only 7½ inches high, 6 inches wide and 4½ inches deep, and is so placed that the controlling handle is 2 ft. 10 inches from the floor. The rotating cylinder of the master controller is of wood, with copper plates and copper spring fingers. The reverse cylinder interlocks with the controller cylinder in a simple manner, so as to prevent the movement of the former unless the latter is at the "off" position, and also prevents the movement of the controller cylinder, unless the reverse is open, over the forward or the backward step. Moreover, the master controller handle is fitted with a spring return, which makes it a "dead man's handle," and it is so constructed that should the motorman lift his hand at any time from the controller handle the brakes are at once automatically applied, unless the reverse handle has first been turned to the center position. By similar mechanism, if the brakes are applied while the current is still on, the current is automatically cut off. These points are accomplished by means of a connection between the spring return handle and the air brake system for setting the brakes; while the release of the brakes is effected by a connection between the air brake system and a small air cylinder, the piston of which opens the battery circuit.

Immediately below the master controller is the junction box to which the seven-battery wires above referred to are brought, this box being 13½ inches high, 5 inches wide and 3 inches deep. The batteries themselves that are used for operating the electro-pneumatic switches are of the well-known "Chloride" type, and two sets are employed in order to insure absolute continuity of function, each set consisting of seven cells. The battery box is 16½ inches by 16½ inches by 25 inches, and with the cells weigh complete 300 lbs. Each set of batteries is in series with a set of lamps for charging from the line current. It will be noted that like everything else except the master controller and the battery switches, the battery is carried beneath the car floor, above which point no power wires are carried except to a main switch in one of the motormen's cabs.

The turret control itself comprises 13 unit switches, which are arranged radially, and are protected by a sliding cylindrical casing. These individual switches are operated by pneumatic pistons controlled by electro-pneumatic valves, and operate against a spring pressure of 70 lbs., so that a very positive movement is given to the circuit breakers. These 13 unit switches have one common blowout coil, located at the centre, and the arms of the spider supporting the individual switches constitute the pole pieces for the blowout. The magnetic field is horizontal, so that the arc is always blown out radially. Several of the switches being worked together, the 13 switches require only 8 pneumatic cylinders and controlling valves. The pneumatic cylinders are drilled in the air reservoir casting, and thus piping between them and the air reservoir is dispensed with. In this turret control, by the use of air pressure operating against a spring, the liability of the welding or sticking of the contact surfaces is avoided. Moreover, the switch finger levers are made flexible so that when drawn up by the pneumatic pressure and released by spring pressure a slight rubbing movement of the contact surfaces is obtained, which also does its share in the prevention of any welding effect.

A diagram is shown herewith of the connections, and a view is also shown of the side of the Manhattan car as equipped with the

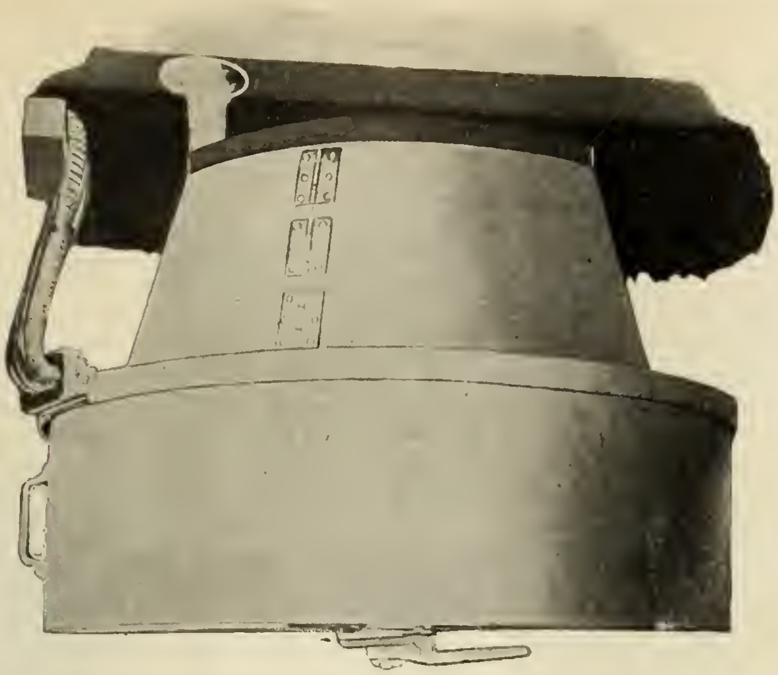

FIG. 2.—TURRET CONTROLLER WITH CASE CLOSED.

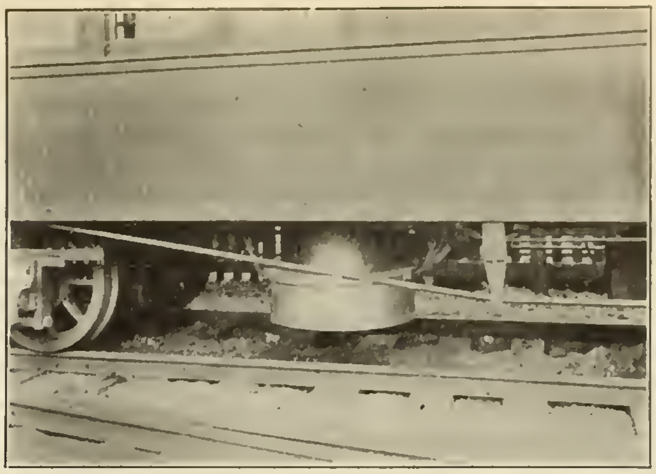

FIG. 6.—SIDE OF CAR SHOWING TURRET.

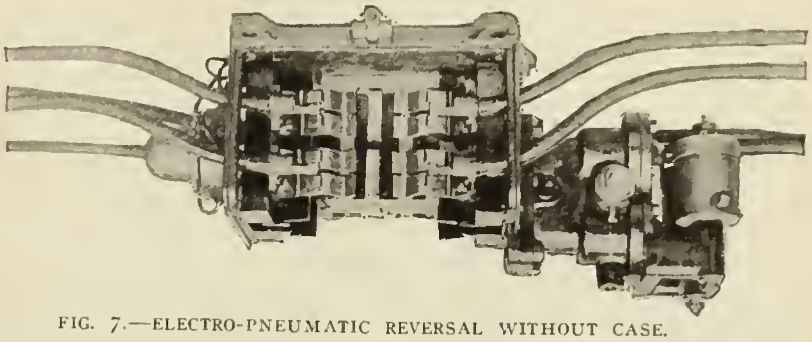

FIG. 7.—ELECTRO-PNEUMATIC REVERSAL WITHOUT CASE.

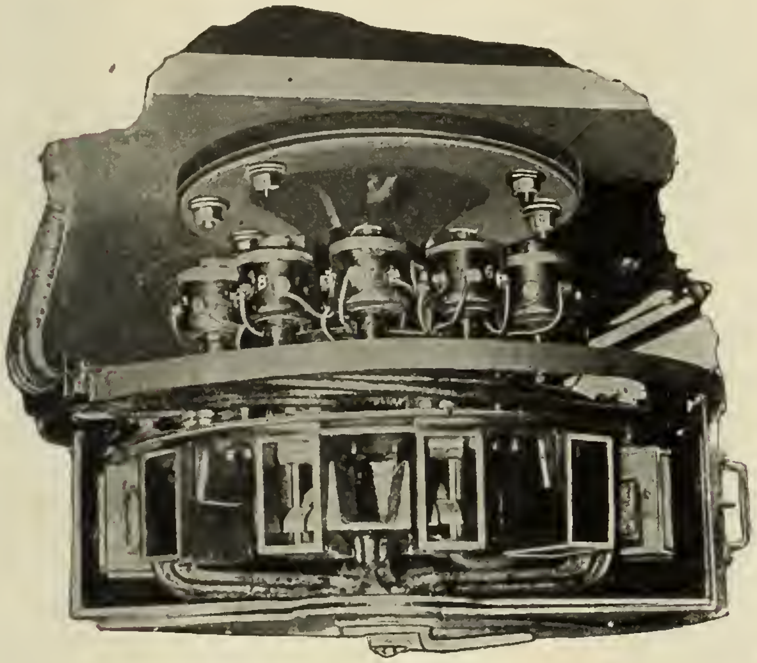

FIG. 3.—TURRET CONTROLLER WITH CASE OPEN.

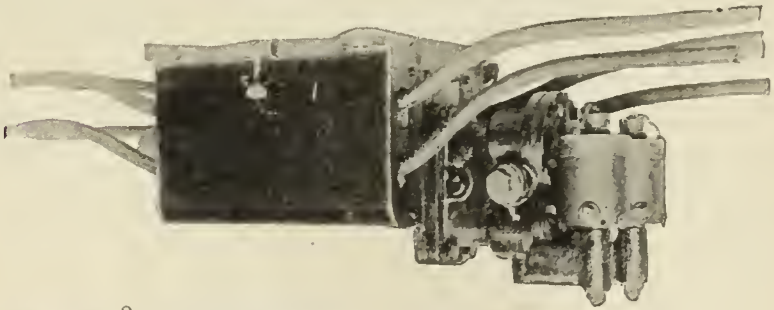

FIG. 8.—ELECTRO-PNEUMATIC REVERSAL WITH CASE CLOSED.

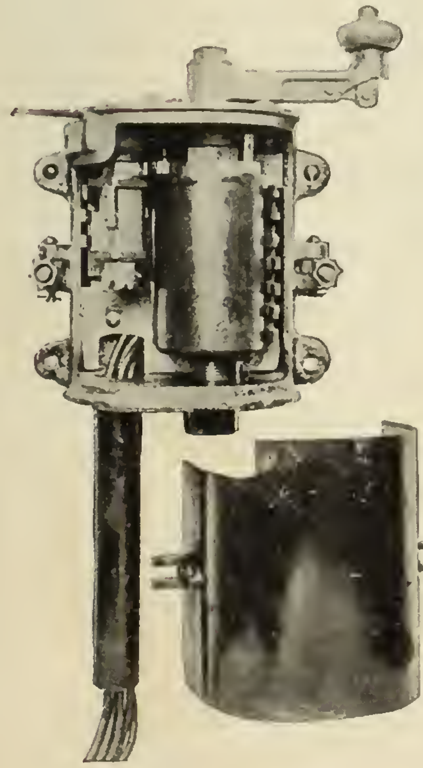

FIG. 4.—MASTER CONTROLLER UNCASED.

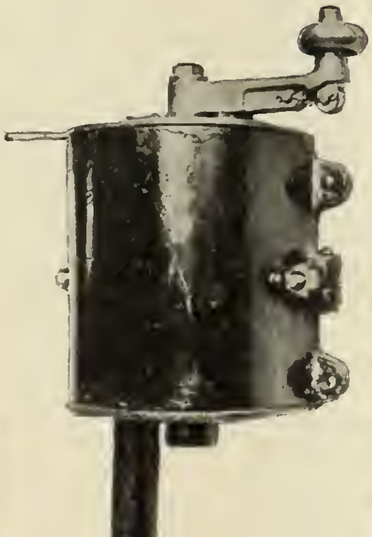

FIG. 5.—MASTER CONTROLLER WITH CASE CLOSED.

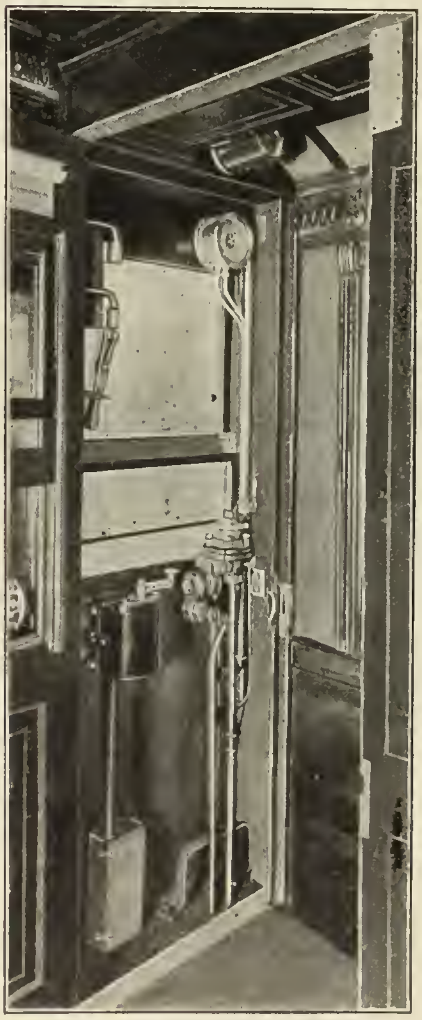

FIG. 9.—MOTORMAN'S CAB, SHOWING MASTER CONTROLLER, JUNCTION BOX AND AIR BRAKE OPERATING VALVE.

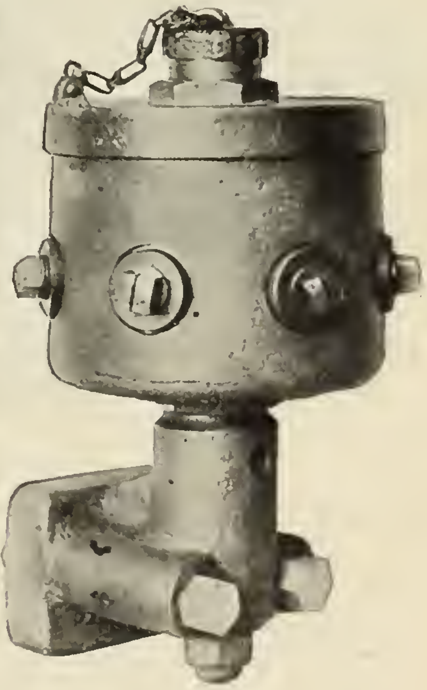

FIG. 10.—ELECTRO-PNEUMATIC VALVE.

TURRET SYSTEM OF ELECTRO-PNEUMATIC CAR CONTROL.

system. The reverse switch is of the usual type, with copper contacts, but is operated by two air cylinders controlled by electropneumatic valves worked from the reverse cylinder of the master controller. This reverse switch is placed as near the motor truck as possible to reduce the length of wire, and adjoining it is the limit switch governing the acceleration. In practice these two switches are usually mounted on the side of the car opposite from the resistance and the turret controller is placed in the centre.

Taking the diagram of connections, as shown in Fig. 1, the first step on the master controller throws the reverser. The circuit as thus constituted actuates the circuit breaker relay, controlling the two pneumatic pistons, 1 and 2, closing the circuit breaker. The second step places all the motors in series by actuating the pneumatic cylinders 11 and 3. These close the series connection and the connection through the rheostat *R*-1. At the third step, the resistances are cut out by closing the circuit through the limit switch and through coil No. 5. The action of the switch No. 5, in closing, establishes a circuit through No. 6, and this in turn as it closes establishes a circuit through No. 7, and so on throughout the full series up to No. 10, when all the resistances are cut out. Each piston in dropping to close its switch, closes also a holding connection seen directly above each piston, which cuts out the limit switch coil. This prevents the switches from opening when the limit switch acts, after they have once been closed; the limit switch simply preventing the next switch from picking up.

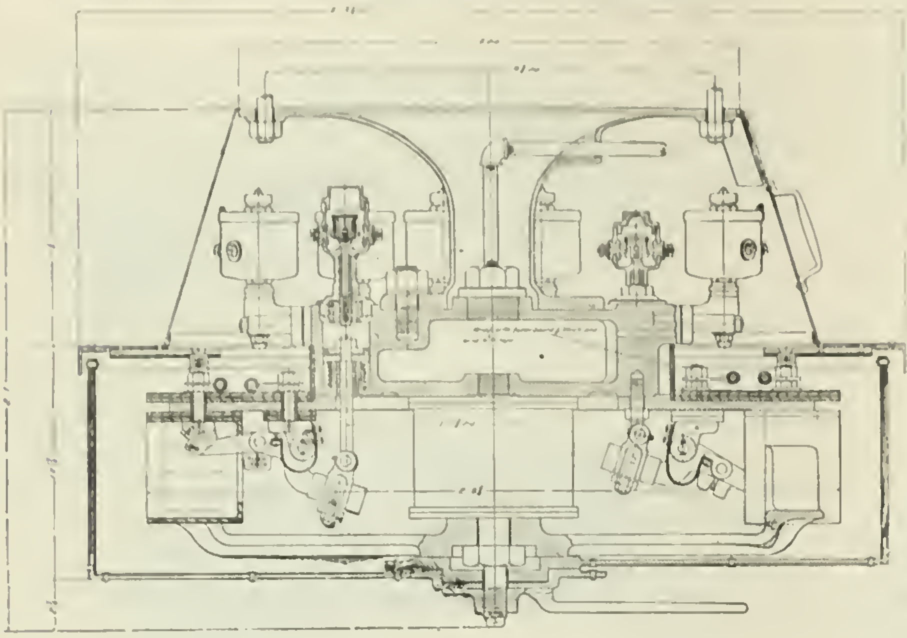

FIG. 11.—CROSS-SECTION THROUGH TURRET.

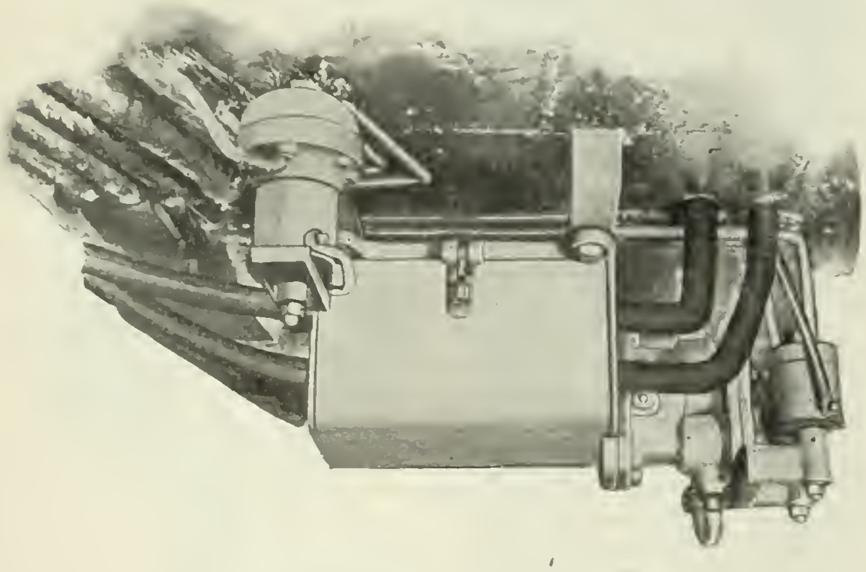

FIG. 12.—LIMIT SWITCH AND REVERSER.

At the fourth position of the master controller the motors are in parallel. This result is obtained by means of solenoids 4, 12 and 13, and actuating switches of the same. These switches as they start to close, open the circuit on switches 3 and 11, and when they are fully closed, circuit is established through the holding coil. The current then starts to pick up the resistance coils controlled by switches 6, 7, 8 and 9, switch 6 being the first resistance used in the multiple position.

At the extreme left of the diagram will be noted a circuit breaker trip. This is actuated by the main circuit, and its object is to interlock the circuit breaker so that in case it opens while the power switch is closed, the circuit breaker cannot be reset until the power switch has been opened again.

The total weight of the complete apparatus, used on the Manhattan system is 1,711 lbs., inclusive of the battery. The wiring is very small in amount, and all the circuits are run in "electro-bestos" conduit. The air for the pneumatic switches is taken from the main train line, and is fed first to an auxiliary reservoir through a feed valve insuring uniform pressure, and passes thence to the air reservoir already referred to above as being located at the centre of the turret. A check valve is also provided with the auxiliary reservoir with the object of enabling it to retain sufficient air to operate the system in case the main supply should be cut off.

It will be obvious from this brief description that the new system has been worked out with great ingenuity and with careful forethought to provide against any emergency which might possibly arise in the operation of cars or trains. As here illustrated, the system is applied to only one car, but any desired number of cars can be operated from one master controller by carrying the battery connections from it to turret controllers upon motor cars constituting the train. The system has been worked out under the personal direction of Mr. George Westinghouse himself, and by the engineering staffs of the Westinghouse Air-Brake and the Westinghouse Electric & Manufacturing companies. It will be noted at once that the system is strikingly different from the company's "drum" type of electro-pneumatic control, and it must be a matter of interest and reassurance on the part of the public to observe how quickly improved methods are forthcoming as soon as the problems are indicated in actual service. The details of construction referred to above are shown very clearly in the series of illustrations, Fig. 2 to Fig. 12.

* * *

Recent Electrochemical Developments.

OXIDATION OF METALS DISSOLVED IN MERCURY.

In the familiar mercury cathode cell electrolysis of sodium chloride yields sodium amalgam, which afterwards gives off the sodium in a second compartment, with the formation of caustic soda. In a patent granted on September 15 to Messrs. Chas. E. Baker and Arthur W. Burwell, of Cleveland, Ohio, an apparatus for oxidizing the sodium is proposed which is essentially a short-circuited galvanic cell with amalgam as anode and carbon as cathode, the electrolyte being water or a dilute solution of caustic soda. The electrochemical action is oxidation of sodium to sodium hydroxide at the anode and evolution of hydrogen at the cathode.

The apparatus is a vessel containing a layer of amalgam at the bottom, and above it a solution of dilute caustic soda. Vertical carbon rods are placed in the vessel in contact, with both the amalgam and the water. Arc light carbons are suitable for use in this apparatus, if their outer surface is removed mechanically; the new surface, which always contains a small percentage of metallic iron, is readily wetted by mercury; as it is in a rough condition, the active surface is large.

STORAGE BATTERY.

A patent granted on September 15 to Mr. Fred A. Redmon, of Chicago, Ill., refers to a construction of a storage battery plate in which, for the firm support of the active material, a corrugated perforated metallic envelope is provided which surrounds an absorbent substance (such as burlap, matting or other fibrous fabric) containing the active material.

New Telephone Patents.

A DEPARTURE IN AUTOMATIC EXCHANGES.

The most interesting of the patents at hand for consideration this week are certainly four relating to various phases of a novel, automatic exchange apparatus. These patents all are granted to Messrs. J. J. Brownrigg and J. K. Norstrom, of Chicago, their rights being assigned to the Globe Automatic Telephone Company. With this system each line has connected therewith one switching machine and one pair of contacts in the contact bank of each other's switching machine. Thus far the system is akin to many others. The means for carrying out the switching processes are, however, novel, as the functions of the various electromagnets are merely that of control, all heavy parts being moved by an extraneous source of power.

Two developments of this idea and two kinds of calling switches are described in the patents, but for the sake of clearness it seems best to devote attention first to the rudimentary machine and then to touch upon its amplification to the requirements of a large system. Referring at once to Fig. 1, wherein are shown two views of the simple machine, at *F* and *G*, is shown the extraneous power source, in the form of a cylinder with piston. Beneath the cylinder appears a valve. This controls an inlet port open to the atmosphere and an exhaust port open to a suction pipe, H^3. The weight of the parts is so adjusted that all forward switching movements are made by the action of gravity. As soon as a conversation is complete the release magnet, F^4, shifts the valve and all parts return to normal, the last operation being the releasing of the valve, to shut off the power.

The sequence of operations taking place in carrying out one call can best be explained by referring simultaneously to the circuits and apparatus. Fig. 2 shows the circuits, including a rudimentary subscriber's calling switch. Sliding upon the frame of the machine will be noticed a carriage *B* carrying two contact wipers. This carriage travels over the face of a contact bank *A*, consisting of two conducting bars *cc* connected to the calling subscriber's line, and contacts *aa* connected serially to the various other subscriber's lines. The wipers on *B* pass over the bars and contacts as the carriage travels, but only a single pair of contacts is connected to the conducting bars at the same instant. The carriage *B* when free to move will fall by its own weight. It is normally restrained by the stop pins, $L\ L^2$, $M\ M^2$, projecting from the shaft *K*. These pins are so spaced that in passing from one pin *M* to the next the wipers will run over ten contacts. There is another vertical adjustment, a motion of the whole shaft *K* in steps of one unit, or the distance between successive contacts. The magnet, C^3, with its armature and fall, controls this movement.

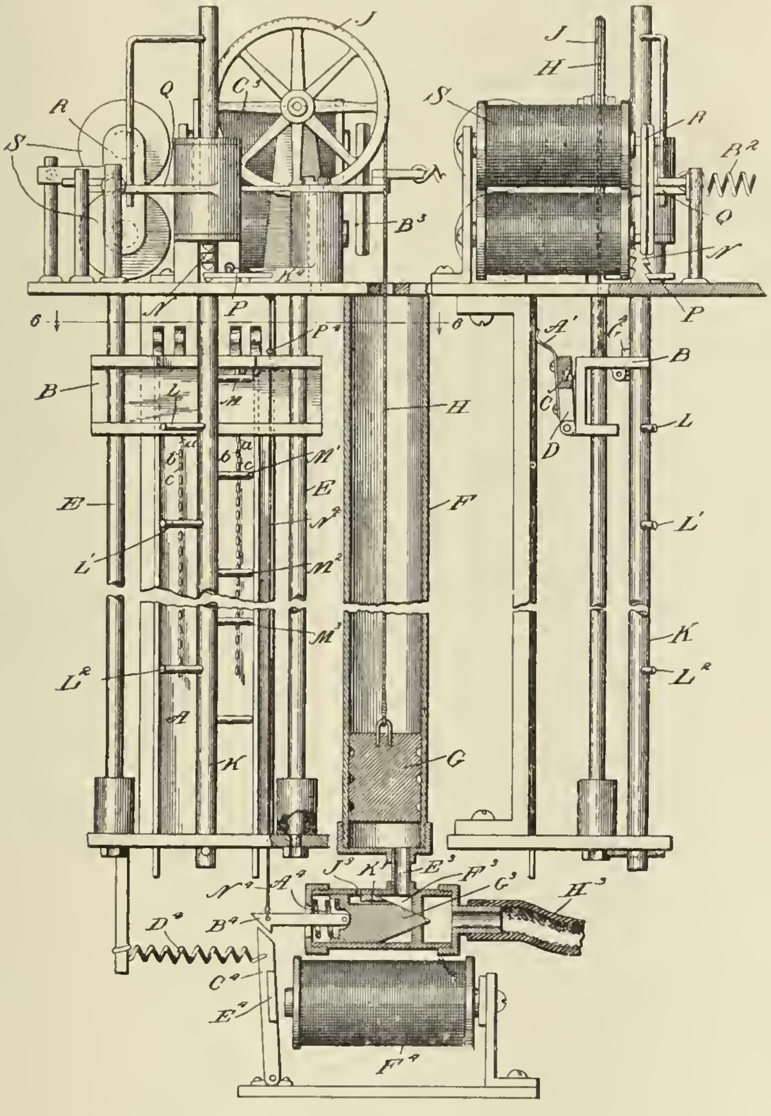

FIG. 1.—BROWNRIGG AND NORSTROM AUTOMATIC TELEPHONE SYSTEM.

Now suppose our subscriber desires number 63. Six impulses sent by key a^6 will energize magnet *S* six times, current being received over common battery wire, a^3. The armature of magnet *S* is linked to shaft *K* to rock it against its retaining spring. Thus shaft *K* will rock forward and back once for each impulse and thereby for six impulses drop the carriage to contacts number 60. The next operation is the sending of three impulses by key a^7. Thereupon magnet c^3 responding through its rachet escapement lowers the carriage three units to number 63. Connection to subscriber 63 is now complete and a signal call and conversation may be carried out in the usual manner. When the conversation is completed, keys a^6 and a^7 are to be simultaneously depressed to cause magnet F^4 to operate and catch the valve rod so as to cause the returning armature of F^4 to shift the valve and restore the carriage.

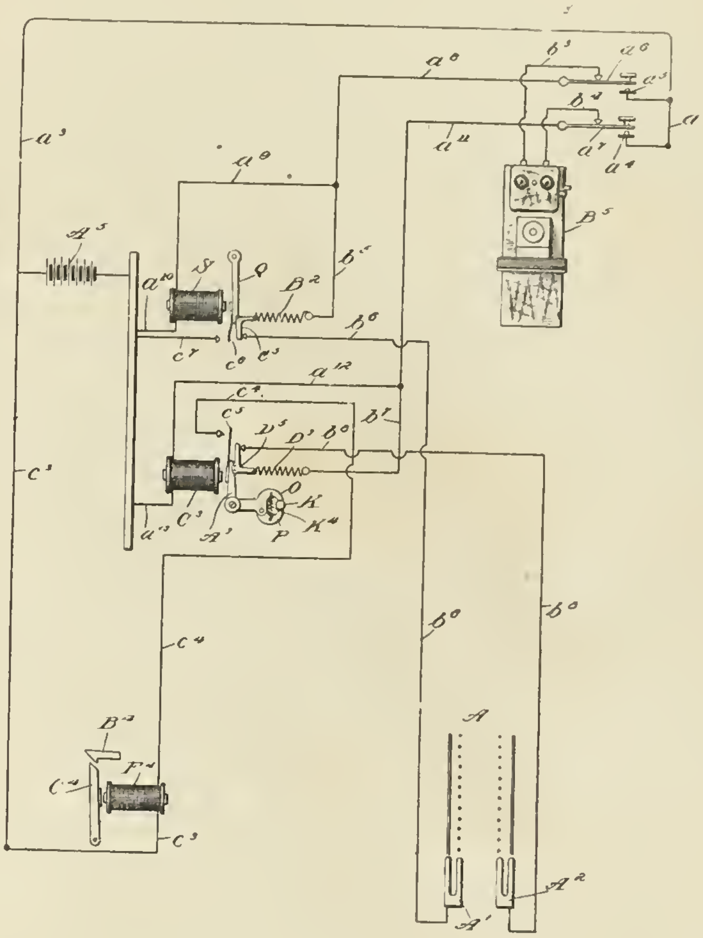

FIG. 2.—DIAGRAM OF CIRCUITS.

In order to make such a system suitable for more lines than can be conveniently arranged in a single pair of vertical rows, the number of rows is increased and a laterally moving carriage is arranged to move along the main carriage so that the wipers may be made to travel over any desired vertical row. This laterally moving carriage is moved forward by a spring and returned by the air cylinder exactly as is the main carriage. No additional electromagnets are required for the switching, as one magnet controls both cross and long vertical feeds. This is made possible by arranging the short or shaft feed intermediate, in point of time, with the long and lateral feeds. When the shaft is in the returned position the lateral feed only is controlled and when the shaft has moved one or more unit steps from its normal, then the long feed only is affected.

The automatic calling switches serve to replace the hand keys of the preceding description, and after once being set carry out the necessary contacts and combinations of contacts to effect the desired call and to restore the apparatus when the conversation has been completed. A busy signal device has also been provided for the system, but the action of this will be apparent from a study of the patents.

FIRE ALARM ATTACHMENT.

A very simple fire alarm attachment for telephones is the subject of a patent issued to Y. D. Peachey, of East Orange, N. J. A weight is secured to the telephone receiver by a cord in a manner such that when the alarm bell sounds, a co-operating latch releases the weight and removes the receiver from the hook, sending a call signal to central. When the operator answers she is supposed to hear the bell and report the fire.

Acheson Electric Furnaces.

At the meeting last week at Niagara of the American Electrochemical Society, Mr. Francis A. J. Fitzgerald read a paper, in which he discussed the conditions for efficiency of several forms of electric furnaces of the type in which the current passes along a definite path or paths, thus localizing the heat. From this paper we reprint below a description of the several types of electric furnaces that have been developed by Mr. E. G. Acheson.

Graphite Furnace.—In this furnace the highest temperature attainable is desired. The carbonaceous material, anthracite coal, coke, etc., is placed in a trough-like furnace, and through the centre of the charge is a series of carbon rods connecting the furnace terminals. Anthracite coal, the raw material usually employed, is practically a non-conductor of electricity, and at first the current passes through the core of carbon rods. The heat generated in the core converts the surrounding coal into graphite, which then becomes a conductor and heats another layer of coal, and so on till the process is complete. This furnace belongs to both sub-classes of the resistance type.

Electrode Furnace.—This furnace does not properly belong to the type above mentioned, but is peculiar in that the heat is mainly generated outside the articles under treatment. In the most general case the electrodes to be converted into graphite are arranged in piles, and the spaces between the latter filled with granular carbon. Since the resistivity of the granular carbon mass is much greater than that of the electrodes, most of the heat energy will be developed in the former. The advantage of this type of furnace is that it permits of treating a large mass of low-resistance material without using currents of excessive amperage.

Carborundum Furnace.—Carborundum is a substance that is decomposed at the temperature of the graphite furnace, hence in its manufacture careful temperature regulation is necessary. The charge, consisting of sand and coke, in the form of powder, is put in the box-like furnace, and through its centre passes a conducting core, which may consist of carbon in a granular form, or of carbon rods, connecting the terminals of the furnace. The current is confined to the core, raising it to a high temperature, and the heat generated is conducted into the surrounding mixture, converting it into carborundum. If the temperature of the furnace is too high, the carborundum is decomposed and the silicon vaporized.

Furnace for Moderately High Temperatures.—This is the latest of Acheson's patents, and is of great interest. In the outer zone of the carborundum furnace, just outside the crystalline silicon carbide, is a thin layer of an amorphous substance, known as "white stuff." It is an intermediate product in the formation of carborundum, and the temperatures between which it is formed and decomposed apparently lie near one another. For this reason its manufacture, or that of like compounds, involves serious difficulties, and it was to overcome these that Acheson invented this furnace. The furnace is of the same general form as that used in the manufacture of carborundum, but it contains several cores, which are "definitely spaced with relation to each other at distances largely determined by the heat conductivity of the charge, the duration of the operation and the superior and inferior temperature limits of the operation."[1]

In all of the furnaces described above there is one common characteristic—the electrical resistance is a variable quantity, and after any furnace is started there are no means of adjusting internal conditions so as to effect regulation in this respect. In general, the resistance of these furnaces is high at the beginning of a run and low at the end; therefore, means of varying the voltage at the furnace terminals must be used. The resistance of the furnace may be varied by altering the dimensions of the core or that part of the furnace which acts as an electrical conductor. There are limits to the variations that can be made in this respect on account of other considerations, but the resistivity of a mass of carbon granules varies with the size of the latter, and further variation may be obtained by the judicious choice of different forms of carbon, which themselves have different resistivities. By taking advantage of this, any desirable variations in the resistance of the furnace may be obtained. The case of the electrode furnace is a special one, the adjusting of the resistance being obtained, to a certain extent, by the spacing between the piles of electrodes.

The paper then proceeds to develop equations involving the various variable factors, from which deductions are made as to the practical limits of improvement in furnace regulation.

In no case considered are the various fundamental equations rigorously applicable, for these involve numerous assumptions that do not represent the actual conditions, and take no account of certain conditions that are invariably present. Nevertheless, by keeping the theoretical considerations in view a great help will be obtained in the building of furnaces, and waste of time prevented in experimenting with designs that cannot possibly be satisfactory.

Niagara Power Notes.

A new transmission line from the plant of the Niagara Falls Hydraulic & Manufacturing Company to the new plant of the Carter-Crume Company, at the north end of the city, has just been completed, and 150 hp of current sent over the wires. The Niagara Falls Hydraulic & Manufacturing Company has available for sale at the new industrial center in the north end 2,000 hp of current, and this amount will be greatly increased on the completion of the new power station. The pole line carrying the wires is one of the best in the country, the work being excellently done, with the poles of red cedar brought from Idaho. The turning on of the power brings into service the new generator and switchboard in the Hydraulic Power Company's plant. This switchboard is a good example of completeness and was designed and built by Engineer Harper and his assistant, Mr. B. F. Lee, who is in charge of the electrical features of the plant. The generator, built by the Bullock Electrical Manufacturing Company, of Cincinnati, is a 1,000-kw, 11,000-volt machine of three-phase, alternating-current variety, and the first of the kind installed at Niagara. Westinghouse transformers are used on this transmission line. The underground cables are the work of the National Conduit & Cable Company, of New York.

The new transmission line required no experimenting or testing. There was not so much as a flash when the current was turned on. More current will be sent to the Carter-Crume plant as soon as the remainder of the machinery is installed in the new works and the entire plant in operation. Great significance attaches to the transmission of power to the north end, and that section of the city will, without doubt, soon be converted into a teeming factory center.

Options are now being obtained on a right of way for a double-track electric railroad from Buffalo and Niagara Falls to Toronto, over which the largest type of electric cars will travel at a high rate of speed. A number of wealthy Canadians are interested in the project, and it is expected that negotiations will before long be completed with one of three electrical companies for furnishing power to the new road. At present a lively competition exists between the three interested companies. It is planned to construct a road paralleling the Grand Trunk.

Direct Cable to the Azores.

The German cable steamship *Von Podbielski* arrived at New York on Sunday last from the Azores. She will lay the shore end of a new cable from Coney Island to a point 110 miles out at sea for the North German Sea Cable Company.

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[1] U. S. Patent 723,631, March 24, 1903.

Illinois State Electrical Association.

The Illinois State Electrical Association convened at St. Louis Saturday morning, September 19, at the Southern Hotel, and it was found that Secretary H. E. Chubbuck, general manager of the Illinois Valley Traction Company, La Salle, Ill., had made arrangements for a very enjoyable meeting. A special car was in waiting at 9.45 to take the thirty-five central station and street railway men, who convened, to the World's Fair grounds, where carriages were taken for a drive around the place and for a call on President Francis. Few had realized the extent of the undertaking before this visit. After returning to the Southern for lunch the party took the Illinois & West Shore Fish Commission steamer *Illinois,* which was specially chartered for the occasion, to Alton, and on Sunday, August 20, resumed the voyage, going as far as Beardstown. No papers of any kind were read, but the outing was both enjoyable and profitable to all the central station men participating. None but members and representatives of the technical press were invited, as the steamer accommodations were limited.

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Wireless Telegraphy on the "Erin."

The De Forest Wireless Telegraph Company has forwarded us a summary of the work done for Sir Thomas Lipton, on board his steam yacht *Erin,* during her stay in American waters. During the 73 days that the yacht was in New York waters, it is stated, almost constant communication was maintained with the De Forest stations at Coney Island, State Street, New York City, and Block Island. The bulk of the matter transmitted was personal correspondence of Sir Thomas Lipton, and comprised 2,000 individual messages, footing up a total of over 40,000 words; and, in addition, 130 cables, all in code. During the most of the *Erin's* stay the Associated Press and Publishers' Press had a reporter on board, and a total of 10,750 words were transmitted for the press, for which a collection of $25 per day was made. The average length of a message was twenty words and frequently a message ran as high as ninety words. To transmit this bulk of business, it was necessary to send at an average speed of thirty-two words per minute. Sir Thomas was highly pleased with the service rendered, as shown in a letter to Dr. De Forest on the subject.

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Indiana-Ohio Independent Telephone System.

At a conference held in Indianapolis, Ind., September 11, between Mr. Max Reber, vice-president of the Federal Telephone Company of Ohio; Mr. M. B. Overley, general manager of the United States Telephone Company, of Ohio, and Mr. S. P. Sheerin, president of New Long-Distance Telephone Company of Indiana, arrangements were made and contracts signed to build and connect up what is to be known as the Indiana-Ohio system. Connection will be made at Richmond with a line being built from Richmond, Ind., to Dayton, Ohio. Connection will be made at two other points further north in the two states. These connections will constitute a system that will give excellent service with all the towns and cities of Ohio, and as far east as Pittsburg. This far-reaching arrangement will in turn give Ohio people access to all of the Indiana telephones and a greater part of Kentucky, and all prominent points as far west as St. Louis.

◆

Electrical Men at Export Club Dinner.

The Export Club of America, recently organized, had a dinner September 9 at its rooms, 9 South William Street, at which several electrical men and their friends were present. The club rooms were elaborately decorated for the occasion with electric floral lamps. About 100 covers were laid.

Among the diners were Conrad Hubert and J. H. Alvin, of the American Electrical & Novelty Manufacturing Company; Elmer P. Morris, of the Elmer P. Morris Company; J. Jones, Jr., of Jones & Son, etc. The club now has about 250 members. The list includes the names of William Angevine, of the Johns-Manville Company; F. C. Joutras, of W. M. Sheehan & Co.; Arthur Organ, of the Jandus Electric Company; H. L. Shippy, of John A. Roebling's Sons Company; Frank G. Bolles, of the Bullock Electric Manufacturing Company; W. H. Chapman, of the Northern Engineering Company; C. W. Farr, of the Farr Telephone & Construction Supply Company; A. C. Fletcher, of the Ohio Electric Works; A. J. Jupp, of the Lunkheimer Company; N. G. Lyman, of the Peerless Rubber Company; W. F. Malloy, of the Bridgeport Brass Company; C. J. Markham, of the Cleveland Twist Drill Company; F. L. Merritt, of the Standard Pole & Tie Company; Henry G. Pierson, of Foote, Pierson & Co.; I. M. Post, of Stanley & Paterson; F. C. Ayres, of the Jeffrey Manufacturing Company; Saxton Brown, of the Weston Electrical Instrument Company; W. J. Carr, of Carr Brothers; A. T. Compson, of the Rumsey Pump & Machine Company; William H. Frothingham, of Browne & Frothingham; H. C. Gable, of the American Steel & Wire Company; D. J. Gibson, of the Worthington Pumping Engine Company; S. S. Gould, of the Gould Manufacturing Company; William M. Pratt, of the Goodell-Pratt Company, and A. W. Richards, of Manning, Maxwell & Moore.

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CURRENT NEWS AND NOTES.

MUNICIPAL OWNERSHIP FAILURE.—A special telegram from Valley City, N. D., says: The city council has decided to offer the electric light plant for sale. A twenty-year franchise will be given the purchaser. There are about 3,000 commercial lights on the system, and it is said to be the largest plant, outside of Fargo and Grand Forks, in the State. It has not been a paying investment for the city, and the expenses for the past year were about $7,000 more than the receipts.

THE VALUE OF TACT.—An excellent paper was read by Mr. John W. Ferguson, of the Chicago Edison Company, at the last meeting of the National Electric Light Association, on "Tactful Relations with Customers," a subject of great importance to all public service companies. While the paper was addressed primarily to those concerned with electric lighting, it contained so many valuable suggestions of general application that the American Telephone & Telegraph Company has distributed copies of the paper among its employees in all parts of the country.

LARCENY OF STREET CAR TRANSFERS.—Detectives of the Chicago City Railway Company long wondered why John Peats (colored), who has a news-stand at Thirty-first Street and Cottage Grove Avenue, sold more papers than any other boy in that neighborhood, and that most of the people who took cars at that point patronized him. They solved the problem recently when they discovered that Peats sold a street car transfer and a morning paper for five cents, and that conductors in collusion with him kept him supplied with transfers. His profits on the transfers, it is said, were divided with the conductors.

POWER OF RADIUM.—As noted already in these pages, Mr. Edward D. Adams, of this city, has presented to the New York Natural History Museum a tube of radium of 300,000 power. This was secured through Dr. George F. Kunz, the gem expert of Tiffany's, where, as well as at the Museum, some most interesting experiments have been made on precious stones and crystals, including the new Kunzite, to which a special article was devoted in our last issue. Working in experiments together, Dr. Kunz and Dr. Charles Baskerville, of the University of North Carolina, believe they have made a valuable discovery in connection with willemite. By mixing radium with natural willemite, pulverized to a powder, the activity or power of the former substance is multiplied a hundredfold, and probably—for no instrument has been devised for measuring the increase of the activity—a thousandfold. That, at least, is the temporary effect of the mixing of the two substances. Time must tell whether one will nullify the other. Willemite is a comparatively cheap silicate of zinc. It is possible, also, that there is in willemite a substance which is as yet unrecognized as a distinct element, but which produces the radioactivity that has awakened the enthusiasm of the two experimenters. But thus far it is taken for granted that the one substance merely stimulates the activity of the other. The germ of a very valuable discovery seems to lie here. Mr. Adams has now supplemented his previous generosity by authorizing Dr. Kunz to secure some radium of not less than 1,800,000 activity, which will probably be placed at the disposal of some of the hospital authorities for experiments on the alleviation or cure of disease.

ZOSSEN HIGH SPEED.—A cable dispatch from Berlin, of September 18, says: "In experiments made with an electric car on the Marienfelder military railroad to-day, a speed of 106 miles an hour was attained. It is hoped that eventually the cars will attain a speed of 200 miles an hour." A later dispatch states that 114 miles has been maintained for two miles.

WIRELESS MESSAGES.—*Le Figaro*, of Paris, is congratulating itself on the prediction it made two years ago that one could soon communicate with passengers on Atlantic steamers without leaving the boulevards. Last week the Compagnie Generale Transatlantique distributed booklets giving the directions necessary for utilizing this mode of correspondence.

TO STUDY AMERICAN TROLLEYS.—Sir David Barbour, Lord Ribblesdale, George Gibb and Sir J. Dickson Poynder, members of the royal commission of London street traffic, appointed to study the American street railway system, sailed for New York on September 18 on the White Star line steamer *Arabic*. They will collect evidence on the subject while here.

WIRELESS TELEGRAPHY AT NEWPORT.—The naval wireless telegraph apparatus at the torpedo station at Newport, R. I., is now in working order. Communication is had with the station at Montauk Point, a distance of forty-five miles; and on several occasions communication was had with the ships of the North Atlantic squadron off Wood's Hole and while they were going to New York. The pole at the torpedo station is 168 feet above high water, and is situated on the west side of the island, facing the entrance to Narragansett Bay. There are now at the station six men under instruction, who are to be transferred to the various ships after they have become proficient.

SANDY HOOK BUOYS.—The electric buoy station at Sandy Hook was closed last week, gas buoys having been substituted for the nine electric buoys which marked Gedney Channel and Southwest Spit. The three lighthouses on Sandy Hook which have used electricity have returned to the old style oil lanterns. It is understood that electric buoys have never been fully satisfactory to the lighthouse establishment, owing to their frequent interruption through broken cables and other derangements. The buoys have not only been collided with frequently in summer by vessels, but in winter are subject to the assault of heavy ice floes. It will, however, be interesting to see what can well replace them.

COLORING DIAMONDS.—A special telegram from Chicago says: Predictions of a time when the brown diamonds in the crown of King Edward, the Hope diamond and other famous gems of the kind can be practically duplicated at will were made to-day by W. C. Fuchs at a Chicago X-ray experiment station. Mr. Fuchs announced the discovery of a process by which he is able to change a diamond to any color chosen and make such coloration permanent by the use of the Röntgen rays. The method consists in directing the X-ray through the substances from which the color is to be obtained before the rays touch and penetrate the diamond. Various metals and chemicals have been used to color the diamonds and it has been found that by reversing the method the color may also be removed. It is thought by Mr. Fuchs that when he has completely perfected his experiments he will be able to bleach yellow diamonds with ease.

ENGLISH WEATHER PREDICTIONS.—Professor Willis L. Moore, of the United States Weather Bureau, who has been attending the sessions of the International Meteorological Committee, spent several days in London before going to Paris to be the guest of M. Mascart, head of the French meteorological service. "This was the first time the United States had ever taken part in these conferences," he said in an interview. "The English meteorological service is doing magnificent work with a public grant that is extremely small compared with ours. It will always be handicapped in its efficiency by the great ocean lying to the West, and on that account will never be able to do what for a long time we have been doing in America. There we have three thousand miles of territory stretching east of the greatest storm frequency—that is twice daily—under meteorological survey through the medium of the telegraph and of our 180 observations. We, therefore, are able to view the inception and operation of a storm two or three days before it reaches the populous sections of our country, while here the only premonition they get is from the falling barometers at the coast stations when the storm is almost upon them."

LAYING ALASKAN CABLE.—In spite of previous troubles in laying and maintaining Alaskan submarine cables, the United States cable ship *Burnsides* sailed for the north last week to continue the work of laying the cable from the head of Lynn Canal by way of Sitka, the capital of Alaska, to Seattle. She has 600 miles of cable aboard, which was transferred from the steamship *Texan*, which brought the cable around the Horn from New York. On board the *Burnsides* were Gen. A. W. Greeley, chief signal officer of the United States Army; Colonel James Allen, of the Signal Corps, under whose general supervision the line will be laid; Captain Edgar Russell and Captain George O. Burnett, of the Signal Corps; Henry Winter, cable engineer, and Lieutenant Charles P. F. Chandler, of the Quartermaster's Department. Captain A. H. Laflin is in command of the vessel. The *Burnsides* will proceed direct to Juneau, whence, after making a short-line connection, she will leave for Sitka, paying out about 250 miles between the two towns, and continuing south from the capital by the open ocean, as far as the cable supply will reach, possibly to a point off Queen Charlotte Isle. It is expected that the entire consignment of cable on the *Burnsides* will be laid and the vessel be back in port for the final link by October 15.

LIGHT AS TORTURE.—A special cable dispatch to the New York *Journal* has this rather extraordinary yarn about torture in Russia: "Russian refugees now in Berlin relate a fresh form of torture devised and practised on political prisoners confined in the terrible Schlusselberg fortress. They assert that the brains of Russian political prisoners are permanently injured by long exposure to the rays of violet light. The subject selected for the scientific torture is placed in a large cell in which there are many windows. The sunlight streams in through violet panes. By night the glare comes from electric light. Day and night the violet rays are poured on the prisoner, sleeping or waking, until everything looks violet. His food and even his flesh is affected by the treatment. The scientific cruelty produces irritation, ultimately causing a change in the structure of the brain. The power of consecutive thought disappears. The sensory impression cannot be orderly arranged. The victim is not insane, only stupefied mentally. He performs the simple acts of life, but his intelligence runs low, to the verge of idiocy. Frequently the victim never recovers. He might be released without peril to the Government. While the red rays madden, the violet rays produce an incurable brain lassitude. There is no proof that all the political prisoners of Schusselberg are treated thus. Who and what prisoners are subjected to this new scientific torture remains a secret."

LETTER TO THE EDITORS.

Short Circuiting Through Electrolytic Action.

To the Editors of Electrical World and Engineer:

SIRS:—An interesting matter recently came to my notice which may be of interest to those of your readers who are engaged in electrical contracting or construction. A large slate panelboard was installed in a new building in New York City, the parts consisting of copper bus-bars, leads, switches, etc. The screws securing the parts were of iron, the heads being set in countersunk holes and the holes well cemented over with sulphur. The board was supported inside a wooden panel box (closet) against a newly-built brick wall in the cellar.

A few weeks after the board had been put in place, the installation became troubled with "grounds," both on the insulated conductors on the board, and between different branches separated by the slate which held them. An investigation showed that the slate did not carry a vein of iron or other metal. On removing the board from its box, it was found that the sulphur which cemented the countersunk screw holes had disintegrated and formed "streaks" downward across the points supposed to be insulated from each other. These streaky spots were found to be feeble conductors of current, and the holes from which the streaks emanated gave the odor of sulphuric acid.

It would seem that there are but two explanations of this unlooked-for and annoying effect of electrolysis, for such effect it seems to have been. First, water pure and simple from the moist wall first penetrated the wooden back of the panel closet saturating it; the moisture was then absorbed by the pores of the slate and by the sulphur in the holes until it came in contact with the iron screws, thus making a "ground." The feeble current resulting electrolyzed the substance in the wood, thereby liberating some compound capable of attacking sulphur with liberation of hydrogen, and this hydrogen formed with the sulphur a hydrogen compound which slowly trickled down to a screw of opposite polarity, there undermining the sulphur which protected the head of the same, and forming a decided short-circuit. It was noticed that a number of the screw heads had been eaten off by the action, which might have been due to a formation also of sulphuric acid. Second, the effect might have been aided by something in the water coming from the brick wall, possibly a dissolved lime salt from the moist mortar in or around the bricks, together with a part or whole of the above-suggested components. So bad was the ground that every one of the four fastening bolts were in connection with one of the main copper feeders. It was also noticed that the copper had been slightly attacked with the formation of one of the green or blue copper salts, such as the sulphate, carbonate or hydrate.

It is evident that such a cement as sulphur is not "just the thing" under like circumstances, and it would be desirable for some one who has the opportunity to make a scientific examination of the actions I have observed, and present the results to the public.

New York. E. C. Handy.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Compensation of Asynchronous Motors.—Meyer.—An article in which the author investigates whether the main advantages claimed by the advocates of compensated (Heyland) induction motors, viz.: unity power factor at all loads, greater overload capacity and higher all-around efficiency, can be realized in practical operation and if so, at what cost. As far as the unity power factor at all loads is concerned, the author states that it is a "practical" impossibility to obtain it since the wattless current of induction motors is not only determined by the magnetizing current, which is approximately constant, but also by the leakage, which varies in direct proportion with the load. This claim could only be realized by continually varying the brush position, or changing the exciting voltage with the load. With a constant exciting current as required for practical operation, it is possible to obtain unity power factor for only one load. Considering that a power factor of 0.99 means as much as 14 per cent. wattless current, and a power factor of 0.98, 20 per cent., it will be seen that even with compensated or over-compensated induction motors, the system cannot be freed from wattless currents. The author states that undoubtedly the power factor throughout the total range of load is improved by compensation: but when comparing it with that of a modern well-designed induction motor, it seems that in most cases the difference would be hardly large enough to give such an importance to this claim as to outweigh all the disadvantages introduced thereby. In regard to the greater overload capacity, the author admits that the rotor flux in the compensated motor will be larger by about 8 to 14 per cent. at full load and unity power factor. At overloads, however, leakage will be present, and, therefore, the difference will not be so marked; nevertheless, the advantage of greater overload capacity due to the larger rotor flux would in most practical cases be only apparent, since the output of the motor is almost entirely limited by the efficiency and the heating, and in these points the compensated motor can hardly give increased figures when compared with the standard type. He next discusses in detail the claim that in compensated motors the reduction of leakage is no longer of prime importance, which would prevent such modifications as a longer air-gap, a smaller diameter and greater length, a lesser number of slots in the rotor and a more economical shape of the slots; all these points, in his opinion, are only of secondary importance in regard to leakage and are also available for standard induction motors as far as they are not objectionable for other reasons. The question of efficiency is then taken up at some length, the losses introduced by the contact resistance of the brushes and the question of friction losses being considered. To give an idea of the amount of losses from brush friction, the author gives the results of a test of a 9-hp induction motor, which took 290 watts with the carbon brushes on the slip rings and 150 watts when the brushes were taken off. A comparison with the squirrel-cage motor would show still worse for the compensated motor, as there the losses due to the end connections and all of the brush losses are entirely eliminated. In conclusion the question of the commutator and the various accessories, which enable the transformation of voltage and frequency necessary for compensation, is taken up, and the author concludes that these accessories must increase the cost of the compensated motor to such an extent that a commercial competition with the ordinary motor seems out of the question, the more so as the buyer would sacrifice simplicity and reliability, if not also efficiency, to gain only a few per cent. in power factor. The author states as the summary of his considerations that in his opinion there are hardly any practical cases where the compensated induction motor in its present form could be preferable to the ordinary induction motor, and that as long as the commutator is not used for improving either the starting conditions or for obtaining a more efficient speed regulation, it will find no field with alternating-current motors and "compensation" will remain only a pretty idea.—Lond. *Elec.*, September 4.

Variable-Speed, Polyphase Motors.—Burkard.—The author reviews the methods of speed regulation of polyphase motors, subdividing them under three headings: 1, regulation by changing the poles in the stator; 2, by resistances in the rotor, and 3, by changing connections with coaxial stators, wound for a different number of poles. The greater part of the article is devoted to the third division, the motors of which consist practically of several motors on the same shaft; each of these he calls an element. The advantages of such a compound motor, called step-motor, are enumerated. A three-step motor of 4, 6 and 8-pole elements of 3 hp each, is illus-

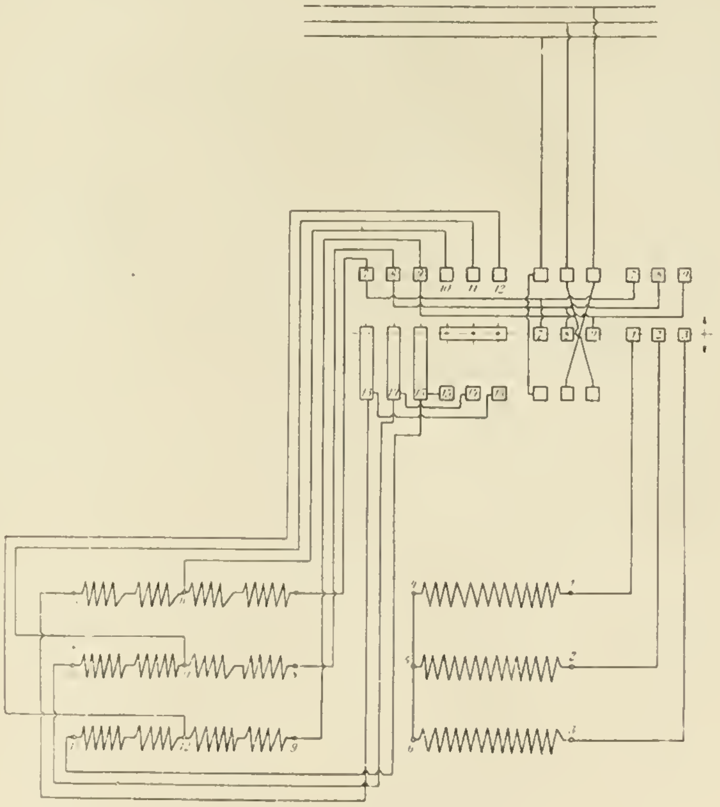


DIAGRAM OF CONNECTIONS.

trated, and the efficiency and power factor curves for each element are given. The 4-pole element has a torque corresponding to 2.9 hp, the 6-pole element one of 3 hp and the 8-pole element one of 2.8 hp, each at 100 volts and 50 cycles. It is stated that the winding of such a motor is very simple, and in case of damage to one winding the work in hand can be continued with the others. With a two-step motor three speeds and different effects can be obtained. For instance, a motor with 4 and 8 elements, each element wound for 3 hp, has speeds of 750 and 1,500 revolutions at 50 cycles. If the 8-pole element is connected to give 4 poles, there are furnished 6 hp at 1,500 revolutions. By connecting in parallel the normally 4-pole element with the one connected to give 4 poles, there are obtained 9 hp at 1,500 revolutions, and when the 4-pole element is connected to 2 poles, 3,000 revolutions are obtained. The adjoining figure shows the arrangement of the connections for the above 2-step motor. A 15 hp, 2 step, slip-ring motor built after the same principle, with 4 and 8 pole winding, is also illustrated in diagrammatic cross section. Another motor designed for use on a large lathe is illustrated which has four steps, and by means of which eight different speeds are obtained, thus dispensing with the speed cone on the lathe. The motor is wound for 2, 4, 6 and 10 poles, and delivers 5 hp at 500 volts and 25 cycles. Some further experimental data with a normal three-step motor of 3 hp are given.—*Elek. Zeit.*, August 27.

REFERENCE.

Design for a 2-hp, Self-Starting, Single-Phase Induction Motor.—An illustrated description giving all the essential features of a self-starting induction motor capable of giving 2 brake horse-power on a single phase circuit of 100 volts and 125 to 133 cycles. The speed will depend upon the frequency of the supply current; the actual full-load speed will be about 2,300 r.p.m. at 125 cycles and about 2,640 r.p.m. at 133 cycles. The illustrations are all dimensional drawings and the article contains all the information necessary for the building of the machine.—*Amer. Elec.*, September.

POWER.

Electric Power for Toronto.—An article containing abstracts of two reports made to the city engineer of Toronto on the estimated cost of developing electric power at Niagara Falls and transmitting it to and distributing it within the city. The first report assumes that power would be delivered at the city limits by a transmission line, as three-phase, alternating current at from 30,000 to 60,000 volts, and 60 cycles frequency. From the terminal station power would be distributed as three-phase, alternating current of suitable voltage to the various sub-stations. A total estimate of the power required amounts to a maximum of 13,750 kw, but not likely to exceed 10,000 kw. The capital cost of the total equipment for the various stations is given in detail and amounts to a total of $1,785,641. The total annual expenses are figured out at $283,955. If the current be delivered at 30 or 25 cycles, approximately $150,000 must be added to this sum for the apparatus to raise the frequency to 60 cycles in order to operate incandescent alternating-current lighting and street lighting. The second report deals with the transmission line from Niagara, which at 20,000-kw capacity is estimated to cost from $700,000 to $1,000,000. Assuming a figure of $10 per hp at Niagara Falls, the maximum cost per horse-power at the city limits is calculated at $18.96 and the minimum for the full capacity of the line at $15.23. The cost of power distribution per annum is estimated at $283,955. The total cost of power distributed is calculated at $38.10.—*Canad. Elec. News*, September.

Electrically-driven Mining Plant.—Hooghwinkel. The author deals mainly with the application of electricity for drilling. He first sums up the advantages of the air drill over hand labor and then dwells upon the advantages of the electric drill over the air drill. The disadvantages of the air drill are: Deafening noise of the exhaust air, no power to draw back the drill when jammed in the bore hole, large amount of power required (about four times as much as with the electrical drill) and large amount of space required. The whole system is in fact disadvantageous on account of its cumbersome pipes, losses in the piping, inefficiency and heavy capital outlay required. Electrically-driven drills have none of these disadvantages. Each drill requires only 1 to 2 hp, according to its size, the working parts are few and any kind of bit can be used. The author then mentions two types of drills of the reciprocating percussion type. He states that the solenoid drills were never a commercial success, principally because they became too hot after a two hours' run, and had to be exchanged. The percussion drill receives its power from a 1 to 2 hp motor by means of a high speed revolving flexible shaft. The machine is simple in construction and strikes a blow of over 200 pounds 400 to 500 times a minute. The author is of the opinion that three phase current of 120 volts is the most advantageous to use, with a transformer connected to the motors by flexible cable on a reel. If the reel runs out the transformer is moved on, and a length of high tension cable is permanently put in. The output of electric drills is stated to vary very much with the number of revolutions of the motor, and it is, therefore, essential to keep the motor speed as constant as possible; as a rule, 5 per cent being the limit for pressure variations allowable at the working face. The author claims that as a good average with skilled men the following output can be obtained: In granite, ironstone, etc., 4 in. per minute; in coal, hard sandstone, hard limestone, shales, etc., 8 in. per minute; and in sandstone and soft iron ores, 10 in. per minute. He states that he drove a 6-ft. roadway in a Luxembourg iron ore mine at the rate of 150 yards a month.—*Lond. Elec.*, August 28.

Electricity in Railroad Repair Shops.—An illustrated description of the electrical equipment of the Central Railroad shops at Elizabethport, N. J. The electrical equipment at present consists of three 110-kw, direct current, 230-volt generators, but two larger units will soon be installed. Power is distributed by electric current through concrete tunnels running beneath all of the buildings and connecting them with the power plant. Special sets of mains are provided for light, for operating the motors in connection with the heating system, and for the operation of machine tools in each of the buildings. There are at present in use 110 electric motors, ranging in size from ½ hp to 30 hp, and having an aggregate capacity of 1,013 hp; other motors are being constantly added. Nearly all of the tools are motor-driven, some of them by motors attached to the frame of the tools and others by a motor-driven countershaft. With the exception of small tools which are intended to be used as floating tools, being taken to the work by the crane, any tool requiring 3 or more hp to operate it is provided with its own motor. Tools requiring less power to operate them are arranged in groups. Locomotives and tanks are handled in the erecting shops by means of two 50-ton cranes, each having an auxiliary 5-ton hoist, so that when not employed in handling engines they can be used continually for transportation of articles through the shops. This is considered an advantage over using one 100-ton crane and is a result of the longitudinal system of transfer. With the transverse system a 100-ton crane would usually stand idle about 85 per cent. of the time and would also require constructional accompaniments twice as strong as for the longitudinal system. A double trolley transfer table having a run of 800 ft. at the rate of 300 ft. per minute is used to connect the various buildings, being operated by means of two direct-current motors with series-parallel control.—*Amer. Elec.*, September.

REFERENCE.

Electric Power in Steel Plants.—Perkins.—An illustrated description of the details of construction and arrangement in a large German steel mill.—*Elec. Rev.*, September 5.

TRACTION.

Tangential Traction.—Guarini.—An article containing a description of a new system of electric traction, invented by Rosenfeld and Zelenais. The most characteristic feature of the system is the absence of the rotating motor in the car, and of any connection between the vehicle and the source of electrical energy. The stator of a polyphase system is developed along a plane surface and fixed between the rails on which the vehicle travels. The rotor, similarly developed, is suspended under the vehicle. The latter will then be put into horizontal motion when a polyphase current is sent into the fixed part of the system, the stator. Under these conditions the magnetic field no longer revolves, but travels along. This principle, however, cannot be applied practically under ordinary conditions, owing to the necessity of keeping the air-gap small. The inventors have, therefore, devised an arrangement by which they were enabled to increase the air-gap while retaining the same reluctance. Instead of enlarging the whole of the core they enlarge it at only the poles by means of sheet iron laid transversely, the core itself being laminated longitudinally. By this method the winding round the core retains its original length, and the surface of the air-gap can be increased to the extent required in order to keep the reluctance the same. In order to supply the normal tractive effort, it is sufficient to have stators occupying only a small fraction of the length of the track. In order that the action of the stators on the rotor (called propeller) may be continuous, notwithstanding that they are discontinuous, the length of the propeller must be equal to or a little greater than the distance from center to center of the stators. The entire length of the track is divided into sections of suitable length, each containing one or more blocks of stators. All the stators in one section are connected in series; the three wires of the three-phase winding of the first stator in each section are connected with the distributors placed along the track, and the three ends of the last stator winding are connected with the contact blocks of an interrupter. When this interrupter is closed the three ends of the winding of the stators are connected together and form the neutral point. The stators are then traversed by the three-phase current. When, on the other hand, the interrupter is open, the neutral point of the three-phase winding of the stators is broken and the current no longer passes through. In order that a group of stators may be traversed by the current only when the train is passing through this section, the interrupter must close automatically at the moment that the train enters the section in question and open again as soon as the train has left it. The opening and closing of the interrupter is effected by a small three-phase motor, connected between the rails and operated by the train as it passes over the tracks. The author states that he has seen the working of the system on a trial line 800 meters long, where the principal dimensions of the stators are as follows: Total length, 2.77 meters; breadth of the polar expansions, 0.5 meter; section of core, 0.25 x 0.16 meter. Their winding is of the ring type and the number of bobbins is 24, or 3 for each phase. The pressure chosen is from 1,300 to 2,000 volts. The propeller is 19.5 meters long, the distance between the centers of the stator being 18 meters. The winding of the propeller is based on the principle of the squirrel-cage winding. The special feature of the starting rheostat is that it can modify the individual resistance of each bar of the squirrel cage. The whole train weighed about 22 tons, and the propeller traveled on a small track inside the main track. The author then sets forth the advantages of this system of traction, of which he reveals himself an enthusiastic, optimistic advocate. The Ferraris prize of $3,000 has been awarded to the inventors of this system.—Lond. *Elec. Rev.*, August 21, September 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Practical Storage Battery Operation.—Liversidge.—An illustrated article in which the author urges the placing of the storage battery in the care of a competent electrician and not in the hands of an inexperienced dynamo attendant. There is no reason in the world, he says, why a storage battery if properly installed cannot give results which will come very close to those obtained from so-called laboratory tests. The storage battery will do almost any amount of hard work, provided it is kept in a healthy condition. A greater part of the troubles found in storage cells can be traced directly to improper charging. Three methods for charging a battery are described. During the time the battery is floating on the system considerable care should be exercised in order that the charge and discharges may be kept as small as possible. This applies particularly to batteries used on lighting circuits which are provided with end-cell regulation that the charge and discharge can be controlled as desired, irrespective of the load variations in the system. It is a common occurrence for batteries to receive considerable overcharge while supposedly lying dormant on the system. Practical operation has shown that to give the best results the average e.m.f. per cell for any discharge and corresponding charge, or series of discharges and complete charges, should be approximately 2.09 volts, for cells in good condition; it will rise slightly as the battery ages. In the discharge of batteries there are two points which should always receive attention, namely, the rate of discharge and the proper point of cut-off. The cells are designed to give a certain maximum output for some specified length of time, which in general practice is one hour. An excessive discharge rate is sure to weaken the plates. In station work, however, especially on incandescent lighting systems, the discharge may reach several times this value for a few minutes, due to some accident to the line or generating machinery. The e.m.f. at the end of the discharge is dependent chiefly upon the rate of the current flowing; battery manufacturers recommend that a cell should not be discharged below 1.7 volts when discharging at the normal rate. With a maximum discharge current flowing, this value may fall to 1.6 volt without materially damaging the battery, but for practical work 1.7 volt per cell is as low as safe operation will permit. Immediately upon the completion of a heavy discharge the battery should be put on charge. Under no circumstances should a battery be allowed to stand discharged, as the plates will immediately begin to sulphate, causing no end of trouble if allowed to continue. The storage battery is no exception to the general class of electrical apparatus with regard to repairs, so troubles of one kind or another must be expected. It is rarely the case that any trouble arises which will damage the entire battery; in any such event the cause is usually apparent. Frequently, however, individual cells in a series will require special attention, due to some local trouble which may develop. The author considers the most probable cases which are likely to arise in practical operation.—*Amer. Elec.*, September.

REFERENCE.

Hydro-Electric Installation at Rossy Priory, Perthshire, England.—An illustrated description of a hydro-electric plant for lighting a country residence. The water is brought to the turbines with 65 ft. head from a pond. There are two turbines, one on each side of a dynamo, so that one or both turbines can be run. A table of brake tests is given with a varying number of ports open in the turbines.—Lond. *Eng'ing*, August 28.

ELECTRO-PHYSICS AND MAGNETISM.

Radium Emanations.—A long, well-written editorial, reviewing the most recent work in this field. After considering the general fairly well established properties of the radioactive substances, reference is made to the work of Sir William and Lady Huggins on the spectra of the radiations, and their first communication to the Royal Society, in which they stated that some of the lines obtained appeared to agree with the helium lines, and that it did not seem impossible that helium was being liberated in connection with the active molecules in a state of molecular vibration. An addition to this communication was, however, made recently, for when the spectrum had been shifted very slightly with regard to the scale, the seven strongest lines would agree in intensity, character and position with the bands of the nitrogen spectrum. No cause for such shifting could be traced, but a movement through 1/150 in. was all that was required. All of the ultra-violet radiations seem to be due to nitrogen; whether atmospheric nitrogen or nitrogen occluded by the radium, is an open question. Attention is drawn to the bearing of this communication on the work of Sir W. Ramsay and Soddy on radioactivity and the production of helium from radium, recently referred to in the Digest, where six helium lines were distinctly identified in the emanations from 30 grams of radium bromide. Attention is drawn to the fact that nobody has as yet handled pure radium salt, and that spectroscopic tests are, from their very delicacy, not in themselves sufficient to establish what practically amounts to the conversion of one element into another. Reference is made to the work of Sir W. Crookes and Prof. Dawn on the effect of extreme cold on the radium emanation and to the work of Strutt on the penetrating power of the gamma-rays mentioned below in the Digest. The oxidizing action of radium rays as indicated by the decomposition of iodoform is being investigated by Hardy and Willcock. They found that the beta-rays seem to be particularly active in this respect, but as several layers of glass and lead did not stop the effect, the gamma-rays also appear to be concerned. Furthermore, the alpha-rays seem to change the physical state; they coagulate electrically negative colloids, and dissolve colloids charged positively; the beta and gamma-rays produce chemical changes and oxidize tissues. Without dwelling on the differences between Röntgen, light and radium rays, the authors suggest that the lethal effects of radium rays often noticed may be due more to their great power of penetration than to any novel or intense action. The speculative hypotheses with regard to radium, of Lagrange, Filippo Re and Sir W. Crookes are briefly mentioned in conclusion. Suspension of judgment is recommended, until a confirmation or refutation of the conversion of radium emanations into some other substance is coming forth.—Lond. *Eng'ing*, August 28.

Third Species of Radium Rays.—Strutt.—An abstract of a paper presented before the Royal Society, England. The author examined the so-called gamma-rays or intensely penetrating radium rays, which up to now were supposed to be identical with Röntgen rays. He found that they agree with the latter in not carrying an electric charge, in photographic and screen effects, and in ionizing power;

but that they differ as regards their ionizing effects on various gases. This difference is so pronounced that the author feels justified in denying their identity with the Rontgen rays. He found a great differences, for instance, in the case of carbon tetrachloride and methyl iodide. The radium rays of all kinds obey a different law from the Rontgen rays and are probably all of a corpuscular nature. The supposition that the beta or cathode rays produce gamma or Rontgen rays by impact upon the radium itself, is unlikely, for quantitative reasons, since the current emitted in cathode rays by a square inch of intensely active radium is only 10^{11} amp., whereas the current through a focus tube is of the order 10^{3} amp.—Lond. *Elec.*, August 28.

On the Radioactivity of Metals Generally.—McLennan and Burton.—The authors in pursuit of their investigations previously referred to in the Digest, made further experiments on the radioactivity of ordinary metals. They found that when a cylinder of any metal is enclosed within a second of the same material, insulated from it, and surrounded by air and other gases, it gradually acquires a negative charge and after a short time reaches a state of equilibrium at a definite potential below that of the enclosing cylinder. So far the experiments made indicate that the negative charge acquired by the cylinder results from a process in which an excess of positively charged corpuscles is expelled from its surface. This process is probably identical with the alpha radiation observed by Rutherford and others in the highly radioactive substances—radium, thorium and uranium, and experiments are now being made by the authors to determine its relation to the effect observed by Guthrie and others, that a metal like the platinum, for example, when heated to dull red, will discharge a negatively-charged body placed near it, but not one positively-charged.—*Phil. Mag.*, September.

On Resonance Coils.—Mizuno.—The conclusion of the article previously noted in the Digest. The author describes a large resonance coil, which he constructed and with which he obtained beautiful brush discharges. He then investigates mathematically the theory of the electrical oscillations in these coils. He arrives at two complicated equations, from which he deduces that the amplitude of the current possesses a series of maxima and minima, whose values are continually diminished in virtue of the presence of a hyperbolic function. The form of the current is, therefore, stationary in a restricted sense, the set of minima being never absolutely zero, except at the free end. He describes some experiments, with curves plotted from the results obtained, showing the quasi-stationary character of the potential vibrations corresponding to that of the current.—Lond. *Elec.*, August 21.

REFERENCE.

Electromagnets.—Guarini.—A note on a recent construction of an electromagnet, the difference from the ordinary type consisting in the manner of winding, the conductors being drawn through slots in the core. The manner in which the winding is carried out is illustrated. The author states that the carrying weight of an electromagnet of this construction, with a current of 4 amp. at 2 volts, was found to be 9,600 grams, as against 1,050 grams for the ordinary type.—Lond. *Elec.*, August 28.

Electro-Chemistry and Batteries.

Electric Steel Process.—Heroult.—An illustrated description of his researches in the electrometallurgy of iron and steel. He first describes his furnace in which arcs are struck between the ends of two carbon rods and the metal to be fused. For regulating the arcs, a piece of wire is provided in contact with the metal to be melted and connected to one terminal of each of two voltmeters, while the other poles are connected to the poles of the dynamo; each voltmeter is thus in shunt with one arc; all the regulation is automatic. This furnace was extensively used for making ferro-chromium; each charge is about three tons. The operation of obtaining steel from ores is divided into two steps; he first makes cast iron or pig and afterwards treats it in the steel furnace, the cast iron problem being solved by means of a special type of furnace. For making steel, a charge of scrap iron, mixed or not mixed with pig, is melted either in the steel furnace itself or poured into it in the molten state from a ladle or from a converter, etc., the principal condition being that the molten metal should be peroxidized and free from slag; it is then covered with an artificial slag and submitted to the action of the current which has no other object but to heat it without any intervention of flame or oxidizing agent of any kind. This enables him by pouring out the first slag and charging new fluxes, to wash out all the impurities of the metal, by adding carbon and other ingredients a perfect deoxidation is obtained; the best kinds of tool steels are thus made. About 1,500 tons have so far been made by this process, which is soon to be applied in connection with a large Thomas works where electric power will be generated by means of a blast furnace gas engine.—*Electrochem. Ind.*, September.

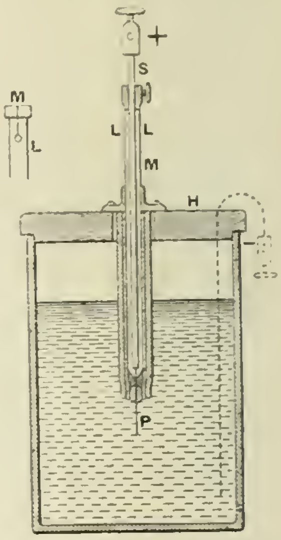
REFERENCES.

International Congress for Applied Chemistry.—Danneel and Clement.—The first part of a condensed report of the proceedings of the electrochemical section of the International Congress for Applied Chemistry recently held in Berlin. Brief abstracts of the following papers are given: Traube, an investigation of critical density; Nernst, the determination of molecular weights at high temperatures; Froelich, a new electric resistance furnace; Wedekind, colloidal zirconium; Moissan, metallic carbides; Marie, electrolytic reduction of unsaturated compounds; Foerster, electrolytic preparation of inorganic compounds; Le Blanc, electrolysis by alternating currents; Gin, electrometallurgy of aluminum; Zengheli, chemical reactions at high temperatures and their industrial application; Goldschmidt, manufacture of iron and steel in the electric furnace. In the last paper details are given concerning the Kjellin process for making high grade tool steels, which has been mentioned in the Digest. The report is to be concluded.—*Electrochem. Ind.*, September.

Italian Caustic Soda and Bleaching Powder Plant.—An illustrated description of the plant of the Societa Italiana di Elettrochimica, on the railway line between Rome and the Adriatic Sea; 6,000 hp have so far been developed. The diaphragm process of Outenin-Chalandre is used. In view of the unsettled state of the market for bleaching powder, a supplementary plant is being erected for the manufacture of chlorates, pure synthetic hydrochloric acid and carbon tetrachloride.—*Electrochem. Ind.*, September.

Units, Measurements and Instruments.

Renewable Wehnelt Interrupter.—Zehnder.—An abstract of an article, in which the author describes a renewable Wehnelt interrupter, illustrated in the adjoining figure. *M* is a brass tube containing the brass rod, *S*, to the lower end of which is fastened the platinum point, *P*. *LL* is a lateral perforation of the tube, down to which it is slit, as shown in the figure, in oder to guide the rod, *S*, in its vertical adjustment. The lower end of the brass tube is closed by a steatite plug, which is perforated in order to let the platinum wire pass through. A rubber tube is slipped over the brass tube and over that again a glass tube is drawn, which presses the rubber tightly against the stone. With this arrangement the acid can do no damage, unless it penetrates through the steatite to the brass rod; this takes place only when the perforation gets widened, and when this occurs, the plug must be renewed. hTe negative electrode is a lead plate or a lead worm, cooled by cold, running water. As an additional precaution, the brass tube may be replaced by a copper tube covered with lead. The lid, *H*, is of wood, paraffined and lacquered.—*Annalen der Physik*, No. 10; abstracted in Lond. *Elec.*, September 4.



RENEWABLE WEHNELT INTERRUPTER.

Measurement of High Potentials.—Voigt.—An article in which the author describes a method by which he claims potentials of 100,000 volts can be measured to within 1 or 2 per cent. Difficulties begin at 50,000 volts, the problem being to keep the actual potential away from the measuring instrument, which must, of course, contain metallic points and lines, which are specially threatened by high voltages. It seems that a part of the voltage is measured by using a potentiometer rather than a condenser. The potentiometer scale consisted of a bar of maple wood embedded in an insulator. With a Holtz machine at 200 r.p.m., 60,000 volts could be attained. To get 94,000 volts 500 turns per minute of two disks were required, or five times the electric quantity. This shows the great loss by dissipation. It was found that errors introduced by the heating of the wood were negligible. The author applied the method to the determination of spark potentials in air and the potentials at which various insulators were pierced. With mica 0.2 to 1 mm. thick, 25,000 to 54,000 volts were required. Glass, 1 to 5 mm. thick required 40,000 to 90,000 volts.—*Annalen der Physik*, No. 10; abstracted in Lond. *Elec.*, September 4.

Telegraphy, Telephony and Signals.

Automatic Block Signals for Railroads.—Scott.—A well-illustrated article describing electric automatic block signals. The author describes in detail the "normal clear" and "normal danger" signal systems. In the former system the blade, semaphore or disk is normally held at the "clear" or no-danger position; continuously occupying this position, unless the block which the signal protects be occupied or be otherwise dangerous. In the normal danger system, on the other hand, the signal is normally held at "danger," maintaining this position until a train approaches the signal, when, provided the block is clear, it will indicate "clear" and hold this position until the first pair of wheels crosses into the block; when the signal moves back to "danger." The battery of a "normal danger" system normally sends no current into the signal, while in the "normal clear" system the battery is normally discharging its full current. The "normal danger" system, on account of its cheapness of operation, reliability and almost entire elimination of false indications, has found greatest favor in practice with both disk and semaphore signals. Railroads require that a good system of signals should never indicate "clear" when "danger" should be shown, while it is considered of comparatively little importance if "danger" signal is up when "clear" should be shown. Long railroad experience has shown that the "normal clear" system is much more liable to false indications than the "normal danger." Moreover, records show that on a main line having trains running every ten minutes, the passage of these trains keeps the signals in operation on an average of 4 hours out of 24 in "normal danger" systems, and 20 hours out of the 24 in "normal clear" systems. This shows the relatively greater demand on the signal battery in "normal clear" systems. American railroads in general show a decided preference for the "normal danger" system on account of its great reliability under all conditions, the only causes of its showing false "clear" signals being mechanical, and these are readily eliminated by proper care on the part of the signal man. In the "normal clear" system nearly all cases of false "clear" indications are electrical and are generally hard to discover after a wreck or an accident has taken place.—*Amer. Elec.*, September.

REFERENCES.

Telephone Engineering.—Dommerque.—An article dealing with telephone cables for aerial and underground construction. The author describes the method of making the various cables and also treats of the mechanical and electrical properties of the wire used in them. —*Amer. Elec.*, September.

Automatic Electric Railway Signaling.—Rosenberg and Balliet. —A paper read before the Franklin Institute on automatic electric railway signaling and its purposes: also past and present installations. The paper first deals with the historical part of the subject and in the second part the authors discuss a number of the more recent devices.—*Jour. Frank. Inst.*, September.

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New Books.

Elementare Voilesungen uber Telegraphie und Telephonie. Von Dr. Richard Heilbrum. Berlin: George Siemens. 164 pages, 45 illustrations.

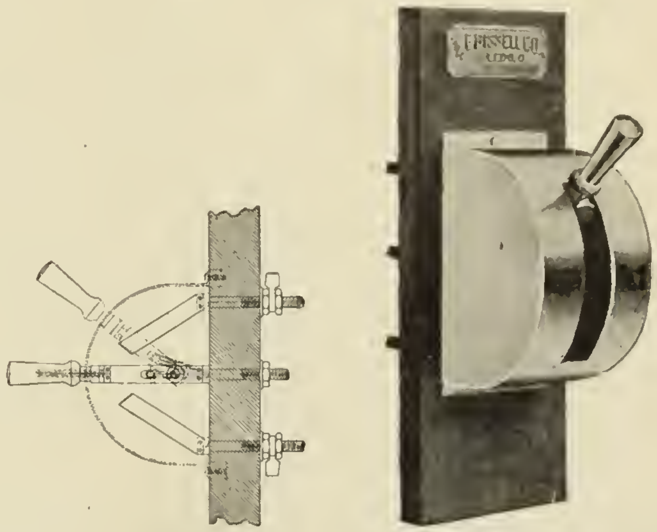
This pamphlet is the fourth part in a German text-book upon telegraphy and telephony. Part III ended in the middle of a description of storage batteries, so that the first dozen pages of the present issue are devoted to a completion of that topic. Then comes a description of the general laws of wave motion, in which the familiar sine curve and diagrams showing harmonics and overtones appear. The concluding chapter in this part is devoted to telegraphy and deals particularly with sounders and the various forms of apparatus for recording Morse signals.

BOOKS RECEIVED.

The Alternating-Current Transformer. By F. G. Baum. New York: McGraw Publishing Company. 195 pages, 122 illustrations. Price, $1.50.

Theatre Switch.

A new theatre switch has been designed and manufactured by the F. Bissell Company, Toledo, Ohio. It is well made and prepared to stand the abuse which is unavoidable in the quick action always required in the manipulation of a theatre switchboard. The electrician has no time to handle a switchboard gently. When he snatches it open, or slams it shut, he must be sure of results.



FIGS. 1 AND 2.—THEATRE SWITCH.

The detailed cut shows how the blades spring into position, on each circuit or between them, and stay there. This can be done with the greatest rapidity, because when the blades are started they jump the rest of the way, and stop in position. A metallic cover conceals the flash.

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Watchman's Time Detector.

The watchman's time detector, manufactured by the American Watchman's Time Detector Company, 47 Sheriff Street, Cleveland, Ohio, is designed to keep an accurate record of the doings of a night watchman. The instrument is placed in the office and connected by insulated wires to magneto stations in different parts of the premises. As the watchman passes these on his rounds he operates each station in turn, a record being made on the detector in the office, showing where the watchman was at any time. The record is made on a paper dial 5, 12 or 20 inches in diameter (according to the number of stations), which makes one revolution during the night. The dial is operated by a Seth Thomas clock movement. The record is made by a series of needles, each punching a hole through the paper dial. The detector may be designed for any number of watchmen, and the company has built instruments keeping a record of fifteen watchmen on a single dial. Instruments are made for as many as 54 stations. The detector shows to a minute when the watchman visits the stations.

WATCHMAN'S TIME DETECTOR.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET. Stock speculation continued dull and largely professional in character. Better crop reports caused recoveries in the railway list, but decided weakness developed in the United States Steel stocks, principally in the common shares on unconfirmed reports that dividends on them might be reduced or passed in consequence of slack business and decreased earnings. A heavy break occurred in Steel shares at the latter part of the week. On Friday common closed at 18 and dropped a point to 17 early on Saturday under a heavy selling. This is the lowest quotation so far recorded for this stock. The preferred declined below 68, while the bonds eased off to 74½. On Saturday there was heavy selling of industrial stocks, General Electric suffering a break of several points. This stock closed at 155, having touched 153½, the highest quotation being 161½. The net loss was 5½ points. Westinghouse common and preferred lost 15 points and 11 points, closing at 151 and 160, respectively. Western Union closed at 81¼, a net decline of ¾ points. American Telephone & Telegraph lost 1¾ points, the ruling and closing figure being 130¾. The transactions declined in sympathy with the general market, Brooklyn Rapid Transit closing at 37¼, being a loss of 3¼, and Metropolitan Street Railway at 111⅜, a net loss of 2⅞. Following are the closing quotations of September 22:

NEW YORK.

	Sept 15	Sept. 22		Sept. 15	Sept. 22
American Tel. & Cable	78¾	79	General Electric	160	153
American Tel. & Tel	130	127	Hudson River Tel	..	..
American Dist. Tel	24	24	Metropolitan St. Ry	113¾	112
Brooklyn Rapid Transit	38¾	37¼	N. E. Elec. Veh. Trns	..	.
Commercial Cable	145	146	N. Y. & N. J. Tel	..	..
Electric Boat	13	16	Marconi Tel	1⅞	1⅞
Electric Boat pfd	38	40	Western Union Tel	83	82
Electric Lead Reduction	1¾	1¼	Westinghouse com	155	149½
Electric Vehicle	5½	4⅞	Westinghouse pfd	160	160
Electric Vehicle pfd	8	7			

BOSTON.

	Sept. 15	Sept. 22		Sept. 15	Sept. 22
American Tel. & Tel	131	128¾	Western Tel. & Tel. pfd	80	80½
Cumberland Telephone	..	*115⅝	Mexican Telephone	1¼	1⅛
Edison Elec. Illum		230	New England Telephone	124	*124
General Electric		152½	Mass Elec. Ry	20	19
Western Tel. & Tel	12	11½	Mass. Elec Ry. pfd	78½	78

PHILADELPHIA.

	Sept. 15	Sept. 22		Sept. 15	Sept. 22
American Railways	44½	43	Phila. Traction	95½	94½
Elec. Storage Battery	55	52	Phila. Electric	6	6¼
Elec. Storage Battery pfd	55	..	Phila. Rapid Trans	13¾	13½
Elec. Co. of America	8¼	8¼			

CHICAGO.

	Sept. 15	Sept. 22		Sept. 15	Sept. 22
Central Union Tel.	..	..	National Carbon pfd	9	*90
Chicago Edison	.	..	Metropolitan Elev. com	..	18
Chicago City Ry	170	170	Union Traction	5	4½
Chicago Tel. Co	..	.	Union Traction pfd	30	32
National Carbon	20	*20½			

*Asked

AMERICAN RAILWAYS' ANNUAL.—The American Railways Company has issued its annual report for the year ended June 30, 1903. We make the following comparison of the income account:

	1903.	1902.	1901.	1900.
Gross	$423,028	$370,384	$274,623	$144,081
Deductions	148,336	67,652	48,517	49,346
Net	$274,692	$302,732	$226,106	$94,735
Dividends	223,774	178,178	112,530	......
Surplus	$50,918	$124,554	$113,576	$94,738
Previous surplus	330,865	206,311	92,735	......
Total surplus	$381,783	$330,865	$206,311	$94,735

President J. J. Sullivan says in part: "Gross earning of the subsidiary companies were $1,245,298, an increase of $238,802 over 1902, or about 23 per cent. During the year the $910,000 5 per cent. collateral trust convertible bonds were disposed of at a price netting the company 98 per cent. and interest. In July, 1902, the Bridgeton & Millville Traction Company delivered to this company $150,000 first mortgage 5 per cent. gold bonds in part payment for its Port Norris extension. These bonds have been sold at par and interest. Since June 30, 1902, $52,000 5 per cent. collateral trust convertible bonds have been converted into stock. In September of 1902 the company sold 2,000 shares of unissued stock at par. This company now owns the entire capital stock of the People's Railway Company, of Dayton, Ohio. The total trackage owned by the American Railways Company is 217.1 miles, showing a gain for the year of 34.1 miles. While the growth of the property shows great improvement, the increase in the cost of labor, coal and electrical equipment has been a factor in keeping down profits."

DIVIDENDS. Easton (Pa.) Consolidated Traction directors have declared a semi annual dividend of 60 cents, payable September 24. The directors of the Hall Signal Company have declared the regular quarterly dividend of 1½ per cent. on the common stock, payable October 1. The directors of the American Telephone & Telegraph Company have declared the regular quarterly dividend of 1½ per cent. The directors of the Electric Storage Battery Company have declared the quarterly dividends of 1¼ per cent. on the common and 1¼ per cent. on the preferred stocks, payable October 1. Directors of Cleveland Electric Railway have declared a quarterly dividend of 1 per cent., payable October 5. This is the first dividend since the merger with the Cleveland City Railway, and establishes a rate of 4 per cent. The Cincinnati Gas & Electric Company has declared the regular quarterly dividend of 1 per cent., payable October 1. The Cincinnati Street Railway Company has declared a quarterly dividend at the rate of 5¾ per cent. per annum. A dividend of 2½ per cent. has been declared on the preferred stock of the Union Traction Company, of Indiana, payable October 1. The Chicago Metropolitan Street Railway Company has declared its usual quarterly dividend of 1¾ per cent., payable October 1.

CUTTING A BELL DIVIDEND.—The Bell Telephone Company of Philadelphia, is to give notice to stockholders that the quarterly dividend to be paid in October will be 1½ per cent., instead of 2 per cent., as heretofore. An authority on the affairs of the Bell Telephone, of Philadelphia, says: "The reduction of the dividend was at the instance of the new Boston directors in the board elected last year, who believe that the company is expanding so fast that some of the earnings as well as the new capital should be used on the plant. The present action comes as a surprise to the minority interests, and it would seem that the management might have done better than to reduce the dividend, while the books remain open for subscription to the $2,000,000 new stock. The dividend is payable the latter part of October. The Bell system is by no means on a uniform rate, as some of the Bell companies are paying as high as 8 per cent. and 10 per cent. per annum." Secretary Pierson says: "The occasion for the cut in the rate from 8 per cent. to 6 per cent. is to make a uniform rate for the Bell companies. It maintains the stock on an investment basis." It is estimated that the gross earnings for the current fiscal year ending December 31, 1903, will increase $750,000.

WORK AT THE SOO.—Pending the outcome of the financial difficulties in which the Consolidated Lake Superior Company is now involved, President Shields has issued orders to close down temporarily all of the operations of the company except the street railway system on both sides of the river, the ferry system, and the Tagoma Light and Power Company of the Canadian Soo. This step is taken, it is announced, because the funds of the company are exhausted, and Mr. Shields does not want to incur further liabilities until it is known from where the money with which to meet them is coming. Inasmuch as the company's operations on the American side are confined to the street railway and the power house force, the order will not materially affect the American Soo. In the Canadian Soo, however, the effect on business will be very extensive.

CONSOLIDATION IN SALT LAKE.—It is learned that negotiations are practically completed for the transfer of the Consolidated Railway & Power Company's system to the Utah Light & Power Company. Approximately $6,000,000 is involved in the transaction, although half of this amount represents the bonded indebtedness of the company. The purchase will be made from A. W. McCune, and the transfer will be effected as soon as experts have made an examination of the books of the company. By this transfer the street railway system becomes the property of the Mormon Church. President Joseph F. Smith, of the Utah Light & Power Company, is president of the church and the other officers of the company are representatives of the church.

JERSEY CITY POWER HOUSE.—The North Jersey Street Railway Company, recently absorbed by the Public Service Corporation of New Jersey, has bought a tract of land on the Hackensack River at Jersey City for which it paid $12,500. The river frontage is 300 ft., the plot being 1,140 ft. deep at the north end and 935 ft. deep at the south end. It will be used for a new power house in connection with an extension of lines on the west side of Jersey City Heights contemplated by the Public Service Corporation.

CUMBERLAND TELEPHONE.—The Cumberland (Bell) Telephone system reports as follows: August gross, $281,013; expenses, $182,926; August net, $98,087; other income, $10,223; total net, $108,310; total subscribers, 93,378, a gain of 281 for the month.

ST. LOUIS LIGHTING DEAL.—The stockholders of the Missouri-Edison Electric Company and the Union Electric Light & Power Company voted to combine the two companies, to be known in the future as the Union Electric Light & Power Company. The vote of the Union Company stockholders on the consolidation was unanimous, while the vote of the Missouri-Edison Electric Company resulted in 35,175 shares being voted for the proposition and 1,272 shares against it. The consolidation of the two big lighting companies is, in reality, a mere technicality, as both are dominated by the North American Company, which recently purchased the Laclede Gas Light Company, and had previously bought the Missouri-Edison and Union Companies. The scheme is to consolidate all the electric light and power plants of St. Louis. It is said also that this same company has plans for uniting with its other properties the electric street railway systems of the city. The stock of the new Union Company will be $10,000,000, all common. Under the terms of the consolidation stockholders of the Missouri-Edison Company will receive one share of the new stock worth $100 and $5 in cash for two shares of the preferred stock of the Missouri-Edison Company. The same allowance will be made for four shares of common stock of the Missouri-Edison Company.

WESTINGHOUSE AIR BRAKE.—The annual meeting of the Westinghouse Air Brake Company will be held October 6 next. The report for the fiscal year ended July 31, 1903, compares with the two preceding years as follows:

	1903.	1902.	1901.
Net sales of brakes	$8,452,474	$7,890,831	$7,149,000
Other income	727,113	668,672	720,857
Total income	$9,179,588	$8,559,503	$7,869,857
Expenses	5,460,508	5,630,807	4,888,515
Net earnings	$3,719,080	$2,928,696	$2,981,342

The company charged off $25,506 for depreciation and set aside a special depreciation reserve fund of $300,000, leaving earnings applicable to dividends of $3,393,573. Dividends paid for the year $2,636,748. The surplus after dividends amounts to $3,993,869. The net sales for the past fiscal year were the largest in the company's history

BELL TELEPHONE OUTPUT.—The instrument statement of American Telegraph & Telephone for the month ended August 30 and since December 20 compares as follows:

	1903.	1902.	1901.
Gross output	63,565	84,279	81,144
Returned	46,136	43,034	42,997
Net output	17,429	41,245	38,147
Since Dec. 20:			
Gross output	732,823	733,323	607,593
Returned	325,393	303,355	267,807
Net output	407,430	429,968	339,786
Total outstanding	3,557,750	2,955,514	2,292,602

NEBRASKA TELEPHONE COMPANY.—The Nebraska (Bell) Telephone Company has addressed a circular letter to its subscribers offering $600,000 of additional stock at a par value of $100 per share, the issue having been authorized by the stockholders for the purpose of making extensive improvement in its system and plant. Space in the letter and an accompanying pamphlet is devoted to explaining the company's views of the independent competition.

Commercial Intelligence.

THE WEEK IN TRADE.—Irregular conditions still prevail, but in spite of this there is a tendency to view the general outlook for fall and winter trade with favor. Heavy rains and alleged killing frosts Northwest and in portions of the West, with drought, followed by unseasonably cool weather, and destructive wind and rain storms along the Atlantic coast, have tended to retard expansion in fall trade in widely separated sections of the country. The Northwest returns the poorest reports as to current distributive trade, while the Southwest and Pacific coast and some sections of the South give excellent reports of business already booked or in prospect. Northern Texas will make a larger cotton crop than last year, but the southern part of the State will return less. A feature of the week in New England has been the resumption of a large number of cotton mills, notably at Fall River. Trade in lumber at the East shows little if any improvement, though the resumption of building helps trade somewhat at New York. The iron and steel markets are reported weaker. Buyers of finished materials are said to be holding off at Chicago and at New York, the feeling being that heavy reductions in prices of pig iron since the first of the year should be reflected in lower prices for the finished products. A good volume of business is reported booked for the balance of the year. A better tone in iron is reported from Pittsburg, and orders for finished products are coming in there more freely. In copper the market was dull and inactive, prices being somewhat easier than for some time. The Exchange quotations have not been changed, but in the open market Lake can be obtained at 13½c.;. electrolytic at 13.37½c., and casting stock at 13c. A large volume of general business throughout the country is indicated by the railway earnings, which for August showed gross receipts of fully 9 per cent. over those of the corresponding month of last year, and of nearly 10 per cent. over the first week of September. The car shortage is beginning to be felt, especially in the Pittsburg district, where sufficient labor cannot be secured for handling freight. There was a slight increase in the number of business failures during the week ending September 17, the aggregate being 170, against 165 the week previous, and 182 in the corresponding week of last year.

THE SHEFFIELD COMPANY, which is to construct a plant at Sheffield, Ala., for lighting the towns of Florence, Sheffield and Tuscumbia and operating an electric railway, both freight and passenger, to be built by the company between those places, has just placed contracts through its New York office for cars, etc. The American Car & Foundry Company, Jackson & Sharp, Wilmington, Del., branch, has taken an order for eight cars—5 open, 15 bench type and 3 closed, 44 ft. 2 in. The trucks will be Peckham. The motors—4 No. 68—of each car will be of Westinghouse build. The power house, whose initial capacity will be about 850 hp, will be equipped with Wickes boilers, Brown Corliss engines and Westinghouse generators. A 325-kw, three-phase, alternating-current machine will take care of the railway work, while a 250-kw generator will furnish the lighting power.

GOULD STORAGE BATTERY CONTRACTS.—Among the recent contracts secured by the Gould Storage Battery Company are the following: Lexington Street Railway, Lexington, Ky., 256 cells S-613 elements in S-17 tanks, with a capacity of 480 and 640 amperes respectively. An automatic regulating booster of the Gould type will be installed with this battery. Easton Power Company, Easton, Pa., 255 cells of Type S-617 in S-25 tanks, with a capacity of 640 and 960 amperes respectively. Also switchboard and regulating booster of the Gould type. This plant is the second installation made for this company, after extended use of the Gould battery and booster. Northampton Power Company, Easton, Pa., floating battery with a maximum discharge of 360 amperes and 600 volts.

BIDS WANTED.—The Kokomo Railway & Light Co., of Kokomo, Ind., will receive bids up to 2 o'clock in the afternoon of October 14, 1903, at the office of the Kokomo Railway & Light Company and the Indiana Interurban Construction Company, in Kokomo, Ind., for the complete construction of power house, sub-station and installation of all machinery and all equipment therein. Detail plans and specifications covering this work will be on file on and after October 1, 1903, at the office of the companies in Kokomo. Bids will be received for the whole work complete or on various sub-divisions of the same.

MORE AMERICAN EQUIPMENT FOR CAUVERY FALLS PLANT.—The General Electric Company has secured an important contract for generators, etc., to be installed in an extension of the Cauvery Falls hydraulic plant, India. As already mentioned in these columns, the General Electric people secured the contract for the initial equipment. The additional turbines will be of Pelton type built by the Swiss engineering firm of Escher, Wyss & Co., of Zurich. A Scotch firm, Mechan & Sons, of Glasgow, has been awarded the contract for the structural steel.

SYSTEM FOR MOSCOW.—An extensive network of electric lines is to be constructed and operated by the municipality of Moscow, Russia. New lines will be built and then the existing horse roads will be electrically converted. Before the system is completed, which will take about three years, fully 175 miles of lines will be electrically operated. Vladimir F. Gnesin, a well-known Russian electrical expert, Morris Building, New York, can give further particulars to interested parties.

GENERAL ELECTRIC EQUIPMENT FOR AUSTRALIAN PRINTING WORKS.—The General Electric Company has secured a contract for several motors to be installed in the new printing works of J. Sands & Co., Sydney, New South Wales. The contract calls for 61 motors, varying in capacity from ⅛ hp to 1 hp each.

FOR MEXICAN CENTRAL SHOPS.—The new shops of the Mexican Central Railroad, now being built at Aguascalientes are to be equipped with De Laval turbines, two 60-ton electric cranes and some large machine tools built by the Niles-Bement-Pond Company.

INSULATING MATERIAL, ETC., FOR SOUTH AMERICA.—The Standard Paint Company, 100 William Street, New York, reports a substantial foreign demand for insulating material, etc., especially from the Argentine Republic and Chili.

UNION SWITCH & SIGNAL INSTALLATIONS.—Two recent and important contracts by the Union Switch & Signal Company are those for the Interborough Rapid Transit Company (Subway), of New York, and the North Shore Railway, of California. The Westinghouse electro-pneumatic system is to be installed on the first named, but a new feature is to be introduced, that of using alternating current. It is obvious that the use of track circuits on third rail roads, where the rails are used for the return circuit, and at the same time for the signaling circuit, introduces what may be serious complications. In order to avoid these difficulties the signals will be controlled by alternating current, through relays that are sensitive to alternating current only, and which will not be affected by the direct current used for train service in the subway. On the North Shore Railway, which runs about thirty miles north from Sausalito, Cal., across the bay from San Francisco, the electric semaphore system of automatic block signals is to be used with a track circuit. This being a high tension, third rail electric road, alternating current will be used for the signal system.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed contracts for the installation of batteries of the Chloride accumulator for the Indianapolis & Northern Railway, at Sulphur Springs, Ind., making seven batteries operated by this company at Broad Ripple, Ind.; an increase in the two batteries recently installed for the Los Angeles Railway, Los Angeles, Cal., and an installation for the Northwestern Elevated Railway, of Chicago, Ill. Four new batteries have been contracted for by the Chicago Edison Company, making thirteen batteries operated by this company; an installation for the Paterson Edison Company, Paterson, N. J.; the second battery for the Los Angeles Edison Company, Los Angeles, Cal., and an additional battery for the New York Edison Company, which makes twenty-two batteries operated by this company. Isolated lighting and power plants are being installed for the Murphy Building and for William P. Stevenson, at Detroit, Mich.; Alexander Winton, Cleveland, Ohio; F. T. F. Lovejoy, Pittsburg, Pa.; the House of the Good Shepherd, Roxbury, Mass., and for the Irving Building, Louisville, Ky.

MANILA TRACTION SYSTEM.—Construction work has begun on the Manila electric traction system, in which project J. G. White & Co., 29 Broadway, New York; the Westinghouse interests, Ex-President Buhl, of the Sharon Steel Company; Peter L. Kimberley, of Sharon, Pa., and Charles M. Swift, of Detroit, Mich., are principally interested. J. G. White & Co. will execute the construction work. Seventy-pound rails will be laid, 4,000 tons of which have already been ordered from Wonham & Magor, on behalf of the London iron and steel firm of Suter, Hartmann & Co. The power house equipment will have an initial capacity of 3,000 hp. Westinghouse turbo-generators will be installed. The system, which will be about 40 miles long, is expected to be in active operation inside of 18 months. It will cost between $2,500,000 and $3,000,000.

BALL ENGINE ORDERS.—The Ball Engine Company, Erie, Pa., which is now installing three 400-hp vertical cross-compound, directed-connected engines in the Oliver Building, Pittsburg, Pa., has just received an order for an additional unit—a 700-hp vertical cross-compound Corliss direct-connected engine. This will make one of the largest isolated plants in Pittsburg. The Haskell & Barker Car Company, of Michigan City, Ind., has purchased a 200-hp direct-connected unit from the Ball Engine Company, Erie, Pa. The Ball Engine Company has also sold a 60-hp direct-connected unit to the National Ammonia Company, St. Louis, Mo.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, of Chicago, has designed a new generator call, self-restoring, drop switchboard, embodying a number of important new features. The board will be ready for the market in about 30 days. It is said that the company has a number of orders on file for this type of equipment. Owing to the rapid increase of its business in the Southwest, it has been found necessary to establish a branch sales office at Mexico, Mo. Mr. G. F. Graham, who is well known to the independent interests of that section, has been appointed manager of this division.

PLANT FOR ROSLYN, L. I.—The Nassau Light & Power Company has been giving out contracts for its plant at Roslyn, L. I. The contract for the buildings was awarded to the American Bridge Company. The Alphons Custodis Chimney Construction Company, of 95 Nassau Street, received an order for a 200 x 10-ft. stack. Contracts for the first battery of 1,000-hp water-tube boilers were awarded to Thayer & Co., Limited, of 39-41 Cortlandt Street. The General Electric Company received orders for two 1,500-kw Curtis turbo-generators. Mr. C. O. Mailloux is consulting and contracting engineer for the company.

WESTERN ELECTRIC COMPANY is to have large new buildings in Philadelphia to cost about $100,000, at the southwest corner of Eleventh and York Streets, where its present factory plant in that city will be concentrated. This is trivial, however, compared with the plans for Chicago, involving from $5,000,000 to $7,000,000, in the construction of a plant at Hawthorne, south of Twenty-second Street, and east of Forty-eighth Avenue. Nine buildings are already rising, the contracts for which aggregate $1,207,247. It is expected to have the first part of the work done by February next year.

EQUIPMENT FOR MEXICAN MINES.—The Mexican-American Mining Company, of Sierra Juarez, State of Oaxaca, Mexico, is to construct a hydraulic plant on the Socorro River at a point in the vicinity of Sierra Juarez, for the purpose of developing power to operate its mine. Several water power rights have been recently granted by the Mexican authorities to mining companies, whose properties are near the Socorro and Natividad Rivers, and contracts are pending for the equipment of other plants. The initial capacity of the Mexican-American company's plant will be 200 hp.

LIGHTING EQUIPMENT FOR SOUTH AFRICA.—The Mutual Life Insurance Company, of New York, is to erect a large office building in Johannesburg, South Africa, which will be fitted with American electric lighting equipment. The General Electric Company will furnish the generators, two of 75 kw capacity each, while the contract for the engines has been taken by Mackenzie, Quarrier & Ferguson, 114 Liberty Street, New York. There will be two direct-connected engines of 120-hp capacity each, of Harrisburg manufacture.

INDIANA POWER PLANT.—Power enterprises are cropping up quite numerously in the Hoosier State. The Indiana Hydraulic Power Company, of Hindostan, Ind., has been incorporated with $150,000 capital, to construct and operate a water plant at the Hindostan Falls, and to construct a dam on White River. The plant will generate hydraulic and electrical power for manufacturing purposes. The directors are Jerome Herff and Joseph Bergman, Peru, Ind., and Wm. A. Cullop, Vincennes, Ind.

PERUVIAN LIGHTING PLANT.—The Compania Santa Rosa, Limitada, of Lima, which furnishes power for lighting, has just contracted for additional equipment. The existing capacity, which is operated by water power, is 2,000 hp. It is to be increased to 3,000 hp. The Pelton Water Wheel Company has secured a contract for a 1,000-hp water wheel. The generator, a 450-kw machine, will be of General Electric build. The original plant has Pelton wheels and General Electric generators.

BIDS FOR MUNICIPAL PLANT AT CIENFUEGOS.—On September 28 Senors F. Ga Vieta, the mayor, and Rodriguez Pedro Morales, city clerk, will open bids simultaneously at Cienfuegos, Cuba, and in the office of the secretary of state at Havana, for the municipal electrical lighting plant of Cienfuegos. Bids will be received till noon of the day of opening. The city will pay for the plant in yearly installments of $4,000 gold.

J. G. WHITE & CO. SECURE BRITISH CONTRACT.—J. G. White & Co., Limited, of London, has been awarded an important contract for the construction of another British municipal electric traction system, the corporation of Northampton, one of the leading cities in the English Midland district, having allotted them work which will represent an expenditure of more than $200,000.

MEXICAN HYDRAULIC POWER PROJECT.—John R. McDonough, of Mexico City, is after a concession which will permit of his constructing a hydraulic plant at the junction of the Del Valle and La Asuncion Rivers. Application has been made to the Mexican authorities with a view to utilizing 8,000 liters per second.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester and Chicago, recently closed a contract with the Benson Telephone Company, Benson, Minn., and the Red River Valley Telephone Company, of North Dakota, for one of its 400-line generator call visual signal switchboards.

ELECTRIC TRACTING FOR TORREON, MEXICO.—An electric traction system is about to be constructed in the city of Torreon, Mexico. A company has just been organized for the purpose of building and operating the road. D. Daniel Rios Zartuche is primarily interested in the enterprise.

TELEPHONY AND LIGHTING.—The Johnstown Light, Heat & Power Company, of Johnstown, Pa., is going into the telephone business and will put in a first-class exchange, to be located at the central station. Mr. J. W. Reeves is general manager and Mr. August Weis is superintendent.

ALASKA CABLE SHIPMENT.—The Safety Insulated Wire & Cable Company, 114 Liberty Street, New York, has just completed the shipment of 1,300 miles of deep sea submarine single-conductor cable for the Alaska system.

General News.

THE TELEPHONE.

LOS ANGELES, CAL.—Articles of incorporation have been filed with the County Clerk by the Monrovia Telephone & Telegraph Company, with a capital stock of $50,000, of which amount $5,000 has been subscribed. Monrovia will be the company's principal place of business. The incorporators and directors are D. E. Juvinall, M. Juvinall, C. O. Monroe and George McLaughlin.

WHITEWATER, KAN.—The Whitewater Telephone Company has been incorporated with a capital of $2,500. This company will establish a local exchange in Whitewater which will be in connection with the long distance lines of the Wichita Telephone Company.

JACKSON, MICH.—The Munith & Grass Lake Telephone Company has filed articles of association in the sum of $2,500. The company is organized for the purpose of operating and maintaining a general telephone business in this county. The stockholders are M. A. Taylor, A. A. Welch, H. H. Murray, F. J. Kilpatrick, J. C. Welch, D. J. Soper and F. Welliman, of Grass Lake, and Fred Schrak, B. Suylandt, C. Harr, D. Vanderlyn, C. M. McIntee, F. Harr, G. Heydloff, G. Walz, J. G. Harr, N. Lanlis, Agnes Randolph, W. Dixon. T. Ready, J. Hoyt and P. Cavender, all of Munith.

ST. LOUIS, MO.—The organization of the St. Louis County Telephone Company has been completed at Clayton and the incorporation papers have been sent to the Secretary of State. The company has a capitalization of $1,000, but this amount will be increased, it is said, as soon as the work of installing the plant is begun. The first board of directors consists of H. J. Weber, J. B. C. Lucas, J. Kessler, Ernest Marshall, G. W. Von Schroeder, F. A. Heidorn, Albert Jacobsmeyer, Alex Kessler, H. W. Karrenbrock, Judge Edward Rannells, Edward Miller, D. Clinton Taylor and J. D. Houseman. A meeting will be held in a few days for the purpose of adopting by-laws, etc.

LACONIA, N. H.—A switchboard capacity of 300 drops, with 25 miles of toll line, is operated by the Citizen's Telephone Company. The rates are $15 and $18 per annum. There are at present 1,100 subscribers, of which 350 were added since January 1. The Citizen's Company is constantly extending its work and reports the outlook as remarkably good.

NEW LISBON, N. J.—The Farmer's Telephone Company operates Kellogg apparatus; has a switchboard with 50 drops and 75 subscribers. The subscription rate is $20 a year. This company is just completing a 20-mile line, with two exchanges and three toll stations from New Egypt to Allentown. Its prospects are good.

PLATTSBURG, N. Y.—The Clinton Telephone Company of Plattsburg has been incorporated to construct lines in Northern New York; capital $50,000. Directors: John M. Wever, R. S. Rumsey and Isaac Merkel, Plattsburg.

OXFORD, N. Y.—Messrs. Mead & Derrick, of the Oxford Exchange, inform us that business has doubled within a few months. There are 100 miles of toll line, and subscribers pay $18 for business and $12 for residence service.

MILFORD, N. Y.—A gradual increase is the report from the Milford Telephone Company, which operates a 50-drop North switchboard, has 120 miles of toll lines and 50 subscribers. The subscription rate is $15 per annum. Mr. Cuyler E. Carr sends us this information.

PERRY, N. Y.—With 180 subscribers on Sept. 1, 100 of which have been added since February of this year, the Perry Telephone Company reports still further probable increase during 1904, when 50 new telephones are to be installed. A 320-drop switchboard is operated. Mr. C. W. Smith is manager.

EARLVILLE, N. Y.—The Earlville Telephone Company of Earlville, Madison County, has been incorporated to operate in Madison and adjoining counties; capital $40,000. Directors: Parker Newton, Gertrude C. Newton, Ernest C. Newton, Morris Newton, Guy H. Clark, Clayton I. Burch and Avery M. Hoadley, all of Earlville.

MALONE, N. Y.—The Franklin County Telephone Company reports good progress and states that it is giving satisfaction. It uses Stromberg-Carlson apparatus, the switchboard capacity being 200 drops. There are 340 subscribers, who pay $15 annually for their service. At present there are 15 miles of toll lines and 20 more are projected. In the past eight months the business has increased about one-third.

NEWARK, N. Y.—The telephone plant here was built in 1898, and opened in February of 1899 with 65 subscribers. Without solicitation this number has steadily increased. There are 210 subscribers. Connecticut Telephone & Electric Company's apparatus is used, the switchboard being of 200 drops. Business charges are $20 and residences $15 and $12 per annum. There are a number of applicants for service, whose demands cannot be supplied until new cable is installed.

NEW YORK, N. Y.—The New York & Long Island Telephone Company operates in Nassau and Suffolk counties, N. Y. It has six central offices, in four of which there are switchboards of 100 drops each, one with 150 drops and one with 300 drops. Kellogg and American apparatus is used. There are 600 subscribers. The rates are from $20 to $30 per annum, toll five cents for five miles. The company estimates the recent growth at 20 per cent., and contemplates an increase of 20 per cent. in the territory in the coming year. The outlook is favorable. Extensions under way will add 100 per cent. more toll line, five more exchanges and 700 more subscribers. Mr. D. James Cronk, the engineer and manager of this company, informs us that the best of construction material is being used, poles, cables, No. 12 B. & S. copper trunk, and that they are doing some U. S. Government work, and combining as large a territory as possible in each office.

SALISBURY, N. C.—Mr. W. F. Snider is the owner of the Salisbury Telephone Company, which uses Williams-Abbott apparatus. The switchboard has a capacity of 400 drops; there are about 100 miles of toll line. Mr. E. C. Heins is manager of this exchange as well as that of the Spencer Telephone Company, Spencer, N. C. The Mt. Airy Telephone Company is operated in connection with these two. The rates are from $18 to $24 per annum. The system is growing very rapidly. It is expected to add from 75 to 100 telephones.

MORNING SUN, OHIO.—The Morning Sun Telephone Company has been incorporated by R. H. Douglas, W. M. Cook, J. R. McCrary, S. M. Paxton and S. C. Weed. Capital, $10,000.

DOYLESTOWN, OHIO.—A North 100-drop switchboard is operated by the Doylestown Telephone Company, which has 100 subscribers and 25 miles of toll line. The company reports a 25 per cent. increase within a year, and some extensions are to be made. The rate is $12 per annum for each telephone.

QUAKER CITY, OHIO.—The entire system of the Quaker City Telephone Company is being rebuilt, and its 80 subscribers are well pleased with the service. There has been an increase of over 20 per cent. in the last year. This company's rate is $1 a month; it uses American Electric apparatus.

SHELBY, OHIO.—The Shelby Local Telephone Company operates a 500-drop North switchboard, giving service at $1 and $2 a month. Of the 700 subscribers 125 have been added since March, and the manager, Mr. F. B. Chapman, tells us that the outlook is good for 1,000 subscribers at end of 1904.

ASHLEY, OHIO.—The New Ashley Telephone Company uses a Stromberg-Carlson 100-drop switchboard, which gives service to 135 subscribers. The rates are $12 and $18 a year. Twenty-five telephones have recently been added and "prospects are good," says Mr. G. M. Dennis, secretary and manager, "if we could get men to do work."

LONDON, OHIO.—The London Home Telephone Company has just commenced to reconstruct its line, putting in about 5,000 feet of cable. It has at present more subscribers than it can accommodate, there being 1,000 of them. An American Electric 500-drop switchboard is operated; the service costs $2 per month for business and $1 for residences. Mr. W. J. Meech is secretary and general manager.

MT. STERLING, OHIO.—A total of about 275 subscribers is accredited to the Mt. Sterling Telephone Company by its secretary and manager, Mr. H. Clay Johnson, who tells us that about fifty telephones were added last year and that the system is in good condition. An American switchboard of 300 drops is used; there are about 80 miles of toll line, and the subscription rates are from $1 and $2 per month.

BRIDGEPORT, OHIO.—The Belmont Telephone Company operates five exchanges, Barnesville, 350 subscribers; Bridgeport, 210; Martin's Ferry, 240; St. Clairsville, 125; Belmont, 25. One hundred and fifty miles of toll line are operated. Mr. A. H. Dondua, the general manager, tells us that the prospective gain is four to five per cent. per month. One exchange and some new toll lines are projected. The company uses the central energy system, and general satisfaction is felt by subscribers.

HAMILTON, OHIO.—The Hamilton Home Telephone Company which began business on Jan. 15, with about 600 subscribers, has passed the 1,000 mark and now has 1,011 telephones in this city. In addition it has one hundred subscribers on its Bethany exchange and a number of other city contracts are about to be closed. The work of building a metallic circuit line to Dayton, Ohio, will soon be commenced. This will give the company direct connection from here with Columbus, Cleveland, Toledo and other importnat points in Ohio, and also with Pittsburg.

CLEVELAND, OHIO.—Acting General Manager French, of the Cuyahoga Telephone Company, informs us that by the first of the year his company expects to have its present equipment replaced by the latest type of common battery and lamp signal equipment, thus doing away with the divided multiple exchange board. He adds: "With its four divisions A. C. M. and R. our new equipment is the best money can buy and we look for an era of unparalleled prosperity for the company." The Cuyahoga Company operates a very large system, having 8,229 subscribers. North and Kellogg apparatus is used. The recent growth has been satisfactory, but no special effort has been made to secure new subscribers owing to the contemplated change in the system noted above. When the new system is in working order a general canvass will be made to increase the number of subscribers.

LANSFORD, PA.—The Carbon Telephone Company has forty subscribers, the subscription rate being $1 a month. This company has secured franchises in East Mauch Chunk and Mauch Chunk and contemplates building a ten-mile line.

KITTANNING, PA.—The common metallic system is being installed by the Kittanning Telephone Company, which uses American Electric and Stromberg-Carlson apparatus. The subscription rate to the 425 subscribers is $15 to $18 per annum. Mr. K. B. Schotte, secretary and treasurer, says the outlook could not be much better.

LEWISTOWN, PA.—The United Telephone & Telegraph Company of Philadelphia, which operates the system in this city, is the successor of the old Spring Telephone Co. which was merged with the Juniata & Susquehanna Telephone Co. and the latter afterwards with the United Co. The company's switchboard here has a capacity of 450 drops. It has 750 subscribers, the apparatus used being that of the Western Telephone Construction Company, Kellogg and American. The company operates 65 miles of toll line, and among the improvements planned is the establishing of an exchange at Duncannon and the extension of its country lines about 20 miles. Mr. D. L. Temple, division manager, notes that he has recently installed a private branch exchange which has a battery pressure of 50 volts and has but one relay for each cord, at the same time giving the full supervisory signals. In addition to this the company is giving connections from the central energy telephones to its long distance lines to Philadelphia and other points without the use of repeating coils as is tho present custom and it finds that it is getting much superior service to that given when repeating coils are used. The rates for Lewistown are $18 to $30 per annum.

DEADWOOD, S. D.—The Nebraska Telephone Company is seeking a new franchise and promises to spend $30,000 in improvements.

ELECTRIC LIGHT AND POWER.

LOS ANGELES, CAL.—The announcement is made that H. E. Huntington is looking to the San Joaquin River as a source of power for his mammoth electrical projects in Southern and Central California. The plans are large, involving the expenditures of millions of dollars, the long distance transmission to take the water out of the main river twenty miles north of Shaver and by a series of tunnels and pipe lines carry it through the mountains to the South Fork. The largest tunnel will be one mile in length. From this point the waters of the South Fork and those of Big Creek will be carried on to a place affording natural reservoir facilities, giving a fall of over 2,000 feet. Then the water will be carried along by conduits and tunnels a distance of four and a half miles, making another drop of 1,700 feet. With the normal low water of river and conserved flood waters, there will be a flow of nearly 1,000 miner's inches.

ELBERTON, GA.—Capt. D. B. Cade, of Elbert County, is the chief promoter of a company proposing to develop Anthony Shoals near Elberton. The dam will cost $167,000 and the canal $60,000. It is estimated that 22,000 horse power is available.

LEWISTON, IDA.—The Idaho Water Power Company has filed articles of incorporation at Lewiston, with a capitalization of $1,000,000. The company will build an electric railway system from Orofino to Pierce City, a distance of 30 miles, and one from Orofino to Nezperce. The company will also operate telephone and telegraph lines. The officers and directors are William L. Cook, president; Elmer Waldrip, secretary; Frank A. Farrish, William T. Farrish and Simon P. Fitzgerald. The power plant of this company will be installed on Orofino Creek, a purchase at that point having been made of the holdings of the Cascade Lumber and Power Company. When the surveys are completed, the company will solicit bids for the construction of a flume and the installation of a power plant. The flume will be 1,000 feet in length.

DIXON, ILL.—The Lee County Lighting Company has been incorporated by Edward B. Darling, E. H. Cassell and F. E. Bailey. Capital $100,000.

ROSEDALE, IND.—The citizens of this place are considering a proposition to establish a new lighting plant here.

WEST LEBANON, IND.—It is reported that a water works and electric light plant is to be installed here by Wm. H. Goodwine.

WESTSHOALS, IND.—The Indiana Hydraulic Power Company, of Hindostan, Martin County, has been incorporated, with a capital of $150,000, to construct and operate a water plant at the Hindostan Falls. The water power will be used to generate hydraulic and electric power for manufacturing and other purposes. Directors: Jos. Andrea and Jerome Herff, both of Peru, and Wm. A. Cullop, of Vincennes.

ACKLEY, IA.—The Ackley Electric Light & Power Company's plant has been disposed of to Smith Brothers, of Central City, Colo.

CUMBERLAND FALLS, KY.—H. C. Brunson, president of the Cumberland Falls Power Company, writes that complete plans for contemplated improvements will not be completed until about Dec. 1, and the company will be ready to open bids about June 1, 1904, for said improvements, the probable cost of which will be $1,800,000. C. P. Folsom, Dayton, Ohio, is engineer in charge.

PORTLAND, ME.—The Belfast Gas & Electric Company, capital $60,000, has been incorporated by Arthur B. Sederquist, Boston, Mass., H. P. Sweerser, Portland, and others.

RIVER ROUGE, MICH.—McCleary & Colquith, of Detroit, have secured the contract for constructing an electric light plant at River Rouge for $19,570.

DETROIT, MICH.—M. R. Bacon, of the Michigan Alkali Company, and Frank Nellis, of Wyandotte, Mich., are interested in a company formed for the purpose of supplying power to the manufacturing industries along the line of the Detroit & Toledo Short Line now in course of construction. The plant of the new company will be at Rockwood, and will furnish the Detroit & Toledo Short Line the necessary power to operate the road between Monroe and Detroit. The flow of the Huron River will be utilized for the generation of the power.

ST. CHARLES, MINN.—The St. Charles Light & Power Company has been organized, with M. J. McGrath, of Winona, as president, and Charles F. Knapp, of St. Charles, as secretary and treasurer. Capital, $12,000.

CHASKA, MINN.—J. G. Robertson, of St. Paul, Minn., secured the contract for an Ideal engine for the electric light plant at $2,228, and the Triumph Electric Company, of Cincinnati, Ohio, for a generator at $1,597.

LINCOLN, NEB.—The Fullerton Electric Light & Power Company has filed articles of incorporation with the Secretary of State, its capital stock being $20,000. The incorporators are A. Ellsworth, I. J. Bennett, W. P. Hatten and S. F. Rolph.

NEWARK, N. J.—The East Coast Electric Light, Power & Ice Company, of Newark, has been incorporated with a capital of $100,000 by Chas. Dutton, Jos. Gerrardt and Jas. R. Mapletoft.

GOUVERNEUR, N. Y.—The Village Trustees have granted J. Henry Abbott a franchise for an electric light plant.

EDENTON, N. C.—The Town Council will receive bids at once for the construction of water works and an electric light plant.

LAURINBURG, N. C.—W. Drummond Marrow, of Charlotte, is the engineer and contractor for the proposed electric light plant at Laurinburg; the probable cost of which will be $10,000.

SHELBY, N. C.—The Westinghouse Company is preparing plans for equipping a big water power plant for the Lily Mill & Power Company to furnish electric power to cotton mills at Shelby. It is said that the electric power will be much cheaper than the steam power now in use.

CLEVELAND, OHIO.—The Cleveland Engineering Company is preparing plans for a central heat, light and power station to be erected in the business section of Cleveland, by W. F. Black, Electric Building, this city. The plant is to be located in the business district bounded by Euclid Avenue, Sheriff Street, Ontario Street and Prospect Street, to furnish steam heat and electric light and power in this block. The plant will cost about $150,000.

CUYAHOGA FALLS, OHIO.—It is stated by Mayor Young that a number of Eastern capitalists have become interested in a project for a water power plant near Cuyahoga Falls. There is a considerable fall in the river and a large amount of power could be obtained at all seasons of the year. It is only eight miles from Akron and twenty miles from Cleveland, while manufacturing plants in Cuyahoga Falls are expected to take considerable power. It is estimated that the plant would cost about $1,000,000.

OKLAHOMA CITY, OKLA. TER.—It is reported that the Oklahoma Gas & Electric Company will expend about $75,000 in enlarging and improving its plant.

WILLIAMSPORT, PA.—The proposition to issue bonds for a municipal plant is being considered.

CORRY, PA.—The Corry City Electric Light Company, of Corry, has been incorporated, with a capital of $21,000.

BERNVILLE, PA.—The Deem Electric Construction Company, of Reading, has received the contract for the installation of an electric light plant in this place.

HARRISBURG, PA.—The Harrisburg Light, Heat & Power Company has reduced its rates for incandescent lighting from 15c. per kw-hour to 10c. per kw-hour. Graded discounts will be allowed.

SUNBURY, PA.—The West Branch Valley Electric Light Company has been formed under New Jersey laws, with a capital stock of $3,000,000, to use the power of the Susquehanna River at this place for the operation of electric light plants. The new company has procured options on twenty plants.

WATSONTOWN, PA.—Mr. T. H. Kisner, secretary of the electric light department of this borough, states that this town offers good opportunity for electrical enterprise. There is a dam in the river four miles from the town that could be utilized for the development of electrical energy. Mr. Watson states that a line of general supplies is needed for the electric light service.

SPARTANBURG, S. C.—Ladshaw & Ladshaw, of Spartanburg, have secured a contract for developing 40,000 horse power for electrical transmission on Little Tennessee River in Swain and Graham counties, Tenn. A preliminary survey is being made.

GREENVILLE, S. C.—As the result of the consolidation of a number of southern water power companies there has been formed in South Carolina the Southern Water Power Company with $2,000,000 capital. The center of operations will be at Greenville and the company will expend more money than any similar concern has ever spent in the state.

YOAKUM, TEX.—The electric light and power plant of the Yoakum Improvement Company at this place is to be enlarged.

DALLAS, TEX.—The electric light and power plant here, which is owned by Stone & Webster, of Boston, Mass., is to be enlarged.

EUREKA, UTAH.—The Eureka Electric Company has been organized under the laws of Colorado to furnish light and power in Eureka. The capital stock is $36,000. W. B. Searle is president, and A. L. Woodhouse, secretary.

WALLA WALLA, WASH.—The Washington & Oregon Power Company has been incorporated, with a capital of $300,000, to construct the new power plant of the Northwestern Gas & Electric Company on south fork of Walla Walla River. Isaac W. Anderson and Geo. L. Munn are among the incorporators. It is reported that the Walla Walla Gas & Electric Company has transferred its plant to the Northwestern Gas & Electric Company.

WOODSTOCK, WIS.—It is stated that $8,000 bonds are to be issued to enlarge the water and light plant.

KENOSHA, WIS.—The Kenosha Gas & Electric Company has received plans for a new power house to be erected here. Work has already begun on the improvements.

MATAMOROS, MEX.—John W. Maxey, of Houston, Tex., and associates contemplate establishing an electric light plant here. Application will be made to the municipal and state authorities for concessions for the proposed public improvement.

ORIZABA, MEX.—It is stated that the electric light and power plant here which is already furnishing light and power for a number of towns and manufacturing concerns of this section is to be enlarged and its electric transmission lines extended. Licenciado Joaquin Villada, of the City of Mexico, can probably give information in regard to the matter.

CULIACAN, MEX.—Henry T. Lavellert, of San Francisco, has been investigating the water power available in the rivers of this state with the view of establishing a large electric power plant to provide electric power and lights for this town as well as for a number of mines and industrial concerns of the state. He will make appliaction to the Mexican government for a concession for the proposed enterprise. He states that he represents a syndicate of American capitalists who have several hundred thousand dollars to invest in the enterprise if it is found to be feasible.

FORT WILLIAM, ONT.—Papers were signed on September 12 by which the Kakabeka Land & Electric Company agrees to sell power to this town in any quantity at $18 per horse power per annum. The company will begin its work in one hundred days, and it agrees to have developed and to deliver to the town of Fort William 5,000 horse power within two years. The city retains its franchise of light and water. Kakabeka Falls are located a few miles from this place and have a capacity of 30,000 horse power.

The Electric Railway.

FORT SMITH, ARK.—The Sebastian County Electric Railway Company has been incorporated, with a capital stock of $1,000,000, to build an electric railway to connect Fort Smith, Jenny Lind, Greenwood, Bonanza, Mansfield and Hartford and to furnish these cities with electric light and power. The officers of the company are S. A. Williams, president; Wharton Carnall, secretary and treasurer; H. G. Bollinger, vice-president.

LOS ANGELES, CAL.—Standardizing the lines of the Pacific Electric Railway Company in Pasadena has been completed and the construction camps are now at work on the division into Rubio canon.

HAZLEHURST, GA.—The City Council has granted a right of way and other privileges to Russell & Seeckle, promoters of the proposed electric railway from this city into the western portion of this county.

GAINESVILLE, GA. The Atlanta, Buford & Gainesville Railway Company has applied for a charter and proposes to erect an electric plant on the Chattahoochee River to furnish power for operating a street railway from Gainesville to Atlanta, and for furnishing power for Buford and other points along the line. Options are being taken on large tracts of land near the river. The petitioners for the charter are H. D. Jaquish and C. C. Sanders, of Gainesville; M. S. Garner, G. W. Thompson, J. O. H. Brown, of Buford; E. J. Michael, of Idaho; J. W. Peterson, W. W. Gorman and G. W. Winslow, of Chicago, and D. B. Stancliff, of Atlanta. The capital stock of the company is to be $100,000.

KEWANEE, ILL.—The City Council has granted a fifty-year franchise to the Kewanee, Cambridge & Genesco Electric Railroad Company.

JERSEYVILLE, ILL.—The Union Traction Company, of Jerseyville, has been incorporated, with a capital stock of $2,500. The object of the company is to build an electric railway and furnish light and power. The incorporators are A. O. Auten, June M. Rhoades and Joseph W. Becker.

CHICAGO, ILL.—Marshall Sampson, one of the receivers of the Chicago Union Traction Company, who has just returned from New York, is quoted as authority for the statement that steps are to be taken at once to equip with electricity all the lines of the company now operated by cable..

MUSKOGEE, I. T.—C. N. Haskell, for the Muskogee Traction Company, has given a bond of $10,000 to commence work on the street railway in Muskogee within thirty days. Cars are to be running within fifteen months.

LOUISVILLE, KY.—The Louisville & Southern Indiana Traction Company has decided to authorize a bond issue of $1,000,000, the proceeds of which are to be used in extending and equipping the company's lines in New Albany and Jeffersonville and its interurban lines, and in acquiring and purchasing other lines. The company has already projected an interurban line from New Albany to Corydon, Wyandotte Cave and Leavenworth, and another from New Albany to French Lick and West Baden Springs. Still another interurban line that the company has in contemplation will extend from Jeffersonville to Madison, along the Indiana side of the Ohio River. These lines the company expects ultimately to build. In addition to the new lines the company has in contemplation, it will make vast improvements in the lines it already has in operation between New Albany and Jeffersonville. The company expects to double track a good portion of this line, and the Big Four bridge will have to be equipped when the line is extended to Louisville. Improvements will also be made in the New Albany Street Railway system, a portion of which will be double tracked. There will also be some extensions to the New Albany Street Railway lines.

CADILLAC, MICH.—The Council has before it a proposition to grant a franchise for an electric railway in twelve of the principal streets and around the little lake. The projectors are W. J. Cornwell, of Cadillac; F. O. Gaffney, of Lake City, and James H. Orr, of Warren, Ohio.

DULUTH, MINN.—It is said that the Duluth-Superior Traction Company will spend $40,000 on new machinery to be installed in the power house in Duluth.

KANSAS CITY, MO.—The City Council of Kansas City, Kan., has passed an ordinance granting the Metropolitan Street Railway Company the right of way across the James Street viaduct for the stock yards line, for which the company is to rebuild the Seventh Street Viaduct. The viaduct is across the Union Pacific and Missouri Pacific tracks, a concession which the Metropolitan has been endeavoring to secure for some time.

TRENTON, N. J.—The Trenton Street Railway Companv has decided to make an important extension, the building of a second route to Cadwalader Park. This will give electric railway facilities to a desirable portion of the town which is but sparsely settled.

TRENTON, N. J.—A map has been filed with the Secretary of State by the Burlington & Mount Holly Railroad Company, covering the route of a proposed line from Morrisville into Trenton, to connect with the line of the Camden & Trenton Company, the connection to be made at Bridge and Union Streets, and from that point over Union and South Warren Streets to the center of town. No papers were filed with the map, but it is generally understood that the company is the Pennsylvania Railroad, which was formed two years ago to equip with electricity the Pennsylvania's branch lines in Burlington County.

SYRACUSE, N. Y.—It is stated that the Auburn & Syracuse Electric Railroad Company has decided to proceed at once with the work of double tracking its road as far as Mauellers.

ITHACA, N. Y.—The Ithaca-Horseheads Electric Railway Company will soon file letters of incorporation at Albany. The capitalists interested in the road are W. H. McFarland, of Toledo, and M. D. Baly, of the Standard Oil Company, ot Cleveland. The company has been able to extend the originally proposed line from Horseheads over Grand Central Avenue to Elmira Heights, and thence over private right of way into Elmira. The road will extend to Enfield Glen, through Newfield, Pony Hollow and Alpine, where the power house is to be built, to Odessa and to Horseheads. It is proposed to lay a double-track system from Ithaca to Newfield. The entire length of the line will be 59 miles. The Chemung River will be crossed at Big Flats by a 350-foot span.

GREENSBORO, N. C.—The Greensboro, N. C., Street Railway Company may extend its lines to one or more neighboring towns. The legislature has granted a charter to the company for extensions to High Point and Winston-Salem.

MARION, OHIO.—The Columbus, Delaware & Marion Railway Company has completed its line into Marion, and cars are now running in regular service between Columbus and Marion.

COLUMBUS, OHIO.—W. H. Luchtenberg, contractor for the Columbus, Marysville & Bellefontaine Railway, states that actual construction work on the line will start within forty days. Practically all the right of way has been secured.

ZANESVILLE, OHIO.—The Southern Ohio Railway, Light & Power Company has been incorporated by M. H. Hissey and others. Temporary capital stock is $10,000. It is proposed to build an electric railway from Zanesville to Roseville, Crooksville, Sayre and New Lexington.

LIMA, OHIO.—The annual meeting of the stockholders of the Western Ohio Railway was held recently, and the following officers were re-elected: A. E. Akins, President; L. J. Wolf and J. R. Nutt, vice-presidents; M. J. Mandelbaum, treasurer; H. C. Lang, secretary, and F. D. Carpenter, general manager.

CINCINNATI, OHIO.—It is announced that the Interurban Railway & Terminal Company is planning to extend its Rapid Railway from Lebanon to Xenia. In connection with the Springfield & Xenia Railway, already in operation, this would form a new through system between Cincinnati and Springfield.

CLEVELAND, OHIO.—Property owners on West Madison Avenue, in Lakewood, have signed a petition which will be presented to the Lakewood Council, requesting them to give a franchise to the Cleveland Electric Railway to run to Rocky River out West Madison Avenue. R. B. Martinetz, who is one of those interested in getting signatures to the petition, stated that the railroad committee had promised, if a twenty-five-year franchise is obtained from the Lakewood Council, to extend the road out that way inside of two years.

PHILADELPHIA, PA.—The Northern Street Railway Company has been incorporated to build five miles of electric railway in Beaver County. William Redwood Wright, of Philadelphia, Pa., is president of the company.

PHILADELPHIA, PA.—The Germantown & Chestnut Hill Belt Line Railway has been incorporated to build an electric railway at Germantown. F. C. Eberhardt, John McConley and W. B. Eltonhead, Germantown, are interested

JOHNSTOWN, PA.—The Johnstown, Woodvale Heights & Conemaugh Street Railway Company has been incorporated to build a four-mile electric railway here. The company is capitalized at $30,000, and the president is Joseph H. Berlin, of Johnstown.

DOYLESTOWN, PA.—Plans are progressing for the extension of the New Jersey & Pennsylvania Traction Company's lines now running from Newtown to Trenton, and from Newtown to Willow Grove. It is thought the road will be in operation within a year.

DARBY, PA.—The Philadelphia, Morton & Swarthmore Street Railway Company is making rapid progress with its extension into Darby. The work of building the bridge over Darby Creek has been commenced, and tracks have been laid across Springfield Avenue in the borough.

CLARKSVILLE, TENN.—The Clarksville Street Railway Company will, it is reported, build an extension to Dunbar's Cave, three miles, and possibly other extensions will be built to New Providence and through South Clarksville.

SALT LAKE CITY, UTAH.—T. P. Steffey, Milando Pratt and F. M. Lyman, Jr., have applied for a franchise to build an electric railway through the county. It is proposed by them to build an electric railway from Springville to Logan via Provo, Salt Lake and Brigham. The promoters have already secured a franchise in Utah County, and will apply for the same rights in Davis and Weber counties at once. They have petitioned the City Council of Salt Lake City for a similar grant through the metropolis, but no action has yet been taken on the matter by that body. It is understood that United States Senator Smoot, State Senator C. E. Loose and others, with the Telluride Power Company, are behind the project.

RICHMOND, VA.—It has been definitely decided to extend the Seven Pines line of the Virginia Passenger & Power Company to Mechanicsville, which is ten miles beyond the present terminus of the line.

JANESVILLE, WIS.—The Janesville Traction Company announces that it will not build the proposed $1,000,000 line from Janesville to Madison, owing to the clause in the franchise which makes its life thirty-five years instead of fifty years.

MADISON, WIS.—The Chicago & Northwestern Lakes Electric Railway Company, which proposes to build an electric railway from Chicago to Kilburn City, has filed articles of incorporation with the Secretary of State. The capital stock is $50,000. The incorporators are Alexander Clark, Charles S. McIlvain, Samuel M. Hamilton, of Chicago; Fred Kull, E. P. Wheeler, of Lake Geneva.

GUELPH, ONT.—On September 28 the ratepayers of Guelph will vote on a by-law to purchase the Guelph Street Railway. The price agreed upon is $78,000, of which $30,000 is to be in cash, $48,000 representing the bonded debt. The road originally cost $100,000.

NEW INDUSTRIAL COMPANIES.

THE THOMPSON ELECTRIC COMPANY, of St. Paul, Minn., has been incorporated with a capital stock of $25,000. The names of the incorporators are Frank B. Thompson, of St. Paul, and William G. Gordon, of Stillwater.

THE ERNEST J. WILLIS COMPANY has been incorporated in New York to manufacture automobile vehicles. The capital stock is $75,000. The incorporators are Ernest J. Willis, Raymond Cole and W. E. Baker, all of New York City.

THE BUNDY ELECTRICAL SUPPLY COMPANY has succeeded to the business of the Bundy Electrical Construction Company, of Binghamton, N. Y. Mr. A. H. Shaffer and L. R. Erwin are at the head of the business, Mr. Erwin being manager.

THE CRAWFORDSVILLE ELECTRIC COMPANY has been organized in Crawfordsville, Ind., to build dynamos, transformers, arc lamps, switchboards and general electrical appliances. The capital stock is $10,000, of which $25,000 has been paid up. The officers are: President, W. T. Hulet; vice-president, H. W. Ornbaum; secretary, Geo. B. Luckett; treasurer, Hal McClamroch; general manager, O. C. Irwin.

PERSONAL.

J. B. MCCALL.

MR. J. B. McCALL. We are glad to present herewith the portrait of Mr. McCall, who has just been elected president of the Association of Edison Illuminating Companies, and to add a little biographical data. Joseph Benjamin McCall was born in New York City in the year 1869, but his parents shortly afterwards moved to Philadelphia. He began his business career in 1885 in the office of Rufus E. Shapley, attorney-at-law, early attracting the attention of Messrs. W. L. Elkins and Martin Maloney, of the Elkins-Dolan-Widener syndicate; the result being that he accepted a position as stenographer in their Pennsylvania Globe Gas Light enterprise for constructing gas works and naphtha street lighting, and soon rose to the position of secretary. In 1895 the Pennsylvania Heat, Light & Power Company was formed by Mr. Elkins and Mr. Maloney with Mr. McCall as secretary and treasurer. In 1898 the Pennsylvania Manufacturing, Light & Power Company was organized with Mr. McCall as president, and he accepted the same position with the Philadelphia Electric Company, the present parent holding security company when it was formed in 1899. The remarkable success achieved by these companies in the electric light field of Philadelphia speaks volumes for the able management of Mr. McCall. His judgment, business intuition and executive ability are of a high order, and his charming and democratic manner insures pleasant relations with all, high or low, with whom he comes in contact. Thus far he has declined to take part in any outside enterprise, devoting his entire time and attention to the building up of a great electric light property.

MR. W. R. CORSON, consulting engineer, has removed his offices in Hartford, Conn., to Room No. 724 in the Connecticut Mutual Life Insurance Building, Main and Pearl Streets.

MR. F. V. L. TURNER has resigned as general manager of the Cuyahoga Telephone Company, Cleveland, Ohio, and O. F. French, assistant chief engineer of the Federal Telephone Company, has been appointed acting manager.

MR. T. H. OREDEN has resigned the managership of the Cape Breton Electric Company, Ltd., which operates the Sydney and Glace Bay Railway and supplies power and lighting current to Sydney, C. B.

MR. H. H. HUNT, manager of the Tampa, Fla., Electric Company, has been called to Stone and Webster's home office in Boston to take charge of their southeastern group of properties as district manager. G. H. Wells has succeeded Mr. Hunt at Tampa.

MR. GRANBERRY JACKSON, of the firm of Jackson & Omberg, consulting engineers, Memphis, Tenn., has recently accepted a professorship in the engineering department of the Vanderbilt University, Nashville, Tenn., where he should now be addressed.

MR. W. J. HAMMER has just recovered from a serious three weeks' illness, brought on by his recent unremitting experiments with radium that have attracted so much attention. Mr. Hammer attributes his indisposition, however, rather to the work than the curious effects of radium.

MR. W. J. SPLATT, of Splatt, Wall & Company, Perth, Western Australia, is in this country for a short visit. Mr. Splatt's firm, which is the leading electrical house in West Australia, has made a specialty of introducing American electrical machinery and appliances in that section of the world.

SCHEIBLE-LEARY. Announcement is made of the marriage in Chicago of Miss Anna M. Leary to Mr. Albert Scheible, who has for so many years past been actively connected with electrical interests in that city. The happy pair have the hearty congratulations and good wishes of a host of friends.

MR. M. R. McADOO, president of the Compania Mexicana de Traccion (Mexican Traction Company), is at present in New York to confer with the American directors of the company regarding contracts, etc., at the offices of W. G. McAdoo, 15 Wall Street. He returns to Mexico City early in October.

MR. PRESTON PLAYER has been appointed superintendent of the Brockton Edison Company, a Massachusetts electric lighting organization under the management of Stone and Webster. Mr. Player is a former resident of Worcester, Mass., a graduate of Harvard and the Massachusetts Institute of Technology, and was for some time with the Walker Company of Cleveland before going to Boston.

DR. F. N. TAYLOR has been appointed to the chair of electrical engineering at the Western University of Pennsylvania. Dr. Taylor was formerly one of the faculty of Syracuse University, and recently passed a year in research work in Germany. A study in electrical discharges attracted much attention from German authorities, and will probably be continued in this country under the auspices of the Carnegie Institution at Washington.

MR. A. C. WALL, of the law firm of Vredenbergh, Wall & Van Winkle, of Jersey City, has been elected president, and Marshall Van Winkle, of the same firm, vice-president of the Hudson and Manhattan Railroad Company, incorporated to build and operate a tunnel from Jersey City to Cortlandt Street, New York City. Mr. Vredenbergh is of counsel to the Pennsylvania Railroad in New Jersey, which is interested in the tunnel project.

MR. REYNOLD JANNEY has resigned the superintendency of the Locomobile works at Bridgeport, Conn., to accept the position as manager of the Edison Storage Battery works at Glen Ridge and Silver Lake, N. J. The employees of the Locomobile Company expressed their appreciation of Mr. Janney's services and the high esteem in which he is held by his associates by presenting him with an elegant tea service and a beautiful water color. The best wishes of his many friends go with him in his new position.

MR. HUGH L. COOPER, some time hydraulic engineer of the Stilwell-Bierce & Smith-Vaile Company, and now chief engineer of the Mexico Electric Light & Power Company, which is building an hydraulic plant at Necaxa with an initial capacity of 45,000 hp to generate current in the first instance for transmission 90 miles to Mexico City, has left for Mexico after a short visit to New York. As already mentioned in these columns the turbines have been ordered abroad and it is very probable that the generators will also be built in Europe.

MR. LOUIS SIMPSON, of Ottawa, Ont., has recently visited the United States for the purpose of investigating the merits of the different electrical furnaces. He is confident that the electrical reduction of iron ores, and their conversion into steel, is a commercial possibility under the conditions which exist in the Ottawa valley and near the city of Ottawa. The difficulty seems to be only in the collection of sufficient data in order to decide which of the several different furnaces and processes are the best to adopt. Mr. Simpson is continuing his invesitgations with a view of utilizing some of the immense water power at the Chats Falls, within twenty miles of the city of Ottawa, for the purpose of producing iron and steel.

ALLIS-CHALMERS PERSONNEL.—According to advices from Milwaukee important changes have been announced in the officials of the Allis-Chalmers Company and others are still to be made. Probably the most important change is the coming appointment of G. O. Dixon, of Scranton, Pa., as general manager of all the plants. Mr. Dixon was formerly at the head of the Scranton Company, which became a part of the engine-building consolidation. David Harlowe, of Milwaukee, formerly superintendent of the Clinton Street works of the E. P. Allis Company of Milwaukee has been named as general transfer manager of the company, with authority at every plant. William P. Harper, assistant purchasing agent of the company, has been promoted to general purchasing agent. This position has been held by H. F. Young of the Gates works.

MR. G. MARCONI, who has been working at wireless telegraphy at Glace Bay, N. S., is to sail for England on the *Lucania*, on October 3, from New York, where he will do some more experimental work. He is quoted as saying: "The new improvements will necessitate some changes, but whether they will eventually do away with the tower system I am not prepared to say. The improvements will be distinctly for the better in speed and accuracy. My new inventions will mean big improvements in the whole system of wireless telegraphy. Upon my arrival in England similar improvements will be installed in the station there, and if my anticipations are realized, as I feel certain they will be, the inauguration of wireless telegraphy for commercial purposes will follow very shortly afterward. My experiments on the *Lucania* will be conducted with Table Head in particular, carrying on the work until the English coast is reached."

MR. LOUIS DE GOLL, president of the Rowland Telegraphic Company, of Baltimore, who has been abroad for the last six months on business connected with the introduction of the company's system, which is the invention of the late Professor Rowland, of the Johns Hopkins University, has returned home from his travels, greatly encouraged by his European experiences. Mr. De Goll spent his time principally on the Continent, and visited a number of countries in the interest of his company. He also attended the sessions of the International Telegraphic Congress, which was held in London last May. Mr. De Goll will remain in Baltimore for a while, but expects to return to Italy after some weeks in connection with the further introduction of the Rowland system in that country. The apparatus installed in Italy is now working on the line between Rome and Naples under the conditions of actual service, and has for about three months past been sending messages from 10 o'clock in the morning to 10 o'clock at night daily. The number of messages being handled is more than double that stipulated in the contract. At the time of the death of His Holiness Pope Leo XIII, the extraordinary pressure of business on this line was handled almost entirely by the Rowland installation.

Trade Notes.

EXHAUST HEADS IN UTAH.—The plant of the Utah Light & Power Co., Salt Lake City, has just been equipped with Burt exhaust heads by the Burt Mfg. Co., Akron, Ohio.

THE NERNST LAMP COMPANY, of Pittsburg, has recently established an agency for the sale of Nernst lamps and supplies with the W. G. Nagel Company, Toledo, Ohio, this company having, for several years, acted as selling agent for the Westinghouse Electric & Mfg. Company.

"SOLDERING SENSE," is the pithy title of a pithy little pamphlet issued by the L. B. Allen Company, of Chicago, in regard to the merits of its Allen soldering sticks about which a good deal of information is given in brief form for the benefit of electrical workers of all kinds. The Allen soldering paste is in big popular demand.

CROCKER-WHEELER COMPANY, of Ampere, N. J., has issued a very neat and artistic bulletin in regard to its railway generators. It is a quarto pamphlet on deckle edge embossed cover, with a photo print of one of its generators tipped on the first outside cover page. The contents are illustrations of the machine in detail, with a brief specification of the features of each part.

CIRCUIT BREAKERS. In an attractively designed catalogue (No. 6005) the Western Electric Company describes its automatic circuit breakers for direct current. In the construction of these circuit breakers ample copper is provided in the laminated brushes and in the coils, and in their design the three principal features aimed at are reliabilty, simplicity and strength. The catalogue is well illustrated with half-tone views and diagrams, the latter giving the dimensions and other data of breakers of different capacities and types. Price lists, code words, etc., are tabulated.

EXPENSIVE FEED-WATER. Owing to the absence of any water supply in the gold mining regions of West Australia, all water used was formerly shipped by rail from near the coast, several hundred miles distant. An electric lighting and power plant in the mining country formerly paid $1.80 per hundred gallons, though at one time the price was as high as $7.00 for that quantity. At present water is pumped through a pipe line nearly 200 miles long by a Worthington pumping plant, at the coast, and is sold at the rate of $1.80 per 1,000 gallons.

ARCTIC SPORTS IN SUMMER. The North Electric Company held a field day and picnic at Silver Lake, thirty-five miles south of Cleveland, on Saturday, September 18. The programme received indicates that however chilly the participants may have been on arrival, they had a very warm time subsequently. A long programme of athletic sports was carried out most successfully, and Mr. F. F. Sapp officiated as starter. The identity of the umpire remains concealed, but as he was as big as a house, it is believed he escaped with his life. The thrilling baseball game was won by the Polar Bears over the North Stars with a score of 7 to 2. Mr. W. North captained the winning team. The prize is a permanent challenge trophy silver cup, which will be played for by the teams of this prosperous telephone manufacturing concern each year. The party went and returned in a special train of ten coaches. Many of the competitions were open to and were won by ladies.

"EXIDE BATTERY."—This well-known battery is so extensively used that the Electric Storage Battery Company has very wisely issued a 32-page pamphlet containing rules for the care of the battery. By strictly following the rules laid down the best possible results will be obtained from the battery. The information contained will be found very useful indeed to those having charge of this type of battery. Two tables show the rate of charging and the voltages when charging. An important part of the text matter is that relating to automobile batteries. Full directions are given for charging them; removing them from vehicles, and for putting them out of commission. The general rules for the proper care of a battery are very carefully drawn up and complete and are the result of many years experience and observation. The last nine pages of the pamphlet contain illustrations of the plates, separately and in groups, and of assembled cells, besides detail parts.

A PERPETUALLY UP-TO-DATE CATALOGUE. The F. Bissell Company, Toledo, Ohio, has made a new departure in catalogue-making. Its latest catalogue is of the "loose-sheet" style, which, permits the addition of the company's new bulletins and price-lists as they are received, and the removal of obsolete ones. The bulletins just put out in this form are bound in a substantial temporary binder of excellent design. When bound in this way the bulletins are as firmly secured and as readily handled as if they were bound in book form after the conventional style. The bulletins cover everything dealt in by the company. It handles electrical supplies and machinery in general, including apparatus and supplies for lighting, power, railways, telephones, dynamos, motors, switchboards, etc. The catalogue is very complete and nothing in the different lines seems to have been omitted in the make up. All the goods listed are illustrated, and a telegraph code enables the purchaser to indicate by this means any particular article. This form of catalogue will no doubt be received with satisfaction by the trade.

A WIRELESS DEMONSTRATION.—The skepticism of which many hundreds of people had in regard to the commercial wireless telegraph theme took flight when they were invited to send messages from the Thos. E. Clark Company's two stations located in Pontiac at the Michigan State Agricultural Association grounds. Hundreds of messages were sent and received without one mistake. It proved to be one of the greatest attractions at the successful State Fair. The company holds a copy of all messages sent and received and the signatures of some of the most prominent men in Michigan and other states can be seen on the telegraph blanks Many complimentary remarks as well as good wishes were showered upon the operators. Any one desiring an article on "Space Telegraphing" or a description of this Company's instruments will be supplied by sending stamp to its general office, 71 Michigan Ave., Detroit, Mich. This company is also manufacturing a special wireless spark coil for automobiles, gas and gasoline engines, together with X-ray coils, and all lines of electrical specialties.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 15, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

738,193. TROLLEY POLE OF ELECTRIC TRAM CARS OR THE LIKE; Carl R. F. Hommel and Reinholdt J. Hommel, Fredericksberg, Copenhagen, Denmark. App. filed Jan. 15, 1903. The rise of the trolley above the wire trips a dog and releases a spring which retracts the trolley pole.

738,747. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; Harry M. Acly, Pittsfield, Mass. App. filed Jan. 31, 1903. The upper part of the holder is pivoted to the lower part and contains the spring and the adjusting devices therefor, so that when the brush is to be removed, the upper part can be tipped back to allow it to come without altering the spring adjustment.

738,752. ELECTRIC SWITCH; Allen H. Babcock, Oakland, Cal. App. filed March 23, 1903. A field switch having one position of the switch blade for starting, a second position for running and a third position for discharging the field current.

738,782. DYNAMO ELECTRIC MACHINE; Edgar A. Edwards, Cincinnati, Ohio. App. filed Dec. 9, 1901. That portion of the casing covering the commutator is hinged and provided with a handle so that it can be easily opened.

738,792. MANHOLE TERMINAL FOR CONDUIT SECTIONS; Guy M. Gest, Cincinnati, Ohio. App. filed Jan. 23, 1903. An outwardly curved or flaring flange made in sections and adapted to fit around the end of the conduit and held in place by the machinery of the manhole.

738,801. ELECTROMAGNET; Carl M. Hedman, Chicago, Ill. App. filed Jan. 2, 1902. To obtain an adjustment of the stroke of the armature without bodily adjusting the armature itself, a screw is fixed in the armature opposite the pole piece and is adjustable to limit against the pole piece.

738,803. THERMAL CUT OUT OR CIRCUIT CHANGER; Gustavus E. Hoglund, Chicago, Ill. App. filed July 1, 1902. A heating coil surrounds a fusible conductor at the point where the fuse is weakest to concentrate the heat at that point.

738,824. ELECTRIC LOCK; William MacMillan, New York, N. Y. App. filed July 29, 1902. An electro-magnet is arranged inside of the lock and retains the bolt until it has been energized.

738,862. INSULATED JOINT FOR RAILROAD RAIL SECTIONS; George A. Weber, New York, N. Y. App. filed Sept. 20, 1902. Details.

738,864. TRANSFORMER; Roy R. Wiley, St. Catharines, Canada. App. filed Jan. 24, 1903. The windings are made in sections and strung upon a core in inclined position with respect to each other to afford heat-radiating surfaces between them of such shape as to uniformly cool the apparatus.

738,870. ELECTRIC REGULATOR; Gilbert Wright and Harry M. Acly, Pittsfield, Mass. App. filed Jan. 31, 1903. A pivoted arm carries contacts at each end adapted to engage with a set of fixed resistance terminals, one end of the arm only engaging the terminals at the same time. A reversing switch is actuated when a different end of the arm is presented to the terminals.

738,871. SPEED REGULATING DEVICE; Magnus W. Alexander, Lynn, Mass. App. filed June 5, 1903. The armature shaft drives an oil pump in which the movement of the liquid is more or less throttled. A variation of speed alters the pressure on the liquid and causes a piston to move in one direction or the other to cut in or out a regulating resistance.

738,874. ELECTRIC FUSE; George B. Baby, St. Catharines, Canada. App. filed May 2, 1903. Details of an inclosed fuse operating in a tube containing oil.

738,896. ARC LAMP; Walter C. Fish, Lynn, Mass. App. filed June 12, 1901. The mechanism includes a magnet for striking the arc, an opposing magnet, and means for causing the current in the opposing magnet to lag behind with respect to the current in the main magnet.

738,897. HYDRO-ELECTROTHERAPEUTIC APPARATUS; Daniel C. Fisher, Boston, Mass. App. filed Oct. 21, 1902. A tubular apparatus for attachment to a water-pipe and source of current whereby an external application of both water and electricity can be directed to any part of the body.

738,902. ELECTRIC METER; Ludwig Gutmann, Peoria, and Robert C. Lanphier, Springfield, Ill. App. filed Aug. 26, 1902. A rotating magnetic field rotating synchronously with an inclosed armature acts at opposite sides of the path of rotation upon a suitable external armature mounted upon an oscillatory axis.

738,906. TRACK INSTRUMENT FOR RAILWAY SIGNALING; Lewis R. Hummel, Omaha, Neb. App. filed Aug. 29, 1902. A box placed beside the rail and having a cover adapted to be depressed by the car wheel to alter the condition of a circuit closer contained in the box.

738,908. THERMAL CUT OUT OR FUSE FOR ELECTRIC CIRCUITS; Rudolf Hundhausen, Wilmersdorf, Berlin, Germany. App. filed Dec. 15, 1899. To prevent metal particles from flying about when the fuse is ruptured it is packed in talcum powder which, it is stated, absorbs the scattering particles.

738,909. NON-INTERCHANGEABLE CONTACT PARTS; Rudolf Hundhausen, Wilmersdorf, Berlin, Germany. App. filed Feb. 19, 1900. To be able to make the parts of a fuse plug and socket uniform in dimensions, notwithstanding the various capacities of the plug, and to prevent the insertion of a plug of the wrong capacity into a socket, certain limiting shoulders are applied at positions on the plug to correspond with the capacity of the plug and prevent its entering a socket not intended for it.

738,919. SUSPENSION OF TROLLEY WIRES; Martin T. A. Kubierschky, and P. Herkner, Berlin, Germany. App. filed June 8, 1903. The ends of the wires are passed into the clip and caught by wedge-shaped keys which increase their grip with the tension on the wire.

738,926. TROLLEY; Harry E. Myers, Kittanning, Pa. App. filed Oct. 13, 1902. A guard to keep the wheel on the wire.

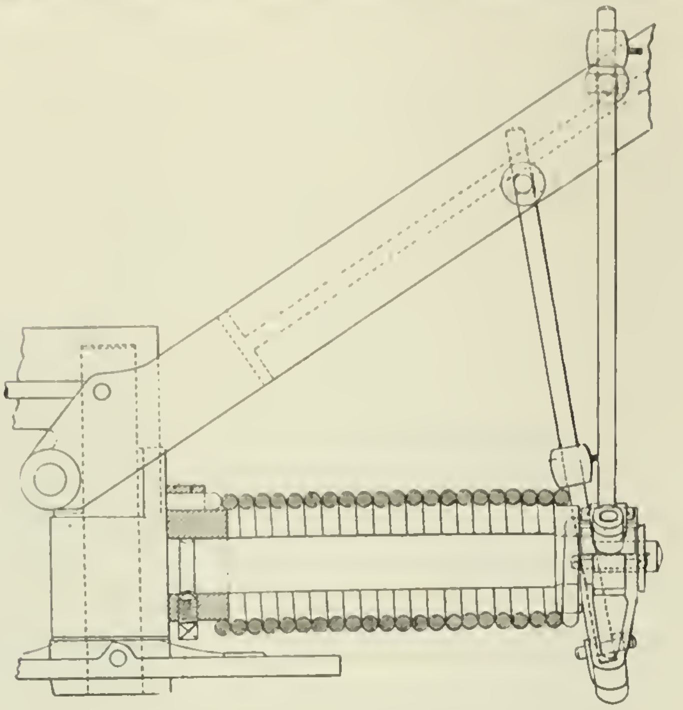
738,941. SNAP SWITCH; Robert H. Read, Schenectady, N. Y. App. filed June 22, 1903. Two blades which enter the same clip are connected together by a spring which is put under tension to lift the second blade only after the first has fully withdrawn from the clip.

738,945. STORAGE BATTERY; Frederick A. Redmon, Chicago, Ill. App. filed March 16, 1903. (See page 524.)

738,956. ELECTRIC SWITCH; William H. Spiller, Holyoke, Mass. App. filed Sept. 25, 1902. Details of construction.

738,964. BURGLAR ALARM; Ferdinand Walder, Rochelle Park, N. J. App. filed June 5, 1903. Details.

738,969. ELECTRIC SWITCH; Benton W. Woldridge, Trenton, Mo. App. filed May 19, 1901. A switch for holding a telephone wire arranged so that the wire can be dropped quickly during a storm to prevent a lightning charge from reaching the instrument.



738,193. Trolley Pole of Electric Tram Cars or the Like.

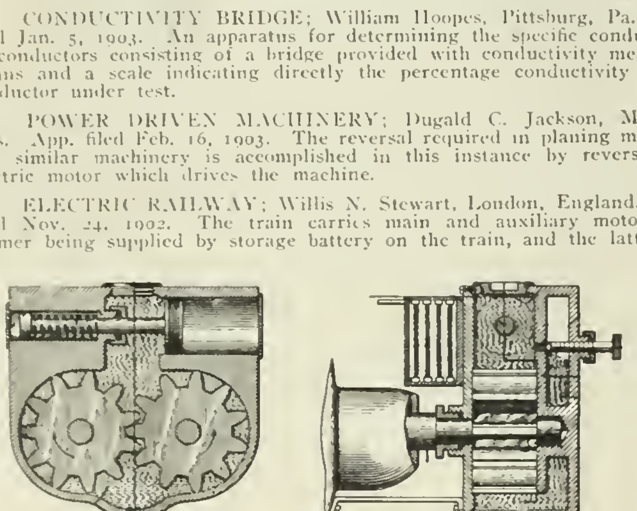
738,970. RHEOSTAT; William C. Yates, Schenectady, N. Y. App. filed Jan. 5, 1903. The resistance units are each inclosed in a sheet metal casing insulated therefrom to rapidly conduct away the heat.

738,988. LIGHTNING ARRESTER AND PROTECTOR; John Davis, Sterling, Ill. App. filed Oct. 20, 1902. Where carbon electrodes are used the material is corrugated so that the dust created by arcing will fall away from the ridges into the depression, and thus not interfere with the air gap.

739,001. CONDUCTIVITY BRIDGE; William Hoopes, Pittsburg, Pa. App. filed Jan. 5, 1903. An apparatus for determining the specific conductivity of conductors consisting of a bridge provided with conductivity measuring means and a scale indicating directly the percentage conductivity of the conductor under test.

739,005. POWER DRIVEN MACHINERY; Dugald C. Jackson, Madison, Wis. App. filed Feb. 16, 1903. The reversal required in planing machines and similar machinery is accomplished in this instance by reversing an electric motor which drives the machine.

739,032. ELECTRIC RAILWAY; Willis N. Stewart, London, England. App. filed Nov. 24, 1902. The train carries main and auxiliary motors, the former being supplied by storage battery on the train, and the latter taking current from a roadside conductor at points only where additional power is required.



738,871. Speed Regulating Device.

739,052. SWITCHBOARD; Benjamin Beerwald, New York, N. Y. App. filed May 26, 1903. An apparatus facilitating the operation of theatre dimmers.

739,056. MAKE AND BREAK SWITCH FOR ELECTRIC SIGNALS; Charles B. Campbell, Waterloo, Iowa. App. filed Jan. 20, 1903. Details of a circuit closing device attached to a trolley wire and adapted to be operated by the trolley wheel.

739,057. AUTOMATIC SIGNAL FOR ELECTRIC RAILWAYS; Charles B. Campbell, Waterloo, Iowa. App. filed Jan. 20, 1903. Details.

739,066. CIRCUIT BREAKER FOR AUTOMATIC ELECTRIC RAILWAY SIGNALS; Roy A. Doty, Waterloo, Iowa. App. filed March 31, 1903. A mechanism intended to open the circuit through the signal light without short circuiting, after a predetermined number of cars have left a block upon which they have been moving.

739,075. LOCKING MECHANISM; Rudolph W. Goeb, St. Louis, Mo. App. filed Oct. 13, 1902. Details of a locking mechanism for a coin operated telephone.

739,077. INSULATED RAIL JOINT; John J. Gunn, Ypsilanti, Mich. App. filed May 26, 1903. The insulated joint is supported by a section of rail reversed and applied against the bottom of the joint.

739,126. BAROMETER ALARM; Guillermo Vives, Ponce, Porto Rico. App. filed Dec. 3, 1902. Contacts are placed in the path of movement of the index barometer to close an alarm circuit at predetermined times.

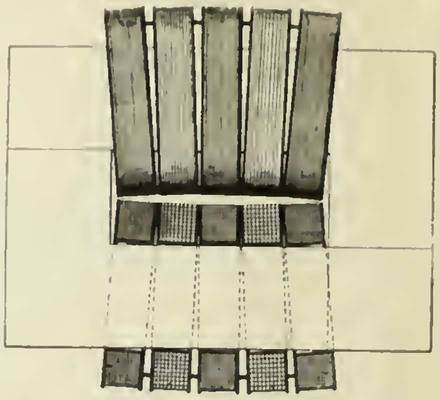
739,128. POLE CHANGER; Thomas W. Warner, Muncie, Ind. App. filed Sept. 7, 1901. The object of this invention is to provide a system of wiring from the pole changer to produce three different kinds of current, namely, positive and negative pulsating currents, and alternating currents to be used for ringing telephone bells.

739,139. ELECTROLYTIC PROCESS OF RECOVERING METALS FROM THEIR COMPOUNDS; Charles E. Baker and Arthur W. Burwell, Cleveland, Ohio. App. filed Nov. 11, 1902. The process involves electrolysis of a solution of the metallic compound with a mercury cathode, distillation of the resulting amalgam to volatilize and separate the mercury from the metal to be recovered and condensation and return of the mercury to the electrolytic cell.

739,140. APPARATUS FOR OXIDIZING METALS DISSOLVED IN MERCURY; Charles E. Baker and Arthur W. Burwell, Cleveland, Ohio. App. filed November 11, 1902. (See page 524.)

739,147. INSULATOR FOR ELECTRIC WIRES; Herman Bottjer, Augusta, Ga. App. filed Oct. 23, 1902. A socket in the head of the insulator in which the wire is confined by a threaded cap.

739,164. TROLLEY; Elmer E. Frederick, Easton, Pa. App. filed April 30, 1903. The ordinary trolley wheel is replaced by three metal balls between which the wire runs, the balls being set in ball bearings.



738,864.—Transformer.

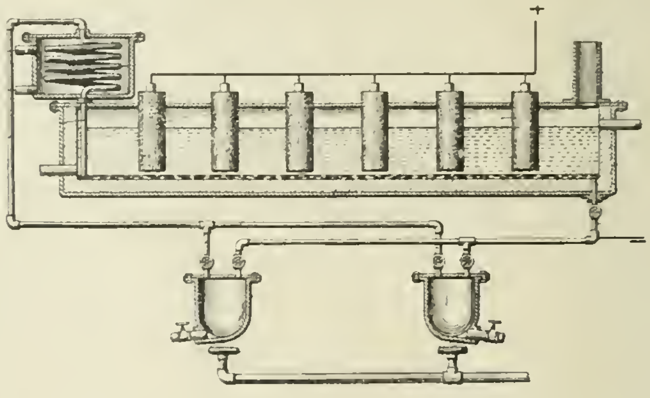
739,176. ELECTRIC WATER HEATER; William E. Heal, Marion, Ind. App. filed March 29, 1900. A carbon tube passes through a water tank and serves as a heating resistance for the water; a contact traverses the tube to regulate the amount of heat.

739,179. TROLLEY ALARM AND INDICATOR; William B. Hillyer, Atlanta, Ga. App. filed July 19, 1902. An annunciator showing when the trolley is off the wire.

739,181. ELECTRIC RESISTANCE APPARATUS; Robert Hopfelt, Berlin, Germany. App. filed Jan. 28, 1902. Metal plates with carbon facings having between them a resistance mass of pulverized carbon, which is adapted to give coherer action when the current passes.

739,186. CONTROLLER FOR ELECTRIC MOTORS; Charles W. Kennedy, Rutledge, and Francis A. Pocock, Landsdowne, Pa. App. filed April 15, 1902. Where two motors are geared to the same vehicle, the controller is constructed to change the circuits of one motor at a time, so that changes in speed will be less sudden.

739,204. ELECTRIC LIGHTING SYSTEM; James F. McElroy, Albany, N. Y. App. filed Oct. 22, 1902. A train lighting system in which the regulating device is a magnet in the main circuit in series with both lamps and battery and whose action is adjusted by means of a supplementary reversely wound coil contained in the lamp circuit only.



739,139.—Electrolytic Process of Recovering Metals from their Compounds.

739,205. AUTOMATIC SWITCH; James F. McElroy, Albany, N. Y. App. filed Jan. 13, 1903. A switch that is positively thrown to one side or the other by the engagement therewith of a pawl carried by the dynamo shaft, the engagement being controlled by a cam which acts upon reversal of the shaft, the switch being used on an axle-driven dynamo.

739,223. TROLLEY HARP; Harrie A. Ripley, Westdale, Mass. App. filed Jan. 26, 1903. Details.

739,251. ELECTRICITY METER; Leonard J. Aron, Birmingham, England. App. filed Feb. 6, 1903. In a two-clock meter, one of the clocks as affected by the current to be measured and the other runs at normal time and a double rating or rate changing device is controlled by the normal time clock.

739,272. ELECTRIC ALARM LOCK; Otto E. F. Himmighoefer, St. Louis, Mo. App. filed Feb. 9, 1903. A pair of contacts are set into an ordinary lock so that the turning of the knob or of the key will close an alarm circuit.

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See-Saw Exporting.

One of the great difficulties experienced by this country in building up export trade lies in the fact that many who seek such trade are not persistent in their efforts. During "boom" periods of prosperity, such as this country has been enoying for five or six years, the domestic demand for many goods outruns the capacity of production, so that little incentive exists to look up markets abroad. Hence, export trade and all who try to promote it, have a rather hard time, and much of the previous effort is wasted. Then comes a period when production has caught up with consumption, or when demand at home has slackened, and at once the manufacturer we have in mind is keenly ready for all the foreign trade he can get, and wonders why it does not all come back his way at once. But he ought to realize that persistency counts for something, and that while he has been withdrawing from neutral foreign markets, his competitors abroad have not been idle, but have strengthened their connections, accustomed the public to certain styles and brands of goods, and learned pretty much all there is to know about the best conditions of selling.

We look for a period of renewed activity in export trade, including that in general electrical supplies and apparatus, but desire to point out that the business is not to be caught or won back as easily as some people imagine. It is fortunate, so far as electrical goods are concerned, that American styles and methods are among the most popular, and can hold their own anywhere; but no small amount of effort has yet to be expended in cultivation of the field. The article by Mr. Gerssel, in this issue, on Egypt, is a case in point. Probably many of our readers never thought of Egypt as a market, but few could read this article or become familiar with present development along the Nile without believing that in a country where American engineering apparatus is already so favorably known, excellent opportunities ought to be found by manufacturers in various lines. And what is true of Egypt is true of other countries.

Residual Charges of Condensers.

On page 562 of this issue is a brief article by Mr. J. J. Cort on the subject of residual charges of condensers. This phenomenon was first discovered in connection with Leyden jars about a century ago, and much research and attention have since been devoted to it. There is a compendious literature upon the subject bulky with mathematical theories. Nevertheless, the existing theory is by no means completely satisfactory, and contributions of precision on this subject are always welcome. The curve accompanying Mr. Cort's article refers to the residual charges in a two-microfarad condenser, the dielectric of which does not seem to be mentioned. We find that within the limits of the diagram this curve is very closely represented by the formula:

$$D = 2.43 \log_e t\ (1 + 0.00231\ t)\ .\ .\ .\ .\ \text{divisions},$$

where D is the number of scale-divisions and t the elapsed time in seconds. The agreement between this particular formula and Mr. Cort's curve of observations seems to be within about one per cent. at all points of observation. In ordinary language Mr. Cort's curve of residual quantity is practically a logarithmic function of the time of accumulation and increased in a linear ratio with the time, or increased according to a straight-line law. It would be interesting to have a series of such curves prepared under definitely varied electrical conditions to see whether the same formula would continue to apply.

The Coming Institute Year.

Following the example of retiring President C. F. Scott, Mr. Bion J. Arnold, at the beginning last Friday of his term of office as president of the American Institute of Electrical Engineers, outlined briefly the policy which he considered should guide the Institute during the coming year. While at no time could it be charged that the Institute had seriously lagged in its duty to the profession for which it stands, yet for some years its rate of growth had not corresponded to the rate of increase numerically of the profession. During the past two years, however, there has been a remarkable increase in membership, which is to be ascribed to a number of causes. Among these, aside from the influence of the great wave of prosperity which has been passing over the country, and the vigorous policy, of which we shall speak later, of the last two presiding officers, were the attention attracted to the Institute by the very successful Conversazione in 1901, and the Kelvin, Marconi and Library dinners; the foundation of the Institute Library by the gift of Dr. Wheeler and Mr. Carnegie, and its subsequent phenomenal growth through the generosity of members; and the conspicuous part played by Institute officers and members in the negotiations leading to Mr. Carnegie's gift of one million dollars for a union engineering building. But perhaps the greatest impetus was derived from the change of policy instituted by President Steinmetz and continued by President Scott with respect to the paper programme, and the inauguration by the latter of numerous local meetings throughout the country. In addition are several other commendable features introduced by President Scott, having for an object to increase the value of the Institute to its members, and thus tending to attract adhesions to the body.

The great extension of the activity of the Institute entailed by the increase in membership and the various new measures instituted, has naturally very greatly increased the expense of conducting the body. While the income has more than doubled—growing from $13,617 for the year ending April 30, 1901, to $30,181 for the year ending April 30, 1902—the report for the latter period showed a credit balance of but $621 for the year's operations, notwithstanding that all accounts receivable are credited as assets and no accounts payable appear debited to liabilities. In the same period the membership grew from 1,260 to 2,229, and as Mr. Arnold stated in his remarks, it is improbable that this rate of increase can be maintained. Consequently, the situation that the new president has to meet is a probable decrease in rate of growth of membership, with perhaps an actual decrease should a period of industrial depression occur; and a necessity for checking expenses so that a safe balance will be assured at the end of the year's operations. The remarks of President Arnold indicate that he recognizes this situation, and it is fortunate for the Institute that its new presiding officer, besides being an eminent engineer, is also a thorough business man, and thus qualified to put the Institute in the securest possible position with the least possible slackening of its activities, should any sacrifice be indicated—which all will sincerely hope will not occur. The administrations of Messrs. Steinmetz and Scott will always be memorable as periods of great constructive work. We are sure that none of their predecessors can regard this work with other than pride and gratification, since it came to crown as a stately structure the foundations they had laid so faithfully and laboriously. While the new era entails for the succeeding presidents greater burdens and responsibilities than any heretofore dealt with, the incumbents of the office will prove equal to them.

Speed Extraordinary.

Recent reports from the tests of high speed electric cars on the Berlin-Zossen line indicate that the experimenters have achieved a signal success. As our readers will probably remember, the previous series of tests was a distinct success, but that at speeds above 80 to 90 miles per hour the track began to show serious weakness; and that for this reason the highest speed attempted was a small fraction short of 100 miles per hour, instead of the 125 miles per hour, which was the goal toward which the experimenters were working. On the other hand, the electrical part of the equipment worked admirably, and it was effectually shown that the power allowed for the work in the motors was ample. It was found that the contact devices did their work well at the highest speed attempted, and that the air resistance, concerning which direful predictions had been made, was well within the limits allowed for in planning the work. Resuming work now after an interval of about two years, on a roadbed in suitable condition, the experimenters started in a couple of weeks ago at about 90 miles per hour and have raised the speed from time to time until the unparalleled rate of over 117 miles per hour is stated to have been reached, without developing weakness of car equipments or of track. Although the tests have been interrupted by the need of using the military road, for its proper purpose for a few days, they will soon be resumed and the engineers have full confidence that the 125 miles per hour originally planned will be reached without difficulty. We wish to add that we shall be somewhat surprised if even this immense speed is not surpassed.

This latest achievement is most noteworthy. The car reached a speed considerably higher than any moving body short of a projectile had previously attained, if we possibly except the maximum rates touched by Mr. O. T. Crosby in one of the runs at Baltimore with the Weems experimental cigar-shaped car in 1891. That car, however, carried no passengers and wrecked the track before its speed could be definitely determined on its last fateful run. There is a single record of about 108 miles per hour for a steam locomotive, and there are numerous locomotive records a little short of 100 miles per hour. The Zossen mark, however, stands in a class by itself, and while it will probably stand only until the resumption of the tests it is a fine demonstration of what the present century may see in the way of rapid transportation. Great credit is due to the German engineers who conceived the plans and have carefully and with characteristic Teutonic patience carried them through to brilliant success. The deliberate formation of a syndicate to thresh out the details of a great technical problem was itself a thoroughly characteristic measure which quite deserved the success it has met, and it is hard to say too much of the skill which has been displayed. We extend most hearty congratulations and best wishes for 150 miles per hour. We have persistently expressed our belief in the feasibility of these very high speeds, and have had very small sympathy with the efforts that some have made to throw cold water upon the scheme. It is all very well to belittle such experiments and damn them with faint praise as theoretical and uncommercial; but the fact now stares us in the face that these patient and clever German engineers have actually done the thing at which Yankee enterprise has shied. True enough, there has been a small group of American engineers which has stood firmly out for the feasibility of the work, and which has been ready at any time within the last decade to undertake it, but the American high-speed plans have failed for the lack of support, and the first laurels have fallen to others.

Whether American enterprise will allow this defeat to be "rubbed in" by the construction of a German commercial high-speed road before we get around to doing anything on this side of the water, is now the question before the house. There is no doubt that Germany is in the position of vantage at present, and that it is an easier field in which to operate. For the German railroads are under government direction, and if the German Emperor, than whom no Yankee was ever more alert and keen-sighted, gives the word, the enterprise will go through. If rumor is to be given credit, the Berlin-Zossen experiments were really instituted to awaken an interest in the highest governmental circles which would, at the proper moment, more than neutralize anticipated bureaucratic opposition to an electric express line between Berlin and Hamburg. Here, where the railways are in private hands and combined into huge groups, with elaborate devices for "dividing the spoils" between them, any attempt to disturb the concert of the magnates by the inauguration of high-speed service would, it is to be feared, be repelled with violence, and there would be no appeal to a higher power. The almoners of the great systems would get busy at once and a franchise would be obtained, if at all, only at the cost of indefinite cash and interminable legal proceedings. A high-speed road must be, as we have several times pointed out, of considerable length in order to realize the full advantages of speed, and the task of obtaining rights would thus be doubly formidable. There seems, too, to be an impression current among American engineers that we may gradually work up to great speeds along the line of progress taken by our present interurban systems. The public frequently hears of plans for 60 or 70 miles per hour, but we are strongly under the impression that these will simmer down to more modest figures when total running time is considered. The methods now in vogue are not suited to the ready development of the hundred-mile-an-hour train, and suburban service is not the place to develop it. There is a great gulf fixed between a maximum speed of 70 miles per hour between stations and a schedule speed half as great again over a long run. This latter is the goal at which our German friends are aiming, and they have made a good start. Is American enterprise staggered at the proposition, or does it fear to tread in the path the Germans have blazed? For the credit of our country and century we hope not.

THE ELECTROLYSIS OF WATER.

An interesting paper on this subject was read by Prof. Richards and W. S. Landis, before the American Electrochemical Society at its recent meeting in Niagara Falls, the paper forming a sequel to a predecessor read last April. Much discussion has taken place during the last few decades as to the nature of the conduction of water. A complete understanding of the subject would entail a complete knowledge of the nature of electricity and of matter; but at present all we can hope for is a working hypothesis which will reconcile the observed conditions. It is well known that a battery of two Daniell cells in series will effect the electrolytic decomposition of water into its constituent substances, oxygen and hydrogen. The oxygen bubbles up on the anode and the hydrogen on the cathode. The gases are capable of being collected. If the gases so collected are mixed and exploded, a certain amount of energy is liberated in the recombination. This energy must have been expended by the electrolyzing current, unless we impugn the doctrine of the conservation of energy. In order that the electrolyzing current may expend energy at the rate which the evolved gases can liberate, it can readily be shown that the voltage at electrodes must be 1.48 volts, approximately, over and above that required to satisfy the drop of potential, or *IR* drop, in the electrolyte considered as a simple resistance. This accounts for the crude fact that one Daniell cell will not visibly decompose acidulated water; while two Daniell cells will. Excluding temperature changes and their effects, the theory, at first glance, would seem to be thus satisfied.

But the matter is by no means so simple. It was observed many years ago that with one Daniell cell a feeble current passed through water without visible decomposition. The voltage could be brought down to a small fraction of a volt, and yet traces of an electric current might be detected in the water. Very complex phenomena of polarization were observed, varying with the voltage, the current strength, the nature of the solution, the arrangement of electrodes, and yet other conditions. One of the most intricate problems that could be cited would be a given set of conditions for a liquid voltameter under a given magnitude of impressed e.m.f. at electrodes. Roughly speaking, there would or would not be visible electrolysis, according as this e.m.f. was less or greater than 1.5 volt. But the predetermination by theory as to just how much current would be found flowing through the cell after a given time of application would baffle all computation. Not even the theoretical outline of the actions involved was known.

Prof. Richard's papers throw light on this obscure phenomenon. The theory is that if the water contained no dissolved impurities of oxygen and hydrogen, it would not conduct until the applied pressure was 1.5 volt, the amount required by thermo-chemical law. In general, however, there will be some dissolved oxygen and hydrogen. The application of, say, 1 volt to the water, or dilute sulphuric acid, establishes an electrostatic gradient through the liquid mass, under which the oxygen ions come trotting to the anode, and the hydrogen ions to the cathode. The oxygen ions are not, however, liberated, but combine with the dissolved free hydrogen atoms swimming around the anode; while the hydrogen ions similarly combine with the dissolved free oxygen atoms around the cathode. Consequently, no decomposition occurs in the solution, taken as a whole, and yet the transfer or ions and delivery of electricity to atoms has taken place in the condition that we call a feeble electric current. But this process of conduction without decomposition depends upon the initial stock of dissolved atoms. As the stock gets consumed the process of conduction tends to stop, by a building up of c.e.m.f. at the electrodes towards the magnitude of 1.5 volt necessary to effect true electrolytic decomposition. The strength of current falls lower and lower as time goes on, and the dissolved atoms get used up, until finally we may suppose that all the dissolved atoms have been consumed. This would mean eventual absolute non-conduction of the solution for pressures below 1.5 volt.

But this condition cannot be attained, because some of the ions drawn over toward the electrodes by the electric gradient drop into solution as atoms and these drift by regular diffusion to the opposite electrode. That is to say, the electrolytic movement of ions sets up a small dissolving process. Thus, some of the hydrogen ions electrolytically impelled towards the cathode go into solution as free hydrogen atoms or molecules. These cease to be electrified ions, and drift about aimlessly. By the ordinary process of diffusion they will find their way eventually to the anode. There they can act as neutralizers for freshly impelled oxygen ions, just like originally dissolved hydrogen. The final residual current through the solution may thus take many days to attain; but its magnitude will depend on the speed with which atoms starting at one electrode can diffuse to the other electrode. That is to say, the final residual current through the solution at low voltages will depend upon the shortness of the electrolytic path through the cell. A number of experimental measurements are adduced in the paper in support of this diffusion theory of residual current through water. They seem to be fairly well explained on this hypothesis. Assuming the theory to be correct, it might still be impossible to predict the strength of current produced by one volt acting on a voltameter for x minutes; but it might, at least, be possible to predict the ultimate strength of current through the cell if its geometrical form were simple enough to admit of diffusion being computed.

September Meeting of the American Institute of Electrical Engineers.

The September meeting of the American Institute of Electrical Engineers was opened last Friday evening by retiring President C. F. Scott, who, after pointing out the success of various movements in several lines, particularly in that of local branches, which are the beginnings of a great future for the Institute, introduced the president elect, Bion J. Arnold.

President Arnold in taking the chair said that while the constitution does not call for a formal address from the incoming president at the time of his inauguration, which address is specified for the general meeting, he would follow custom and briefly point out the lines which he believes should be followed during the coming year. The remarks of Mr. Arnold are printed in another column.

Mr. George A. Henry, Jr., and Joseph Le Conte presented a paper entitled "An Efficient High-Pressure Water Power Transmission Plant," which is devoted to a description of the Pelton water wheels used in the new plant of the Edison Electric Company, of Los Angeles, Calif., and records of tests made on the wheels. In the absence of the authors the paper was read by Mr. F. O. Blackwell. The head utilized is equal to 1,960 ft. vertical fall, corresponding to an effective pressure at the wheels, allowing for friction loss, of 825 lbs. per square inch. The power of the wheels is controlled by means of a combined throat needle and deflecting nozzle. The nozzle is operated automatically by a governor, and the needle controlled by hand. Each generating unit is of 750-kw normal capacity at 430 r.p.m., with a margin for 50 per cent. of overload; the number of units and voltage is not given in the paper.

The paper describes the pipe line, water wheels and governing arrangement in detail, and gives the results of tests to determine the efficiency of the wheels for different loads and styles of nozzle tips. The experiments showed the necessity for very careful calculation to establish the more efficient shapes of needle and tip. The tests gave wheel efficiencies varying from 76.5 per cent at 482 at 331 kw to 86.8 per cent at 826 kw.

In the discussion of the paper Mr. F. O. Blackwell gave further details of the Los Angeles transmission, formerly known as the Redlands plant, and the first three-phase transmission plant in this country. The line voltage is 35,000, and there are seven power stations located up to 100 miles apart, all feeding the same transmission line. The Edison company is now developing on Kern River a new station which will have a capacity of 20,000 hp, generate at 60,000 volts and transmit to Los Angeles, 150 miles distant. The diameter of the wheel referred to in the paper is 7 ft., and that of the nozzle 2 inches, giving a ratio of 40 to 1, the usual ratios being from 5 to 10 to 1. The needle nozzle not only increases the efficiency at partial load by cutting down the water used, but increases the efficiency at the bucket, since the stream is directed at the center of the same. The original Redlands plant had an efficiency of 70 per cent. at full load, which has been increased to 85 per cent. at full load and 75 per cent at half load, while the regulation is inside of 2 per cent. The high-head part of the pipe line has forged flanges. Mr. H. A. Lardner said that the Santa Ana pipe line is of steel pipe with flanged joints bolted together with no provision for expansion, the head being 900 ft. Since the water in the case of the California plants has about the same temperature throughout the year, it is probably not necessary to provide for expansion; moreover, nearly all lines have a considerable curvature, horizontally or vertically. The Standard company has a cast-iron section for the upper third of its pipe line, each length of pipe being firmly grouted into the rock on the side of a mountain. A rivetted pipe line in Colorado has given some trouble. Some of the wheels of California plants have two sets of runners and two nozzles, the latter being both full on, or one partially on or entirely off, depending on the load. President Arnold said that in the majority of cases it is found desirable to put in a steam plant rather than rely on water power, except where the price of coal is very high.

Mr. H. A. Lardner, in the absence of the author, Mr. Augustus J. Bowie, read a paper entitled "Electric Motors for Centrifugal Pumps and Fans," in which the subject was treated under the following heads: Constant speed and varying load; changing speed with head varying directly as square of speed; constant head and varying speed. Mr. Bowie points out that a centrifugal pump, when operated at too low a head, shows a very low efficiency. In general, however, with a well-designed pump, the range of efficient operation for a constant speed is fairly broad. He emphasized the danger of overloading a motor through too low a head. A manufacturer will usually guarantee a certain efficiency and input for a pump at its rated load, but will say nothing concerning the power required to drive it at heads lower than that called for. The question may arise, why not give a pump the proper speed for a given head. This is frequently impracticable, since pumps must often be installed to work under widely varying heads, where it is not an easy matter to change the speeds. Oftentimes the heads at which the water must be elevated may vary practically from zero to the maximum head against which the pump will deliver. In some cases these overloads may be of long duration, and a sufficiently large motor should be installed. On the other hand, the maximum load will often be only of short duration, as, for example, in the case of pumping from a well, particularly where there is a pit in connection with it, which is partially filled up with water. Generally it will not take the pump long very decidedly to lower the water, and the duration of overload will be brief.

Increasing the speed of the runner, where the effective head varies as the square of the speed, will result in increasing the capacity of the pump directly as the speed, and increasing the power input and output directly as the cube of the speed. The condition presupposed in this case, namely that the head varies as the square of the speed, is the condition which exists in the case of ventilating fans.

The condition of constant head exists when pumping against a fixed lift, when the velocity heads lost at entrance and discharge, and when the fractional losses in the pipe may be disregarded in comparison with the lift.

In this case the input increases faster than the cube, and not as fast as the fourth power of the speed. Ten per cent. increase in speed represents 40 per cent increase in power and 96 per cent increase in the $I\ R$ loss in the armature. From this it may be seen what an extremely large effect speed variation has on motors driving centrifugal apparatus. There is perhaps no other form of apparatus so sensitive to change of speed in its power consumption. The effect which a steady pump load has in holding the voltage constant by preventing the racing of generators is thus explained.

Mr. Bowie considers that speed control of direct-current motors by variation of field resistance has a limited range in practice and has many points which tend to make it objectionable for the best conditions of commutation. Even at best there will be considerable field distortion at the high speeds. The effect of a load which would increase as the cube of the speed, and even faster would seem to limit still further the allowable speed variation to be obtained in this manner. While the output of a centrifugal pump varies directly as the speed of revolution, many manufacturers rate their pumps at a fixed volumetric output, and publish a list of suitable speeds for different heads under which it may be desired to operate the pump. In some cases the highest speed given in these lists is three, or more times as great as the lowest speed. Such misinformation leads to a great deal of trouble and cannot be too strongly condemned.

The paper includes curves from tests of centrifugal fans, giving the relation between pressure, input, output and efficiency.

In introducing the discussion, President Arnold said that anyone who has attempted to vary the speed of a motor working on a pump and gotten the former working at a speed too high for the pump ought to be able to appreciate the considerations laid down in Mr. Bowie's paper. Mr. Stott said that the variation of power taken by centrifugal pumps under different heads is so complex that it seems impossible to make any equitable flat-rate for electric power for that service, and wattmeters should be installed. His experience with shunt-wound motors applied to centrifugal motors working on barometric condensers has been unfortunate; a variable speed motor is indicated for this use, since in starting, a speed at least 15 per cent. above normal is required. Mr. J. J. Brown disagreed as to this point, saying that recent developments have shown that within reasonable variations of head, such as 10 to 20 per cent., constant-speed motors can be used on barometric condensers without serious overload. Mr. F. O. Blackwell said that the very high head centrifugal pumps with several sets of runners, each one feeding into the next one, is a development extremely promising, and in time he believes it will replace the reciprocating pump altogether for all heads. These pumps are being made with each runner up to 100 ft. head, and there have been as many as seven or eight sets of runners connected together, which would give 700 or 800 ft. total lift in the pump, and the efficiencies have been very high, too. Eighty per cent. efficiency has been obtained with these high head plants with the centrifugal pump, which is practically as good as given by any reciprocating pump.

Mr. Ralph L. Montague contributed a paper entitled "A Suggested Hydraulic Unit," which is reprinted elsewhere in full.

Electrical Supply in Fitchburg.

FITCHBURG, Massachusetts, in the upper valley of the Nashua River, varying in parts between 500 and 900 feet above tide water, and fifty miles by rail from Boston, is a center of industry. The machine tools, the textile fabrics, the power machinery and the paper manufactured in this city are widely and favorably known.

With a population of 31,531 by the late census, the city enjoys a pure water supply, a large public library, a park that would add charm to any municipality, a hospital that is probably unexcelled within the Commonwealth as to location and equipment, a new Federal building and a large number of attractive retail stores. As may easily be guessed from these facts, the prosperity of Fitchburg rests not on a location close to some great commercial center, but rather on the enterprise of its business leaders and the industry of its population.

Such conditions favor the development of an electrical supply system, and the physical location of the city has had a like effect. The Nashua River, whose head waters trickle down from the 2,015-ft. summit of Mount Wachusett some eight miles distant, marks the line along which the industrial and commercial interests of the city are closely grouped. On the abrupt hills which rise a little way back from the river bed on either side are the handsome residences of the mill owners, and the more humble but substantial homes of the operatives.

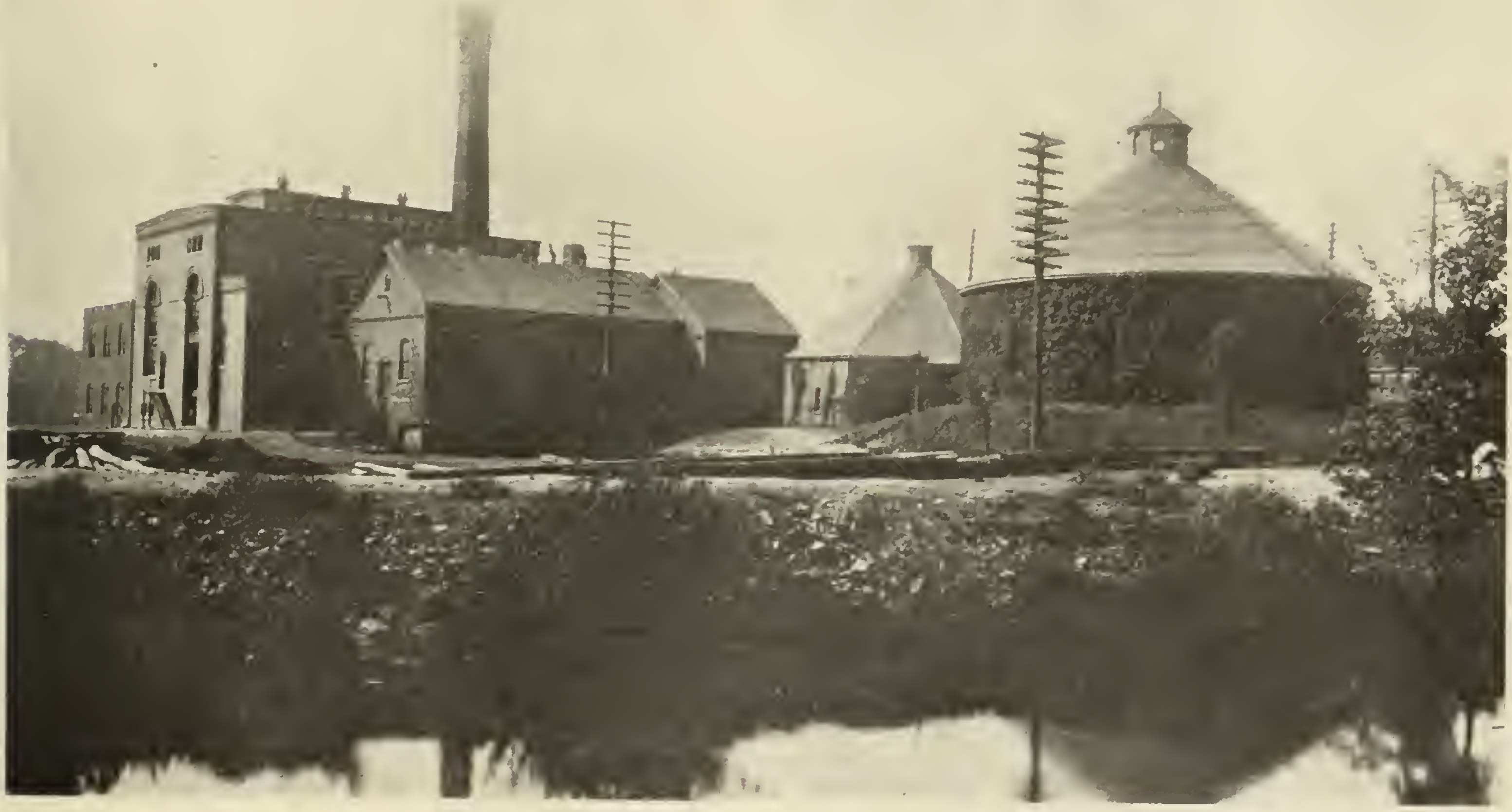

Fig. 1.—New and Old Stations at Fitchburg.

The city thus offers an attractive distribution area, since all of the heavier electric loads are comparatively close to a generating station at any point near the river bank, and even the residence lighting is not far away. Under these circumstances an electrical supply system has been built up, and the new plant recently completed to furnish energy for this system, while of only moderate capacity, equals the best to be found elsewhere in construction and equipment.

Public electrical supply seems to have been inaugurated at Fitchburg by the Wachusett Electric Light Company, a Maine corporation organized in 1883. The date on which this company began to do lighting in Fitchburg is not at hand, but the start was probably several years after its organization for the dynamo capacity of its plant had reached only 150 arc lamps of 1,200 nominal candle-power each, and 500 incandescent lamps of 16 nominal candle-power, in 1889. During the year just named the Fitchburg Gas Company secured authority to engage in electrical supply there, and shortly thereafter this company purchased the Wachusett plant.

In December, 1895, the name of the Fitchburg Gas Company was changed *to* Fitchburg Gas and Electric Light Company, and the present corporate owner of the entire gas and electric supply systems of Fitchburg was born. On June 30, 1902, the connected electric load of the Fitchburg Gas and Electric Light Company included 89 commercial arc lamps of about 1,200 candle-power each, 300 public arcs of like rating, 12,750 commercial incandescent lamps, and 40 direct-current motors of 217 horse-power total capacity, on a 500-volt circuit. This lighting load was carried on direct-current series arc circuits, and 60 cycle alternating circuits of about 2,300 volts. Wires in these circuits had a total length of 68,700 feet, all overhead, and was carried on 1,488 poles, of which 1,460 were set in 168,000 feet of public streets.

The generating station for this system was located not far from the Nashua River, and close to the union station and railway tracks, at the east end of the main business section of the city. Like so many other sections of the older type, this plant contained fire-tube boilers, slow-speed horizontal engines and belted dynamos. On June 30, 1902, the equipment consisted of five boilers with a total rating of 550 horse-power, four engines rated at 450 horse-power, and seven dynamos with a combined capacity of 370 arc lamps or 1,200 candle-power each and 4,000 incandescent lamps of 16 candle-power; also two 500-volt power generators with a total rating of 155 kilowatts. With these classes of equipment, and arc and incandescent lamps and motors each operated by separate dynamos, a very high efficiency was not to be expected, but the income from sales of electrical energy per ton of coal burned at the Fitchburg plant has been held at a creditable figure, considering the circumstances, through a series of years, as pointed out in the paper on efficiencies of electric stations in the Electrical World and Engineer of September 5, 1903. For each of the years ending June 30, between 1892 and 1902, both inclusive, the electric income of the Fitchburg Gas and Electric Company per ton of coal burned at the generating plant was as follows:

Year	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.
Dollars	26.93	24.99	31.00	25.14	23.68	24.17	25.34	28.46	29.81

Prior to June, 1902, the capital stock of the company was $150,000, and its prosperity was such that no bonds had ever been issued. In that month a further issue of capital stock to the par value of $150,000 was decided on in order to build and equip a new generating station. Stockholders were given the first opportunity of subscription to these new shares at an advance of 20 per cent. over their par value.

The new station of the company adjoins the site of the old one, and represents the most modern ideas in fire-proof construction and power plant design. The main building, containing the engines, generators, transformers and switchboard is 56 by 90 ft. in plan, outside, and contains a basement and first floor room. Between basement floor and the main or engine room floor the elevation is 13 ft., and from engine room floor to the lower cord of the steel roof trusses is 38 ft. Outside, the building stands 53 ft. 9 in. from the top of the foundation to the eaves.

The roof is of tar and gravel laid on plank, which is supported by the steel roof trusses. Along the center of the roof in the direction of its greater length runs a monitor with side windows for ventilation. Between the inside of the monitor roof and the floor of

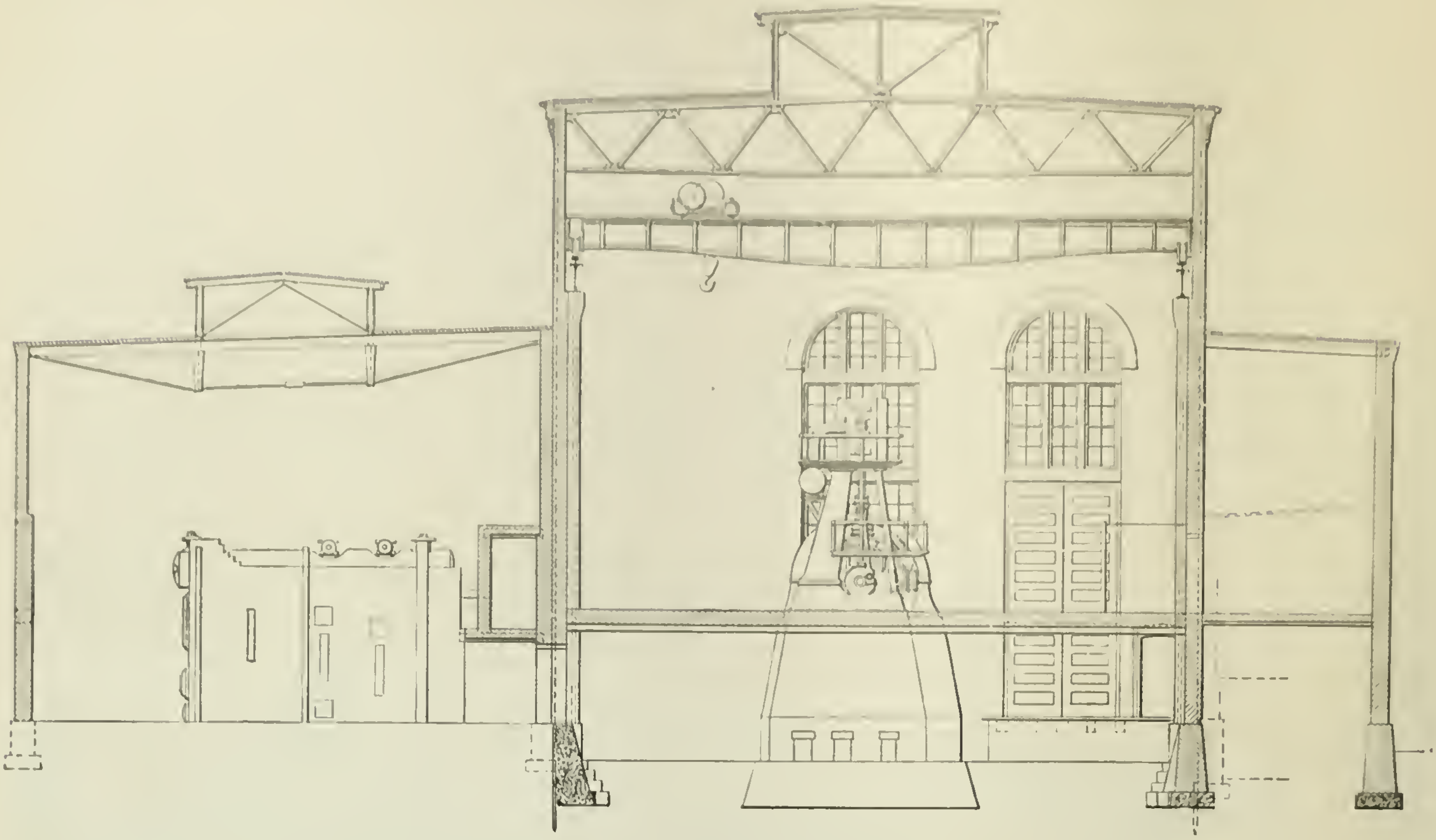

Fig. 2.—Cross Section of Station.

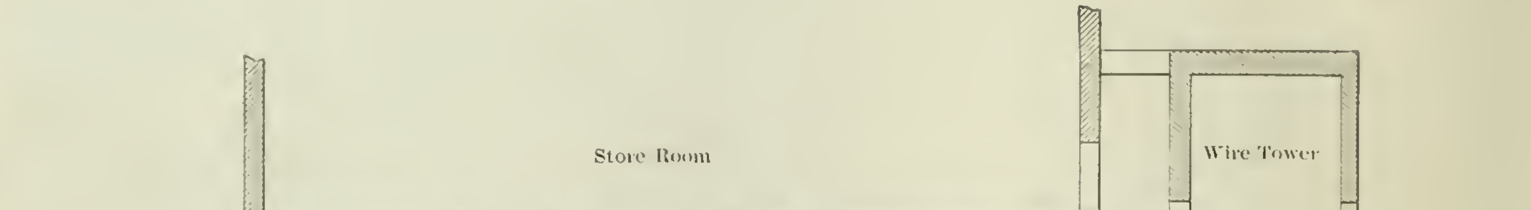

Fig. 3.—Plan of Station.

the engine room the distance is 52 ft. In structure this building is steel and brick with concrete foundations and floors. The concrete foundations have a depth of 10 ft. below the brick walls. The brick walls are 16 in. thick to a distance of 27 ft. 3 in. above the floor level. At that elevation the two opposite walls on the longer sides of the station shrink to a thickness of 12 in. each. In the corners and at intervals of 17.5 ft. on each of the longer sides brick piers increase the thickness of the wall to 28 in., and in each of these piers, save those at the corners, there is set a steel column. On the shelf formed by the change in the thickness of the walls, and by the tops of the brick piers and steel columns, rests the steel tramway over which moves a crane that sweeps the length and breadth of the room.

For its main floor the station has cement covered with sheets of cork, and supported on steel beams. The basement floor is solid concrete. A dado to a distance of five feet above the main floor runs about the four walls inside, and above this the walls are finished with enameled bricks. The engine and generator room is lighted by eight large windows below the crane level, 42 small windows higher up in the walls, and 24 windows in the monitor.

At one corner of the main building, and outside of the dimensions already named, a brick wire tower 14 ft. 8 in. by 12 ft. 6 in. on the ground rises to a height of 36 ft. Close to one side of the main station is a brick store house, and on the opposite side is the boiler house, also a separate building. This boiler house, when completed, will have brick walls, a cement floor and a tar and gravel roof, this last supported by combined iron and timber trusses. On the ground the dimensions of the boiler house will be 43 ft. by 69 ft. 10 in., inside, and the height from the concrete floor to the lowest points of the roof timbers will be 31 ft. A monitor with windows will run along the center of the boiler-house roof.

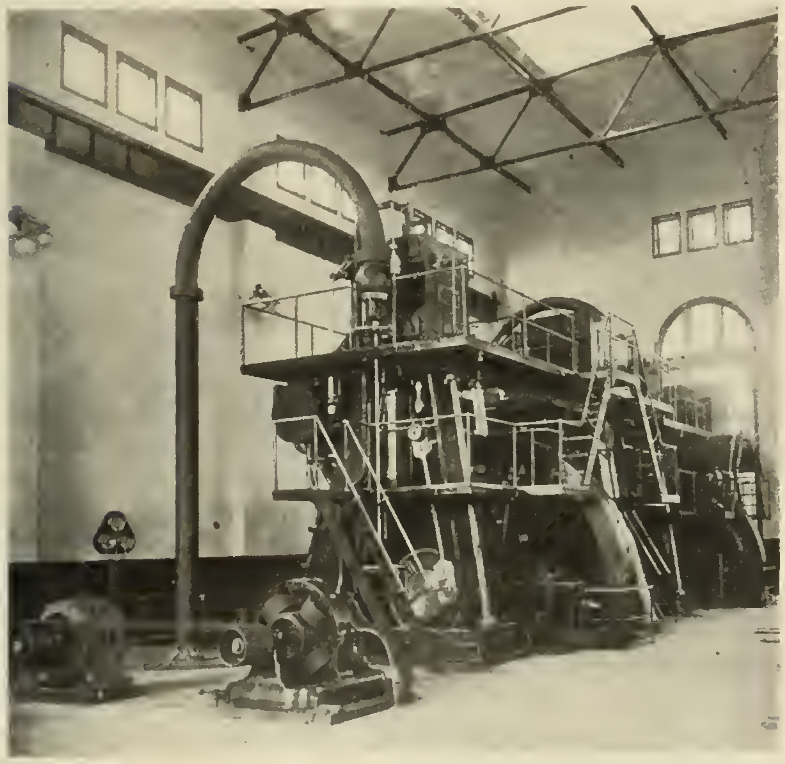

FIG. 4.—MAIN GENERATORS.

At one end of the boiler house and separated from it by a 16-in. brick wall is a room 42.5 ft. square for coal bunkers. The brick chimney 11 ft. square on the ground and with a 5-ft. circular flue is located at one corner of, but entirely without, the walls of the main station.

Space is provided in the boiler house for water-tube boilers of 1,250 horse power total capacity, and three Sterling boilers of 250 horsepower each will be installed at the start. These new boilers will operate at 150 pounds gauge pressure. Meantime, the old boilers are in use.

Steam mains from the boilers enter the basement of the generating station, and rise thence to the engines. In this basement are located the two Warren condensers, the two feed pumps, a heater for each engine, an auxiliary heater, and all the pipes and valves necessary to connect this steam apparatus.

On the main floor of the station space has been provided for three generating sets of different capacities, and the two smaller sets have been installed and are in regular operation. Each of these sets consists of a vertical, cross-compound engine with a direct-connected generator mounted between the high and low-pressure cylinders. The smaller of these two engines has cylinders of 18 and 36 in. diameter, respectively, with a 36-in. stroke, and is rated at 650 horsepower with 150 pounds steam pressure and 120 revolutions per minute. This engine sets with its connected generator on a masonry foundation that is 21 by 22 feet square at its base, tapering to 18 ft. by 19 ft. 3 in. at the top, and 23 ft. high. Of this height 10 ft. is underground and 13 ft. extends from the basement floor to that of the engine room. Direct connected to this engine is a three-phase, 60 cycle, 2,300-volt alternator of the internal revolving-magnet type, and with a capacity of 400 kilowatts.

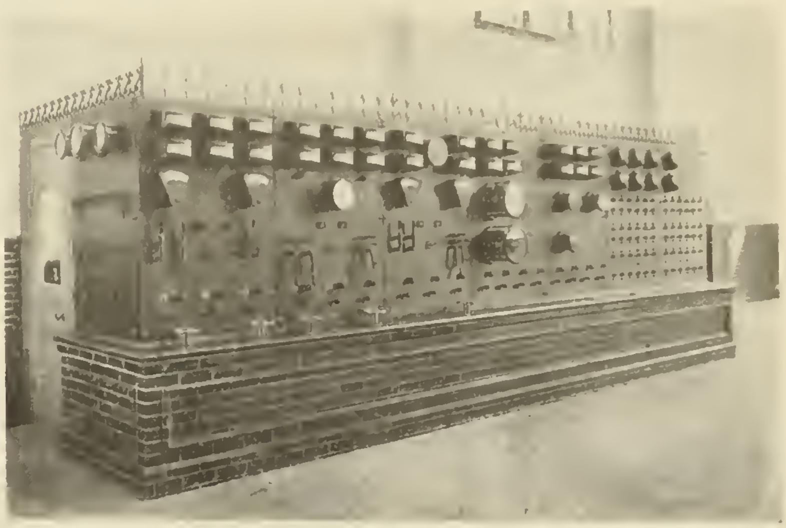

FIG. 5.—NEW SWITCHBOARD.

The engine of the larger generating set has cylinders of 22 and 44 in. diameter, respectively, with a 36-in. stroke, and like the smaller engine, operates at 120 revolutions per minute. With 150 pounds steam pressure this engine is rated to develop 1,000 hp. Beneath this large unit the foundation sinks to a depth of 23 ft., 10 ft. of which is below the basement floor. At its base this foundation measures 24 ft. 9 in. by 23 ft., and tapers to 21 ft. 9 in. by 20 ft. at the top. The generator connected to this larger engine is three-phase, 60 cycle, 2,300-volt, and is rated at 600 kilowatts. Both of these engines were built by McIntosh and Seymour. The two alternators are of the same type, and were built by the General Electric Company. With these two generators the station has a capacity of 1,000 kilowatts, and this may be raised to 2,000 kilowatts by the addition of a third engine and generator in the vacant space. Oil is supplied to the generating sets automatically from pumps and tanks

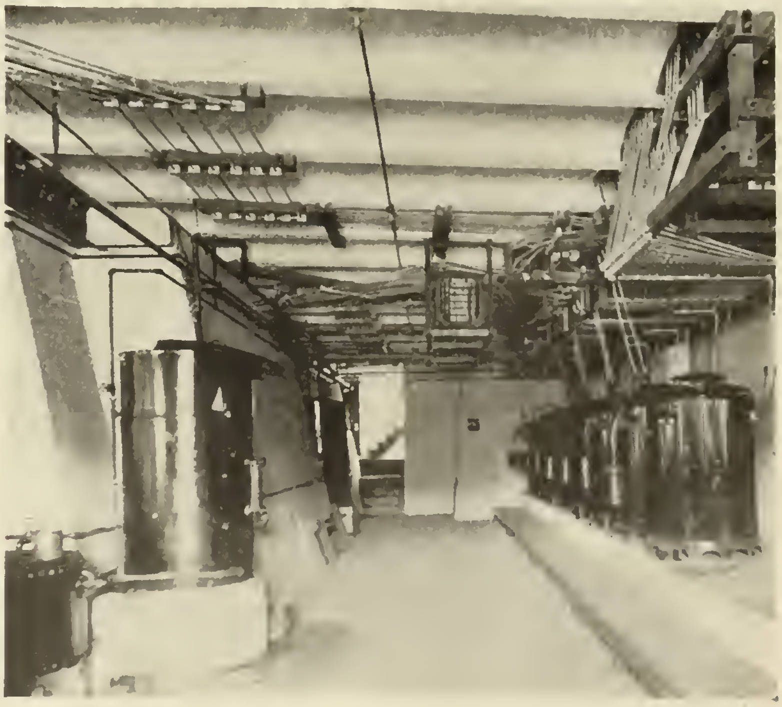

FIG. 6.—TUB TRANSFORMERS IN BASEMENT.

in the basement. Each engine governor is electrically controlled from the switchboard, so that the two units can easily be brought to uniform speed for parallel operation.

Current for the revolving magnets of the main generators is supplied by either of two exciters, one rated at 30 and the other at 35 kilowatts. The smaller of these exciters is driven by a direct-connected, vertical engine, and the larger is coupled to an induction motor. Both the exciters and their engine and motor are of General Electric make. The only belted apparatus about the new station is an induction motor driving a 500-volt, direct current generator of small capacity, which latter carries a part of the station-city motor load. This direct current set will be removed when all connected motors have been changed to the alternating type.

About midway along one side of the generator room the switchboard is located with its back 7 ft. from the brick wall. The board is made up of nine panels of black Monson slate mounted on a base of enameled brick. A door at either end of the switchboard gives easy access to the large space behind it, where all connections are accessible. Of the nine panels in this board, one controls the station lamp, one is devoted to meters and ground detectors, two panels are fitted for series arc circuits of 600 lamps total capacity, one panel handles the 550-volt, three-phase motor circuits, another the 2,300-volt lines for commercial arc and incandescent lighting, and three panels connect the generators. All the main switches connected with the switchboard are electrically operated, and lamps on its face indicate whether each switch is closed or open.

The differences in generating apparatus at the old and new stations have brought with them changes in the connected loads. It is, of course, desirable to carry all of the loads on the two main alternators. This is done in the case of the motor load by a substitution of 550-volt, three-phase, induction motors for a part of the direct-current machines formerly in use, and by the motor-driven generator already named at the station for the remainder of the direct-current motors. In the case of the direct-current, open-arc street lamps the change has been even more complete, as all of these lamps have been replaced by alternating, enclosed arcs. The old direct-current lamps were of the double carbon type, and rated at 1,200 candle-power, or about 300 watts each. At the terminals of each of the alternating enclosed arcs from 430 to 450 watts are required. It is expected that the change from open to enclosed arcs will greatly improve the street-lighting service, as much trouble has been experienced in the past with open arcs in ice storms and high winds. During December last the number of arc street lamps reported out for the month was 207, and this was due almost entirely to bad weather.

To operate the present load of about 300 arc street lamps and also provide some reserve capacity, eight constant-current or tub transformers have been installed in the basement at the main station, underneath the switchboard. Each of these transformers has a capacity of fifty enclosed arc lamps, rated at 450 watts each, or about 22,500 watts total. These constant-current transformers each change the 2,300-volt pressure of the main generators to about 4,000 volts as a maximum on an arc line. All of the commercial arc and incandescent lighting is carried by the 2,300-volt, three-phase, 60-cycle circuits.

The new station and equipment above outlined embody the ideas of Mr. H. F. Coggshall, general manager, and of Mr. A. H. Kimball, electrical superintendent of the company, as well as those of the architects, Sheaff & Jaastad, of Boston. S. S. Lawrence & Son were the contractors for the station. The switchboard was built by S. B. Condit, Jr., & Company, of Boston.

This new generating plant is not the only public utility that the enterprise and public spirit of General Manager Coggshall has given to Fitchburg. Coggshall Park lies on the slopes of Mount Elam, which rises to an elevation of 840 ft. at one side of the city. This park is approximately 0.4 mile long and 0.25 mile in maximum width, and is the free gift of Mr. Coggshall to the citizens of Fitchburg. Probably no municipal park in the Commonwealth, aside from the Metropolitan system about Boston, rivals this one at Fitchburg in natural beauty and advantages.

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Electrical Transmission for Chicago.

A dispatch from Chicago says the Sanitary Board of that city proposes to construct a water plant in Lockport township, utilizing the flow in the Chicago drainage canal. The electrical power thus generated will be transmitted to Chicago and other places.

Electrical Progress in Egypt.

By Henry L. Geissel.

ELECTRICITY is penetrating more and more every quarter of the globe. Wherever conditions are favorable, the electric current is generated by water power and takes the place of steam. That this should be especially the case in countries poor in coal is but a matter of course, and whenever those countries, on the other hand, are privileged with an abundant presence of powerful waterfalls, the installation of electric power stations is assuming larger proportions all the time.

The writer visited last year a number of countries bordering the Mediterranean. He was surprised to find that the application of electricity, both for power and for lighting purposes, had made immense progress in Spain and Italy, and even on the Italian islands of the Mediterranean. However, this is but natural. Most of the countries in Southern Europe do not produce any quantities of coal worth mentioning, while they have at the same time wonderful hydraulic forces, and there is little doubt that these very same territories will offer in the near future a most valuable field for the sale of our surplus manufactures of all kinds of electrical machinery and appliances. But not only in countries which offer special opportunities for the introduction of electric power, but also in those which produce no coal, and are destitute of natural water power, electricity is making steady progress.

This is especially the case in the land of the Nile, where electricity has doubtless made better headway than in many European countries. Egypt may be regarded by the majority of American manufacturers and merchants as a market of little or no importance, but their attention may be drawn to the steadily and largely-increasing imports to prove it a field well deserving of their close study. With the opening up of the Dongola province, the imports in many lines of manufactured goods will go ahead with great strides, and there is plenty of chance for American firms to extend their operations to Egypt, provided they are prepared to do so in an enterprising spirit.

Comparing the population of Egypt with some other countries, it may be of interest to mention that it has about three times that of the whole of Central America, and in South America, Brazil is the only country which exceeds Egypt in population. American engineering enjoys the very best reputation in Egypt. The building of the Atbara bridge by American engineers, the supply of American locomotives for the Egyptian railways, and the considerable imports of agricultural machinery from the United States have largely contributed to this reputation.

Strange, therefore, that our electrical business, which a few years ago obtained some foothold on the Egyptian market, is now decreasing, while that of other nations is growing. The German consul-general at Cairo prepared recently an exhaustive, and, it may be added, highly interesting report on the present state of electricity in Egypt, and the following abstract from this official document will doubtless prove of interest to readers of the Electrical World and Engineer.

The physical conditions of Egypt, says the German official, do not in any way present special inducements for an extensive application of electricity, as the country does not possess any amount of hydraulic power which could be utilized. To generate current Egypt has to-day to avail herself of steam engines or other prime-movers. In spite of this great drawback, electric light has not only penetrated such cities as Cairo and Alexandria, but has also made its appearance in the larger towns of the interior, such as Mansurah (34,000 inhabitants); Jantah (57,000); Zifta (14,000); Suez (25,000); Heluan (3,000), and Ismailia (7,000). Electric light is also about to be installed at Assiut (119,000 inhabitants); Fayoum (31,000); Yagaziz (32,000), and Demanhur (32,000).

In Cairo the Gas Company, by a contract entered into with the government in 1897, secured the exclusive right to supply electric light for a period of thirty years. The plant of this company is equipped with six steam engines of a total capacity of 12,000 hp, driving six dynamos of an average capacity of 800 kw. In 1901 there were 1,230 customers using 7,000 lamps, an increase of 36 per cent. over the previous year. The underground cables had a length of 72,000 meters, and the current was supplied at the rate of 1 franc (20 cents) per kw-hour. At the expiration of the contract the entire system becomes government property. There are, besides, a number of private installations at Cairo, but all of them are of relatively little importance. Thus, for instance, the National Printing Office has a small plant which derives its power from a small 20-hp steam engine, generating current for light as well as for working the presses. Another little installation supplies light for the Abassije Hospital, situated in the suburbs of the city. The Vice-Royal Opera House possesses a plant with two dynamos feeding 850 incandescent lamps and six arc lights. Two of the larger hotels have also their own electric plant. As to private industrial enterprises outside of the city of Cairo, no statistical returns are available.

In the city of Alexandria it is also the local Gas Company which supplies the electric light. But there the plant is owned by the municipality, and is in no way dependent upon the government. Neither Cairo nor Alexandria has a street lighting system. In this regard the two largest cities of Egypt are far behind some of the towns in the interior, where not only historic monuments, but also the streets and squares, are lighted by incandescent lamps. At Mansurah, Suez and Heluan English companies operate the electric plants, while at Ismailia a syndicate, chiefly composed of Swiss capitalists, furnish electricity to the town. The central power station at Mansurah feeds 373 lamps installed in public streets and about the same number of lamps for private individuals. In the streets of Heluan there are 200 lanterns, each of them provided with two incandescent lamps of 26 cp. The plant at Heluan has been built in such a way as to be able to meet emergency demands, and during the winter season the plant also supplies three large hotels.

According to information furnished by the government authorities there will be built, for the towns of Jantah and Zifta, but one plant, at some place between the two cities; and this installation has, at the same time, to supply electric energy along the canal for the working of pumps and similar purposes. This plant is to generate tri-phase current at 10,000 volts, which, reduced by means of transformers, will be the first installation to transmit current over long distances ever constructed in the land of the Pyramids. For its lighting purposes the government is to pay $10 at Mansurah, $11 at Heluan, and $17.50 for the Jantah-Zifta system, per lamp per year.

Regarding motive power for industrial enterprises, it may be said that in this respect electricity has made relatively little headway so far in Egypt. As traction power, however, it is especially used on the tramways of Cairo and Alexandria, at the usual pressure of from 500 to 550 volts. The power station of the Cairo tramways, which, by the way, belongs to a Belgian company, is equipped with four steam engines, each of from 350 to 400 hp, and each of them coupled to dynamos of 200 kw. The length of the system, at the end of the year 1901, was 36 km, of which 21 km were double-track. During the same year the rolling stock consisted of 94 motor cars and 59 trailer cars. In 1900 these tramways carried 11,225,000 passengers, and in the following year 14,750,000, a daily average of 30,000 passengers for 1900, or 5.45 per cent. of the population of that year, as compared with a daily average of 40,000 passengers in 1901, or 7.07 per cent. of the population. In 1896 a concession was granted to this company for a period of 50 years, thus expiring in 1946, when the entire system, including rolling stock, becomes government property. The Cairo tramways are capitalized at 6,000,000 francs; in 1900 the gross receipts amounted to 1,500,000 francs and rose to nearly 2,000,000 francs in 1901, while the total expenses did not exceed 52 per cent. of these gross earnings. The gross receipts, per car-kilometer, were 0.65 and .054 franc respectively in 1900 and 1901.

The Cairo Gas Company employs for lighting purposes exclusively single-phase alternating current, which is not adapted to run powerful motors. During the hot season, however, this current is extensively used for driving a great number of electrical fans. As far as large storage batteries are concerned, there were only six of them in Cairo at the end of 1901.

The above remarks show evidently that Egypt offers a favorable market for a large number of dynamos, especially for those of small and medium capacity, and furthermore for the sale of suitable motors. The chances for the sale of storage batteries are smaller. On the other hand, however, all kinds of supplies for electric lighting should find a ready sale. Up to some time ago, the dynamos used in Egypt were almost exclusively of English or Swiss origin, but the Cairo Tramways Company introduced American dynamos. It seems, however, that up to the present time German manufacturers still get the bulk of the trade. In steam engines the famous Sulzer Works, of Winterthur, Switzerland, are doing the largest amount of business. The writer saw Sulzer and Tosi (Legnano, Italy) steam engines all over Southern Europe last year. These two firms are doing an immense amount of business in the countries of the Mediterranean, and it must be admitted that their makes rank among the best in the world. In petroleum motors German and English manufacturers compete together, while in gas motors Germany still holds her own. On account of the high prices charged by the Cairo Gas Company, the chances for an increased sale of gas motors are not very great at present.

Lighting fixtures are largely imported from Germany. The latter country is making the most strenuous efforts to obtain a firm foothold on the Egyptian market, and two of the leading German electrical companies are already established in the country. There is little doubt that others will follow. It was only recently that the Allgemeine Elektricitäts Gesellschaft, of Berlin, secured an important order from the Egyptian Telephone Company, the headquarters of which are at London. The order in question consisted of the laying of an underground telephone line between Cairo and Alexandria, and amounted to about $260,000. At the same time, in many quarters of Cairo, the overhead telephone lines had to be converted into underground lines, on account of grave disturbances having occurred after the completion of the Cairo-Alexandria underground telephone system. For this purpose armored steel cables, containing 100 double wires each, were employed. At the present time the Cairo underground telephone cables have a total length of a little over 20 km.

Another German firm, the Siemens & Halske Company, installed the necessary electrical equipments for the great Assuan dam, and also secured the order for the installation of an electric lighting plant at the Khartum barracks.

According to the official returns of the Egyptian custom house authorities, the imports of electrical appliances into Egypt amounted in value to $249,645 in 1899, $191,695 in 1900 and to $209,255 in 1901. In reality, however, the imports have been larger, as many machines being practically for electrical purposes are classified among other items. The official figures referred to above divide the imports of electrical appliances as follows:

	1899.	1900.	1901.
Germany	$64,735	$77,400	$115,495
Austria-Hungary	82,150	54,920	34,385
France	29,630	16,090	13,110
England	28,955	19,140	21,560
Italy	4,110	10,880	9,520
Sweden	945	1,635	11,040
United States	29,490	2,680	335

It will be seen from these figures that, while the imports from Germany and Sweden have considerably increased, those from other countries, and particularly from the United States, have largely decreased. The increase in the imports from Sweden is due to the fact that the telephone company of Cairo uses at present almost exclusively Swedish apparatus of the Ericsson make.

Recent Electrochemical Developments.

Last week but two electrochemical patents were issued, one being granted to Mr. J. W. Madigin, of Toronto, Canada, for mechanical details of construction of a non-corrosible terminal connection for storage batteries. The other patent, for a method of making bleaching liquor, was granted to Mr. Marcus Ruthenburg, well known to the public by his electric iron process. While in the manufacture of caustic alkali and bleaching powder, the anodic and cathodic products of the electrolysis of sodium chloride must be kept separate and prevented from mixing with each other, the opposite is true for the production of bleaching liquor or hypochlorites. Here it is necessary to enable the anodic and cathodic products of the electrolysis of sodium chloride to mix thoroughly to obtain the reaction resulting in the formation of hypochlorite. Any chlorine which is set free at the anode and escapes as gas is lost for the formation of bleaching liquor. Mr. Ruthenburg, therefore, does not use simply sodium chloride, but mixes it with hydrated oxide of calcium, the object being to have the chlorine taken up by the hydrated oxide of calcium, "forming additional soluble chlorine salt in the solution and thus augmenting the bleaching capacity of the latter." Another advantage is that this addition reduces the electric resistance of the cell. A mixture of 20 per cent. sodium chloride with 10 per cent. of hydrated oxide of calcium is recommended with a current density of ½ amp. per sq. in. of electrode surface, the e.m.f. at the terminals of the cell being about 3 volts.

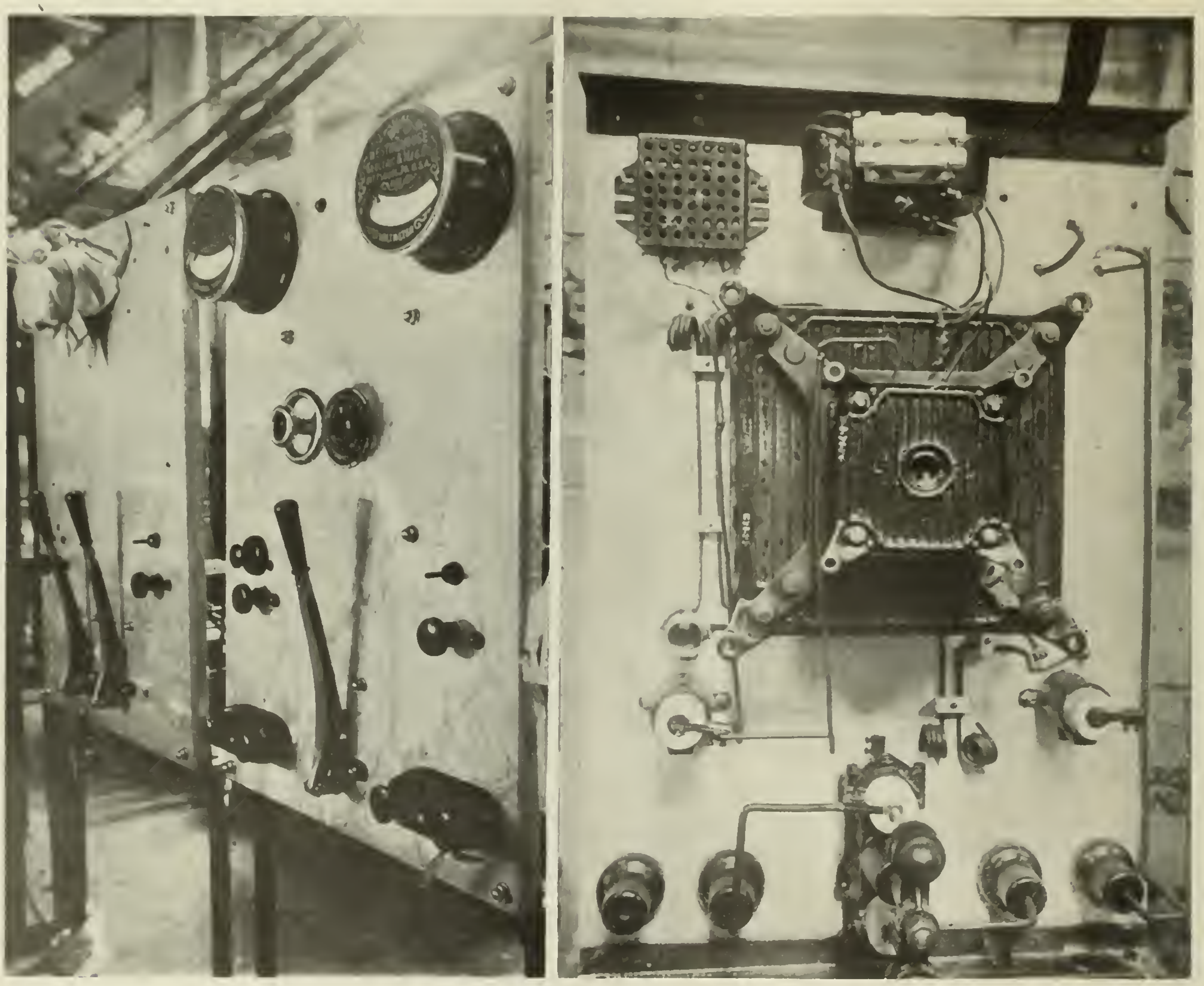
Alternating Current Switchboards—II.

By Stephen Q. Hayes.

THE switchboards, such as are shown in Fig. 4, are mechanically the same as the 110-250 volt type previously described, but being intended for 1100-2200-volt service, the knife-blade switches of the latter are replaced by plunger switches so arranged that no charged metal parts are exposed on the front of the board.

These switches consist of a cast iron frame mounted on the back of the switchboard and serving as a support for the porcelain cylinders and as a guide for the operating rod which passes through the frame and is controlled by the handle in front. One switch terminal is mounted at each end of the porcelain cylinder, which has a ½ in. bore through which a copper rod or plunger passes, making the electrical connection between terminals.

The plungers are supported by an iron cross-head rigidly secured to the operating rod and moving with it, but entirely insulated from it. The only charged metal on the switch consist of the plungers and the two terminals on each porcelain cylinder. In opening the switch the plunger is withdrawn from the lower contact, and the arc which tends to follow it is destroyed by the combined effect of the cooling action of the porcelain walls and the draft caused by the expansion of the heated air through the outlet from the porcelain tube.



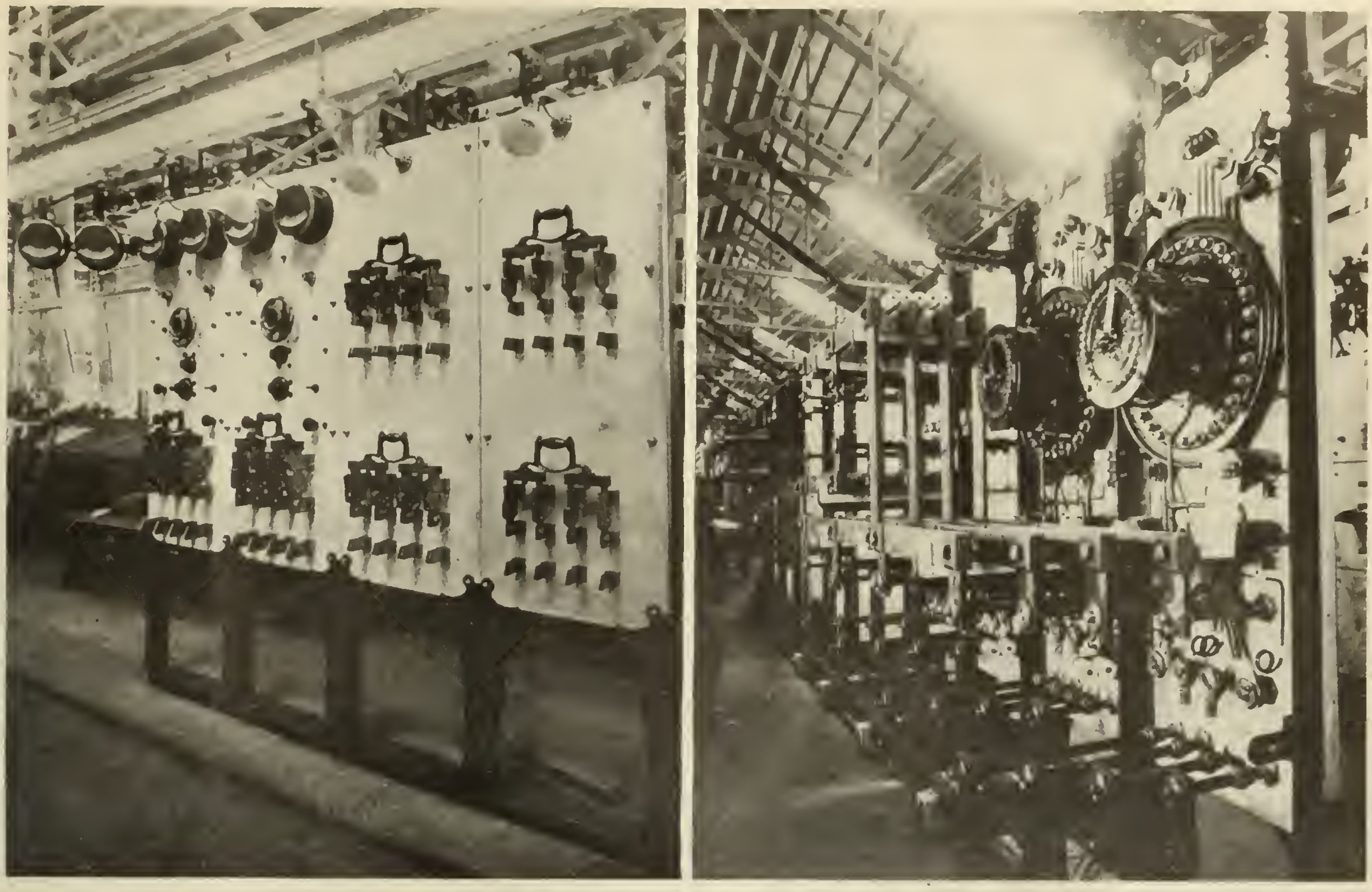
Figs. 4 and 5.—Front and Rear Views of 1100—2200-Volt Switchboard.

The switches used on these boards have one porcelain cylinder in each leg of the circuit, giving two breaks in series, and are known as single-brake. Switches have two porcelain cylinders in each leg, giving four breaks in series, are designated "double-break switches." The relative breaking capacity of these switches will be given later in connection with other boards.

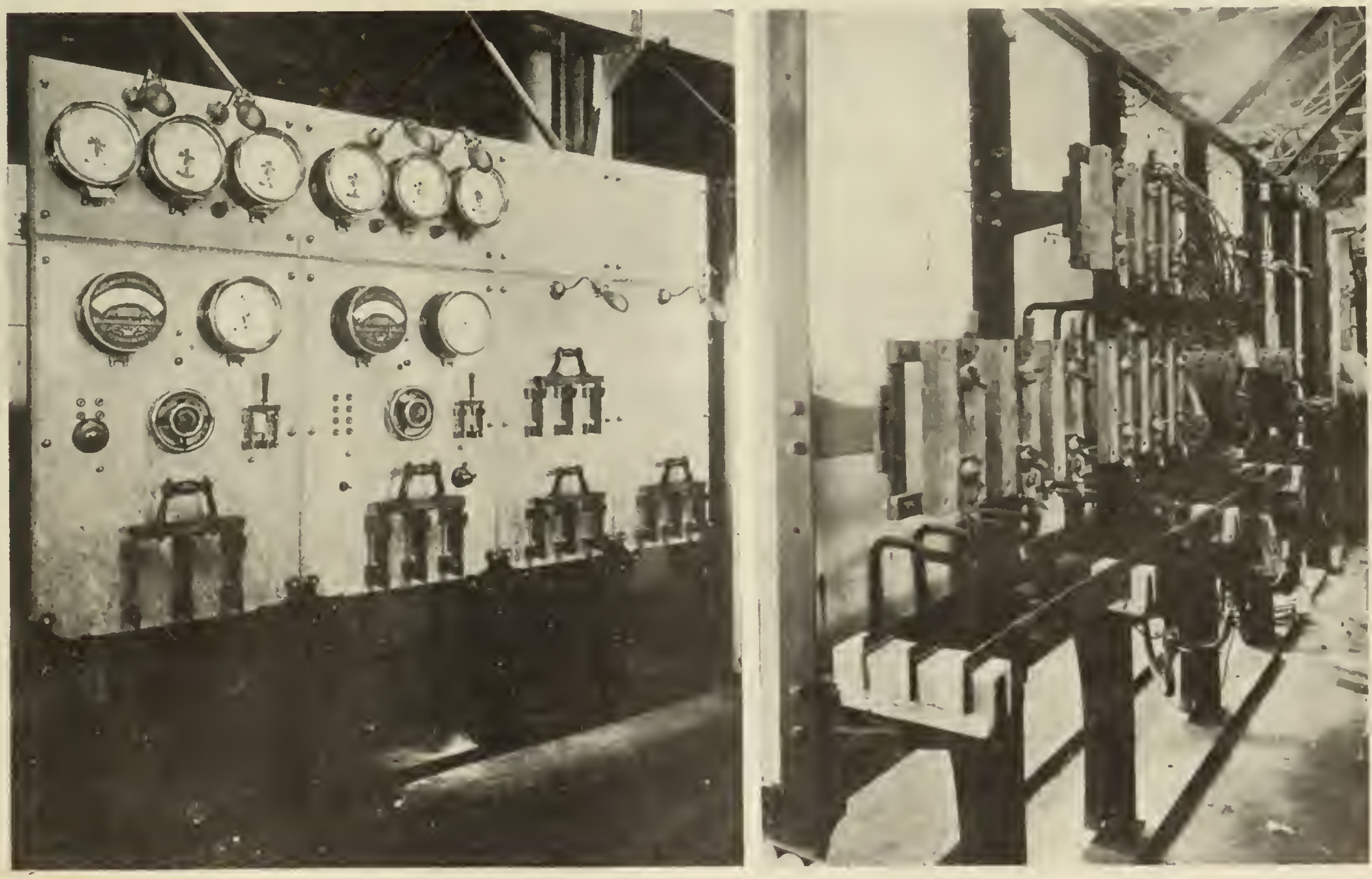
Fig. 5 is a rear view of this type of board, and shows clearly the back of the plunger switches, rheostats, fuse block, etc., used in the rear of Fig. 4. Concentric rheostats are also used on these panels, and the voltmeter is utilized, in connection with a plug receptacle and push button, for a ground detector. Under normal conditions, when the reading of the voltmeter alone is required, the plug is inserted in the two receptacle sockets that are covered by the red fibre ring.

It may seem strange to some that while it is customary to recommend against the use of fuses in generator circuits, with this type generator panels with fuses are standard. The reason for this is that, as a rule, these panels are used for both generator and feeder, and the fuse is put in for the protection of the feeder circuit. While this panel can be used with multiple running machines, not more than 10 per cent. of the boards of this type are so used. When they are intended to operate in multiple, the feeders are often taken direct from the bus bars without either switches or fuses—full dependence being placed on those on the generator panels. Occasionally the fuses on the generator panels are connected in the feeder circuits.

If the capacity of the panel be over 30 amp., single-pole lignum vitæ fuse blocks, described at some length farther on, are used mounted on the front of the board. If the capacity is less than 30 amp., double-pole porcelain fuse blocks are supplied, mounted on the rear of the board. The panels are built to control one generator and one feeder, single-phase, for use with a similar panel to control separately two generators and two feeders, single-phase; to control one single or one two-phase generator and two single-phase feeders; to control one generator and one feed, two-phase; to control four single-phase feeders or two single-phase feeders with dynamo changing switches; to control two two-phase feeders; to control



Figs. 6 and 7.—Front and Rear Views of 220-Volt Switchboard.



Figs. 8 and 9.—Front and Rear Views of 440-Volt Switchboard.

ALTERNATING-CURRENT SWITCHBOARDS.

one generator and one feeder three-phase, to control two three-phase feeders.

Fig. 10 is a diagram of connection for a board of this sort, and illustrates the method of operating ground detector, voltmeter and synchronizer connections. When the alternating current generators are composite wound, additional field plugs are provided for putting these composite fields in multiple. The field plugs on boards for two generators and two exciters are often so arranged that either generator can be fed from either or both exciters, or both generators from one exciter.

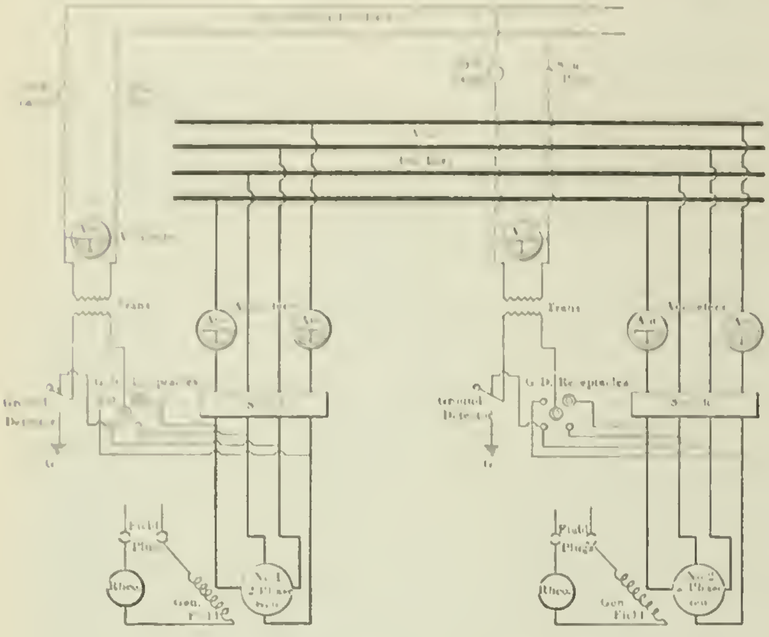


FIG. 10.—DIAGRAM OF CONNECTIONS OF 2200-VOLT BOARD.

Next in order are a type of board intended for larger generators and installations than that just described, and distinguished from the latter by the use of 2-in. marble and a frame-work built up of vertical-angle irons resting on a channel iron and connected together by flat irons at the top. The standard boards, like Fig. 6, have a clear space of about 25 inches between the bottom of the marble and the floor. The marble rests on ornamental iron legs, which also serve to conceal the connecting wires and that portion of the angle iron frame which projects below the panels.

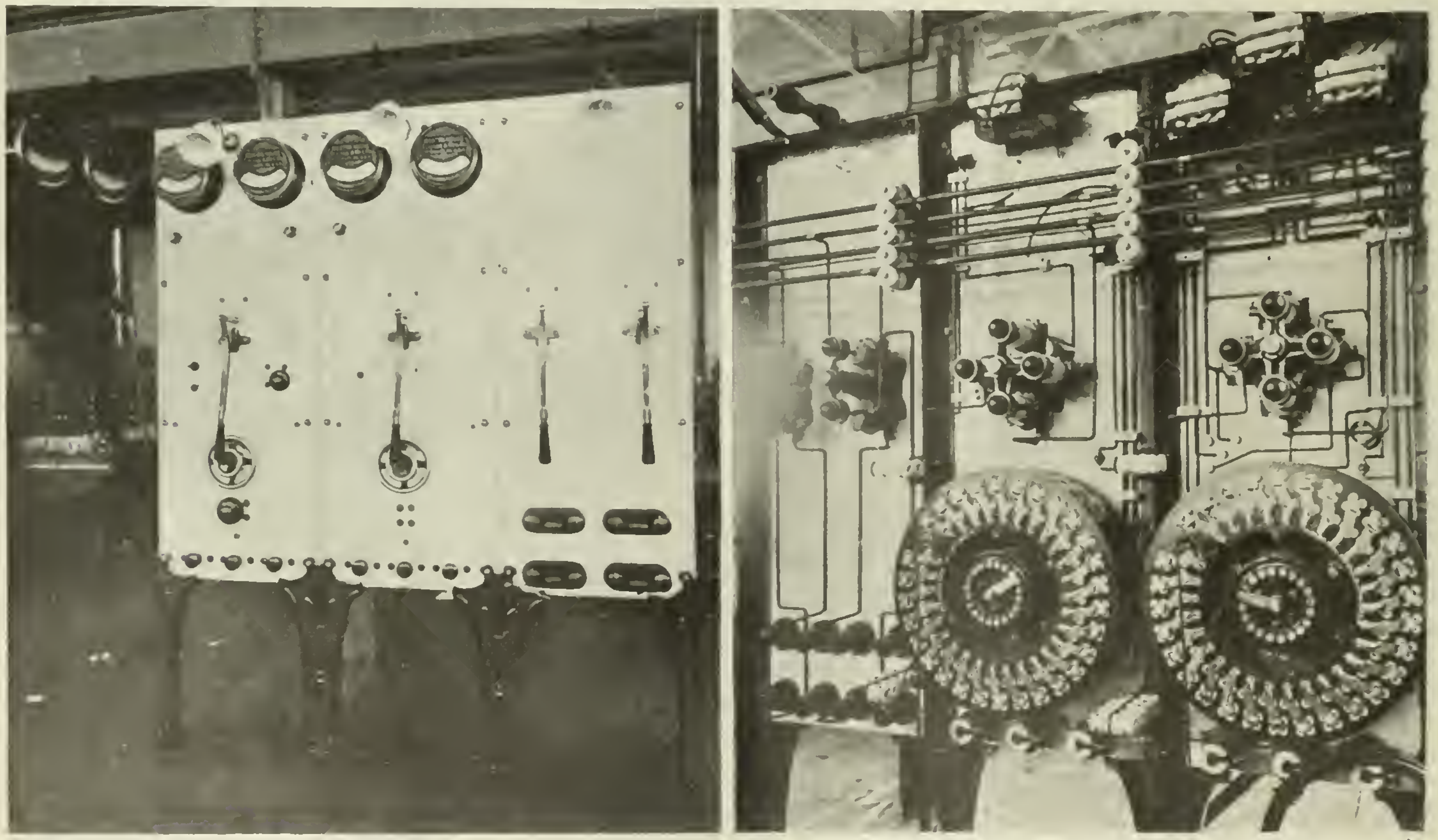
When it is necessary to install extra or special apparatus, it may be mounted on marble panels placed below the standard panels, the iron supporting legs being removed, and the smaller panels fastened directly to the frame. The remaining spaces may be fitted with blank marble for uniformity. One modification has the panels in a single slab, 6 [illegible] in. high, while in another the panel is in two slabs, the top 1 ft. 8 in. high, and the bottom 3 ft. 9 in. This arrangement is to permit these alternating-current panels to match up properly with similar lines of direct current panels.

Fig. 7 shows the rear of this same board, and illustrates the bus-bar structure, and the method of connecting the switch studs to the bus by means of copper straps and extension studs or "adapters." The bus bars consist of copper straps 3 in. x ⅛ in. in section resting on porcelain insulators and supported on cast-iron brackets. This construction gives ample ventilation, ready inspection, and avoids use of any rubber insulation or other inflamable material, a point of great importance in switchboard work. All wires and bus bars are thoroughly insulated by proper spacing apart in air and carried on porcelain insulators wherever necessary.

On this type of board, as a rule, the exciters for the generators can be controlled from the generator panel by means of field plugs or field switch and the exciter field rheostat. The limiting sizes of exciters for such control are 15 hp, 110 volts, and 20 hp and 220 volts. For larger exciters, or if meters are required, separate exciter panels must be provided.

Fig. 8 is the front view of this type of switchboard intended for the control of three three-phase feeders and two three-phase generators and shows the field ammeter, polyphase, indicating wattmeter and long scale ammeters used with this type of board—relatively a high-priced one. On the modified types field ammeters and indicating wattmeters are not, as a rule, supplied, and less expensive ammeters and voltmeters are used. Fig. 9 is a rear view of this board taken from the feeder end and illustrates the method used for mounting fuse blocks on the back of these panels. It also shows very clearly the porcelain spacing blocks between the bus-bars.

At the time these panels were designed they were only listed up to 250 volts, but since that time the underwriters' requirements have been modified and the switches rated at 250 volts direct current are permitted to be used on 440 volts alternating current. The type is provided with 600-volt switches, but as alternating-current generators are seldom wound for any voltage between 440 and 1,100 volts, these 600-volt switches are seldom used on these alternating-current panels. On alternating-current voltages up to 600 volts,



FIGS. 11 AND 12.—FRONT AND REAR VIEWS OF 1100—2200-VOLT SWITCHBOARD.

currents up to 1,000 amp. can readily be broken with a quick-break switch, so the limiting capacity for generators controlled by this type is about 1,000 amp., 440 volts, or, allowing for 90 per cent. power factor, about 800 kw, two-phase, and 650 kw, three-phase.

Fig. 11 is the front view of a board of the type here considered and shows the general appearance of the plunger switches, fuse blocks, meters, etc., on the front of the board. For these panels, plunger switches are supplied for operation at 1,100 and 2,200 volts. These switches, previously described, are made both single and double-break and all have the same carrying capacity, namely, 200 amp. The breaking capacity, however, is different for lighting and for power load and for different frequencies.

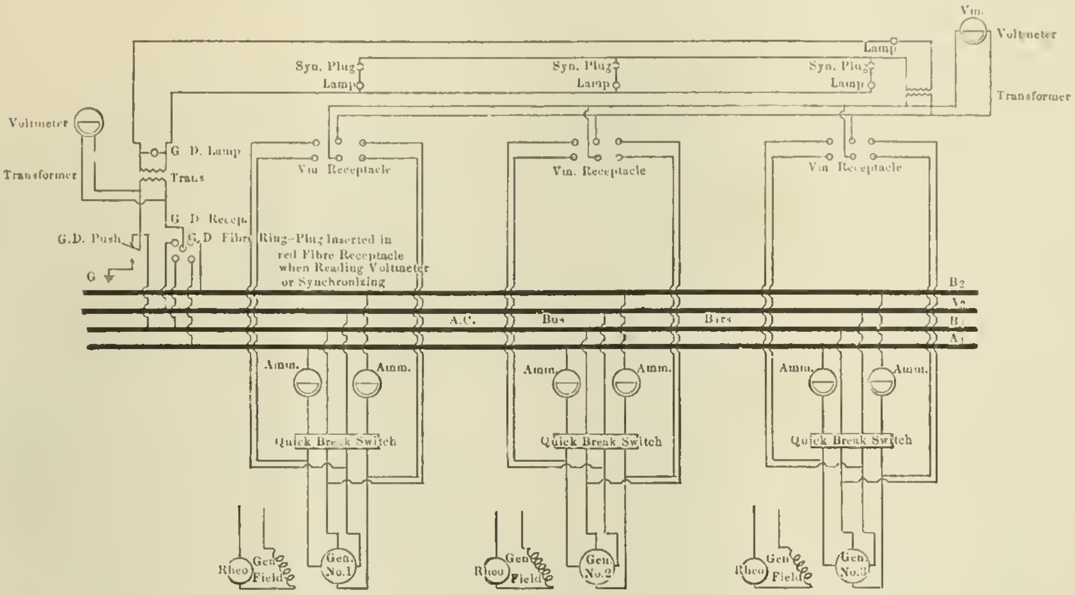


FIG. 13.—DIAGRAM OF CONNECTIONS OF 440-VOLT BOARD.

Character of load.	——Lighting load.——				——Power load.——			
Alternations	7200		16000		7200		16000	
Voltage	1100	2200	1100	2200	1100	2200	1100	2200
Cap. in amp. single-break .	100	50	100	50	60	25	25	15
Cap. in amp. double-break.	200	100	200	100	150	75	50	30

As the breaking capacity of the switch is the limiting factor on lighting loads where the power factor is .90 or above, these panels may be used up to 400 kw, two-phase, or 350 kw, three-phase, and on power load with a power factor of .75 or above the limits are respectively 300 kw and 250 kw.

The alternating-current generator field rheostat is mounted in most cases on the back of the generator panel with the exciter rheostat placed within the alternating frame. Both rheostats are independently operated by concentric handwheels on the front of the board. In the case of large generators only the rheostat face plate is on the switchboard, connection being made from it to the rheostat resistance which may be installed in any convenient place. As a rule, synchronizing is done by lamps, but when desired a synchroscope may be used and mounted on a swinging bracket at the end of the board.

The proper place for automatic protection is in the feeder circuits and fuses as a rule are satisfactory for circuits of the sizes usually controlled by these panels, i. e., less than 1,000 amp. at 440 volts, 200 amp. at 1,100, and 100 amp. at 2,200 volts. The low-voltage fuses furnished ordinarily are of the open type and are usually mounted apart from the switchboard in the outgoing feeders. Occasionally the open fuse blocks are arranged in gangs on slabs of suitable size and mounted on brackets on the back of the switchboard. Instead of open fuses a line of enclosed fuses has been designed and these occasionally are located on the front or rear of the board.

For 1,100 and 2,200-volt service, a lignum vitæ expulsion type fuse block is used with aluminum fuses enclosed in a chamber, which is air-tight except for one small vent. The melting of the fuse causes a rapid expansion of the air contained in this chamber and consequently creates a strong and quick air blast through the vent, blowing out the arc. Lignum vitæ being an extremely heavy, close-grained wood, cannot burn from the arc. It has great strength combined with considerable elasticity, and the tremendous expansive tendency produced by the arc is thus properly restrained, while just enough flexibility is allowed to avoid rupture. These fuse blocks are mounted at the bottom of the board, and the vent is so constructed that it discharges the fuse vapors downwards towards the floor.

The blocks containing the fuse are on the front of the panel, the terminals on the rear and plugs extending through the marble and forming part of the fuse holder, complete the connections between the terminals and the fuse. These fuse holders are readily detachable from the board and by having extra holders on hand already fused, the interruption to the service is reduced to a minimum. A new fuse can be inserted to replace the blown one, whenever convenient, and without the least danger to the attendant.

Fig. 12 shows the rear view of the board and illustrates the bus-bars, wiring, brackets, transformers, etc., used.

It is often deemed important that the generators and feeder panels be equipped with wattmeters, and it is customary to use indicating wattmeters on the generator panels and integrating meters on the feeders. The use of indicating wattmeters on the generator panels allows a ready means of determining when the fields of the machines are excited to give as high a power factor as possible. With the kilowatt output constant, the power factor will be a maximum when the armature current is a minimum, so the field current is adjusted until this minimum point is reached. Indicating wattmeters also show at a glance the output of the machine at all times. Instead of indicating wattmeters, power factor meters are sometimes used.

Integrating wattmeters on feeder panels keep a record in kilowatt-hours of the energy supplied to a feeder which supplies a certain section of a factory, a certain portion of a town, or a particular customer or set of customers, and by checking up these readings against those of the customer's meters, the actual commercial efficiency of the transmission line is readily obtained.

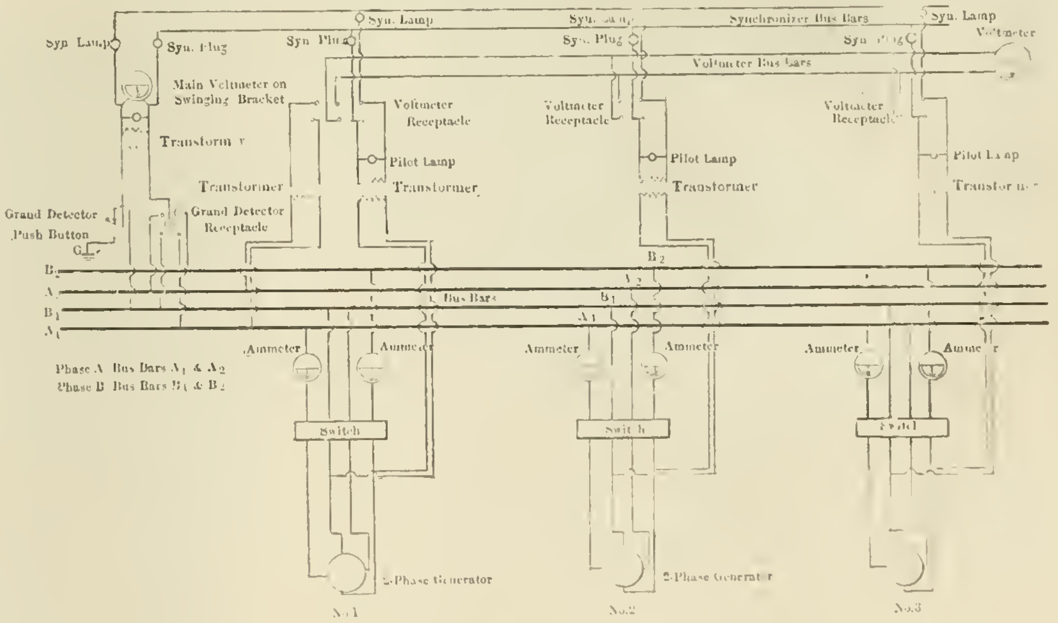


FIG. 14.—DIAGRAM OF CONNECTIONS OF 2200-VOLT BOARD.

The feeder panels are provided with one ammeter per feeder instead of one in each phase to allow two feeders to be controlled by one panel. The panels have an ammeter in each phase of a feeder, and are not as a rule arranged for double-throw systems; but the modified boards are provided with double-throw switches and two sets of bus-bars when required.

As single-phase lighting circuits are often run from 1,100 and 2,200-volt systems, suitable feeder panels for this line of work have been included in this type. These single-phase feeder panels are arranged usually with two feeders per panel and either with single or double-throw switches. On a two-phase switchboard with single-throw switches on feeder panels, these feeders are usually equally divided between the phases. With double-throw switches, the feeders can be thrown on one phase, or the other to balance up the load.

Fig. 13 is a diagram of connections with three 440-volt, two-phase generators operating in multiple. It shows the scheme used for ground detector, synchronizer and voltmeter connections. Field connections have been omitted to avoid confusion. When synchronizing the ground-detector plug is placed in a red receptacle the voltmeter plug put in on the right-hand side of a 6-point receptacle of the panel for the machine to be synchronized and the plug inserted in the synchronizer receptacle of same panel. Connections as shown are for synchronizing with dark lamps. If it is preferred to synchronize with bright lamps the connections of one of the transformers can be reversed.

Fig. 14 is the diagram of connections for a switchboard with three 2,200-volt, two-phase generators operating in multiple, and shows all of the connections except the field wiring.

Illinois State Electric Association.

Note was made in these pages last week of the opening sessions of the Illinois State Electric Association, at St. Louis, and the subsequent trip on the Mississippi.

At Alton, on Saturday night, September 19, the Alton Railway, Gas and Electric Company, through President J. F. Porter, entertained the association by a theater party. The trip up the river the next day, from Alton, was very enjoyable. The delegates were given an opportunity to see some of the beautiful but now comparatively little-known scenery along the Mississippi and Illinois rivers.

The only formal meeting of the Association was that held on the steamer for the election of officers. The old officers were all reelected, as follows: W. E. McCullough, Beardstown Electric Light and Power Company, president; John W. Glidden, first vice-president; R. L. Allen, Economy Electric Light and Power Company, Joliet, Ill., second vice-president; C. L. Gerould, Galesburg Gas and Electric Company, third vice-president; D. Davis, Litchfield Electric Light and Power Company, treasurer; H. E. Chubbuck, Citizens' Lighting Company, La Salle, Ill., secretary; and W. B. McKinley, Urbana and Champaign Railway, Gas and Electric Company; J. N. C. Shumway, Taylorville Electric Company; Frank J. Baker, North Shore Electric Company, Waukegan; C. E. Hay and S. S. Davis, People's Power Company, Moline, Ill., executive committee.

Applications for membership were received from the Mt. Sterling Electric Light and Power Company and the Pana Electric Company. The place of the next meeting was left with the executive committee. Resolutions were passed, thanking the Fish Commission for its courtesy in allowing the association the use of the steamer Illinois; thanking the officers of the Alton Railway, Gas and Electric Company for the entertainment at that place; thanking the officers of the Louisiana Purchase Exposition for the courtesies extended while visiting the World's Fair grounds; thanking the St. Louis Transit Company for the use of a special car to and from the World's Fair grounds, and thanking the St. Louis Car Company for the reception and entertainment at that company's works in Baden, where a stop was made on the way up the river Saturday afternoon.

Convention of Electrical Workers.

The annual convention of the International Brotherhood of Electrical Workers was held in Salt Lake City, Sept. 14, there being about 250 delegates in attendance. The convention was presided over by Grand President W. A. Jackson. A resolution was passed voting $5,000 to the electrical workers at San Francisco, who are on a strike against the telephone company. There was a large electrical street display in honor of the occasion. The delegates were entertained in various ways during their stay in the city.

An Object Lesson in Telephone Receivers.—III.

By Arthur V. Abbott, C. E.

In Fig. 56, published on page 517, last week, a somewhat different model of the Kellogg receiver is shown. Here a threaded block, b^1, is placed on the top of the magnet bars, which engages in a screw thread on the inside of the case. By this means adjustability is secured between the pole pieces and the diaphragm. Fig. 56 also illustrates the method of attaching the receiver cord. On the rear of the case is a cap, *e*, which is secured by means of a screw thread. Underneath this cap a partition is formed in the receiver case having a hole in its center. The leading-in wires from the line coils pass along through the case beside the magnet and through a hole in the center of the partition, a^2. On the top of this partition are two screws, *d*, to which the leading-in wires are attached. The receiver cord passes through a hole in the tail cap, *e*, and is then knotted at f^1. From the receiver cord the conductors pass to the

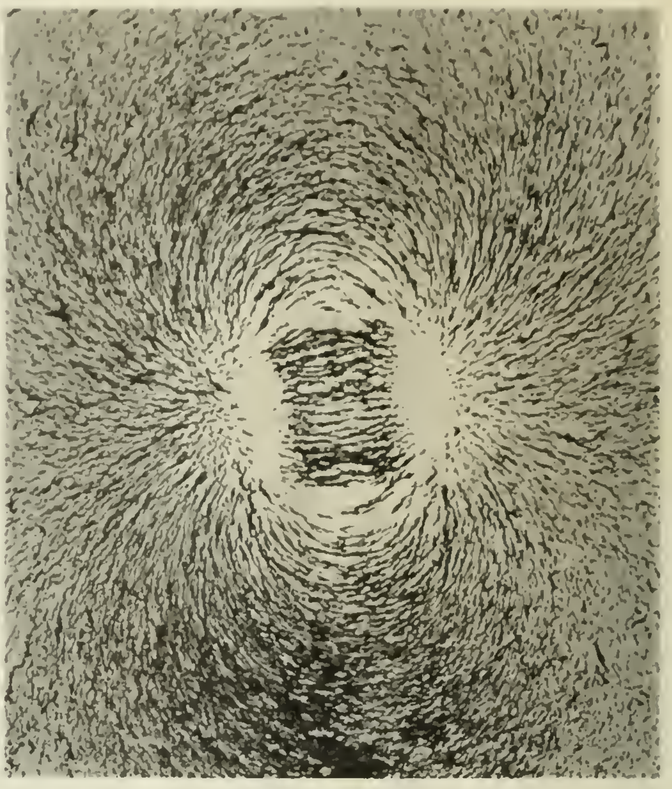


FIG. 57.—PHANTOM OF KELLOGG RECEIVER WITH DIAPHRAGM REMOVED.

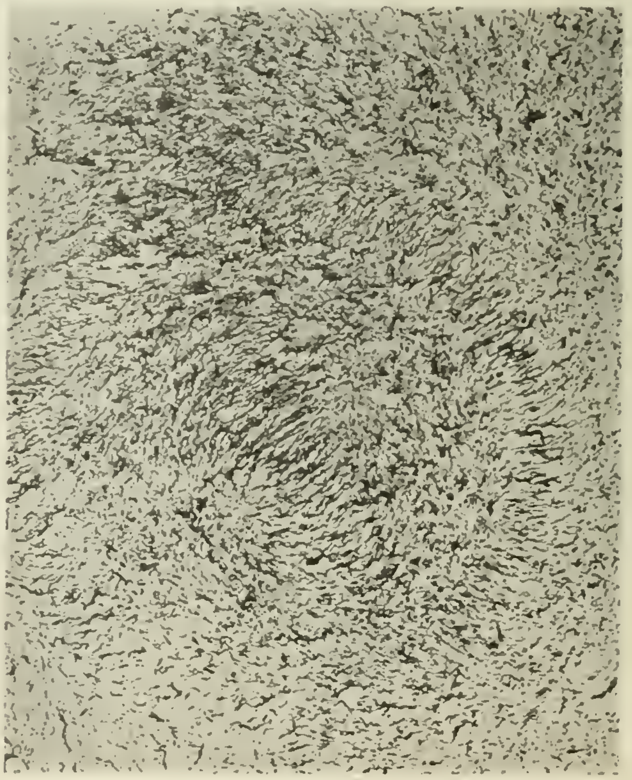


FIG. 58.—PHANTOM OF KELLOGG RECEIVER WITH DIAPHRAGM IN PLACE.

screws, d^1, thus securing electrical connection with the leading-in wires. Figs. 57 and 58 are the phantoms of the Kellogg receiver, Fig. 57 is taken with the diaphragm removed, while Fig. 58 shows the field with the diaphragm in place. The phantom of Fig. 57 is noticeable for the uniformity of the field which is produced, while Fig. 58 indicates that the magnetic relations between the diaphragm and the field are well preserved, as there is little or no evidence of any external field outside of the diaphragm.

THE MANHATTAN TELEPHONE RECEIVER.

The Manhattan hand telephone is illustrated in Figs. 53, 59 and 60. Fig. 53B shows the instrument assembled, while in Fig. 59 it is dissected. The case consists of three pieces: the body, the diaphragm cap and a tail piece, which is simply a composition disc, carrying two binding posts, through the center of which a screw runs into the interior of the instrument and is tapped into the magnetic system. The magnetic system consists of two bars of steel .628 in. wide, .120 in. thick and 3.75 in. long. In the rear the bars are clamped together by means of a screw bolt and a filling piece of soft iron, while in front there is a filling piece cast of non-magnetic metal that carries a screw thread which engages with a similar thread on the inside of the case. This block is also provided with a shoulder and presumably the magnetic system is to be screwed into the case until the shoulder reaches a bearing. This receiver is noticeable in having no pole pieces. The magnet bars extend directly through the composition block and on to their ends the line spools are forced. The spools are .44 in. wide, 1.0 in. long and .43 in. deep. The winding is of No. 34 or No. 36 wire and the resistance from 68 to 70 ohms, both of the line coils being joined in series. The diaphragm is flat, of ferrotype metal .01 in. thick, 2.25 in. in diameter over all, and 1.75 in. free diameter. The tractive effort is .851 pounds, corresponding to 369 grams. This is equivalent to a tractive effort of 1,216 grams per square cm., showing an induction of 5,500 gausses in the pole pieces, and remanance the same in the magnets. The leading-in wires pass from the line spools through two slots in the composition filling piece and thence extend to the rear of the receiver and are soldered into the binding posts. The leading-in wires are carefully insulated with rubber tube to prevent any possibility of crosses. Fig. 60 is the phantom from the Manhattan model with the diaphragm removed. The field is exceptionally symmetric and uniform and is noticeably less intense than that of other models, which is fully substantiated by a lower tractive effort.

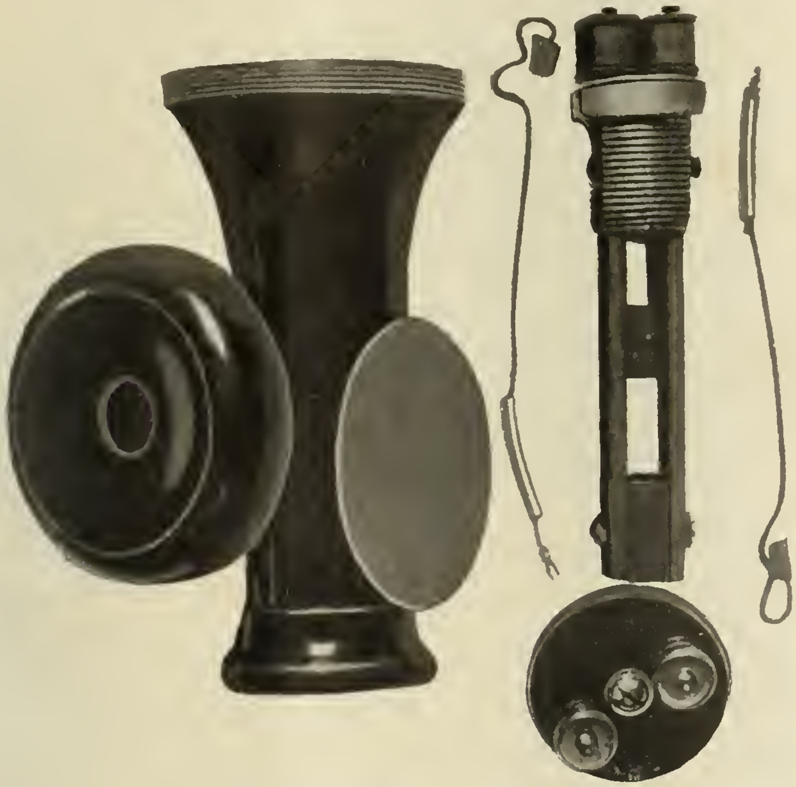


FIG. 59.—MANHATTAN HAND-TELEPHONE DISSECTED.

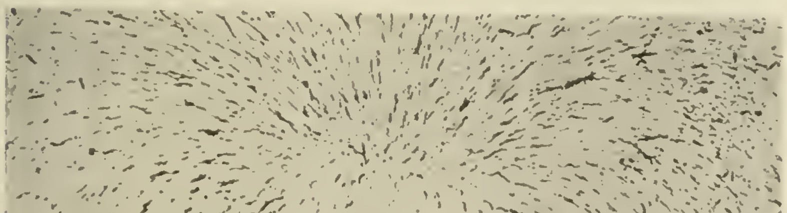


FIG. 60.—PHANTOM OF MANHATTAN HAND-TELEPHONE.

THE MANHATTAN HEAD TELEPHONE.

The Manhattan head telephone is a curious model in many respects. It is illustrated in Figs. 54, 61, 62 and 63. In Fig. 54B the instrument is shown assembled, while in Fig. 61B it is dissected. The instrument consists of a wash bowl-shaped casting of hard iron or steel. In the center of this a small round hard steel stud is secured, which extends upwards and is faced off even with the rim of the casting. Around this central stud is a wooden spool, which carries the line coil. Through the side of the case two holes are drilled and are furnished with small binding posts to which the cord tips may be attached and from which the leading-in wires pass to the spool. The diaphragm is flat, of ferrotype, .005 in. in thickness, 2 in. in diameter over all and 1.75 in. free diameter. The exciting coil is a single spool of wood 1 in. in diameter and .312 in. deep. The receiver is wound with No. 38 wire to 70 to 80 ohms. The pole piece, if it may be so termed, is a steel stud .280 in. outside

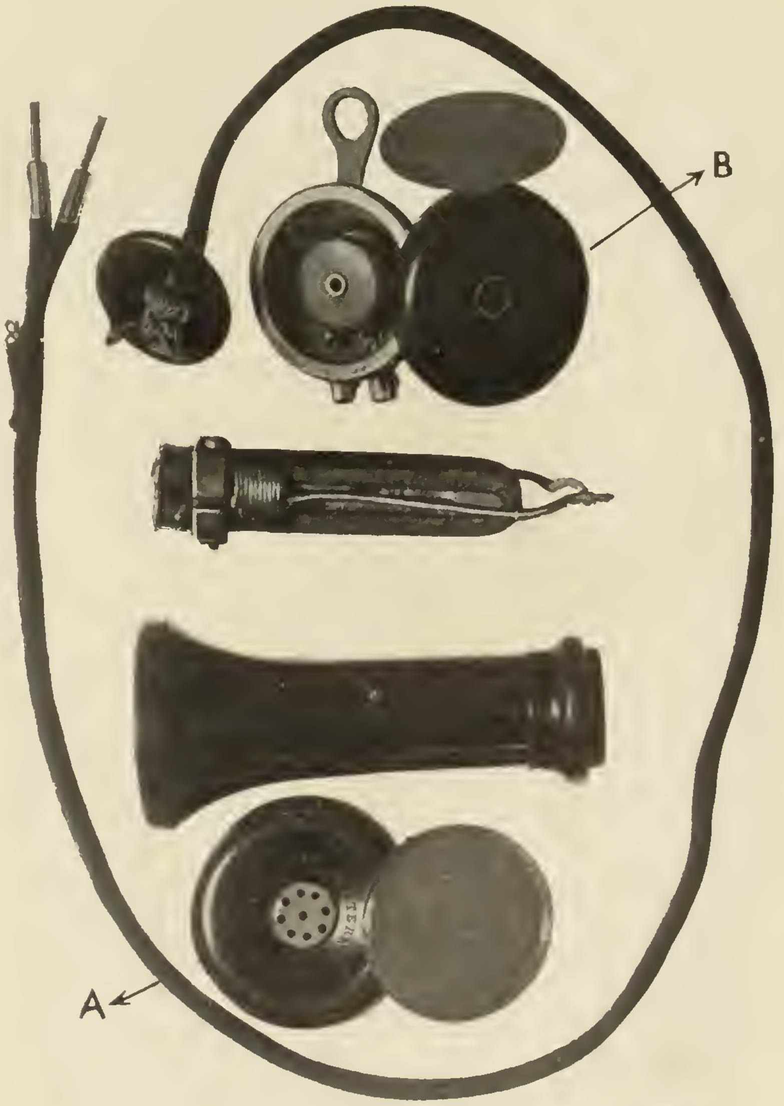


FIG. 61.—A—WESTERN TELEPHONE RECEIVER DISSECTED.
B—MANHATTAN WATCH-CASE RECEIVER DISSECTED.

The tractive effort is .344 pounds, corresponding to 156 grams. This is equivalent to 276 grams per sq. cm., showing an induction of 5,300 gausses in the pole piece. The phantoms of this model are shown in Figs. 62 and 63 (Fig. 62), being the phantom with the diaphragm removed, while Fig. 63 is that taken with the diaphragm in place. The field shown in Fig. 62 is a curious one, but is what would naturally be expected from a magnetic system designed upon the lines of this model. The effect of the central magnet is clearly shown. In Fig. 63 the phantom taken with diaphragm in place it is curious to notice that the reluctance of the diaphragm is sufficient to cause a noticeable magnetic leakage from the circumference of the casting which forms the case of the instrument.

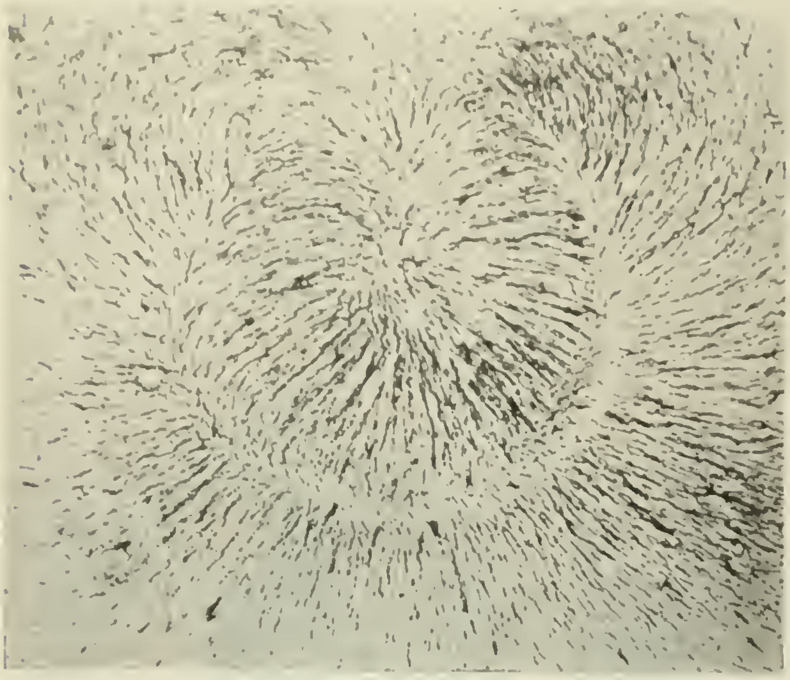


FIG. 62.—PHANTOM OF MANHATTAN WATCH-CASE RECEIVER WITH DIAPHRAGM REMOVED.

RECEIVER OF THE ERICKSON TELEPHONE COMPANY.

The model adopted by the Erickson Telephone Company is shown in Fig. 53c and in Figs. 64, 65 and 66. Fig. 53c illustrates the receiver assembled, while in Fig. 64 it is dissected, Figs. 65 and 66 being the phantoms. In this receiver a pressed brass case forms the foundation of the instrument over the handle portion of which a tube of rubber or other insulating material is slipped, which is furnished with a tail piece that carries the binding posts to which the receiver cord is attached and in the center of which is a screw eye to which a supplementary cord is knotted to support the receiver and relieve binding posts and cord conductors of any strain. In this respect this model is a departure from those that have been previously considered, for the foundation in the case is entirely metallic and merely enough insulation provided to protect the receiver. The magnetic system consists of a U bar .622 in. wide and .20 in. thick; the magnet is 4 in. long. Each pole piece is bolted to its appropriate side of the U by means of a bolt and nut. The pole pieces are .573 in. wide, .115 in. thick and .970 in. long. The tractive effort is 2.595 pounds (corresponding to 1,177 grams). This corresponds with tractive effort 1,315 grams per sq. cm., the induction in the pole pieces is 11,600 gausses, and the remanance is 6,000 gausses. The line coils are of brass .41 in. wide, .88 in. long and .31 in. deep. The receiver is wound with No. 36 wire with about 2,000 turns and has a resistance of 120 to 125 ohms. After the magnetic system is slipped in the side of the case two holes are bored through the sides of the case and the magnet bars, and two screws inserted from the exterior. By this means the case and magnets are bolted firmly together. The screw holes in the case are slightly elongated and thus it is possible to adjust the pole pieces with reference to the diaphragm. The surface of the case is faced

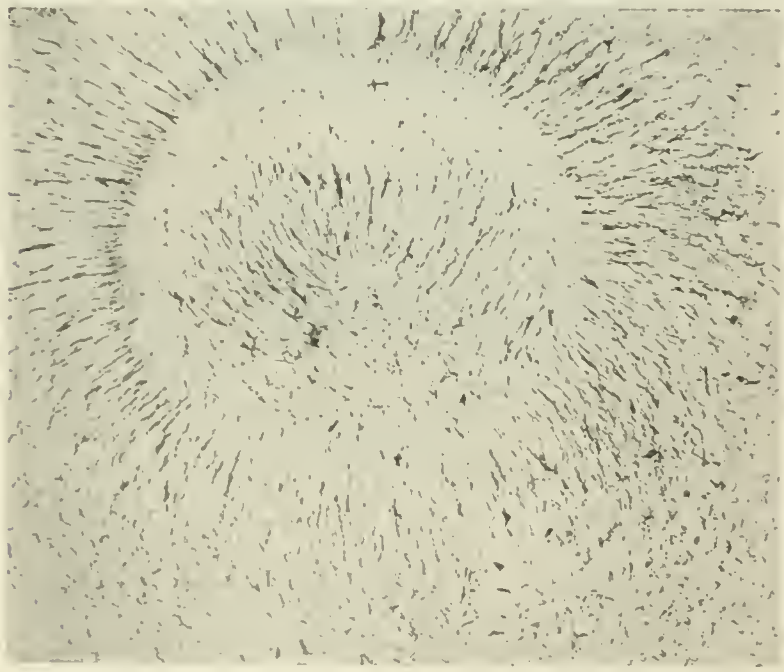


FIG. 63.—PHANTOM OF MANHATTAN WATCH-CASE RECEIVER WITH DIAPHRAGM IN PLACE.

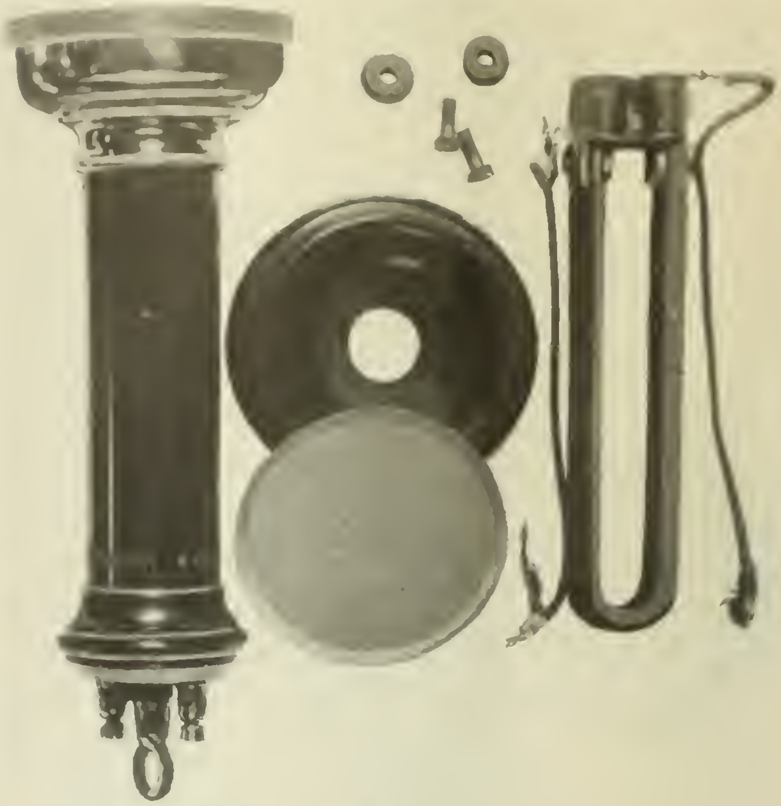


FIG. 64.—ERICSSON RECEIVER DISSECTED.

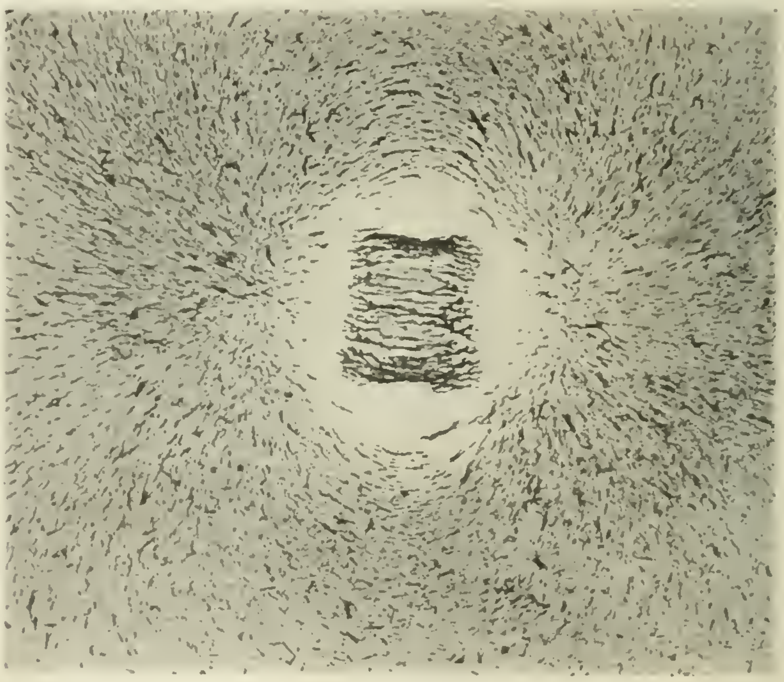


FIG. 65.—PHANTOM OF ERICSSON RECEIVER WITH DIAPHRAGM REMOVED.

off and the diaphragm by means of the cap clamped firmly upon the exterior of the shell. The leading-in wires are insulated with a double covered paraffined cotton. They are attached directly to the line coil wire and thence carried backward to the case and soldered to the binding posts. The diaphragm is flat, of tin .01 in. thick, 2.31 in. in diameter over all, giving 2 in. in free diameter. The phantoms of this model shown in Figs. 65 and 66 are noticeable. Fig. 65 shows a field that is exceedingly uniform and intense. The phantom of Fig. 66 is taken with the diaphragm in place and shows a uniform distribution of field and that the diaphragm is slightly above saturation.

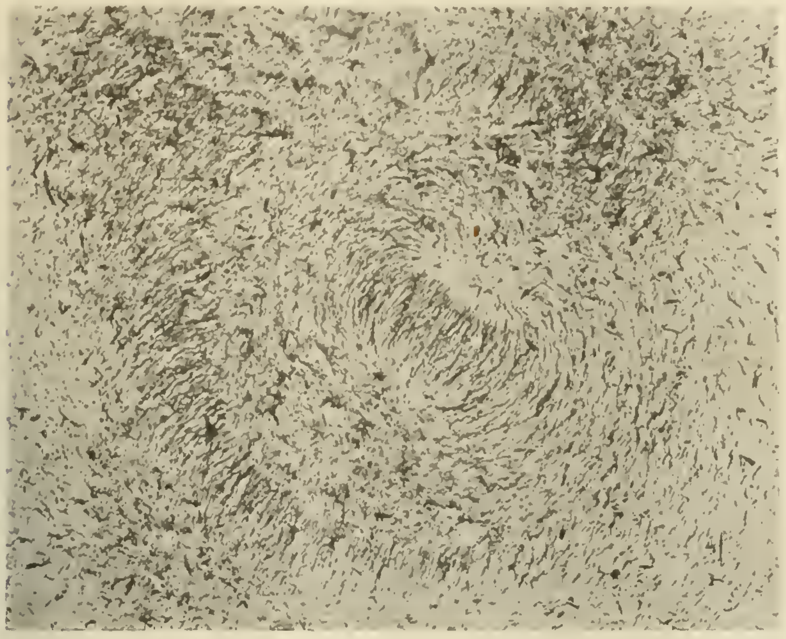


FIG. 66.—PHANTOM OF ERICSSON RECEIVER WITH DIAPHRAGM IN PLACE.

◆

Electric Trolley Lines in Germany.

A recent report from U. S. Consul H. W. Harris, Mannheim, Baden, deals with street-car lines in Germany. Recently published figures, he says, place the total number of miles of electric car lines in Germany at 2,117. Considering the area and population of the Empire, these figures show a comparatively slow development of this branch of railway building—this, too, in spite of the fact that in electric lighting and in other applications of electricity Germany had taken advanced rank. The cause of this backwardness is to be sought mainly in the fact of State ownership of the larger part of the existing steam railways, and the unwillingness on the part of city and other authorities to grant charters to private companies.

The Grand Duchy of Baden, a small part of the Empire, has an area slightly larger than that of the State of Connecticut, with a population somewhat more than twice as great. In 1900 it had five cities of upward of 40,000 population, namely, Mannheim, Carlsruhe, Frieburg, Pforzheim and Heidelberg. There were in 1900 fourteen cities of upward of 10,000 population. The State includes a thickly settled portion of the Rhine Valley about 160 miles long, with an average width of 10 miles, which would seem to be a specially good field for electric railway lines. And yet at present electric lines are in operation only in or near the following cities:

	Length of line. Miles.
Mannheim (including Ludwigshafen extension)................	25
Carlsruhe (including line to Durlach)	9
Heidelberg (including Heidelberg-Wiesloch line)	11½
Freiburg	8

The city of Kehl, Baden, is connected with Strassburg by a branch of the Strassburg city lines, but does not operate an independent line. Of the above lines, each belongs to the respective city except in the case of the Heidelberg city lines, which are operated by a private corporation, the city being the owner of three-quarters of the capital stock.

The fare charged carries with the distance long rides and transfers on a single fare not being permitted to the extent they are in the United States. The fare for ordinary distances is 10 pfennigs (2½ cents), tickets good for 25 rides being sold for 2 marks (48 cents).

A Proof of the Law for Grouping Cells to Obtain Maximum Current.

By E. Dana Pierce.

Suppose we have a circuit of known resistance, R, to which we wish to furnish current from a given number of similar galvanic cells (or other direct-current generators), each of an e.m.f., e, and internal resistance, r. To obtain the maximum current we must so connect the cells in series-parallel groups that the total internal resistance of the battery shall be as nearly as possible equal to R, the resistance of the external circuit. This principle is usually stated without proof in elementary text-books of physics. Its truth may be easily verified by trying a few test cases, and it may also readily be proved by the use of calculus. It is the purpose of this article to give a simple algebraic proof which is mathematically complete and also capable of being understood by any one familiar with simple algebra:

Let I = current.
e = e.m.f. of one cell.
r = internal resistance of one cell.
R = external resistance of circuit.
p = number of cells in each "parallel" set.
s = number of such sets in series.

Then for any given number of cells, n,

$$\text{Let } n = p\,s, \tag{1}$$

$$n = \frac{1}{k} \tag{2}$$

$$\text{Then } p\,s = \frac{1}{k} \tag{3}$$

$$p = \frac{1}{s\,k} \tag{4}$$

Now, by Ohm's law, we have

$$I = \frac{e\,s}{R + r \times \frac{s}{p}} = \frac{e\,s}{R + r\,k\,s^2} \tag{5}$$

It is to be proved that I in the last equation will be a maximum when $R = r\,k\,s^2$. (6)

To prove this by calculus we differentiate I with respect to s in (5), and obtain

$$\frac{d\,I}{d\,s} = \frac{e\,(R - r\,k\,s^2)}{(R + r\,k\,s^2)^2} \tag{7}$$

For a maximum value of I, the second member of (7) is put equal to zero:

$$\frac{e\,(R - r\,k\,s^2)}{(R + r\,k\,s^2)^2} = 0; \tag{8}$$

$$\text{or, } e\,(R - r\,k\,s^2) = 0. \tag{9}$$

$$R = r\,k\,s^2 \tag{10}$$

That is, the external and internal resistances must be equal for maximum current.

The algebraic proof of this proposition is as follows, using the same symbols:

In any case, the total *internal* resistance is

$$r \times \frac{s}{p} = r\,k\,s^2 \qquad \text{(from [4])}$$

Now, $r\,k\,s^2$ is either equal to R, i. e.,

$$R = r\,k\,s^2 \tag{11}$$

or $r\,k\,s^2$ equals R plus or minus some quantity, i. e.

$$r\,k\,s^2 = R \pm d. \tag{12}$$

Assuming first (11), we have

$$s = \sqrt{\frac{R}{r\,k}} \qquad (13)$$

and substituting this value of s into (5), we have $(r\,k\,s^2 = R)$.

$$I_1 = \frac{e\sqrt{\frac{R}{r\,k}}}{2\,R} \qquad (14)$$

But if we assume the condition of equation (12), then

$$s = \sqrt{\frac{R \pm d}{r\,k}} \qquad (15)$$

and from (5) we have the current value for this case $(r\,k\,s^2 = R \pm d)$,

$$I_2 = \frac{e\sqrt{\frac{R \pm d}{r\,k}}}{2\,R \pm d} \qquad (16)$$

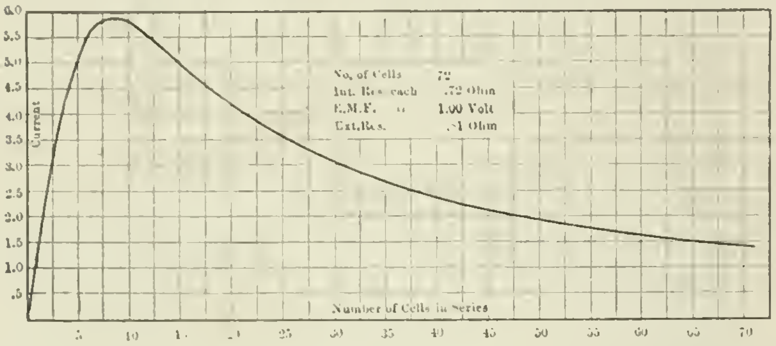
It remains to be shown that I_1 of (14) is greater than I_2 of (16). Expressing the ratio of I_1 to I_2 from (14) and (16),

$$\frac{I_1}{I_2} = \frac{(2R \pm d)\ \sqrt{R}}{2R\ \sqrt{R \pm d}}$$

$$= \frac{2\,R \pm d}{2\sqrt{R\,(R \pm d)}}$$

$$= \sqrt{\frac{4\,R^2 \pm 4\,R\,d + d^2}{4\,R^2 \pm 4\,R\,d}}$$

But here, since d^2 is essentially *positive* (that is, whether d is a plus or a minus quantity), the numerator of the fraction is greater than the denominator, and, therefore, I_1, the current value when the external and internal resistances are equal, is proved greater than the current value when they are unequal.



CURRENT CURVE.

The diagram gives the curve obtained by plotting the number of cells in series, s, as abscissæ, and I, current values, as ordinates for a given numerical case.

It will be seen from the curve that there is one and only one maximum value for the current, and that this is represented by the top of the curve where the external and internal resistances are equal, namely, .81 ohms.

It is also evident from the curve that the rate of decrease of current with changing number of cells connected in series is not the same on the two sides of the maximum.

A New Journal of Physical Chemistry.

The first issue has appeared, dated July, of the *Journal de Chimie Physique*, published in Geneva, Switzerland, under the editorship of Prof. P. A. Guye. In a list given of collaborators appear the names of Arrhenius, Berthelot, Curie, Duhew, Guillaume, Heroult, van't Hoff, Le Chatelier, Mond, Morley (Cleveland, O.), Nernst, Ostwald, Poincaré, and other names well known in chemical and physical science. The journal will appear monthly at a subscription price of 25 francs per annum.

A Possible Source for Securing Wide Speed Range in Direct-Current Motors.

By Albert F. Hemingway.

THE work of constructing an electric motor capable of wide speed variation was first attempted with the supposition in mind that the problem would consist in the use of greater bulk of copper and iron within the motor itself, as a substitute for foreign accessories, armature resistances, special systems, gearing, etc., now largely employed for obtaining speed changes, all of which are accompanied by undesirable complications more or less inefficient and expensive. I refer here, of course, to a motor in which the speed variations are accomplished by varying the magnetic density of the field magnets, the manipulation for such speed changes being accomplished by adjusting a variable resistance in circuit and through which the current passes to the field magnet coil. Preliminary determinations on the subject show at once the impossibility of obtaining a design productive of anything like a satisfactory range of variation. In fact, about all that is possible is being daily accomplished by a number of electrical manufacturing companies. I believe a speed ratio of two to one is about the practical limit.

The obstacles preventing results may readily be noted by the following summary:

First. Arcing at the commutator when the magnetic field is abnormally reduced, owing to distortion created by armature reaction.

Second. Under normal conditions of design, not sufficient cross-section of magnet cores to convey additional magnetism, even if provided for by field coils.

Third. Assuming normal proportions, if provision be made for reducing speed by increasing the density of the magnetic flux, field core dimensions, armature diameter and length must proportionately increase. Thereby each turn of wire upon the armature encircles a corresponding greater section of iron; and the effect of the armature current becomes greater in the same degree as the proportions have grown. So that in retaining torque, it will be found impossible to approach the maximum speed originally established without excessive arcing at the commutator; and altogether, so far as the per cent. of variation is concerned, very little is gained by increasing the normal proportions.

In any type of machine a definite ratio between armature and field magnetism, or the coil energy producing it, must be had to obtain satisfactory commutation, and as is readily observed from the foregoing, speed may be reduced, but not successfully varied.

It is true that there is in existence a large number of methods and auxiliary devices for counteracting armature reaction. The foremost and more important of these consists, in principal, of maintaining a powerful and permanent saturation at the polar extremities of each magnet pole, by suitably shaping the projections or through the use of auxiliary coils. These devices are familiar to all, and conform with the theory that at the point of commutation the current circulating in the armature is caused to change its course.

Where the work of reversal is forced by the commutator brush forming connection with the coil through the commutator bar, commutation is said to be poor, and worse if the coil undergoing reversal is at that moment within a field tending to excite an e.m.f. contrary in direction to the course the current takes in leaving the armature. Commutation is said to be best when the coil undergoing commutation is within a field tending to assist the reversal; in other words, the coil being within a field tending to excite an e.m.f. opposite in direction to that of the other coils in the advancing side of the armature. The function of these devices, as previously noted, is to maintain this proper shading or fringe of magnetism stable at the point of commutation, regardless of load or distortion taking place at other points of the polar surface.

Another method that has gained considerable attention is that applied in the Thompson-Ryan dynamo, wherein coils through which the armature current flows are suitably disposed upon the polar face of each pole. The magnetism created by these coils is opposite to that of the armature and is intended to counterbalance armature reaction. Primarily the aim of any of these inventions is to obtain arcless operation at the commutator with a fixed position of the brushes.

Between zero and full load of a dynamo or motor there is on the one hand a condition where armature reaction is at a minimum, and on the other a maximum: but it has become quite general with many dynamo designers to overlook any auxiliary methods for the suppresion of arcing at the commutator, the practice being to construct a massive and stiff field, offering little opportunity for distortion at maximum load, and consequently not in need of brush adjustment. Giving consideration to any such devices for use when speed is to be varied, by varying the field magnetism, records as to the satisfaction given would not warrant an expenditure of effort along these lines. The problem of building a motor or dynamo that will not arc at the commutator between zero and maximum load is, comparatively speaking, a simpler matter than the building of one in which this condition is not only to be maintained, but arcing is to be avoided between great variations of field density and speed.

After some study and searching as to the availability of any such existing device for the suppression of arcing at the commutator that could be used to advantage in variable-speed motors, the writer came across in the London *Electrical Engineer* in the issue of October 12, 1900, a contribution of some length entitled "A Continuous-Current Dynamo for Widely-Varying Voltage, Designed by E. Lanhoffe."

In this dynamo two or more magnet yokes are arranged in tandem common to a single armature, and it is claimed to have remarkable speed and voltage-varying characteristics. One of the field yokes is maintained at a maximum density, while the other is varied and capable of being reversed. A five to one ratio of speed or voltage variation is stated to be possible. Although the article is adversely criticised by the editors of the journal in which it appears, there is reason for expecting as good results with this method as with any other. One method at present on the market for varying speed by varying magnetic density, consists in adjusting by inward and outward travel the centers of the motors' poles or field cores, leaving the border fixed and in permanent relation with the armature, thus maintaining at the polar projections a saturated and stable fringe. By the preceding plan of double yokes, the results should not materially differ.

In the development of dynamo construction the tendency has been towards increasing the number of poles, and theoretical considerations demonstrate that an increase in the number of poles aids materially in obtaining arcless operation at the commutator. A machine having a large number of poles is capable of greater variations in field density without arcing than one of a lesser number; that is, assuming a machine of normal design and known capacity at maximum speed, to obtain speed reduction will require a corresponding increase in field core dimensions, and as previously noted, a larger armature with proportionate increase in armature reaction. If, however, this increase can be made to take the form of additional poles, the armature turns remaining the same in number, owing to the decrease of angular span of each armature coil, it does not encircle as great a section of iron, and consequently the armature reaction does not increase with the increased dimensions. A design to withstand considerable field strength variation is thus a possibility until the external dimensions reach an undesirable diameter, which follows from the fact that under ordinary circumstances diameters are much greater than length; and, therefore, can meet with but limited success where symmetry of outside proportions are to be normal.

Multiplying the number of poles by arranging yokes in tandem has the advantage that each yoke is only susceptible to the armature reaction of that portion of the armature enclosed by it, although, where the yokes are doubled, armature length and reaction are doubled. Once the best design has been arrived at for a single yoke, the question remains whether there is anything to be gained by adding the second yoke.

It is self-evident that by the addition of a second yoke, equivalent in magnetic density to the first, the speed would be reduced one-half. By varying one of them to zero, the speed is brought back to that of one, and by reversing the polarity, the counter e.m.f. of the armature is reduced, because of the reverse field, and the speed increases as a result. The complications arising at this stage make it difficult to predetermine without tests as to what effect this combination would have upon arcless operation.

If one of the yokes has its poles shaped and situated for the best operating conditions with respect to commutating fringe, the poles of the yokes undergoing varying densities will take a central position well within the boundary of the polar prospections of the other. That is, the magnetic flux of the yoke undergoing change and reversal enters the armature at a point midway between the armature coils undergoing commutation, being so applied as not to interfere with the magnetic fringe for proper commutation established by the first yoke. If the poles of both yokes to be alike, when operating with one reversed, the distortion due to armature reaction arises from a peculiar influence. It would appear, assuming it a possibility, to reach the condition where the poles of each yoke are oppositely energized, when the commutating fringe would take an ideal position because of the counteracting influence of the two divisions of the magnetic circuit.

The foregoing is in line with the type of construction conceived by the author to satisfactorily meet the conditions of reasonable speed variation in direct-current motors, and is offered as nearest to any in producing fruitful results.

An electric motor capable of giving a wide range of speed is a great necessity. If it can be attained without freakish and elaborate designs it will be gladly received by a large percentage of motor users. We can safely assume that so long as the applied magnetic field maintains stable relations with that portion of the armature winding undergoing commutation, arcing during commutation is a minimum, regardless of the varying density within this polar border.

A notable instance of a design of pole in which this method takes direct form is one referred to among others under the heading of "methods for counteracting armature reaction in direct-current dynamos" in the work of Sylvanus P. Thompson, wherein each pole is provided with three energizing coils. A large shunt coil with coils connected in series with the armature circuit is placed upon the upper and lower polar propections. By means of these polar divisions, the portions constituting the polar propections are maintained saturated, and consequently retain a powerful fringe at the proper point for commutation, no matter what the variations and load may be, or what distortion due to armature reaction befalls the larger middle pole. It is not necessary to point out the limitations of this arrangement for extensive speed variation, although the difference between this and the preceding plan, that of double yokes, is one of adopting the same underlying principle to greater structural advantage in the case of the double yokes.

The type of construction conceived by the author utilizes a second magnetic yoke, also a second armature, both armatures being common to the one shaft. The second armature may be considerably narrower than the first, and the ratio between armature and field ampere-turns need not be great. The windings of both armatures are connected in series at each armature coil, employing only one commutator. The field poles of the second yoke are calculated to take a central position well within the commutating border of the poles of the first yoke. Owing to the large number of turns on the second armature, a comparatively small field is needed, which is varied and reversed for speed variations. The first or main yoke is massive and calculated in itself to have, so far as it is possible, characteristics conducive to arcless commutation within speed and load variations, by means of a high ratio between armature and field ampere-turns, a maximum number of poles, and a compound field winding in addition to the shunt.

The secondary division of the motor is entirely relied upon to give the speed variations by varying and reversing its field, its functions being similar to the interposition of an external generator, generating a variable and controllable e.m.f. motor force, commonly known as the booster or teaser method, but with less apparatus.

Development in Cuba.

A recent report to the U. S. State Department from Cuba gives the revenue from posts and telegraphs from May 20, 1902, when the Republic was established, to December 31, as $279,470. As to water power development, it is said: Water power has been very little employed in Cuba, although a great many rivers and creeks of considerable capacity exist to supply power. The Almendares River, which passes through the outskirts of Habana on the west side, supplies the city and suburbs at present with 1,200 hp for a paper mill, brewery, and other turbines already established of 250 hp each. By going farther up more power may be obtained without causing great damage to the others below. Mayabeque River, in Guines, Province of Habana, was, until a few years ago, supplying power to run two sugar plantations. The water employed then is now used in irrigation. In the San Juan River, Matanzas, there is a turbine established to run an ice factory. Water power is not known to be used anywhere else in the whole island.

High-Speed Electric Railway Work in Germany.

The fact that in the renewed trials on the Marienfelde-Zossen military railroad an electric car made a speed last week at the rate of 118 miles an hour, gives special interest to the subjoined details of the plan under which the experiments are being carried out:

The Studien Gesellschaft fur Elektrische Schnellbahnen (which is the name of the German corporation which has financed and conducted the high-speed trials), has just issued its third report, covering the year 1902. The board of directors consists of 18 members, among whom are Ernst Borsig, the chief of the great Borsig works, Geheimrat Moritz Lochner, Geheimrat Emil Rathenau, general manager of the Allgemeine Electricitats Gesellschaft, now in this country; Adolf Schmidt, director of Friedrich Krupp, Essen; Wilhelm von Siemens, Prof. Adolf Slaby, and Geheimrat R. Ulbricht, president of the German Association of Electrical Engineers. The technical board consists of 20 members, many of whom are engineers of international reputation.

The report reads, in effect, as follows: "As already mentioned in our last annual report, the Prussian Secretary of Public Works (Minister der Öffentlichen Arbeiten) has offered to supply the new rails required for the construction of a more solid road on the experimental line. In order, however, to obtain a road which shall be sufficiently solid to stand even the highest contemplated speeds, it was considered necessary to renew also the whole roadbed and to provide the greater part of the experimental line with a guide rail on the inside of each of the two running rails. This programme required a considerable expenditure, estimated at $75,000. As the members of the Studiengesellschaft had already been assessed for an extra 50 per cent. above the original capital, the association was unable to raise this money. The more credit is, therefore, due to the Prussian Secretary of Public Works, who, on the request of the Studiengesellschaft, placed the above sum in the budget of the Prussian Railroad Department for 1903, and to the Prussian Parliament, which voted a grant of this sum. Thanks are also due to the Prussian Secretary of War (Kriegsminister) who has permitted the construction of the new roadbed by the Eisenbahn Brigade (a corps of the German army specially trained in erecting railways and in general engineering work).

"Under these circumstances it was not possible to make trial runs at high speeds during the last year, and the time was spent to advantage for other purposes. Preparations were made for the coming experiments; the designs of the high-speed railroad cars were improved on the basis of experience gathered from previous trials; experiments were also made with a three-phase locomotive, built by the Siemens & Halske Company, with high-voltage motors, and a larger number of trial runs were made with the high-speed cars. The experiments with the three-phase locomotive have shown that it is possible to build motors to take current direct from the 12,000-volt, high-pressure mains, thus making it unnecessary to carry heavy and expensive transformers on the cars.

"Although on account of the lightness of the rails no higher speed than 125 km. (74 miles) per hour could be attempted in the former runs with the high-speed cars, yet it was possible to make with the lower speeds detailed tests and investigations of the electric equipment of the cars, of the resistance of the cars, of the air resistance and the most favorable form for the front walls of the trains, as well as measurements of the electric power, the lateral oscillating vibrations of the cars and the effect on the rails. The results of these experiments offer a valuable basis for devising the plan of the runs on the new roadbed and for the design of new high-speed cars.

"For the trial runs on the new roadbed the original intention was to provide both cars with eight-wheel trucks; when the design was worked out in greater detail it was found, however, that to make the eight-wheel trucks effective, they would have to be given dimensions for which the space below the cars was not sufficient. It was, therefore, decided to employ six-wheel trucks instead of eight-wheel trucks; the final design having been chosen according to a decision of a sub-committee of the board of directors, in agreement with the electric manufacturing companies and Messrs. van der Zypen & Charlier. The former, who had promised to provide the cars at their own expense with eight-wheel trucks, have agreed to do the same with the six-wheel trucks. The new trucks are being built and it is hoped that in the trial runs to be made during the summer of 1903 on the new roadbed, a speed of 200 km (120 miles) per hour will be reached."

The above is all the technical information contained in the report. Concerning the financial situation, it is stated that the expenses in 1902 consisted of general expenses, the purchase of measuring instruments, the maintenance of cars, road and electric transmission line, etc. The exact amount of these expenses for which the board of directors has granted $12,500, cannot yet be given, but it is thought that the expenses have not been beyond the amount granted. According to the report the former expenses were as follows:

	$287,500
General expenses to end of March, 1903	10,250
Expenses for trial runs in 1902	12,500
Total expenses up to date	$310,250
The original capital with 50 per cent extra assessments was	$281,250
Income in interest up to date	2,500
Total	$283,750

Under the assumption that about $50,000 more can be made available, the difference between $333,750 and $310,250, i. e., $23,500, is at the disposal of the Studiengesellschaft, and it is believed that this amount will be sufficient to finish the experiments this year.

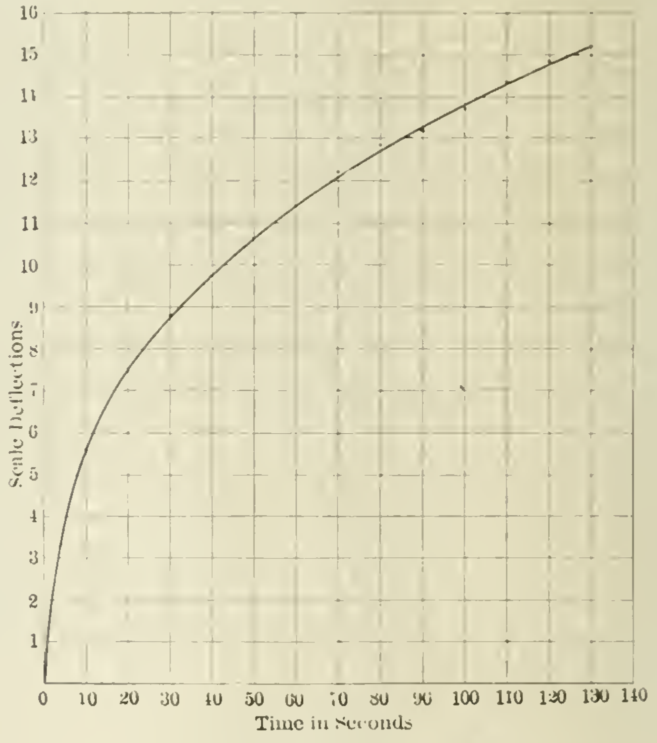
It would appear from the cable dispatches that the high-speed run noted above was made by the Siemens-Halske locomotive, taking current directly from the feed wires at 13,500 volts.

Residual Charge of a Condenser.

BY J. J. CORT.

In the ordinary theory of the condenser the charge is assumed to be strictly proportional to the charging e.m.f. This simple proportionality, however, is not strictly true, for there is a "soaking-in" and "soaking-out" effect in charging or discharging a condenser which is analogous to the elastic lag of glass.

When a given constant bending force is applied to a glass rod the rod will take a large bend promptly and then for several hours the bend will increase very slowly; or when a bent glass rod which has been subjected to a given constant bending force is released, the rod will quickly become very nearly straight, and then for several hours slowly settle into its unstrained condition.



CURVE OF DISCHARGE DEFLECTIONS.

In an exactly analogous way when an e.m.f. is connected through a low-resistance to a condenser, there will flow into the condenser a sudden pulse of current which quickly drops to a very small value, continuing for several hours and gradually falling to zero. (In this statement the very small leakage current due to imperfect insulation of the condenser is ignored.) This lingering current may be termed the "soaking in" current. Or when a charged condenser is connected to a low-resistance discharging circuit, there will flow out of the condenser a sudden pulse of current which quickly drops to a small value, continuing for several hours and gradually falling to zero. This lingering current may be termed the "soaking-out" current.

In any ordinary commercial condenser the value of this lingering current that flows during the "soaking-in" or "soaking-out" period is too small to be measured directly; but if a charged condenser is momentarily connected to a low-resistance discharging circuit and then insulated, the "soaking-out" current will accumulate in the condenser, constituting a residual charge. The value of this charge may be observed by discharging the condenser a second time through a ballistic galvanometer.

In obtaining the data for the accompanying curve, a two-microfarad condenser was used, this condenser being charged by connecting it for five minutes to five small dry batteries in series. The condenser was then discharged by connecting it for a moment to a low-resistance discharging circuit of seventy ohms, after which it was allowed to stand insulated for ten seconds, when it was discharged a second time through a D'Arsonval galvanometer and the deflection observed. This same process was repeated a number of times, except that the time during which the condenser was allowed to stand insulated before the second discharge was varied, being increased by ten seconds each time.

The Institute's New President.

Following are the remarks of Mr. Bion J. Arnold upon assuming the presidency of the American Institute of Electrical Engineers:

The remarkable development and growth of our body during the past two years has introduced many new elements which must stand the test of time and possibly be tried in a period of financial depression. Our energies, therefore, should be directed toward carrying forward the work, so well started by my predecessors, upon conservative lines which will insure its permanency and result in the greatest good to the Institute:

1. For obvious reasons, our recent great rate of increase of membership cannot continue indefinitely, and our expenditures should, therefore, be gauged to meet this condition.

2. Our local chapters should, if possible, be made to last after the enthusiasm, born of novelty, has worn off, which implies encouragement from headquarters and sustained effort on the part of the local members.

3. The work of our special committees in connection with electrical engineering standardization and the collection of technical data should be encouraged, and additional committees appointed to extend the work in other promising directions.

4. We should allow the authors of papers more time for presenting them, and our members more time for their discussion, even, if to accomplish this, we are compelled to have fewer papers.

5. Contributions making provision for our interest in the land for the Engineering Building should be placed in a separate fund, which should be set apart from all other Institute funds, and to which should be credited all funds for building purposes now on hand, and subsequently received for such purposes, from donations or from the sale of bonds or other securities.

6. Our library fund should also be carried as a distinct fund, and all donations and appropriations for library purposes credited to it; all expenditures for library purposes to be debited to this fund.

7. On account of the International Electrical Congress to be held at St. Louis in 1904, we shall be called upon not only to contribute to the scientific value of this Congress, but to receive and entertain many distinguished guests and members from foreign countries. Our plans should, therefore, be so well and broadly laid and executed that our guests shall return home not only fully repaid for their visit among us, but shall also feel that the splendid hospitality which was shown us as a body on our trip abroad in 1900, and to our individual members before and since, has been fully appreciated.

8. Our relations with the other large engineering societies of this country have, during the past year, become more intimate, and we are now about to join with them in the ownership and membership of a union engineering building, which shall meet the ends of all. The general preliminaries have been perfected, and the work of the coming year will consist in the crystalization of the plans and the originating of definite means and methods for raising funds and for promoting the material progress of the work.

I trust we may be able to carry to a successful conclusion the work so splendidly initiated by my predecessor, Mr. Scott, and his able lieutenants, and in such a manner as not only to retain but to heighten the respect and good will of those who may co-operate with us; and by the adoption of rational methods and the exercise of good business judgment in carrying on the work, insure that the generous gift of Mr. Carnegie to the engineering profession shall be ideally, and in its material culmination, all that he hoped it would be.

I wish to express my appreciation of the confidence you have shown in me by placing me at the head of this Institute, the youngest, yet one of the most progressive, of the several great engineering bodies of this country. I sincerely thank you, and I feel that you will accord me such harmony of action and support that the coming year may be of the greatest benefit to our membership, and add in some slight degree to the prestige of the engineering profession at large.

Electric Moving Platforms for New York City.

The Extensions Committee of the New York Rapid Transit Commission has recommended that approval be given the plan of the Continuous Transportation Syndicate for a moving platform system through a tunnel in New York and then across the Williamsburg Bridge. The moving platform idea is already familiar to our readers, and the present scheme has already been noted in Electrical World and Engineer.

The tunnel in Manhattan will be divided into two sections by a partition, so that trains will run in but one direction in each. The tube itself will be little larger than those now being constructed for the subway. Electricity will be the motive power.

The wheels are not to be on the cars themselves, but are to be stationary. The rails, instead of the wheels, will "run." There are to be three platforms. A passenger getting aboard would step from the station platform onto the first, which is going one-third as fast as the third, whereon are the seats. Then he would step from the first to the second, going in the same direction, but a third again as fast as the first. From the second he would step to the third and last, which is made up of many short cars so closely joined together that they form a single train, and it would be difficult to see the separate sections. The seats are to be crosswise of the car, as at Chicago in 1893, so that the passenger will always be facing the direction of the motion of the train. They will be about three feet apart, and each will seat three persons comfortably. When a passenger approaches a station at which he wishes to get off, he steps from the third platform to the second, and sees the seat in which he sat speed on ahead. Then he steps to the first and finds himself hardly moving. When the station is reached he alights.

For those who might lose their balance, standards or posts will be fixed at points on all of the platforms as at Paris in 1900; when there were no seats provided.

The seats, being three feet apart and holding three passengers, will mean one passenger for each lineal foot. When the platforms are moving at, say, nine miles an hour, and that is a fair average and one perfectly possible, the line could carry 47,520 an hour—nine times the 5,280 passengers in the mile.

In the present plans for the tunnel and trains it is the purpose to use nothing inflammable except the wooden backs of the seats; and steel may be substituted for the wood there when it comes to the construction. The dynamos and all of the wires are separated from the passenger tunnel by a thick wall of concrete.

A modern system of artificial ventilation will be installed which will provide fresh air for the tube, and, in case of the burning of a wire or dynamo, the offensive odors would be carried out of the tunnel immediately. The lighting plant will be separate from the motive power, so that an accident to one would not affect the other. Along the side of the tunnel, below the platforms, and on a level with the dynamos will extend a small passageway for inspectors, who will be on watch all the time for trouble. The wheels and all of the machinery are to be reached from below, so that repairs can be made without interference with the platforms or passengers.

The stations will be similar to those being built for the subway, with guards to give any aid required. No attendants on the trains would be necessary. The fare, it has been tentatively determined will be 3 cents for a single ticket and 5 cents for two.

It is expected to complete the line from Battery Park across the Williamsburg Bridge in about two years, although it may be done in less time. The first section of the tunnel will extend from the bridge to a convenient point a short distance from there, perhaps at the Bowery, which the engineer thinks could be in operation within a year after the work was begun. At the next meeting of the Board of Estimate and Apportionment, it is understood, it will be decided what portion of the new bridge the moving platforms shall occupy.

A Suggested Hydraulic Unit.

At the September meeting of the American Institute of Electrical Engineers, Mr. Ralph L. Montagu suggested the creation of a new unit for the measurement of water power. There is at present in use on the slope a unit of measurement of the flow of water known as the "Miner's Inch." The legal definition of the means of measuring this volume varies so much in different States that the actual flow of legal miners' inches is from 1.30 to 1.73 cu. ft. of water per minute. For this reason a miner's inch unless the cubic feet flow per minute that it represents is specified, can be dispensed with. On the other hand formulæ relating to horse-power of water are based on the number of cubic feet of water per minute, or gallons, under a certain head; that is, the vertical distance of fall. Mr. Montagu suggested that a new unit composed of one cubic foot of water per minute under one foot head be recognized and a name for it suggested by the Institute. This unit would equal 62.3808 ft. lbs., or .00189 hp, or 1.40994 watts.

An analogy can be drawn between this unit and the watt, inasmuch as the head in one is similar to volts in the other, and the cubic feet of water per minute takes the place of amperes in the other. The following formula for horse power of water is based on this unit or its equivalent value, viz., .00189 hp.

$$\text{Horse-power} = \frac{\textit{Cubic feet of water per minute} \times \textit{head in feet}}{K} \qquad (1)$$

$$K \text{ for any efficiency } x = \frac{52900.8}{x} \qquad (2)$$

Mr. Montagu gave the following example of the use of the proposed unit:

A water power consists of a flow of 3,700 cu. ft. of water per minute, with a total available head of 763 ft. There are the following losses due to friction resistance, etc., viz.:

5 per cent. loss of head from friction in pipe line.
15 per cent in prime motor.
3 per cent. in generator.
3 per cent. in step-up transformers.
10 per cent. in transmission line.
3 per cent. in step-down transformers.
2 per cent. in low-tension wiring.
6 per cent. in motors.

Required total horse-power available at motor pulleys:

Total efficiency = 100 × .995 × .85 × .97 × .97 × .90 × .97 × .98 × .94 = 63.12.

$$K = \frac{52900.8}{63.12} = 838 \qquad (2)$$

$$\text{horse-power} = \frac{3700 \times 763}{838} = 3368 \text{ hp available at motor pulleys.} \quad (1)$$

The following table gives values of *K*, based upon water of specific gravity of 1, one cubic foot of water weighing 62.3808 pounds:

% Efficiency.	K.	% Efficiency.	K.	% Efficiency.	K.
94	562	79	669	64	826
93	568	78	678	63	839
92	575	77	687	62	853
91	581	76	696	61	867
90	587	75	705	60	881
89	594	74	714	59	897
88	601	73	724	58	912
87	608	72	734	57	928
86	615	71	745	56	944
85	622	70	755	55	961
84	629	69	766	54	979
83	637	68	777	53	998
82	645	67	789	52	1017
81	653	66	801	51	1037
80	661	65	813	50	1058

In discussion of Mr. Montagu's paper, Mr. C. O. Mailloux said he considered that the author has performed a service, not so much in suggesting the adoption of a new unit of measurement, but rather because he brings forward quite forcibly an additional good reason why we should adopt and use the metric system. Proceeding, he said that if we think of this matter in metric units, we will see at once how simple it becomes, and we find that, in reality we do not need to complicate the unit system and burden it by additional names. According to the metric system a cubic meter of pure water (or, for practical purposes, clean water), weighs 1,000 kgm. or a "metric ton," while a cubic decimetre of water, being the thousandth part of a cubic metre, weighs exactly 1 kgm. We also find that 75 kgm-metres per second equal one "metric" horse power, while 76 kgm-metres per second equal one "English" or "American" horse-power (33,000 ft. lbs. per minute, or 550 ft. lbs. per second). With these data we have all that is necessary to enable us to make readily and quickly any calculations whatever relating to water power. We have our horse-power unit already, and as it is the same for water power as for steam power, namely, 75 kgm-metres per second. We take the volume of water flowing, in cubic metres per second, multiplied by the height through which it falls in metres, and we have kilogram-metres per second direct; and if we divide that product by 75, we have the result at once in metric horse power. If we divide it by 76 we have the result in standard American horse powers, each equal to 33,000 ft. lbs. per minute. Again, let us remember that the kilowatt is, in round numbers, a little over one third of one horse power, or 76 kgm-metres per second, for English horse-power units (1.34 times greater to be exact), also not far from one-third of 75 kgm-metres per second for metric horse-power units (1.358 times greater to be exact). We then see that the kilowatt is equivalent, in round numbers, to 100 kgm-metres per second. (To be exact, it is equivalent to 101.8 kgm-metres per second. Nothing could be easier to remember and to apply. It seems that if the committee of French savants appointed at the time of the French revolution, or over 110 years ago, to work out this question, had sought to devise a system intended to be of special use to water power measurements, they could scarcely have done it more successfully. We have here another of the many ways in which the metric system shows its adaptability to various purposes, and its superiority to all other systems.

In conclusion, Mr. Mailloux said that aside from the possible (he was going to say doubtful) value and utility of the present paper in proposing a substitute for and an improvement upon the "miner's inch" to miners in the West who are accustomed to the old nomenclature, its greatest utility is in the lesson which it contains to the effect that we cannot too soon abandon the old-fashioned system of measurement and adopt the metric system, where there is a well-known definite, rational relation between the specific gravity of water, and measurements of length, area and volume. Instead of trying to patch up the antiquated system with another "unit" which, at best, would be only a name for a string of figures, why not do the more sensible thing of adopting a system which obviates altogether the necessity for any like unit? The remarks of Mr. Mailloux were received with much applause.

New York State Street Railway Convention.

The twenty-first annual convention of the New York Street Railway Association will be held at the Yates House, Syracuse, on October 6 and 7. The executive committee is very desirous to have a large attendance, and has requested the announcement to be made that supply men are particularly invited and will be rendered a cordial welcome. There will be space provided for small exhibits in the writing room and rotunda of the Yates Hotel. Applications for space should be addressed, with full particulars, to Philip J. Honold, care Syracuse Rapid Transit Company, Syracuse, N. Y. The Syracuse Rapid Transit Company has made a number of improvements in its system during the past two or three years, so that the engineer will find a great deal to interest and instruct him in a study of the street railway system.

The general programme of entertainment of the convention delegates has been drawn up under the direction of Mr. Connette, the general manager of the Rapid Transit Company, and is a most attractive one. It includes trolley rides and luncheon for the ladies; tally-ho ride to the Onondaga Indian Reservation and Green Lake Park; the annual dinner, which will be held at the Yates House; a trolley ride to Edward's Falls, for the ladies; a trip to Skaneateles and a Bohemian luncheon and dancing at Long Branch.

As soon as the guests arrive at the hotel and register, a badge will be supplied by the Association, which will entitle the wearer to free transportation during the convention on the lines of the Syracuse Rapid Transit Railway Company, the Auburn & Syracuse Electric Railway Company, the Syracuse, Lakeside & Baldwinsville Railway Company and the Syracuse & Suburban Railroad Company.

New Telephone Patents.

NEW TYPE TELEPHONE LOCK.

Many telephone locks have been patented during the last year or two embracing more and more simple coin-controlled hook switch locks. These locks have all been adapted to be so mounted that their bolts would secure the hook switch in the depressed position until the deposit of the required coin. All have had the same defect, namely, that in case the hook switch, once released, is depressed either accidentally or for the purpose of calling the operator, the bolt at once secures it until a second coin is deposited. Mr. W. H. Scott, of St. Louis, has, therefore, departed from this type of lock, transferring the control from that of the switch lever to that of the receiver itself. To this end a star wheel is arranged partially within and partially without the lock case. This star wheel will take the small end of a receiver between its teeth and when the lock is so mounted that the exposed star wheel teeth when in the locked position are at right angles to the hook switch prongs, the receiver may be secured from removal from the hook. When the star wheel is released the removal of the receiver for calling or conversation is accompanied by a rotation of this wheel. The means for securing the star wheel against rotation is a latch which is adapted to be raised by the deposit of a coin or by auxiliary electromagnetic devices under the immediate control of the owner of the premises where the telephone is located. The lock is so designed that it is impossible to place the receiver upon the hook without its making proper engagement with the star wheel, and lest the receiver be accidentally locked off the hook, the latch is single-acting, securing the star wheel against forward rotation only. Mr. Scott's patent has been assigned to the Controller Company of America.

A MEMBRANOUS DIAPHRAGM TRANSMITTER.

Few persons expect to see transmitters with membranous diaphragms patented at this late date, yet such a transmitter is the subject of a patent issued to Dennis O'Brien, of Limestone, N. Y. This transmitter is truly of a freak type, as it is designed as a microphonic magneto-multiplying transmitting combination. It is also suggested by Mr. O'Brien as a repeater. A sectional view of the apparatus is shown in Fig. 1. Over an insulating frame is stretched a rubber membrane diaphragm with its edges held beneath an adjustable strain ring forming part of the mouthpiece. To the center of the diaphragm a disc of ferrotype metal is attached, forming a movable armature for the induction coil core secured immediately beneath. Resting against the ferrotype disc is the end of a lever, which is fulcrumed at its farther end, and which is threaded through the eye of a short needle. The needle rests in the cup of the adjusting thumbscrew. The fulcrum, needle eye and cup contacts form the microphonic contacts, these several parts being oxidized "to increase their microphonic power." The primary induction coil circuit includes these contacts, while the secondary passes to the line. The motion of the ferrotype disc affects the secondary circuit by direct magnetic influence and also by varying the primary resistance through the microphone. Furthermore, as these two effects are interdependent, a multiplying of some sort should take place, but exactly what this multiplying will result in is certainly hard to predict in the absence of an actual test.

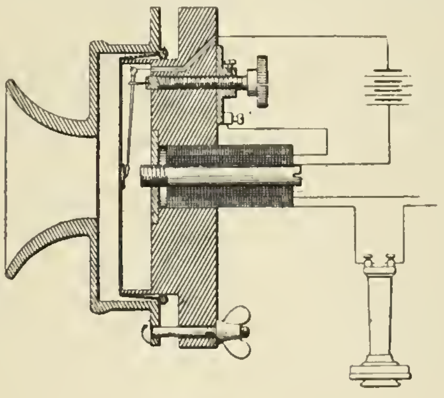


FIG. 1.—O'BRIEN TRANSMITTER.

INSTRUMENT NOVELTIES.

A peculiar arrangement of subscriber set is the subject of a patent granted to M. S. Voight and assigned to the Voight-Berger Company. The talking instruments are of the hand microphone type and are attached to a long cord. This cord issues from a magnetic case passing through a weighted idler and thence over a pulley secured by a ratchet device to the magneto drive shaft. When the hand microphone is drawn toward the user, the passage of the cord over the pulley drives the generator to signal central.

A very compact arrangement of subscriber's wall set is the invention of W. Kaisling, of Chicago. Fig. 2 shows a view of the backboard, with the cover box turned down. A metallic bridge spanning the condenser carries the induction coil, terminal block, hook switch springs and a stud for the hook switch. This stud riveted in the bridge is provided with an annular groove into which a slotted locking plate can slide to lock the lever in the stud. The locking plate in turn is secured in position by a shoulder of the screw which serves as an arbor for the spring actuating roller.

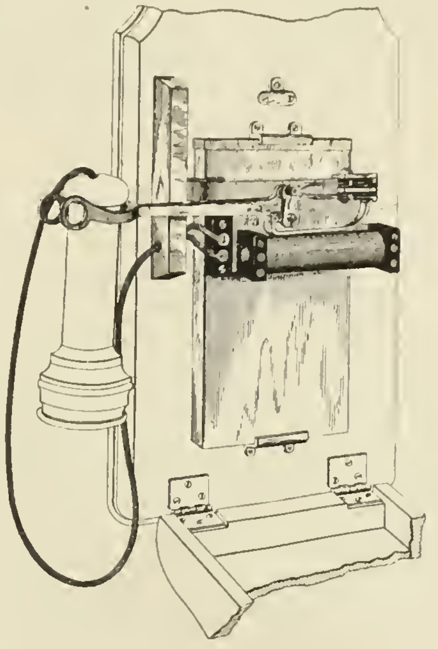


FIG. 2.—KAISLING TELEPHONE SET.

Mr. Kaisling has also obtained a patent for a receiver cord tip. This tip is in two parts, the outer being the tip proper, while the inner is a sheet metal bushing formed up about the end of the conducting cord strand in a manner such that not only does it hold the wires together, but it also secures the braiding from fraying within the end of the tip. Mr. Kaisling has assigned both his patents, the first to the Stromberg-Carlson Company and the second to the Kellogg Company.

A substitute for the secondary cut-out button is a transmitter diaphragm damping device and is patented in the shape of a push button in the transmitter face, which may be pressed against the diaphragm. It is of very doubtful utility, however. The patent for this device is granted to H. D. Stroud, of Chicago.

The receiver holder again appears in a patent issued to E. J. Murphy, of Crandall, Tenn. This seems to have no advantages over, but retains all the defects of, its predecessors.

LIGHTNING ARRESTERS.

Three protecting devices for telephones which have recently been patented are a thermal cut-out invented by G. E. Hoglund, of Chicago—a carbon plate arrester, the work of John Davis, of Sterling, Ill., and a line opener by B. W. Holdridge, of Trenton, Mo. Mr. Hoglund's heat coil is wound upon an insulator having a reduced section. When the coil heats the insulator softens and is pulled apart by the tension of the spring terminals. As the terminals part, the coil end is separated from one terminal by the spring tension. The invention in the carbon plate device lies in serrating the lower carbon to facilitate the falling of dust from between the ground and line elements after a discharge. The line opener is a device having the general appearance of a large safety pin. The end of the line wire is looped and passed over the pin point and normally clasped within the pin. The retaining hook of the pin is rotatable about its longitudinal axis, and is under the control of the operator through a string passing to his premises. When a storm arises a pull on the spring releases the pin which action causes the line wire to fall to earth.

CONTACT RELAY.

A contact relay was discussed some months since in these columns in which adjustment for operating limits was secured by varying the air gap of the magnetic circuit without varying the position of the armature. In this relay a screw pole extension was arranged in the end of the core. This screw adjustment has now been transferred from the core to the armature itself, at the hands of C. M. Hedman. Fig. 3 shows a sectional view of the relay, which is self-explanatory.

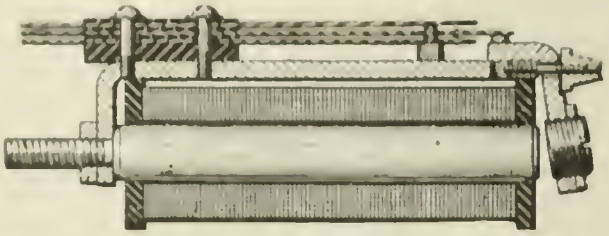


FIG. 3.—HEDMAN CONTACT RELAY.

A CRUDE SWITCHBOARD CIRCUIT.

Most all switchboard circuit inventors are working toward a simplification of the common battery switchboard. The latest patent for a simplified system is that granted to S. A. Duvall, of Chicago. This is a two-wire jack system in which, while separate talking and signalling batteries are used, a cut-off relay is dispensed with. Unfortunately, the circuit shown in the patents seems to be inoperative, as the line signal relay is cut out by short-circuiting, its operating battery being thereby placed directly across the line. This, of course, effectively short-circuits the line to talking currents.

SELF-TYING INSULATORS.

Two types of self-tying insulators are shown in Fig. 4. The right-hand one, in which the line wire is to be fed by a twisting motion through curve slots into a transverse aperture, is the invention of W. G. Rutledge, while the second, with the screw cap, is patented by H. Bottjer.

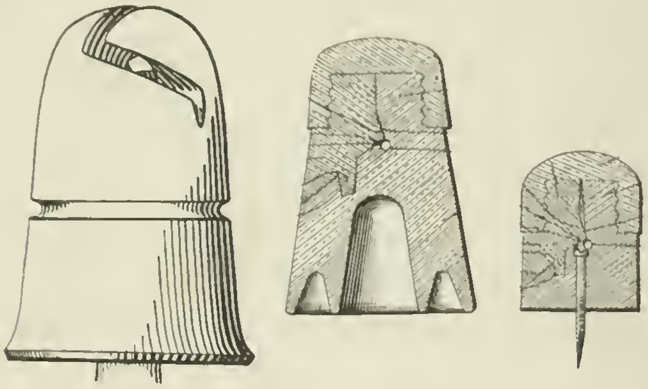


FIG. 4.—RUTLEDGE INSULATOR.

SELECTIVE SIGNALLING POLE CHANGER.

The final patent at hand for consideration is that for pole changer granted to T. W. Warner, of Muncie, Ind., and assigned to the Warner Electric Company. This pole changer requires an operating and a ringing battery. The first keeps the switch arm vibrating continuously, while the second, connected to the arm and various switch springs between which the arm vibrates, sends out independent circuits, positive impulses, negative impulses and alternating impulses.

British Trolley Commission.

The Royal Railroad Commission appointed to study the American street railway systems with a view toward bettering the conditions in Great Britain, arrived in New York on Saturday last on the White Star line steamship *Arabic*. The commission consists of Sir David Barbour, K. C. M. G.; George S. Gibb, director and general manager of the Northeastern Railroad; Lord Ribblesdale, and Sir John Dickson-Poynder, Bart., M. P. No definite plan has been determined upon for the commission to follow out, but an investigation will be made of every branch of American street railroading. Three weeks will be spent in New York and Boston. Hearings will begin in New York this week.

Latest Bell Telephone Statistics.

The American Telephone & Telegraph Company has lately issued $22,000,000, the subscriptions upon which became due last week, and are understood to have been fully taken up. The company has filed the subjoined report with the New York Stock Exchange:

The American Telephone & Telegraph Company requests the admission to the regular list of the New York Stock Exchange of 219,432 additional shares of its capital stock offered to its stockholders, and of 70 shares withheld from previous applications. The authorized capital stock of the company is $250,000,000. Its issued capital stock is now $136,826,600, of which amount the listing has been authorized of $109,702,200; $56,900 of that offered in 1902 have not yet been issued; $27,117,400 are held by the American Bell Telephone Company. In our application of June 18, 1903, it was stated that 271,244 shares were held by the American Bell Telephone Company, of which that company has since that date exchanged 70 shares for shares of its own stock. Application is now made for the listing of these 70 shares as above stated.

In addition to the amount of capital stock above named as now issued, the company has in a circular to its stockholders, dated June 15, 1903, offered for subscription 219,432 shares of stock ($21,943,200), to be issued in October, 1903, or in May, 1904, and the application hereby made is for the listing of these additional shares from time to time as and when issued. The issue of these additional shares has been authorized to provide funds for the general purposes for which the company was organized, namely: Constructing, buying, owning, leasing or otherwise obtaining lines of electric telegraph, partly within and partly beyond the State of New York, and of equipping, operating or otherwise maintaining the same.

An estimate of the disposition of the proceeds of this issue of stock is as follows:

For the New England States	$1,535,900
For the Middle States	6,603,000
For Canada	500,000
For the Middle Western States	2,520,000
For the Western States	1,458,450
For the Southern and Gulf States	2,709,200
For the Pacific States	501,000
For the purchase of instruments, etc., and for the construction of long distance lines	4,250,000

Following are statements of resources and liabilities of the company June 30, 1903, and of earnings and expenses January 1 to June 30, 1903:

Resources:	
Construction, equipment and supplies	$24,491,923
Telephones	7,072,205
Real estate	1,836,029
Stocks and bonds	125,538,075
Patent account	173,715
Machinery and tools	48,126
Cash and deposits	7,246,185
Bills and accounts receivable	16,762,615
American Bell Telephone Company	22,110,401
	$205,279,274
Liabilities:	
Capital stock	$136,826,600
Capital stock installments	9,620
Surplus	3,764,021
Bonds	28,000,000
Reserves	8,543,381
Accounts payable	8,427,052
Income	1,063,390
Contingent	18,645,210
	$205,279,274
Earning (six months):	
Dividends	$3,868,892
Rental of construction	1,469,519
Telephone traffic	2,398,875
Real estate	35,151
	$7,772,437
Expenses (six months):	
Expenses of administration	$477,425
Legal expenses	54,475
Interest and taxes	677,952
Telephone traffic	1,384,837
Net revenue	5,177,747
	$7,772,437

CURRENT NEWS AND NOTES.

PORTO RICO.—Press dispatches from Ponce, Porto Rico, state that during an electric storm on September 28, accompanied by heavy rains, the circuits of the two electric light plants in that city were burned out.

FIRE IN BROOKLYN POWER HOUSE.—On Saturday afternoon last fire in the Fifty-second Street power house of the Brooklyn Rapid Transit Company caused damage to the extent of $6,700, according to official figures. The first reports of the fire were to the effect that the power house was destroyed, entailing a loss of $175,000. The damage was confined to the switchboard. The machinery escaped damage. Service on the street railway lines supplied with power from that station was suspended for some time.

TEACHERS AS CAR DRIVERS.—There are eight township schools in Ohio that have not been opened this fall, and cannot be opened until teachers are secured. There is a dearth of teachers, due to the fact that the salaries paid are considered insufficient. It is said that many teachers in the rural districts have deserted the country and gone to the cities to take places as motormen and conductors on the street railway because the pay is better. A. B. Graham, superintendent of the township schools, said the trouble is due largely to the fact that the poorest workman on the streets receives as much on an average as the country teacher.

WIRELESS ON LARGE TUGS.—On account of frequent trouble due to the breaking away of barges from tows, one of the large Boston towing companies has decided to equip one of its tugs with a wireless telegraph system, and two topmasts and the necessary rigging will be ready for the vessel when she next comes to port. With tugs having on board such equipment, it will be possible, in case of an accident at sea, to notify the agents of the fact and obtain assistance within a short time. In the recent gale on the New England coast when the steamer *Charles F. Mayer* lost a barge, it is claimed that the barge could have been saved had the steamer been able to communicate with the shore. Wireless stations are now so frequent along the shore that tugs will be within range of some one of them all the way from the capes of the Chesapeake to Boston.

TO CLOSE COLOMBIAN CABLE. It is announced that the cable service to Buena Ventura will be closed at the end of September. The inspector of Telegraphs has received orders from Bogota to close the Central and South American Company's office at the seaboard on the suspension of the service to Buena Ventura. If the Colombian Government carries out its threat the company will lose heavily. The Government in the meantime is making efforts to establish the Marconi system of wireless telegraphy between Panama, Chiriqui, Buena Ventura, Colon, Bocas del Toro and Cartagena. It is also reported that the West India and Panama Telegraph Company will offer to construct a cable to Buena Ventura. The Colombian Minister of State has made public the demands of the cable company, which asks for a new concession lasting twenty years and the privilege of raising the tariff. Among the reasons given for the Government's refusal of these propositions is that an Italian company has applied to establish a system of wireless telegraphy.

WATER POWER IN ALASKA.—It is stated that several prominent operators at Cape Nome are developing a project to supply all of Seward Peninsula with electric and water power for hydraulic mining on a mammoth scale. East of Port Clarence, within a few miles of salt water, rise the Saw Tooth Mountains, from the heart of which gush forth several mountain streams. It is proposed to harness these rivers and generate an aggregate of near 100,000 horse-power, using the water-power for generating current, which will be transmitted to Nome and all other mining districts of Seward Peninsula. The current will then be utilized in lifting water from various rivers and creeks for hydraulic mining purposes. At present, steam plants are being used, but the cost of machinery and fuel is so great that they can be employed only where the ground is very rich. Two engineering parties are in the field surveying the falls and rivers of the Saw Tooth Mountains. With ample volumes of water, which can be found nowhere else on Seward Peninsula, and with a fall of 700 to 1,800 feet, enormous power can be obtained. The Saw Tooth Power and Mining Company is being organized to develop it. It is intended to get a portion of the machinery installed next summer.

WATER POWER IN THE PHILIPPINES.—A number of firms in Manila have petitioned the Philippine government for franchises to develop water power in those islands. According to a Washington dispatch, Gov. Taft is now having surveys made of the Botocan Falls and two other falls in the province of Laguna, within 55 miles of Manila. The investigation already conducted warrants the belief that about 10,000 horse-power can be secured at these falls, and no engineering difficulties are presented. Applications have also been received for a franchise to develop the power of the Angat River in the province of Bulucan, where, it is believed, 4,000 horse-power can be secured. The franchises, it is stated, will be let to the highest bidder, after advertising in the United States. The terms will be fixed by the Philippine government, and the government will provide for the sale of power on equal terms to any one who desires it, and the price will be fixed by the Philippine government according to the cost of the operation of the power plants.

ODD DAMAGE CLAIMS.—The managers of street railway systems seem peculiarly liable to queer damage claims, to say nothing of the fraudulent ones. The officials of the Middlesex and Somerset Traction Company, which operates the principal trolley lines in Central New Jersey, believe that there is an epidemic of damage claiming developing around them. Almost every mail brings claims for all kinds of alleged grievances. If a woman gets her dress dusty while riding on a car, the next mail brings a demand for $50 for a new dress. Several days ago a man was jarred by the sudden stopping of the car and dropped his false teeth on the footboard. He claimed damages. Here is a sample of the claims that are filed against the company: "I was on a trolley car that left New Brunswick about 7.30 P. M. Sunday, September 13, 1903. While passing through Sayreville, a short distance from the siding, I was struck in the face by a piece of watermelon thrown by parties along the track, ruining my clothes. I hereby make a claim for same in the amount of $20, and for the assault $100. Please forward check for same."

FIRE IN KANSAS CITY TELEPHONE EXCHANGE. On September 16 fire occurred in the five-story building of the Missouri & Kansas Telephone Company at the corner of Sixth and Wyandotte Streets, Kansas City, Mo., severely damaging the toll board and the main switchboard. It is stated, however, that the greater part of the big "A" switchboard on the fourth floor can probably be saved, although it was drenched. It is thought that when it is dried out it will be available for re-use. Both ends of the board were damaged. It is proposed to dry out the board by using gas stoves to generate the heat for the drying process. The terminal room of this board on the fourth floor was a total wreck, the damage being wrought by water. The company has set up a temporary "B" board, which it will use for toll service, and some old sections of discarded boards have been pressed into service in the emergency. A large force of men from the Western Electric Company's factory in Chicago is at work, and it is stated that it will require about thirty days before the company can re-establish its service on a satisfactory basis. It is making every endeavor to give the public as good service as possible under the circumstances.

ISLES OF SAFETY.—Two more electroliers and isles of safety similar to that recently illustrated and described in these pages, at Fifth Avenue and Twenty-third Street, New York, are to be set up at the intersection of Forty-fourth and Forty-fifth Streets and Longacre Square, between the tracks of the street railway lines converging there. The electroliers will be the gift of a person who withholds his name and makes the Municipal Art Society his agents. The donor will bear all expense of building and placing, but the lighting and care of the structures once completed will fall to the city. Borough President Jacob A. Cantor has consented to take all steps necessary to carry out the donor's wishes, and the Committee on Street Fixtures has reported favorably on the sites selected. The electroliers, standing some 20 ft. high and made of ornamental bronze by the Gorham Manufacturing Company, will be crowned with a pyramid of four white light globes surmounting a triangular street sign. The design is that of H. Wallin, who received the second prize in a contest last year under the auspices of the Municipal Art Society, the giver of the electrolier at Fifth Avenue and Twenty-third Street. Secretary William S. Crandall, of the society, has secured the necessary permits, and work will begin at once.

LETTER TO THE EDITORS.

Tangential Traction.

To the Editors of Electrical World and Engineer:

SIRS:—The three-phase system attributed to Signor Guarini on page 530 of your issue of September 26, and previously described in a general way by you, was patented in this country about ten years ago by Mr. E. E. Ries, in all its essential features, so far as the description in your paper goes.

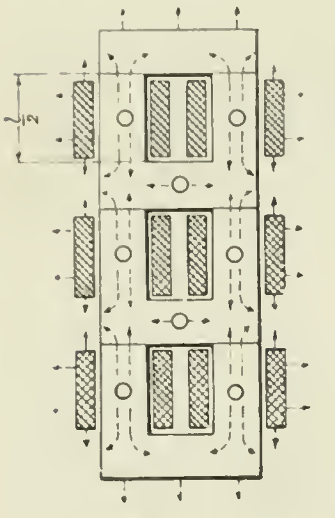
None of these conditions of opening out the stator in plane seem to regard the magnetizing current in the idle sections as of any importance at all. It would be interesting to know what the wattless current would be in such a system as the one outlined.

NEW YORK CITY. T. J. JOHNSTON.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

New Type of Polyphase Transformer.—ZIEHL.—An article in which the author describes a construction differing from the usual arrangement, which is to have the three cores of a three-phase transformer in one plane or at the angles of an equilateral triangle, with two yoke pieces in common to all three. As shown in the accompanying figure, the new arrangement consists in the superposition of two or more cores, each forming a closed magnetic circuit. The author states that this construction has the advantage of considerably simplifying the manufacture, inasmuch as for single, two and three-phase transformers equal cross-sections for the iron sheets, equal patterns for the magnet coils and equal armature parts, can be used. Comparing three individual transformers with a three-pole transformer of the new construction, the latter shows under otherwise equal conditions a considerably reduced weight of iron, inasmuch as the number of iron yoke pieces is only 6 instead of 8. With the same magnetization the losses are, therefore, diminished. Also, when the heat radiation of the new type is compared with that of the three-core type, it is found that the former has a considerably larger cooling surface, and a considerably greater capacity to dissipate the heat. The difference between the maximum inner and outer temperature of the iron will be about one-quarter of that in the old construction, which means that the maximum induction in the new type can be chosen higher. The case is similar with the coils, and another advantage in this connection is the division of the copper coils into as many parts as possible, thus getting a large cooling surface. From the possibility of a higher magnetism of the iron and a larger cooling surface, there results naturally the possibility of a higher current density in the copper, and therefore saving in copper and iron. An influence of the magnetic fluxes upon each other cannot take place as the middle yoke pieces, between two phases, bring about an equalization of a one-sided load, because an excess of lines of force of one phase cannot enter into another phase-winding, but has to travel through the intervening yoke piece. The loss of potential from no load to full load, caused by the leakage and the ohmic loss, has with equal load on the phases, the same percentage value in each of them, because, apart from the ohmic loss, the lines of leakage or the leakage potentials, which appear on short circuit of the transformer, are equal in each phase. The leakage potentials themselves only reach very small amounts on account of the compact construction; that is, the smaller leakage surfaces and the longer leakage-line paths. Therefore the total loss of potential of the transformer is very small. A transformer is illustrated of 25 kw capacity, running at 2200/210 volts and 50 cycles, which had a total weight of 345 kilograms, including the oil, of which weight 59 kilograms were for copper and 116.5 kilograms for the iron sheets.—*Elek. Zeit.*, September 10.



POLYPHASE TRANSFORMER.

Theory and Working of Rotary Converters.—ROGERS.—An article in which the author reviews the working of the rotary converter, and more especially the three-phase type. He discusses the different methods of excitation and regulation, and dwells at some length on the starting and parallel running of converters. He states as advantages of the rotary converter: 1, a large overload capacity; 2, high efficiency; 3, relatively low cost and high power factor. In comparing the cost of rotary converters with other forms of transforming machinery, it must not be forgotten that step-down transformers must be provided, which increase the cost and lower the efficiency of transformation. The disadvantages of the converter are stated as follows: 1, sensitiveness in parallel running; 2, necessity of using complicated regulating apparatus and switch gear; 3, requirement of skilled attendance; 4, necessity of operating by currents of low frequency to obtain satisfactory working, which currents are undesirable for use in other forms of transforming apparatus, so far as economy of copper is concerned. Notwithstanding these disadvantages, however, the author believes that the rotary converter will continue to play a very important part in the working of the large power schemes in connection with electric traction and the supply of electrical energy in bulk.—*Lond. Elec.*, September 11.

Armature Reaction in Alternating-Current Machinery.—THORNTON.—An article, accompanied by diagrams, in which the author discusses some effects of the armature reaction in alternating-current machinery. He notes that the influence of mechanical inaccuracy of construction is small compared with the effect of the armature reaction. When examined with an oscillograph, both exciting current and generated voltage are found to exhibit well-marked ripples, which in the case of single-phase converters, are large enough to profoundly disturb the direct-current output. The author carried out experiments with two bipolar ring-wound, direct-current generators, with solid rectangular cores and yokes, fitted with slip rings so that they could be used as single, two or three-phase generators, synchronous motors or converters. This made it possible to compare the same machine working under identical conditions of load and excitation, but with different kinds of alternating current in the armature. The second machine received alternating current from the first, and its current was conducted to storage cells or an equivalent liquid resistance. The diagrams obtained by the author show, that the general disturbance is much greater in single-phase than in three-phase working. The amplitude of the single-phase ripple in the charging current is about four times as great as the three-phase. The chief interest of the curves is that everything seems to be in a state of quiver, armature currents, field currents and voltages, in order of relative intensity. The author states that it might be expected that a continuous component in the first machine would steady the system, and it does, when this is a double-current generator; but as a converter it is almost as unsteady as when a single or three-phase generator alone. A table of variations of current and voltage caused by armature reaction, expressed in percentage of the average values of each, is given, from which it appears, that in general the second machine has the greater disturbances of continuous armature current, more than double the variation in the first when single-phase. The voltages and field currents have ripples fairly constant in magnitude, whether charging cells or on ohmic resistance. The most pronounced effect is in the change from cells to resistance. With two converters the ratio of percentage current disturbance is 80/33, *i. e.*, 3.4; but with generator and converter it is 93/22.5, *i. e.* 4.1. The three-phase disturbances are much less, and for converters the variation is less with cells than with liquid resistance. So far as the power factor of the continuous-current output depends on field variation, the phase of the ripple in the field with regard to that in the cell current, is important, for it is the cosine of the angle between the generated voltage in the machine, which depends on the instantaneous state of the field, and the armature current, that is the observed power factor. The stiffer the field of the second machine, the less the power factor of the continuous current should be and is. Short-circuiting the series coils on the first machine altered the phase of the field-current disturbance by nearly 90 degrees more into phase with the ripple in the cell current. The power factor of this was therefore increased, but at the expense of the energy lost in the coil and core, amounting to 1, or even 2, per cent. of the output in extreme cases. A lagging current in the machine strengthens the field, and as the magnitude of the voltages changed when the current from the second machine is switched from cells to resistance, the conclusion is that the internal current lagged more when charging cells. It is this which is most conclusive in determining the cause of the ripples to be the armature reaction. The frequency of the ripples is twice that of the main wave, whether the machine is driven from the alternating or direct side. A more important point bearing on the number of teeth or slots per pole per phase which generators should have for driving three-phase converters, is that in all the three-phase armature currents and voltages, 12 ripples per period are to be observed. The conclusion is that three-phase machines with two slots per pole per phase are unsuitable for driving converters, if it is desired to have a perfectly steady, continuous current supply.—*Lond. Elec.*, September 4.

POWER.

Three-phase Motors for Electrical Driving.—Eborall.—The first part of a paper read before the English Society of Arts. As far as the question of direct current versus three-phase current is concerned, the author is of the opinion that if each case is decided strictly on its own merits, it will be found that a three-phase installation is preferable for most classes of work, on account of its greater simplicity, flexibility and reliability, it being at the same time cheaper to install and to maintain. The three-phase equipment appears to greater advantage in these respects as the severity of the work increases, for a properly laid out three-phase plant possesses a capacity for standing overloading and rough treatment, which certainly cannot be equalled by the corresponding direct-current equipment. It is only when a great amount of economical speed regulation is required that a three-phase system cannot hold its own with direct-current working; the question of economical speed regulation over a wide range is the weak point of the three-phase motor. The author then considers some questions relative to the construction and performance of three-phase motors, dividing them into two classes, viz., those with permanently short-circuited rotors and those with round rotors and slip rings. He states that the three-phase motor with permanently short-circuited rotor is in all respects, except with regard to starting performance, an ideal motor to employ for all work requiring constant speed; for certain classes of work, in which the motor has to work in a more or less inflammable atmosphere, it is the only type of motor that can be used with absolute safety for any purpose. Curves are given showing the running and starting performance of a 10-B-hp, three-phase motor, with permanently short-circuited rotor, specially designed for large starting torques and intermittent working. A motor driving a line of countershafting and having a permanently short-circuited rotor, will take about three times the full-load current at starting. As the power factor of this starting current is usually of the order of 20, with a large motor the drop of pressure over the system may be such as to impair seriously the lighting service, and may even affect other motors. The author then deals with motors, which have to start with full-load or still greater torque, such as crane motors.—*Lond. Elec.*, September 4.

Electrically-Driven Mining Plant.—Hooghwinkel.—The second part of his article previously referred to in the Digest. A brief review of the various constructions of coal cutters is given. The motor should be rated 30 to 40 per cent. higher than the horse-power required. The author found for the average required horse-power the following values: for disk machines, 12 to 18-hp motor rated at 25-B-hp. The performance of several machines in active operation is then described. —*Lond. Elec.*, September 4.

Electric Driving in Workshops.—A note on the equipment of the Queensland Railway shops with electric driving equipment. Power is supplied to the shops by three 200-kw, two-phase generators of 220 volts at 60 cycles, connected to vertical, single-acting compound condensing engines. In all, 161 induction motors are employed, ranging from 1 to 75 hp, aggregating about 1,200 hp. Eleven electric cranes are in operation.—*Lond. Elec.*, September 4.

Power Plant.—An article containing an illustrated description of the power plant of the Rock Island-Lake Shore Terminal station in Chicago. Steam is furnished by five water-tube boilers of 250-hp capacity each, fitted with motor-drive traveling grate stokers. The lump coal is crushed by a motor-driven crusher. The generating sets comprise one 500 and two 250-kw units, consisting of cross-compound, horizontal engines and 250-volt, direct-connected dynamos. Current is distributed on the three-wire, 110-220-volt system—*Eng'ing Record*, September 19

Measuring the Power of Machine Tools.—Walsh.—The amount of power used by different machine tools is determined by each individual shop for its own classes and conditions of work. In operating machines in groups by motors, allowances have to be made for the friction of the shafting and belting. Modern line shafting, however, is made in the best shops so that friction is reduced to a small figure. A line shaft 200 ft. long and 2½ in. in diameter, with its counter-shafts, can be operated by electric power with about 1½ horse-power. A line shaft driving a group of nine machines consumed in a 15-minute test a maximum of 10.43 horse-power and a minimum of 0.88 horse-power, giving an average of 4.6 horse-power. In this group of machines there were small and large ones, the large ones including a heavy wheel-press of 50 tons, a 72-in. wheel-lathe, an 84-in. boring mill and a 60-in. planer for cutting cast-iron. When a 42-in. lathe wheel and an 84-in. boring mill were belted to the shaft the power on an average was raised to 6.9 horse-power, but this large increase was due to the fact that the two machines were doing work, and the boring and cutting machines consumed nearly as much power in starting up as all the others of the group did when in full operation. In many shops the grouping of machines to be operated by electric power has been so carefully worked out that the maximum shifting of the load of any group is comparatively small. Slotters and planers are grouped together so that the reversals come at certain intervals. The grouping of machines so that they can be operated together or singly by electric power is an important factor; experience has shown that machines which carry about the same load up to a given maximum can best be grouped together, while those which shift the load frequently between wide extremes should be operated either singly or in pairs, or in groups by themselves.—*Amer. Elec.*, September.

Superheater Tests.—A note on the results of some experiments with a given boiler with and without superheating. The gain in power due to superheating was 36.6 per cent. The consumption of steam per electrical hp-hour was 44.9 pounds without, and 31.7 pounds with superheating. The consumption of coal per electrical hp-hour was 7.51 and 5.45 pounds without and with superheating, respectively.—*Lond. Elec.*, September 4.

REFERENCES.

Coal-Cutting Machines with Three-phase Motors.—An illustrated general description of a machine of recent design of the bar type.—*Lond. Elec. Rev.*, September 11.

Modern Electric Cranes.—Bender.—An illustrated description of the construction of a 10-ton crane, driven by three electric motors.—*Elek. Rundschau*, September 1.

Electric Passenger and Goods Elevators.—An illustrated description of elevators built by a London firm.—*London Engin'ing*, August 28.

TRACTION.

Trolley Omnibus.—An illustrated description of the Lombard-Gerin system in Monteban, France. The cars weigh, empty, about 3½ tons, and are driven by two 8-hp motors, one on each rear wheel, at 500 to 550 volts. The speed is from 6 to 8 miles per hour. There are two overhead conductor wires, on which runs the trolley, which is connected to the car by means of a flexible cable. This trolley is a small automobile in itself, and its speed varies with, but is always slightly greater than, that of the car. It therefore always keeps ahead, and takes up the slack automatically. A small three-phase motor is arranged in the trolley, which obtains its current from the direct-current motors of the car, the armature being tapped for this purpose, and provided with three slip rings. The trolley motor thus runs very nearly in synchronism with the car motor. Provision is also made for actuating a small electromagnetic brake to prevent the trolley running back, as it might do, for instance, if the car stopped when going up hill. The approximate energy required is given as 1,160 watts per car mile, or 200 watts per ton mile, at a maximum gradient of 6 per cent. The cost of the overhead equipment is said to amount to $3,200 per mile, a better way being to put it at between 40 and 50 per cent more than for the overhead equipment of a tramway doing the same amount of work.—*Lond. Elec. Times*, September 10.

REFERENCE.

New Electric Locomotives.—BRUNN.—A series of articles. The present installment contains the illustrated description of an electric locomotive on a iron ore hauling road in Hungary, run by 300-volt, three-phase current. The motor is a 20-hp, polyphase motor, with 8 poles, running at 6,000 alternations and 800 revolutions per minute. Owing to the special conditions under which it has to work, this locomotive is provided with a specially constructed current collector, which is illustrated and described.—*Zeit. f. Electrotech. u. Maschinenbau*, August 16.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Municipal Lighting Plant at Tallahassee, Fla.—POOLE.—An illustrated description of the municipal electric lighting plant at Tallahassee, Fla. The plant contains a 115-kw, 2,300-volt, two-phase, 60-cycle revolving-field generator with its exciter. All of the incandescent lighting is on one phase, and the arc lights run either all on the opposite phase, or one circuit is placed on each side as the lighting load varies. The street lighting outfit consists of fifty 7½-amp. series-enclosed alternating arc lamps. The incandescent service is from 105-210 three-wire secondaries wherever the business justifies the running of the same; the more scattered customers are on single transformers.—*Amer. Elec.*, September.

Evolution of the Starting Switch.—A. H. M.—The author briefly reviews the principal defects of starting switches, and calls attention to several factors which deserve attention. He lays down the essential requirements of a satisfactory switch as follows: 1, the resistance must be of ample capacity and of lasting material; 2, the contacts and contact-maker must be properly designed, according to the current to be dealt with; 3, automatic release for no voltage must be fitted; 4, when the switches will be handled by inexperienced persons an automatic starting device must be provided.—*Lond. Elec. Eng.*, September 4.

REFERENCES.

Operation of Rotary Converters.—FERNANDEZ.—An illustrated article dealing with the operation and control of rotary converters operating at their normal capacity. The author considers the case of a rotary driven by current from another machine located in a station some miles distant from the receiving machine, and connected to it by suitable transformers, etc., and also considers the case of a rotary driven from a prime mover. —*Amer. Elec.*, September.

Electrical Station Practice.—RADCLIFFE.—The first article of a serial on the subject, containing a general consideration of the operating conditions of central stations, which are discussed in an elementary manner.—*Electricity*, September 9.

WIRES, WIRING AND CONDUITS.

The Choice of High-Tension Insulators.—KNOWLTON.—An article in which the author points out that however important good material and workmanship may be in regard to the poles, cross-arms, tie wires and pins of a high-tension line, it is imperative that the insulators be designed, built, tested and installed with the utmost skill and care, since the integrity of the line depends upon their adaptation to the service furnished. In the choice of insulators for circuits of 25,000 volts and upward, four essential features in design should be given special attention, viz.: the resistance to puncture, the resistance to arcing to pin or cross-arm, proper distribution of electrostatic strains and low capacity and proper creepage surface. The voltage required to puncture an insulator should be enough greater than the voltage required to arc over from wires to pin under any conditions to insure the insulator against injury in case of abnormal voltage. Where the petticoats flare widely or are short, there is usually less concentration of electrostatic strain on the inner petticoat, and consequently less liability to puncture. Resistance to arcing is chiefly the function of the longest combined air and insulator surface path which the discharge can be forced to take in passing through the wire to the pin or to the cross-arm. With regard to electrostatic strains, the noise and display of an insulator under test may be taken as an indication of its static capacity and effectiveness of material distribution. The point of visible static discharge should be kept at least as high as the full-line voltage, in order that no insulator should be subjected to undue strain. The area of creepage surface should be made as high as is consistent with reasonable design.—*Amer. Elec.*, September.

REFERENCE.

Calculation of Networks of Conductors.—BUSSET-SCHILLER.—An article illustrated by diagrams, in which the author develops a graphic method for finding the most favorable position of the junction points for mains and feeders.—*L'Industrie Elec.*, August 25.

ELECTRO-PHYSICS AND MAGNETISM.

Self Electrification of Radium.—WIEN.—The author has investigated the self electrification of radium and the intensity of the rays sent out by it. As the positive particles, discovered by Rutherford, are much more strongly absorbed than the negative ones, it ought to be possible by retaining the positive particles in an envelope permeable to the negative ones, to charge the envelope positively, and the amount of this charge ought to furnish a measure for the amount of radiation sent out. The method used by the author and the precautions which had to be taken to get rid of the radium emanation, which interfered with the measurements, are described in detail. The radium bromide used by the author was enclosed in a glass tube, into which a platinum wire was melted, and the electricity collecting inside had to be conducted to the outside by the platinum wire. This tube was suspended by a glass thread in a larger tube, into which a second platinum wire was melted. The author found the current to be of the order of 3 x 10 to the — 12th power, amperes. The radiated masses of the electrons, figured out from this value, give for the positive particles 4.6 x 10 to the — 17th power gram, per second, and for the negative, 2.9 x 10 to the — 20th power. It is therefore totally impossible to determine the radiated masses by weighing. The energy of radiation is, however, not inconsiderable. The latter figures out for the positive electrons, assuming the velocity as 1.65 x 10 to the 9th power, as 60 ergs per second, and for the negative electrons, with a velocity of 2.5 x 10 to the 10th power, as 8.7 ergs per second, from 4 milligrams of radium bromide.—*Phys. Zeit.*, September 1.

Hall Effect.—VAN AUBEL.—The author has found that the addition of a larger quantity of bismuth sulphide to metallic bismuth increases the action of the Hall rotation coefficient, and that the latter is especially high with bismuth sulphide. He found, however, that the bismuth which he had used formerly was not entirely pure, and had therefore given too low a value. He calls attention to the difficulty of getting the metal absolutely pure, and to the influence which traces of foreign metals exert on the Hall effect. He finds from his measurements that the Hall rotation-coefficient has the same sign with pure bismuth, with the sulphide of the metal and with mixtures of both. The strength of the phenomenon is so great with pure bismuth sulphide, that the Hall effect can be used for the measurement of strong magnetic fields. He further investigated whether the Hall effect is influenced, when the plate under investigation is brought into a medium, the specific magnetism of which is considerable. He therefore tried a plate consisting of a mixture of bismuth and bismuth sulphide, containing 4.36 parts by weight of sulphur and 95.64 parts of bismuth. This plate was brought into a glass vessel, which was first filled with pure water and then with a concentrated ferric chloride solution, at the same temperature. No difference in the strength of the Hall effect was observed.—*Phys. Zeit.*, September 1.

REFERENCE.

Terrestrial Magnetism and Atmospheric Electricity.—The last issue of this quarterly journal contains the following articles: Sutherland, the curve of the earth's magnetism; Chree, an analysis of the results from the Kew magnetographs on quiet days during the eleven years 1890 to 1900, with a discussion of certain phenomena in the absolute observations; Adolf Schmidt's charts of the earth's magnetic components for 1885; Bauer and Hasard, results of magnetic observations in the United States up to June 30, 1902; Life and Work of Benj. Franklin, etc.—*Terr. Magn. and Atm. Elec.*, June.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis with Smooth and Platinized Platinum Anodes.—FOERSTER.—A long article in which the author discusses the results of an extended series of researches, made by him and under his direction on the difference of the behavior of smooth and platinized platinum anodes. If no oxygen is evolved at the anode, the difference in the behavior of both kinds of electrodes is small; with a platinized anode the active surface is larger and therefore the real current density smaller, other things being equal; the anodic voltage in the electrolysis of an alkaline potassium iodide solution is only 0.07 volt higher with a smooth than with a platinized platinum anode. A much greater difference exists between both kinds of anodes when oxygen is developed, two special peculiarities being observed. First, the potential of a platinized anode increased continually during the course of electrolysis, while smooth anodes soon assume a potential which then remains constant. Second, the potential which a smooth platinum anode assumes is considerably (several tenths of a volt) greater than that of a platinized anode. It is certain that there is some change going on in the interior of the platinized anode during electrolysis. It seems that small parts of the anodically generated oxygen are absorbed by the platinum black, and are stored in it at a gradually increasing pressure; the formation of a platinum-oxygen compound may be assumed which is dissolved in the platinum black in steadily increasing concentration. The author applies his results to several cases of practical importance, and discusses especially alkali chloride electrolysis, the formation of hypochlorite and chlorate being dealt with. The conditions of a platinized anode represent nearly the ideal conditions for sodium chloride electrolysis, but leave the question undecided whether this method of working can be used without modification in practice on a large scale, or whether it will be necessary to try and approach these ideal conditions as much as possible by different, and though imperfect, yet practical means. The author then discusses the application of platinized anodes for the electrolysis of sodium sulphite, and for quantitative analysis by constant potential electrolysis; the use of a platinized anode together with a stirring device enables one to shorten the time required for electro-analysis very considerably. The author believes that the use of platinized anodes may prove useful in the investigation of the electrolytic oxidation of organic compounds.—*Electrochem. Ind.*, September.

Single Potentials.—Patten and Mott.—An account of an experimental determination, together with theoretical calculations of the single potentials of the alkali metals, sodium and potassium. The theoretical single potentials and the experimentally determined values agree well with each other. The results strengthen the view that metals which give potentials lower than the theoretical, do so rather because of the formation of a film upon them than because the metal decomposes the solution with the liberation of hydrogen.—*Electrochem. Ind.*, September.

Bleaching Liquors.—W. H. Walker.—After an historical sketch of the production of bleaching solutions, the author discusses the principal conditions which must be fulfilled in an efficient apparatus for the production of hypochlorite by electrolysis of sodium chloride. It is necessary to prevent as much as possible the discharge of the ClO ions at the anode. The reducing action of nascent hydrogen upon the hypochlorite at the cathode must also be counteracted, either by making the cathode small or by adding to the electrolyte hydrates of calcium and magnesium or by adding chromates or sodium resinate. The formation of chlorates must be prevented by keeping the electrolyte at a sufficiently low temperature by means of a cooling device. The author then describes the forms of apparatus in commercial use, the apparatus of Hermite, Kellner, Schuckert, and Haas & Oettel being dealt with. For laundries, bleacheries and textile mills, the author believes electrolytically prepared bleaching liquors have advantages over those made from chloride of lime; the color of the finished goods is purer and more even; the solution penetrates the fibres more easily, giving a color of greater permanence; there is no danger of the deposition of insoluble calcium salts, producing a harsh or rough feel on the goods. The cost of the plant, especially where carbon electrodes are used, is not great when compared with the diaphragm cells, and the labor of repair and operation is much less. For large paper and pulp mills, however, especially those in which caustic soda is used to reduce the wood to fibre, the diaphragm cells seem to have the advantage.—*Electrochem. Ind.*, September.

REFERENCE.

Measuring Electrode Potential.—W. McA. Johnson.—An article illustrating by diagrams in which the author describes the various methods of determining decomposition voltages and electrode potentials. He discusses the simple voltmeter method, the condenser method, and the use of the potentiometer, and describes the connections in direct-reading potentiometers. He then describes the method of determining the decomposition voltage by measuring the current which flows through the cell when the applied e.m.f. is gradually increased; the curve giving the current as a function of the applied e.m.f., shows a very sharp bend at the decomposition point.—*Electrochem. Ind.*, September.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measurement of Power in Alternating-Current Circuits.—Craighill.—The power in alternating-current circuits can be measured in various ways, but none of them is very satisfactory except the one which involves the use of the wattmeter. This is the quickest and most accurate, and no computation is necessary, as in the case of other methods, the watts being read directly from the instrument. The author considers the method of connecting wattmeters in order to measure the power of a single-phase circuit, of a two-phase system with separate circuits, of a two-phase system having a common return for the two circuits, of a three-phase Y or delta-connected system, of balanced two-phase and three-phase circuits, and of a monocyclic circuit.—*Amer. Elec.*, September.

New Books.

The Alternating-Current Transformer. By F. G. Baum. New York: McGraw Publishing Company. 105 pages, 122 illustrations. Price, $1.50.

A work written by so competent and thoughtful a man as Prof. Baum is deserving of our most careful consideration. The little book before us is an elementary treatise on the theory of the transformer, written in a concise and strictly scientific manner, the treatment being carried through both analytically and graphically. The circle diagram is treated briefly, as well as the regulation diagrams of transformers as originated by Mr. Kapp. Some interesting remarks about ageing and testing will be appreciated by the reader, and the chapter on "Circuit Regulators" will be found useful and instructive. We should also be glad to have seen Prof. Baum's own views on electrostatic capacity and on his experience with long-distance lines embodied in this book, as they certainly would have greatly enhanced its value.

The work is, however, open to some criticism. The description of commercial transformers is somewhat meagre, and perhaps not quite up-to-date. In section 61 it is said, in referring to some curves of the properties of annealed sheet transformer iron: "Curves between *B* (induction) and watts lost per pound of iron at 60 p.p.s. are given. . . . For any other frequency *multiply the losses given in the curves by frequency* 60." As a matter of fact, the total watts lost per pound of iron are not at all directly proportional to the frequency.

In section 50, speaking about methods of cooling transformers, it is stated: "On account of danger to insulation or of ageing of the iron it is necessary to limit the temperature rise to about 50° C. above the surrounding air. . . . The square inches of exposed surface should be more than *twice* the number of watts to be radiated. See Fig. 46." Now, looking at Fig. 46 (taken from Kapp's "Transformers"), we see that "In case without oil," for 50° C. rise the corresponding watts are .16 watt per square inch, or the square inches are 6¼ times greater than the number of watts to be radiated; and "In case with oil," .27 watt correspond to 50° C. rise, or the number of watts are 3.7 times the radiating surface in square inches. Why then are *twice* the watts the minimum that should be allowed for radiating surface in square inches?

Opere Di Galileo Ferraris. Pubblicate per Cura Della Associazione Elettrotecnica Italiana. Vol. I. Milan: Ulrico Hoepli. 402 pages, 52 illustrations. Price, 12 lire.

To all who consider the increase in our knowledge of the phenomena of nature as the stepping stone to improvement and culture, the death of Ferraris has been a most painful disappointment. The Italian Electrical Association has paid a tribute to the memory of Ferraris by publishing his collected papers, of which the first volume is lying before us. The variety of subjects over which the scientific genius of Ferraris has swept is illustrated by the papers on the propagation of electricity in homogeneous bodies, by his paper on the theory of A. G. Bell's telephone, the theory of the Gaulard and Gibbs transformer, the discovery of the rotary field, his papers on vectors and on many other subjects. Ferraris' famous and fundamental paper on electromagnetic rotations is preceded by a paper on the phase difference in alternating-current circuits, which he used, as is well known, in order to obtain from a single phase circuit two alternating currents of different phase. These two papers are dated December 4, 1887, and March 18, 1888. Among the remainder of the contents, his paper on the resolution of an oscillating vector into two vectors of one half the magnitude rotating in opposite directions, is undoubtedly the most interesting and permanent.

An excellent portrait of Ferraris forms the frontispiece of the volume. His best monument is his life work, and the love and esteem in which he is held by all those who had the good fortune to know however, slightly, this great man of science, scholar and gentleman.

BOOKS RECEIVED

Atlante di Macchine e Caldaie. By Salvator Dinaro. Milan: Ulrico Hoepli. 80 pages, 112 illustrations. Price, 3 lire.

The Elasticity and Resistance of the Materials of Engineering. By Wm. H. Burr. New York: John Wiley & Sons. 978 pages. Price, $7.50.

Laboratory Exercises. Primary and Storage Batteries. By Karl E. Guthe, Ph. D. Ann Arbor, Mich.: George Wahr. 58 pages, 18 illustrations.

Electrically Operated Floating Dry Dock.

By Tom T. Donnelly.

The balanced floating dry dock, a view of which is shown herewith, was built by James Tregarthen & Son Co., foot of Seventh Street, East River, New York, and is of the well-known balanced type which has demonstrated its fitness for a great variety of dry docking work, and is justly so popular in this country.

The dock is 200 ft. long on keel blocks, 186 ft. 4 in. length of body, and 85 ft. wide. It has a depth at center of 10 ft. 4 in. and a height of wings sufficient to take a draught of 20 ft. over 3-ft. keel blocks. The dock is divided by a center longitudinal bulkhead, four side longitudinal and six cross bulkheads, into fourteen water-tight compartments, each of which is provided with two pumps.

The pumps are of the standard dry dock pattern, 14 ft. square and 20-in. stroke. The pumps are operated by a 100-hp electric motor. The motor was especially designed for the work under specifications of Faber du Faur & Donnelly, engineers, by the C. & C. Electric Co., and is a special application of their series-parallel system of control.

The speed of the motor is 175 r.p.m., which is reduced by gearing to 110 r.p.m. of the line shaft, and to 56 r.p.m. for the pumps, which speed will pump the full capacity of the dock (3,000 tons) in about 45 minutes.

The motor is operated from the N. Y. Edison Company's mains at 240 volts, the current being led from the pier to the motor house on the dry dock by flexible cables. The whole is installed in a house shown on the right wing of the dock.

It is very essential in the docking of vessels to have a perfect and reliable control of the speed of the pumps, and the requirements of the contract were that the control should give at least ten different speeds, which should range from full speed down to 10 per cent. of full speed, and that the motor should operate continuously at any of the required speeds. As the motor is necessarily exposed to salt air and moisture, thorough insulation was very carefully provided for, and also the insulation of the pumping machinery (which, of course, is very thoroughly grounded to the water) from the frame of the motor. The installation has been an unqualified success, and has now been in operation for several months without interruption of any kind.

The series-parallel system of control, as built by the C. & C. Electric Company, and installed on this dock, is designed for a range of speed practically as great as can be obtained with a steam engine, and the motor may be operated for any length of time, at any speed from the lowest motion up to maximum, and the speed may be accelerated or retarded as rapidly as desired. This is accomplished without any abnormal consumption of current.

The armature of the motor is built with two commutators and independent windings, which are thrown into different relations automatically by the controller. On the lower range of speed these sets of windings are thrown in series, giving the effect of operating the armature on reduced voltage, and consequently reduced speed, which result is ordinarily obtained only by the use of wasteful armature resistance, externally applied.

The controller is operated by a single hand-wheel, shown in the photograph, and emergency switches are provided so that in case of accident to either set of windings the other set may be operated intact.

The pumping of dry docks is a class of work for which electricity is especially adapted, as it requires a large amount of power for but a short time and at uncertain intervals, and often at short notice; and where the source of electricity is available at any time of night or day, it is of especial value in case of an emergency which may require the docking of an injured vessel in the shortest possible time.

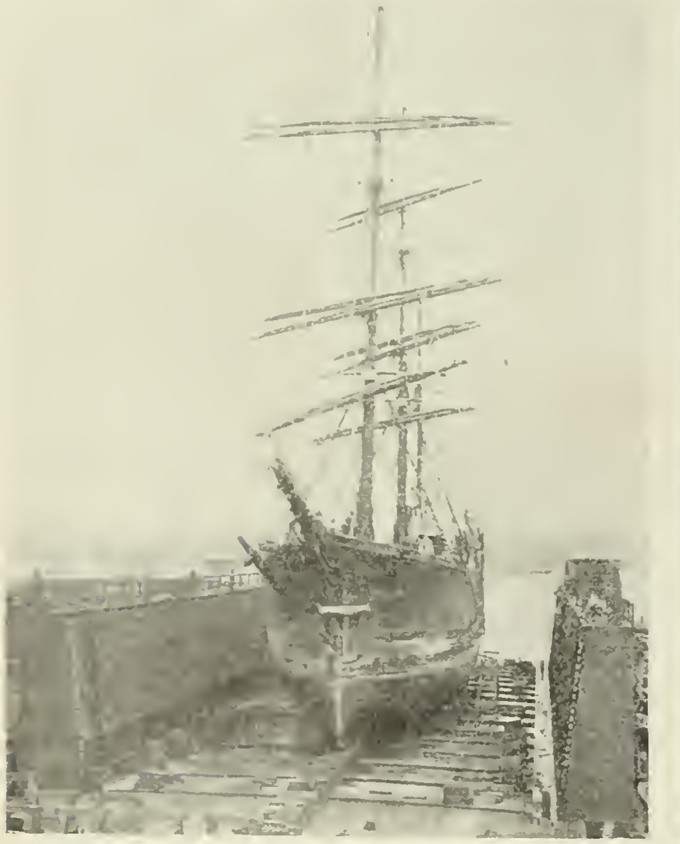


FIG. 1.—ELECTRIC FLOATING DRY DOCK.

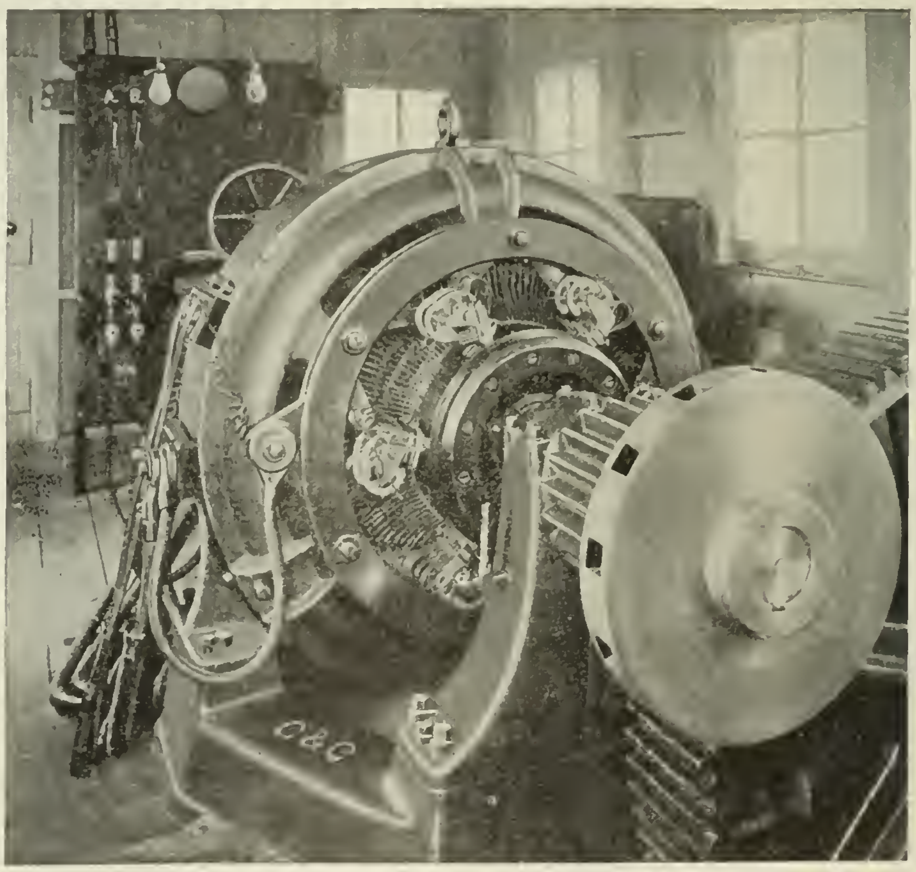
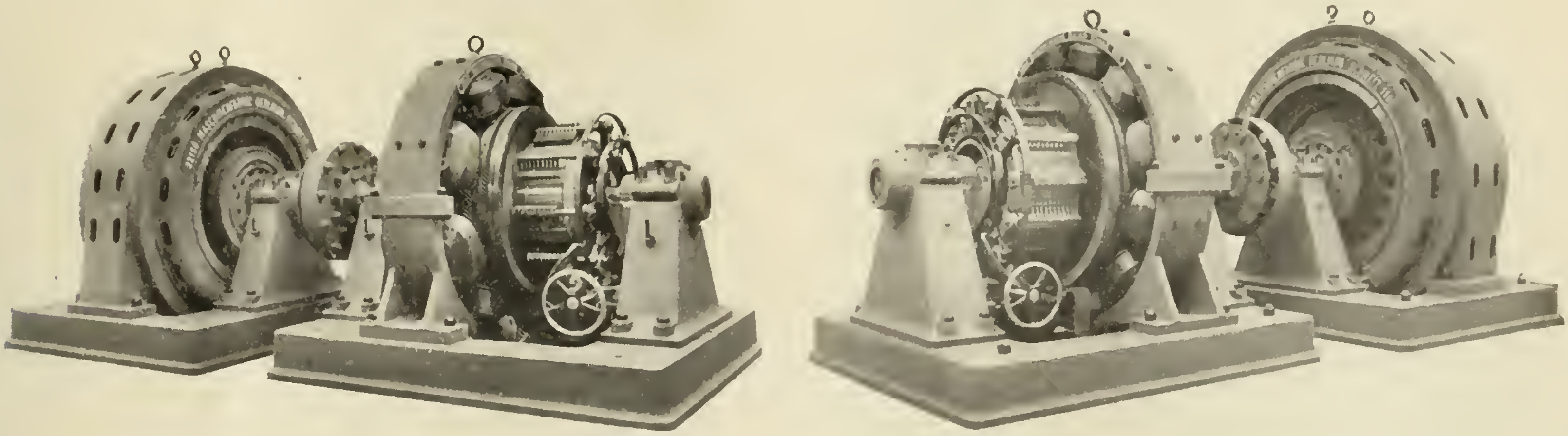


FIG. 2.—PUMP MECHANISM.

Tests of Oerlikon Motor-Generator Sets for the Stockholm Central Station.

Four motor-generator sets recently built by the Maschinenfabrik Oerlikon for the Stockholm electric station, serve for transforming 6,000-volt, three-phase currents of a frequency of 25 into direct current. The alternating-current motors are induction motors with starting resistances provided on the rotor. The four sets shown in Fig. 1 to Fig. 4 have the following capacities: That illustrated in Fig. 1 is a 500-kw set; the 6,000-volt, three-phase induction motor has a capacity of 600 kilovolt-amp. and is coupled with a 500-kw, direct-current dynamo, giving 440 or 600 volts; the number of revolutions is 375. In Fig. 2 is shown a 500-kw set; the voltage of the alternating-current motor is 6,000; that of the direct-current dynamo 220 or 300; the number of revolutions is 300. The set shown in Fig. 3 is of 250-kw capacity; the voltage of the alternating-current motor is 6,000; that of the direct-current dynamo 440 or 600, and the number of revolutions 500. The 65-kw set shown in Fig. 4 is for an alternating-current voltage of 6,000; that of the direct-current dynamo being 440 or 600, and the number of revolutions 500.



FIGS. 1 AND 2.—TWO VIEWS OF 500-KW SET.

All these machines were tested in the testing room of the Oerlikon Company with utmost accuracy and the best commercial measuring instruments. In the test of each machine the no-load losses were first determined for various voltages and the iron losses were separated from the friction losses; the copper losses, due to ohmic resistance, were then determined at full load. For each three-phase induction motor the coefficient of the magnetic stray field was measured, which, according to well-known and reliable theories, determines the phase difference between e.m.f. and current for different loads. For each direct-current dynamo the collector losses were measured and the commutation was studied for short-circuit and for different loads. Moreover, with the 250-kw and 65-kw sets, complete tests were made for a load varying from no-load to full-load. The direct-current generator of the 500-kw set, running at 300 revolutions, was also tested for full load. It was thus possible to compare the measured efficiencies of the sets for various loads with the efficiencies calculated from the separately-determined different losses; and to compare the measured phase differences for various loads with the phase differences determined from the coeffcient of the magnetic stray field.

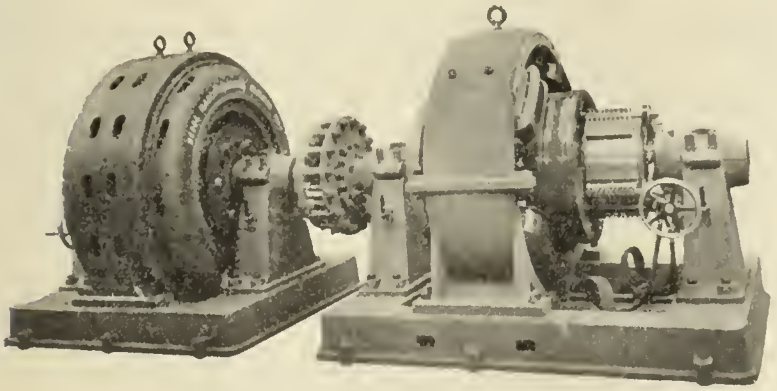


FIG. 3.—250-KW SET.

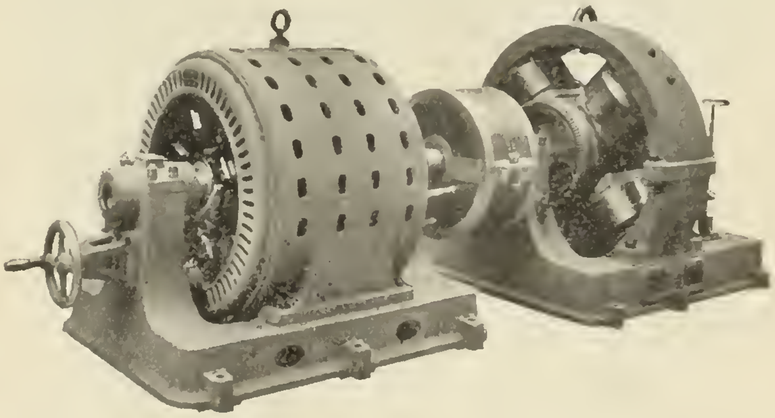


FIG. 4.—65-KW SET.

It was found that the measure values of efficiency and phase difference were in extremely close agreement with the calculated values. Of course, on account of the difficulties and the inherent inaccuracy of direct measurement, the results thus obtained are of less value than those determined with great accuracy by the indirect method. An absolutely exact determination of the efficiency requires the use of three voltmeters, three ammeters and two wattmeters on the alternating-current side, and the use of one voltmeter and one ammeter on the direct-current side. Readings of all these instruments must be taken simultaneously and load and frequency and voltage of the three-phase currents must be kept absolutely constant for some time. It is obvious that this is extremely difficult to accomplish in practice.

Repeated careful measurements have convinced the engineers of the Oerlikon Company that only in very rare cases are the three-phase currents taken from a network really symmetrical, and that even small discrepancies from complete symmetry may have an important influence upon the results of the measurements. Therefore, besides the fact that the readings of the best measuring instruments are inaccurate by at least 0.5 per cent., there are always inherent sources of error involved in the direct measurement of the efficiency, and the result may be wrong by 2 per cent. On the other hand, under the conditions of the test, the error in the indirect determinations of efficiency can reach 2 per cent. only if errors of about 20 per cent. were involved in the separate measurement of the different losses. In the following diagrams, therefore, the values of efficiency are given as calculated from the single losses, and the values of phase difference as determined from the coefficient of the stray field as determined from the magnetizing current and the short-circuit current. There are thus neglected the losses which at full load are caused by eddy currents in the conductors which carry current and by distortions of the field. These additional losses must be very small, as may be shown by direct measurements and from measurements of the short-circuited machines.

The commutator losses of the direct-current machines were calculated from the data (*) given by Dettmar in *Elektrotechnische Zeitschrift*, 1900, p. 429; the engineers of the Oerlikon Company have found these data to be in perfect agreement with repeated measurements made with their own commutators and their own carbon brushes.

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* An abstract of this article was given in ELECTRICAL WORLD AND ENGINEER, 1900, June 23, page 949.

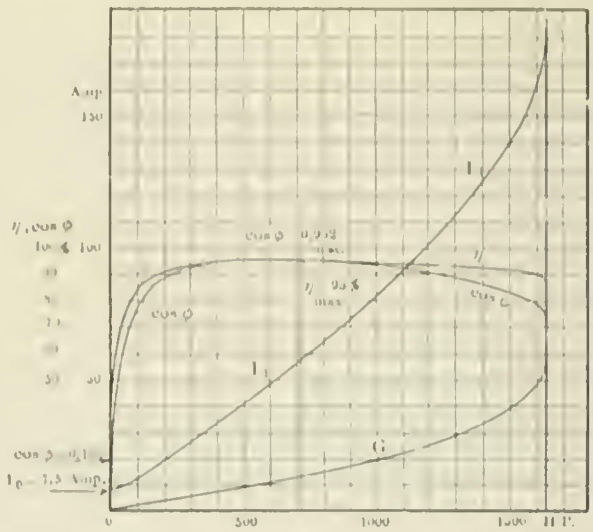


FIG. 5.—TEST OF 500 KW SET (FIG. 1).

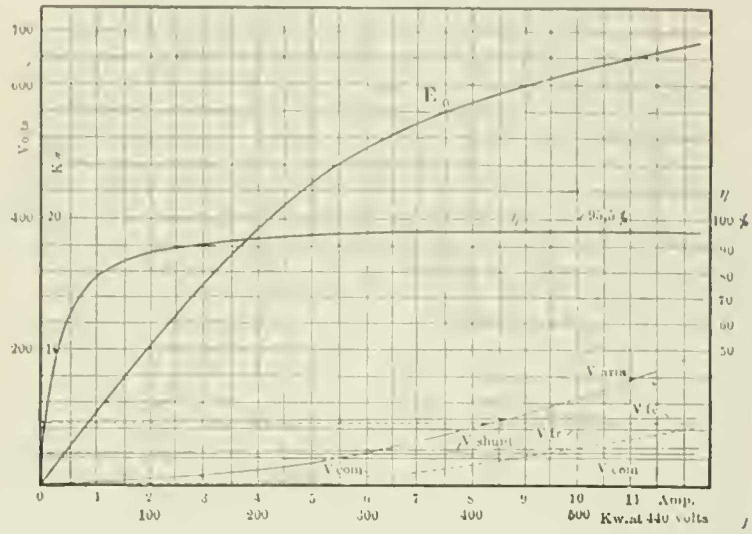


FIG. 6.—TEST OF 500-KW SET (FIG. 1).

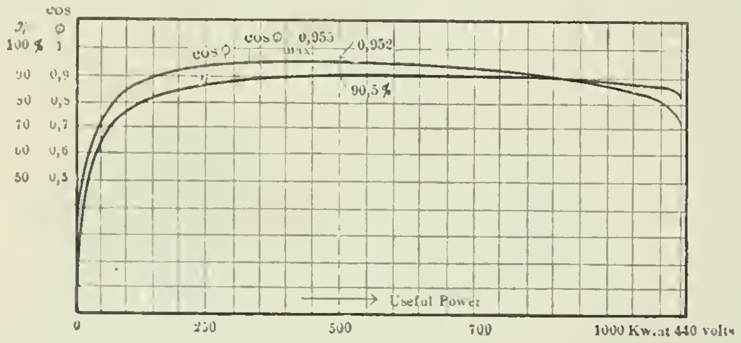


FIG. 7.—TEST OF 500-KW SET (FIG. 1).

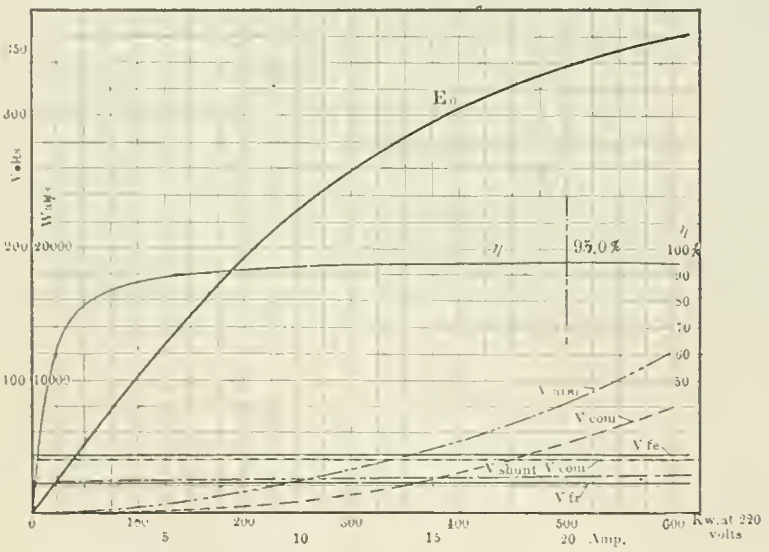


FIG. 9.—TEST OF 500-KW SET (FIG. 2).

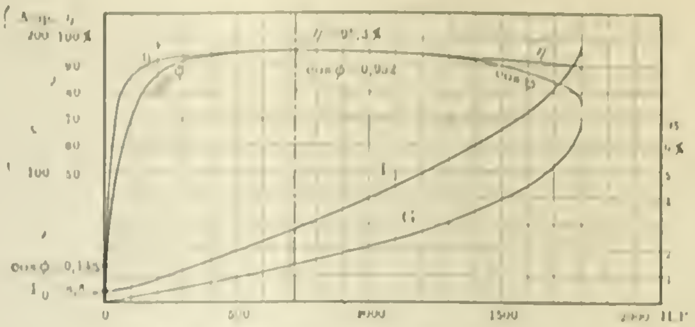


FIG. 8.—TEST OF 500-KW SET (FIG. 2).

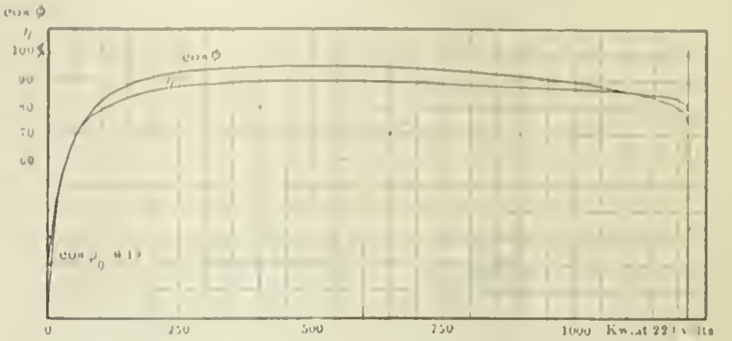


FIG. 10.—TEST OF 500-KW SET (FIG. 2).

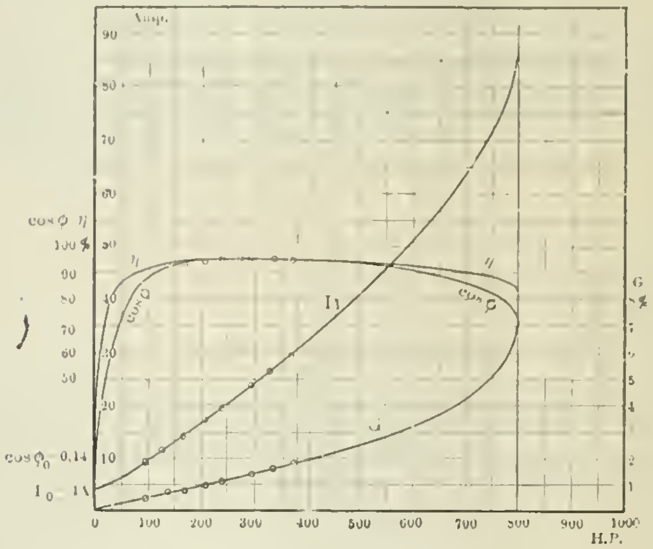


FIG. 11.—TEST OF 250-KW SET.

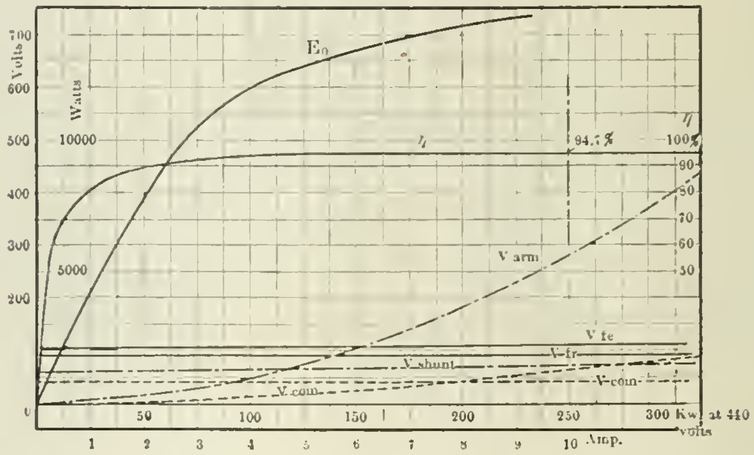


FIG. 12.—TEST OF 250-KW SET.

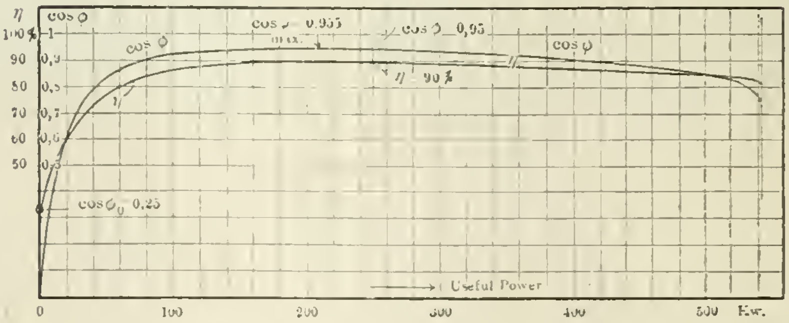


FIG. 13.—TEST OF 250-KW SET.

TESTS OF OERLIKON MOTOR-GENERATOR SETS, STOCKHOLM.

The results of the tests of set I (Fig. 1) are given in Figs. 5, 6, 7; those of set II (Fig. 2) in Figs. 8, 9, 10; those of set III (Fig. 3) in Figs. 11, 12, 13; those of set IV (Fig. 4) in Figs. 14, 15, 16.

Fig. 5 gives the curves for the 720-hp, three-phase induction motor of set I, tested at a voltage of 6,000 and a frequency of 25, and running at 370 r.p.m., the rotor being disconnected from the direct-current generator. I is the current supplied per phase to the stator, n is the efficiency in per cent., $\cos\phi$ the power factor, and g the slip in per cent. The efficiency is 95.2, 95.2, 94.5, 90.0 per cent. at full, three-quarters, one-half, one-quarter load, respectively; the power factor is 0.95, 0.952, 0.94, 0.84, respectively; the slip at full load is 1.47 per cent.; the overload capacity is 225 per cent., and the no-load current is 7.5 amp.

To illustrate how the efficiency was determined, in the case of full load, the no-load losses are 13.5 kw, the primary copper loss at full load 6.3 kw, the secondary copper loss 7.9 kw; hence, the total losses, 27.7 kw; the energy supplied to the motor is 555 kw, of which 27.7 kw are lost; hence, the efficiency, 95.2 per cent.

Fig. 6 gives the curves for the 500-kw, direct-current generator of set I, supplying 1,140 to 830 amp. at 440 to 600 volts, respectively. e_0 is the characteristic curve for no-load, giving the volts at open circuit as a function of the exciting current. The scale for the exciting current is the upper horizontal scale at the bottom of the diagram, reading from 0 to 11 amp.; the scale for the voltage is the vertical one at the left-hand reading, from 0 to 700 volts. η is the efficiency. V_{arm} is the ohmic loss in the armature copper. V_{kd} is the loss at the commutator, due to the transition resistance between the segments and the brushes; V_{KR} is the mechanical loss at the commutator; V_{Fe} is the loss due to hysterisis and eddy currents; V_{err} is the loss in the field copper and in the shunt regulator; V_{R+V} is the loss due to friction of the bearings and to ventilation. The scale for all these losses is the vertical one at the left-hand reading from 0 to 20 kw.

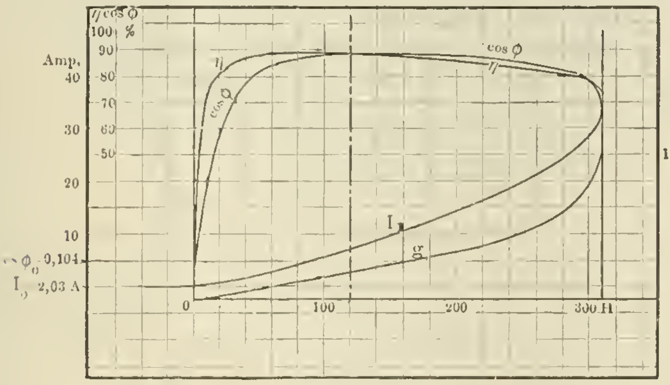


FIG. 14.—TEST OF 65-KW SET.

To show by an example how the efficiency is determined, the following table gives the amounts of the different losses at full load for 440 volts and 600 volts:

Single losses in kw at full load at	440 volts.	600 volts.
Ohmic loss in armature copper	7.4 kw	4 kw
Loss due to transition resistance at commutator	2.5 kw	1.7 kw
Mechanical loss at commutator	2.3 kw	2.3 kw
Loss in armature iron	4 kw	13.4 kw
Loss in field copper and in shunt regulator	2.6 kw	6.3 kw
Loss due to friction of bearings and ventilation	5 kw	5 kw
Total loss at full load	23.8 kw	32.7 kw

The output of the machine is 500 kw; hence, output plus losses is 523.8 or 532.7 kw for 440 or 600 volts, respectively. The efficiency is, therefore, 95.5 per cent. for 440 volts, and 94 per cent. for 600 volts. The curves in Fig. 6 refer to 440 volts.

Fig. 7 gives the curves for the complete set I; $\cos\phi$ is again the power factor, η the total efficiency of the motor generator. The scale of the abscissæ gives the output in kilowatts, at 440 volts.

Fig. 8 gives the curves of the 720-hp, 6,000-volt, three-phase motor of set II, running at 296 revolutions; the notation is exactly the same as in Fig. 5. The total no-load loss at 6,000 volts is 13.2 kw, and the no-load current is 8.6 amp. The efficiency is 95.0, 95.2, 94.5, 91.5 per cent. at full, three-quarters, one-half and one-fourth full load, respectively, and the power factors are 0.953, 0.950, 0.934, 0.85, respectively; the overload capacity is 250 per cent., and the slip at full load is 1.5 per cent.

Fig. 9 gives the curves of the 500-kw, direct-current generator of set II; the notation is exactly the same as in Fig. 8. The dynamo may be used at 220 to 300 volts, the figures in the diagram referring to 220 volts. The total loss at full load at 220 volts is 26.2 kw, the efficiency is 95, 93.8 and 90 per cent. for full, half and quarter load, respectively, at 220 volts.

Fig. 10 gives the curves of the complete set II, the notation being exactly the same as in Fig. 3.

Figs. 11, 12, 13 give the curves for the induction motor, the direct-current generator, and for the combination of both machines for set III. The notation is again the same as in Figs. 5, 6, 7. In Fig. 2 the points surrounded by small circles were found by direct measurement, while the curves were indirectly determined as above stated. The curves in Fig. 12 refer to a voltage of 440. Figs. 14, 15, 16 give the corresponding curves for set IV, the curves in Fig. 15 referring to a voltage of 440.

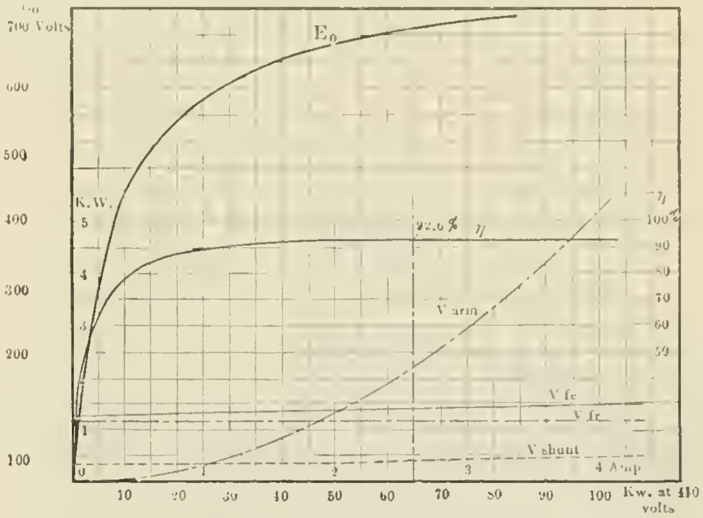


FIG. 15.—TEST OF 65-KW SET.

Finally some of the results of the temperature measurements may be given. As the induction motor of set I could not be tested at full load, it was operated unloaded at 8,000 volts for six hours. At the start the temperature of the iron was 14° C.; that of the surrounding air being 13°; at the end of six hours these temperatures were 58 and 21°, respectively.

The direct-current generator of set I was operated for five hours at 353 volts, 1,180 amp., 363 revolutions, and 4.6 amp. exciting current. After five hours the temperature of the room was 21° C.; that of the armature, 42; commutator, 56; magnet coils, 32°. The same generator was operated for ten hours at 600 volts, with 390 amp., the number of revolutions being 385 and the shunt exciting current 8.1 amp.; at the end of the ten hours the temperature of the room was 19.5° C.; armature, 36; commutator, 35.5; magnet coil, 44° C.

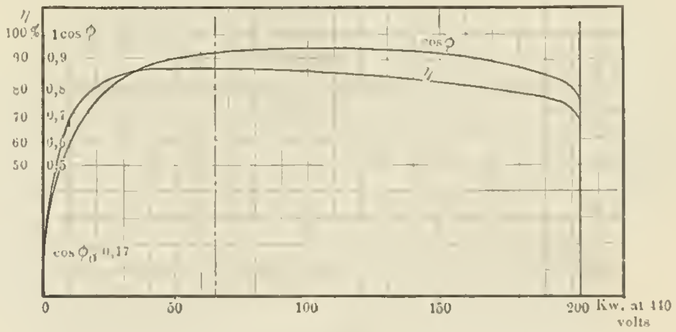


FIG. 16.—TEST OF 65-KW SET.

The induction motor of set III was operated at full load (250 kw) for six hours. At the start the temperature of the room was 17.5° C., that of the motor casing 22°; after six hours the temperature of the room was 26°; that of the motor casing 45°; that of the stator winding 65°.

The Oerlikon Company claim that these results are considerably better than any obtained up to the present in Continental Europe.

Telegraphers' Tournament.

A telegraphers' tournament will take place on October 30 and 31 in the auditorium of the National Export Exposition Buildings, Philadelphia.

New Standard Types of Siemens' Dynamos and Motors.

The large and growing demand for dynamos and motors, together with the keen competition, has caused many of the British manufacturers to investigate closely their types of apparatus with a view to standardizing them, and so being able to reduce the expense of manufacture and more successfully compete in the markets of the world. Among the companies who recognized that much could be done in this field was Siemens Brothers & Co., Ltd., of London and Woolwich, and while their great new factories have been gradually taking shape at Stafford, where they will soon have one of the best equipped factories in Great Britain, they have been busy devising a complete new line of direct-current motors and dynamos which are thoroughly up-to-date in design, both electrically and from the manufacturing point of view. In this work they have been most ably assisted by Mr. A. S. Clift, who was for so many years chief draughtsman of the Crocker-Wheeler Company, of New York. These new standardized types are now ready for the market, and we illustrate several of these machines above.

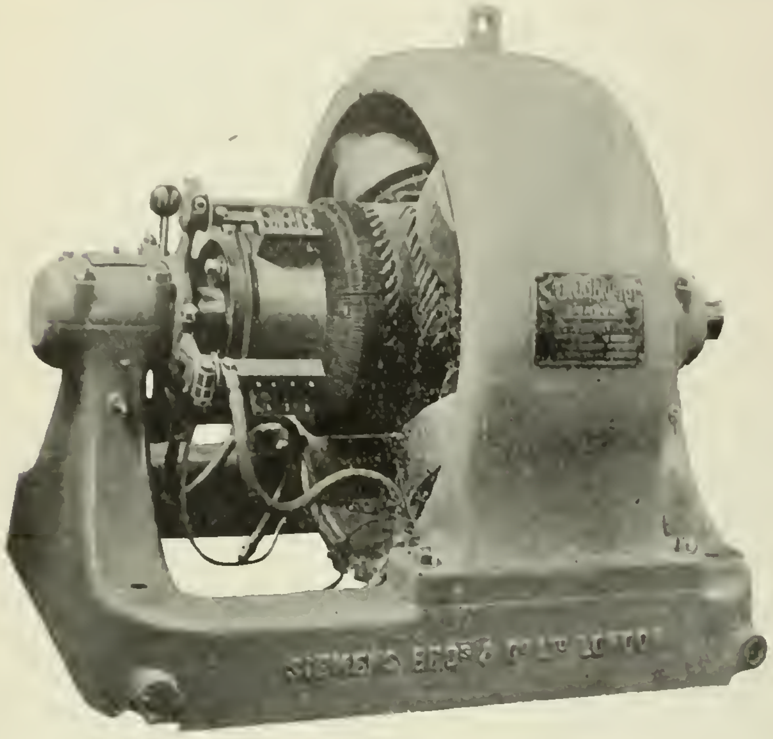


FIG. 1.—50 TO 125-HP MACHINE.

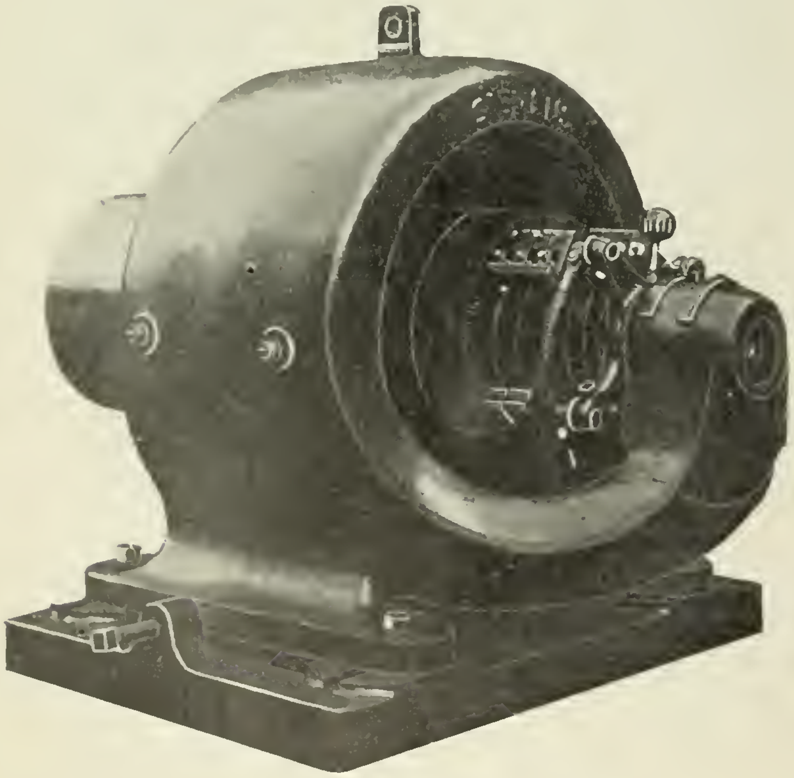


FIG. 2.—2 TO 50-HP MACHINE—OPEN TYPE.

The machines have been divided into four types as follows: ½ to 2 hp., shown in Fig. 3; 2 to 50 hp., shown in Figs. 2 and 4; 50 to 125 hp., shown in Fig. 1; and 75 to 3,000 kw. In all types the armatures are of the slotted drum type form wound, and with field coils form wound. The type including machines from 2 to 50 hp. is made in two forms, open and closed, as shown in Figs. 2 and 4. The magnet frames of all machines are of cast iron with wrought-iron poles cast welded into the frame and fitted with laminated pole shoes screwed to the pole face.

* * *

New Plant at Niagara Falls.

By the middle of October the By-Products Paper Company will have its big plant in operation. This factory was expected to start by October 1, but the failure of an engineering company to deliver one of its boilers has caused the delay. At the outset this plant will employ about fifty men. As the demand for the product increases, as competent authorities declare it is bound to do, the plant will be enlarged. It is believed that within a few years this will be one of the largest plants at Niagara Falls. About fifteen tons of paper stock per day will be the output at first, flax fibre being used in making the stock.

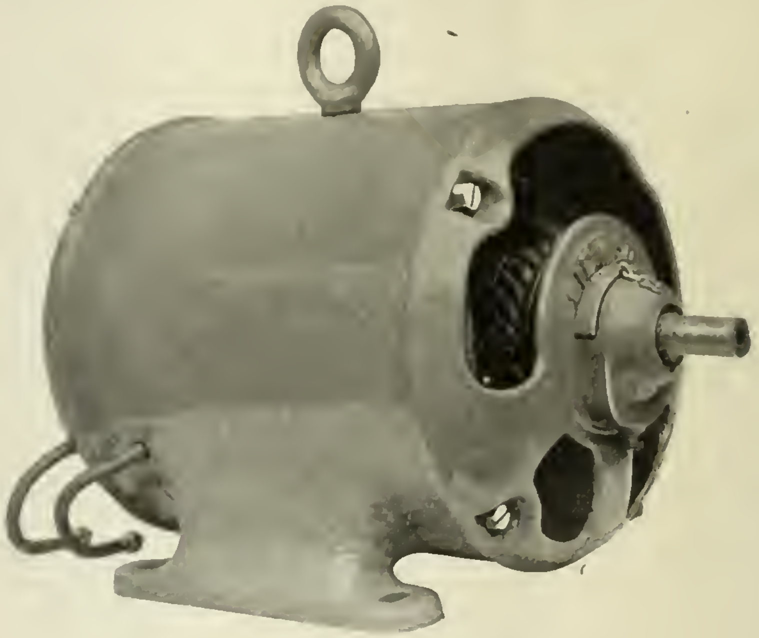


FIG. 3.—½ TO 2-HP MACHINE.

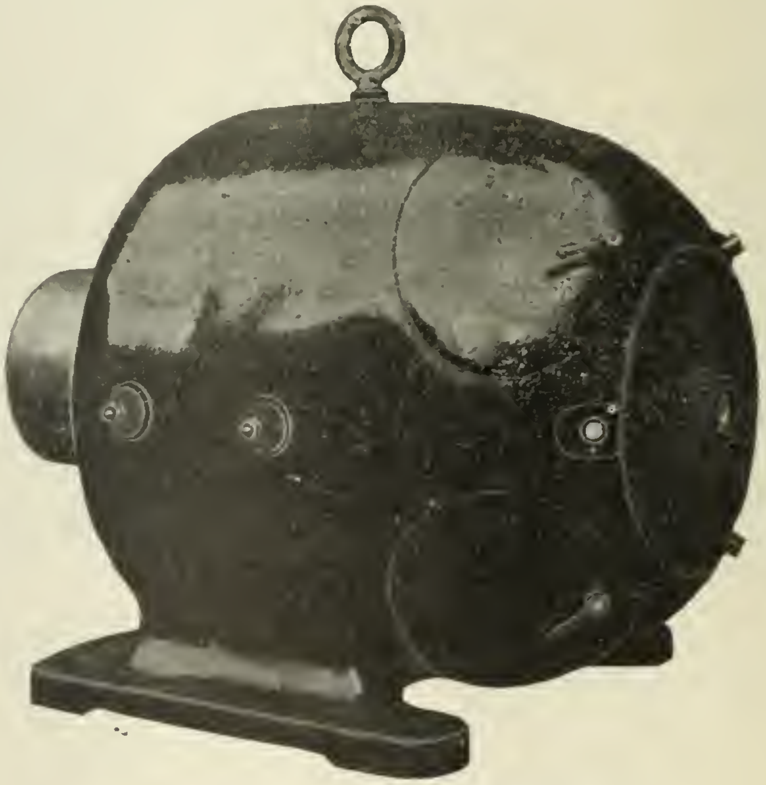


FIG. 4.—2 TO 50-HP MACHINE—ENCLOSED TYPE.

Typo-Telegraphy.

Printing telegraphy has been a much discussed question, and the demand is to secure a system which will be profitable for commercial telegraphy, with the gratifying results of confining it to an economical and simple system. From the earliest attempts at printing telegraphy, the only means of transcribing telegraph messages into printed form, has been by the use of a typewheel, of uniformity of revolution, and in harmony with the positive impulses sent upon the line from the transmitter. However mechanically accurate a printing telegraph system may be constructed, upon the well-known principles of controlling the typewheel by a step by step movement, difficulty arises in obtaining correct operation under high speed, even upon short circuits. In other forms of printing telegraph, the uniform rotation of the transmitter and the typewheel is maintained by synchronous rotation of the motors at each end of the circuit. Each of these systems has correcting devices which are peculiar to their construction.

Dr. George A. Cardwell, of New York, has patented a system of printing telegraphy, commonly called the typo-telegraph, which is peculiarly simple in construction, and appears to have proved its applicability to commercial telegraphy.

The typo-telegraph is not to be classed with any system which sends peculiar signs or signals on a tape, to be mechanically transposed into a printed message. The typo-telegraph requires but one operator at the transmitting end. There is no prior preparation of the messages on a tape. The messages are sent directly to the line by the transmitter, operated by the sender. There is no duplicate handling of the messages. The receiving instrument automatically records the messages on a printed blank ready for delivery. The only assistance that the receiving instrument requires is a daily supply of blanks, of which some three hundred are placed in the machine in a roll, which works automatically.

There are always three electrical pulsations used for each character of the alphabet, and these pulsations may be sent out with no lapse of time between the pulsations for each letter, in order that the letter may be selected and printed. Hence the selection and printing of any character is brought about by three impulses of current, which are of different polarity.

Experiment has taught that to obtain the best results in long line telegraphy it is necessary to diminish the number of impulses and to make these impulses as short as possible. This rule applies more particularly to printing telegraphy than any other system. Therefore, the transmitting device for the typo-telegraph consists of a universal keyboard, which covers the range of all letters, figures, fractions, punctuations, etc., necessary for commercial uses. Upon the depression of any one of the keys, three impulses are sent directly upon the line from three magnets, which close consecutively, throwing into the line the impulses distinctly and clearly, as if they were three dots of the Morse system. These pulsations are sent very rapidly, because the touch of the keyboard is a staccato touch, and is capable of more rapid action than the skill of any operator in striking the keys. It is a fact that no rhythmical operation can be maintained by any operator working at a high rate of speed. No average transmission of words can be obtained, because the operator is liable to be erratic in the manipulation of the keyboard, and certain words may be sent at the rate of one hundred and fifty words per minute, while other words may be sent at a much lower rate. Therefore, the actual printing of messages by a skilled operator, to be correct, is placed at sixty words per minute, although the system has the maximum capacity of printing a hundred and fifty words per minute and more.

Should any impulse be lost upon the line from high inductive disturbance, or the transmissions of the electrical impulses be disturbed by the carelessness of the operator in striking two keys at once, the typewriter will leave a blank space, indicating the loss of one letter. The line has absolute clearness after the transmission of any three impulses, or the printing of a letter, whether correctly or not.

The number of selected combinations in the transmitter is limited to thirty-six, which control the same number of local circuits in the permutating apparatus. These combinations can be changed into the thousands, which are all mathematically and electrically correct, thereby allowing the system to be used in secret service without any danger of wire-tapping or the revealing of any important message. It is a simple mathematical problem electrically solved into direct individual working circuits. There is no clock-work or synchronizing device but the closing of any three magnets of a series of four, which in their sequence remain closed until the character is printed, when they are automatically restored to their normal condition by the printing mechanism.

One magnet controls the movement of the typewheel, and thereby insures a steady and quick movement, with sufficient surplus power to maintain a maximum amount of speed to offset any erratic working of the operator. The carriage is moved in rhythmical step with the printing of each character, and at the end of the line is automatically returned to its original position and the line space given, absolutely under the control of the operator.

The peculiarity of the typewriter carriage is that it will never overthrow a line, is always controlled by the will of the operator, and each blank, after the message has been printed, is thrown into position ready to be taken out and delivered without stopping the working of the system. As each message is finished another blank is immediately thrown into position, thus avoiding any delay on the part of the operator in the continuance of his work. It would seem from the simplicity of the line conditions of the typo-telegraph that it can be operated at all times upon a telephone circuit without any interference to the telephone. The two systems can be worked conjointly on the one circuit.

The typo-telegraph requires but a space of a foot and a half square, and can be put in any convenient place in a telegraph or private office. It is stated that the system has been successfully worked between New York, Washington and Boston, transmitting and printing messages at the rate of 75 words per minute.

Extensive Cuban Traction and Lighting Projects.

An extensive electric traction and lighting system is to be constructed in the southern part of Cuba, power being derived from a hydraulic plant, which will be the largest in that part of the world. The Cienfuegos, Palmira & Cruces Railroad & Electric Power Company has been organized for the purpose of building and operating both systems. The bulk of the capital will be furnished by Cubans. Bruno Diaz, a large Cuban cigar manufacturer, is president of the company. Cornelius C. Vermeule, 203 Broadway, New York, is acting as consulting engineer. The length of the road will be about 43 miles. Four and a half miles of track will be constructed in the busy seaport of Cienfuegos. The line will run from Cienfuegos to Caonao, thence over a private right of way to Palmira, Harmiguero and Cruces. There will be a branch also over a private right of way, from Caonao eastward, 15 miles, through Los Guaos to Cumanayagua. From the harbor of Cienfuegos to Caonao there will be a second line on a private right of way built to carry freight exclusively.

The track will be of the standard gauge. Sixty-pound T and girder rails will be employed. The initial rolling stock will consist of four combination cars, 32 ft. over all, seating 24 persons and operated by two 50-hp motors each; four open passenger cars, 35 ft. 8 in. over all, seating 60 passengers and operated by two 50-hp motors each; three closed passenger cars, 27 ft. 8 in. over all, seating 24 passengers, and operated by two 25-hp motors each; three 8-bench open cars, 25 ft. over all, seating 40 passengers and operated by two 25-hp motors each. Five express cars 21 ft. over all, equipped with four 50-hp motors each and having a capacity of 20 tons will be ordered, also twenty box, 8-wheel freight cars, capacity 20 tons; a similar number of 8-wheel flat cars, capacity 20 tons, also sprinkler and repair cars.

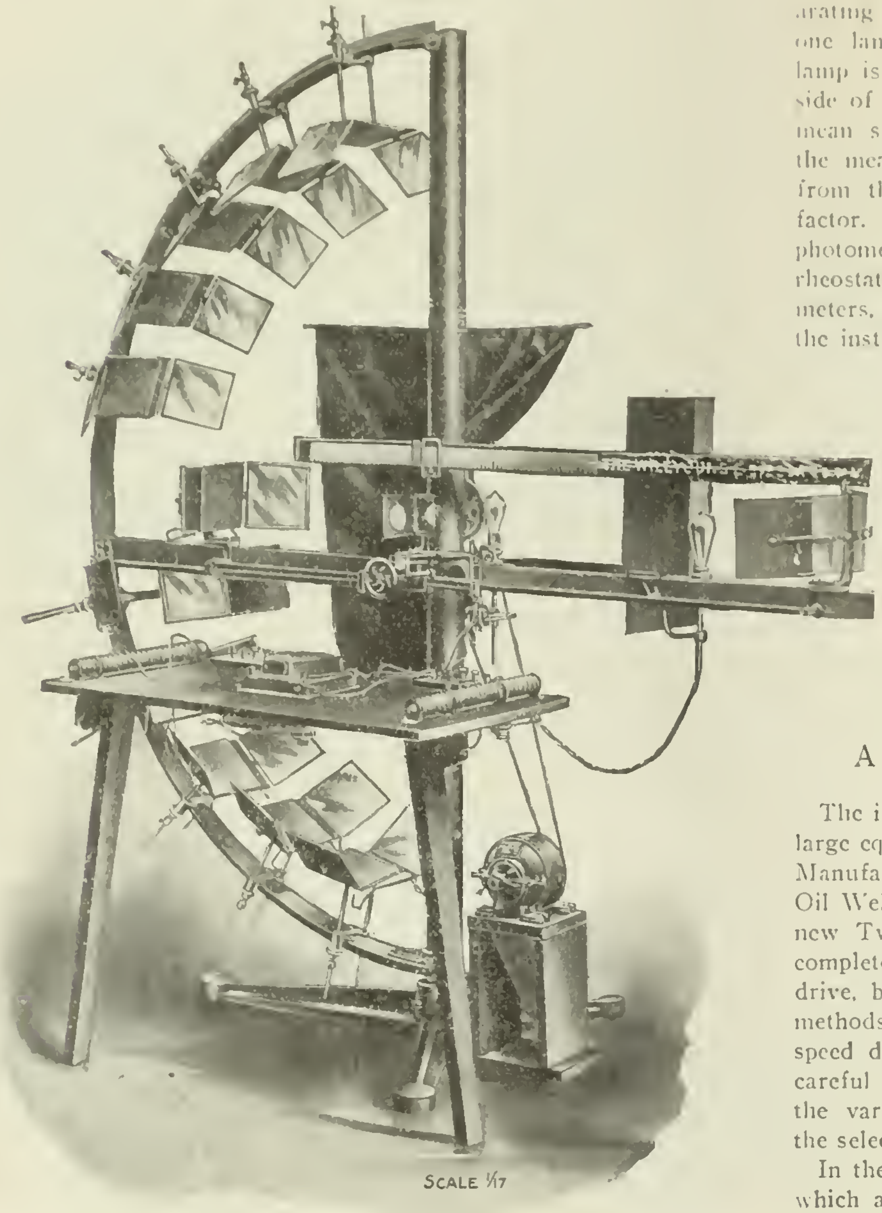
The company will also generate energy for the purpose of lighting Cienfuegos—about 30,000 inhabitants—and the other towns mentioned whose population averages about 8,000 people. Power will be derived from the Falls of Hababanilla, which are known as the Niagara of Cuba, located about 26 miles from Cienfuegos. The voltage at which the energy will be transmitted has not yet been determined. The initial capacity of the plant will be 3,000 hp. extensions being provided for.

The Cuban port of Santiago is also to be lighted by electricity. Hugh Reilly, formerly a New York contracting engineer and now permanently resident in Cuba, is primarily interested in the project. There will be about 10,000 16-cp lights on the commercial circuit and 320 arcs for street lighting. A steam power generating plant will be constructed. The initial capacity will be 1,500 hp in three units. The entire project will be carried out according to the most modern ideas in hydraulic, electrical and steam engineering. Mr. Reilly's address is Hotel Pasaje, Havana.

The Matthews' Spherical Candle-Power Photometer.

We illustrate herewith the latest model of the integrating photometer for direct reading measurements of spherical candle-power, invented by Prof Matthews, of Purdue University. The complete theory and discussion of principles upon which the instrument is based were given in a paper presented before the American Institute of Electrical Engineers, and will be found in their transactions of November, 1902. This theory shows that the mean spherical candle power is proportional to the illumination of a photometer screen receiving its light from 11 pair of mirrors placed at equal angles about the arc of a half circle having the lamp and screen respectively at the two centers of the two parallel arcs of mirrors. The instrument as perfected commercially is a device which offers the only solution of practical mean spherical measurements.

The instrument may be used as a simple photometer for ordinary horizontal measurements; as an integrating instrument for the direct determination of mean horizontal, mean spherical, mean hemispherical or mean zonular candle-power; and as an integrating photometer for the direct determination of the spherical reduction factor—that is, the ratio of mean spherical to mean horizontal candle-power. All these measurements can be made by one operator with one observation with great accuracy, ease and convenience.



SPHERICAL CANDLE-POWER PHOTOMETER.

As may be seen from the cut, the eleven pair of mirrors are supported at proper intervals (15°) by a semicircular frame connected to a central pillar. The "unknown" is behind the curtain, and while under test, is spun around on its axis in a rotator. The rays of light sent out at different angles from the lamp are reflected by the mirrors in such a way that they all meet upon the photometer screen, seen directly opposite the lamp in front of the central pillar. The other side of the screen is illuminated by the standard, but with the horizontal rays only, by aid of two reflecting mirrors. These two mirrors slide along a horizontal bar so as to increase or decrease the distance from the screen to the standard, which is located in the same plant with the unknown, and shielded from it by means of an opaque screen. When balance is obtained the value of the unknown can be read from a scale moving with the sliding mirrors and passing behind a pointer screwed at the central pillar. Thus the mean spherical candle-power of a lamp is readily determined, and it is done without formulæ or figuring.

The apparatus may also be used as an ordinary photometer bench for comparative measurements; for this purpose the two horizontal pair of mirrors only are used, all other mirrors being closed. Both horizontal mirror pairs are now connected to the sliding bar, which is moved to and fro by the rack so as to vary the distance between the screen and the two lamps for a constant distance between the lamps themselves. The scale for horizontal candle-power is used.

To obtain the spherical reduction factor, the opaque screen separating the unknown and the standard lamp is removed, and but one lamp—that whose reduction factor is wanted—is used; this lamp is placed in the rotator, and if all mirrors be uncovered one side of the photometer screen is illumined proportionately with the mean spherical candle-power, the other side proportionately with the mean horizontal candle-power of the same lamp. A reading from the scale at the balance of the screen gives the required factor. A table attaches to the main pillar and rests in front of the photometer, as shown. On this table are mounted the controlling rheostats and the various binding posts for attachment of the voltmeters, ammeters, etc. The table is permanently wired so that the instrument is always ready for use.

The Matthews photometer has been in daily commercial use now for some months by the Lamp Testing Bureau of New York. It is also being used by the Sawyer-Man Lamp Company, the Edison Lamp Company, at Harrison, etc., etc. Among research laboratories that have installed the instrument may be mentioned Cornell University, Leland Stanford, Jr., University, Washington University, Polytechnic Institute of St. Petersburg, etc., etc. The Messrs. Willyoung & Gibson Company, No. 40 West Thirteenth Street, New York, are the manufacturers.

A Large Installation of Variable Speed Motors.

The illustration shown on page 579 gives a view of a portion of a large equipment of multi-speed motors recently installed by the Stow Manufacturing Company, of Binghamton, N. Y., in the works of the Oil Well Supply Company, at Pittsburg and Oil City, Pa. In their new Twenty-first Street (Pittsburg) factory, which was recently completed, this company proposed from the start to use the electric drive, but for a time were undecided as to which of the various methods proposed was best suited to their requirements of variable-speed driving. The question was finally decided after a series of careful and rigorous competitive tests of the motors and methods of the various manufacturers. These comparative tests resulted in the selection of the Stow multi-speed motor.

In the selection of this motor the situation required a motor with which all the speeds could be obtained by the use of one voltage only, and one which should be able to develop continuously its full rated horse-power at its lowest as well as its highest speed, and with an efficiency as high at the minimum speed as at the maximum. These conditions were admirably fulfilled throughout a severe test, and orders were placed for 30 Stow motors to be used for the driving of individual machine tools, lathes, slotters, etc. The accompanying illustration shows a group of 4-hp Stow motors driving 26-in. Bridgeford lathes.

The severity of the original test on this 4-hp motor may be inferred from the fact that steel chips, averaging about one-half an inch wide and one-sixteenth of an inch thick were turned off at the rate of 75 ft. per minute, throwing a 100 per cent. overload on the motor, and causing the point of the tool to melt. The above test, in which the steel chips were removed at the rate of 28 cu. in. per minute was repeated several times, and while it required from thirty seconds to one minute to put the cutting tool out of order, the motor received no damage whatever.

In this installation there is a noticeable absence of all auxiliary apparatus and wiring, as the motors are entirely self-contained and operate on one voltage only. As no resistance or rheostat of any kind is used to regulate the speed, the electric circuits of the motor remain absolutely unchanged.

Reversible motor starters of the Cutler-Hammer type are used to bring the motors up to speed, and when mounted on lathes the speed-regulating hand wheel is located on the side of the motor in a position most convenient for the operator, as shown by the cut.

INSTALLATION OF MULTI-SPEED MOTORS.

A World's Record in Coal Hoisting.

A great advance in the speed of handling coal from freight vessels and barges falls to be recorded, a world's record for rapid unloading having been recently established by the C. W. Hunt Co., West New Brighton, N. Y., at the Lincoln Wharf Power Station of the Boston Elevated Railway Company. Run of mine bituminous coal was raised 90 ft. above the tide water from one hatch of a vessel and delivered to the storage pockets cracked to mechanical stoking size, at the rate of 320 tons per hour, by one tower. This is an advance of about 200 per cent. upon the previous best record, and marks an important mechanical engineering achievement.

To attain this end the steam engines of fifty to 100 combined horse-power in common use have been replaced by machinery of 300 hp, and the coal-cracking machine attached to the tower cracks to the proper dimensions for automatic stokers, before passing to the pocket the enormous quantity of coal, over 5 tons per minute, delivered to it from the hoisting machinery. The ordinary small steam shovel has been supplanted by an automatic one of two tons' capacity at each lift. The time occupied in raising two tons of coal from the hold of a vessel to the discharging hopper, nearly 200 ft. above, is only 6 seconds, while the round trip, involving the operations of lowering and moving the shovel out of the boom, opening the former, digging up two tons of coal, raising it to the level of the hopper and discharging it therein, is frequently performed in 22 seconds.

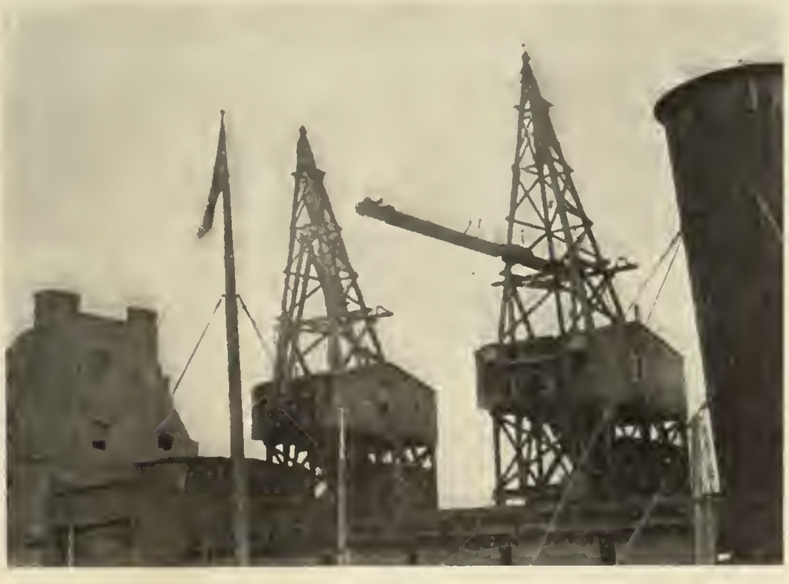


FIG. 1.—COAL HOISTING.

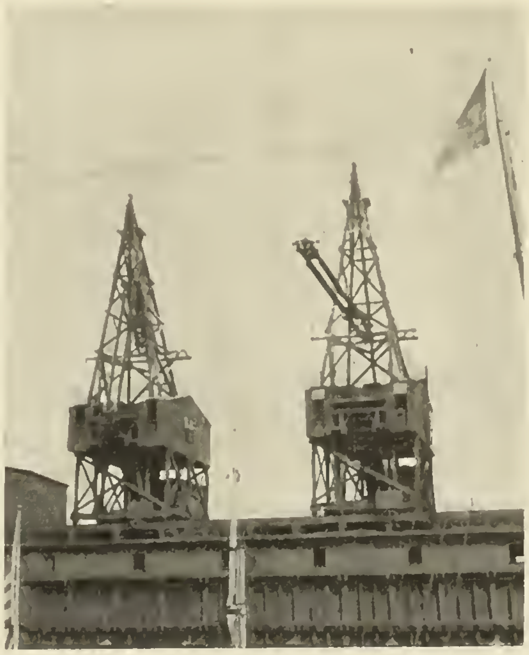


FIG. 2.—COAL HOISTING.

The installation, shown in the illustration, follows in general design, but in heavier proportion, the standard Hunt "Steeple Tower" rig, the moving gear and coal cracker being electrically driven and the hoisting engine direct-connected. The towers have to traverse overhead the whole length of the coal storage pocket and to move 30 ft. at a time without changing steam connection. In this way a single tower can operate on each hatch of a vessel in turn, or several towers can work simultaneously. The boom, made to fold up, for the free manipulation of vessels with their rigging, has an overhang of 40 ft., and enables the tower to operate on coal steamers of the widest beam and largest dimensions.

Trolley Catcher Development.

A simple and effective form of trolley catcher has lately been introduced by Johnson & Morton, of Utica, N. Y., and the construction of the device shows how great an improvement has been effected in this minor but important attachment for street-car service. The appliance is shown complete and in detail in Figs. 1 and 2. In re-

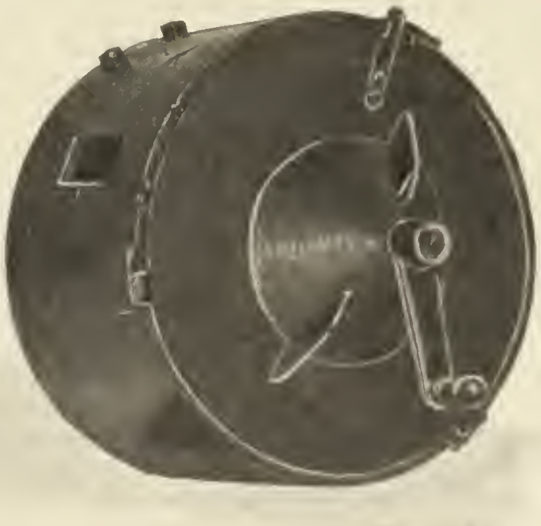


FIG. 1.—TROLLEY CATCHER COMPLETE.

gard to its operation, it may be noted that the rope draw rests by its own weight on a bearing in the case without a cap. The slack trolley rope is wound on the drum by a plain coiled spring. When the speed of the unwinding cord is suddenly increased, the drum is lifted from its bearing before the cord unwinds, and a ratchet on the drum-head engages a stationary tooth in the case above it, thus preventing the drum from turning. On account of this rapid and positive action, barely half an inch of rope is paid out before the catcher operates, and the trolley pole is thus held below the level of the span wires.

The catcher will coil fifteen feet of ¼ in. rope. Three-eighths inch rope may be used, although ¼-in. rope is recommended. The heavier rope is not required with this catcher, as the movement of the trolley poles after leaving the wire is so short, the severe strains from suddenly stopping it are avoided. The base is fastened to the bar by three bolts, and has a substantial bayonet lock so that the catcher proper can be removed by a half turn of the case. Accidental loosening of the case is impossible. This makes it possible to use only one catcher upon reversible cars, as a base can be fastened on each end, and the catcher taken from one end to the other when the trolley is reversed. A chain is provided on the cord drum, so that the trolley cord can be attached by a hook. A crank extending from the head of the case is connected with the cord drum so the spring can readily be wound up. The head of the case is fastened by a latch joint so arranged that it can be taken off instantly, but cannot come loose by accident.

When the case-head is removed, the spring, cord, drum and interior of the case are at once accessible. The spring is held in a recess in the case-head and can be taken out without the use of tools for replacement or inspection.

Fig. 2, with the drum case open, shows the construction and principle of operation. Both the bearing in the case and the head are of chilled iron, to prevent wear. The drum shaft and spring shaft are of best mild steel, and can be renewed with but little trouble or expense. The rack upon the cord drum is of chilled iron, and the catch of case-hardened steel. The spring is fifteen feet in length, of finely tempered steel, and winds upon a shaft one inch in diameter, ensuring durability.

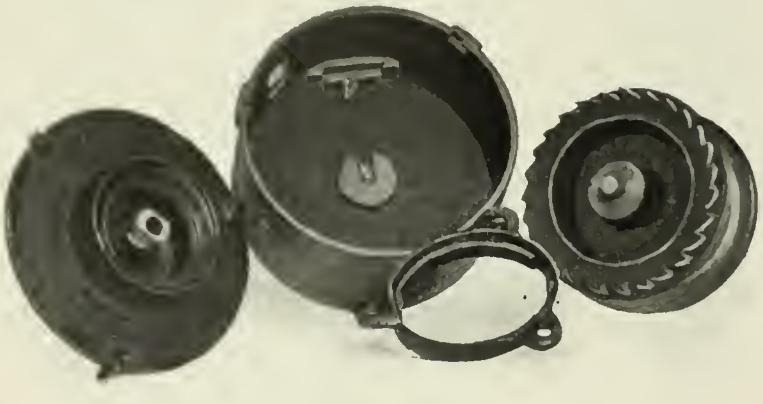


FIG. 2.—DETAILS OF TROLLEY CATCHER.

Field Regulator.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has recently placed upon the market a new type of field regulator, an illustration of which is shown herewith. It consists of a base of insulating material, to which are attached the resistance wire contacts and lever, the whole being carried by a japanned iron casing, which not only gives the instrument a handsome finish, but prevents the possibility of direct contact with the heat-radiating portion of the rheostat. No enamel or similar material is used in the construction, and the resistance material itself cannot possibly disintegrate through misuse. It is claimed that grounding is impossible on account of the insulating base; and the compound by which the various current-carrying parts are attached thereto is of such nature as to become practically part of the base when the apparatus itself is complete. This substance possesses the qualities of insulation, heat conduction and radiation to a marked degree, and is so little affected by heat that the resistance wire has frequently been run white hot by passing excessive currents through it, without in any way causing the compound to deteriorate or separate itself from the base. This insures the maximum factor of safety for the apparatus, as it makes certain that current will be carried without permanent damage up to the actual burning out point of the wire itself. The working parts of the apparatus are all amply proportioned for their designed load.

With these field rheostats for rear of switchboard mounting is furnished a novel 5½-in. hand wheel, which is made throughout of copper, handsomely polished and lacquered. It is obvious that a hand-wheel of this kind possesses many advantages over the ordinary plated hand-wheel, the plating of which in time rubs off and presents a bad appearance. The insulation is of the simplest character, consisting of but a single large piece, and consequently the loosening up of small parts has been entirely done away with, a feature which will be appreciated by those familiar with the ordinary form of insulated hand-wheel.

FIELD REGULATOR.

Turbines for Pennsylvania Railroad Plant.

An order for three steam turbines of the largest size has recently been placed with the Westinghouse Machine Company, East Pittsburg, Pa., by Westinghouse, Church, Kerr & Company, acting as engineers and constructors for the Pennsylvania Railroad in connection with the New York Terminal equipment. These machines will form the initial installation in the new Long Island power house, on which construction is just beginning, and which will serve the traction in the tunnels for the Hudson and East Rivers and the New York Terminal at Thirty-second Street and Seventh Avenue, and also such part of the Long Island Railroad System as is in process of conversion to electric traction.

The turbines will be of the horizontal short-barrelled type, mounted upon a single bedplate, resulting in a particularly compact arrangement and great economy of floor space. They will have a capacity of approximately 7,400 electrical horse-power each, and will drive 5,500-kw. three-phase generators operating in parallel. Their overload capacity will be over 11,000 hp, and each turbine will be provided with a by-pass automatically controlled by the governor to accommodate abnormal fluctuations in load. This will also permit operation at full load non-condensing.

The turbine equipment will operate under conditions favorable to the attainment of high economy, viz.: 200 pounds steam pressure at the throttle, 28 in. vacuum and 175 degrees F. superheat. The generator will be direct connected to the turbine shaft through a flexible coupling, each section of the unit having two bearings of ample proportion, thus avoiding shaft stresses. The three-phase winding will deliver current directly to the distribution system at 11,000 volts, no step-up transformers being employed. The machines will be separately excited, and will carry full load continuously at 100 per cent. to 80 per cent. power factor, with a rise in temperature of 35 degrees C., or 50 per cent. overload for two hours with an increase in temperature rise of slightly over 50 per cent. Each turbo unit will thus be capable of delivering 8,250 kw for reasonable intervals, and considerably in excess of this figure during momentary load fluctuations. The entire equipment will be delivered by July, 1904, one year from the date of contract.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was another sharp break of liquidation and bearish activity during the week, the feature of the movement being the heavy declines in the securities of the United States Steel Corporation. Railroad shares have likewise fallen, and the market disregarded for the time being the favorable items like the fair crop news, good railroad earnings, or the excellent showings for the year past made in various annual railway reports, to say nothing of further measures taken by the United States Treasury calculated to arrest any financial stringency this fall. Electric and traction stocks reflected the condition in the general market, and all suffered marked declines. On Monday of this week the stock market opened very weak and decided demoralization soon became manifest. New low records were made in many important stocks, among them being Brooklyn Rapid Transit, which fell to 29¼. General Electric recorded 136 and Metropolitan Street Railway 100. United States Steel common fell to 15 and preferred to 59¼, the previous low records of these latter two stocks being 20⅝ and 67, respectively. The pressure to sell was especially noticeable. General Electric declined 8 points on sales of 2,850 shares, presumably on reports of a reduced working force at Schenectady, and Westinghouse 13 points on sales of 700 shares. Following are the closing quotations of September 29:

NEW YORK.

	Sept. 22	Sept. 29		Sept. 22	Sept. 29
American Tel. & Cable	79	78¾	General Electric	153	143½
American Tel. & Tel	127	125½	Hudson River Tel	..	..
American Dist. Tel	24	24	Metropolitan St. Ry	112	103¼
Brooklyn Rapid Transit	37¼	32¼	N. E. Elec. Veh. Trns	..	..
Commercial Cable	146	140	N. Y. & N. J. Tel	..	140
Electric Boat	16	15	Marconi Tel	1⅝	..
Electric Boat pfd	40	40	Western Union Tel	82	81
Electric Lead Reduction	1¼	1¼	Westinghouse com	149½	138
Electric Vehicle	4⅞	4¾	Westinghouse pfd	160	160
Electric Vehicle pfd	7	7			

BOSTON.

	Sept. 22	Sept. 29		Sept. 22	Sept. 29
American Tel. & Tel	128¾	125¾	Western Tel. & Tel. pfd	80½	79
Cumberland Telephone	*115¾	*115¾	Mexican Telephone	1¼	1⅛
Edison Elec. Illum	230	225	New England Telephone	*124	*124
General Electric	152½	142	Mass. Elec. Ry	19	18
Western Tel. & Tel	11⅛	10	Mass. Elec. Ry. pfd	78	77

PHILADELPHIA.

	Sept. 22	Sept. 29		Sept. 22	Sept. 29
American Railways	43	42	Phila. Traction	94½	94
Elec. Storage Battery	52	*51½	Phila. Electric	6¼	5¾
Elec. Storage Battery pfd.		*51½	Phila. Rapid Trans	13½	11
Elec. Co. of America	8¼	7½			

CHICAGO

	Sept. 22	Sept. 29		Sept. 22	Sept. 29
Central Union Tel	..	..	National Carbon pfd	*90	*89½
Chicago Edison	.	145	Metropolitan Elev. com	18	17
Chicago City Ry	170	165	Union Traction	4½	4
Chicago Tel. Co	..	112	Union Traction pfd	32	30
National Carbon	*20½	*20			

* Asked

BELL TELEPHONE OUTFIT.—As noted last week, the total output since December 20 last was 407,430, which although somewhat less than for the same period last year, is still larger than for any similar period in the company's history. The output and the number of instruments outstanding for the last five years are shown in the following table:

	Total outstand.	Increase.	Increase per cent.
1898	1,124,846	205,725	22.3
1899	1,580,101	455,255	40.4
1900	1,952,412	372,311	23.5
1901	2,525,606	573,194	29.3
1902	3,150,320	624,714	24.7

The increase in eight months of 1903 was 12.9 per cent, compared with 17.0 per cent. in the same eight months of 1902.

UNITED ELECTRIC SECURITIES COMPANY.—The United Electric Securities Company, in its semi-annual statement for the six months ended August 1, 1903, on the profit and loss account shows a surplus on that date of $1,032,371, against $559,979 January 31, 1903. The increase was mainly derived from a profit of $465,345 from the sale of securities. This company was incorporated May 20, 1890, under the laws of Maine. It has a paid-up capital of $1,000,000 7 per cent. preferred stock and $500,000 common stock. The company devotes itself particularly to buying mortgage bonds of corporations operating electric lighting, power and railway plants, and issuing against them its own collateral trust bonds. Since its incorporation the company has issued $10,500,000 of such bonds bearing 5 per cent. interest, of which only $1,768,000 are now outstanding, secured by collateral having an appraisal value of $2,403,443.

POWER FOR NEW YORK SUBWAY.—It is understood that the Interborough Rapid Transit Company has proposed the purchase of the surplus power of the Metropolitan Street Railway. The purchase of such power as the Metropolitan may have to spare from the operation of its own lines, will, it is expected, so far neutralize the effect of the tie-up of work on the power houses of the Interborough, due to labor troubles, as to make it possible for the subway, now nearly completed from Park Row to One Hundred and Fourth Street over the Fourth Avenue-Forty-second Street-Broadway route, to be put in operation early in the spring of next year. It would mean a gain of several months in getting some sort of rapid transit service under way, even if it were not possible for the Interborough to put on a full schedule of trains.

DIVIDENDS.—The Westinghouse Electric Manufacturing Company have declared a quarterly dividend of 2½ per cent on the preferred and the assenting and the non-assenting stocks of the company. The dividend is payable October 10. Philadelphia Company directors have declared the regular quarterly dividend of 1½ per cent. on the common stock, payable November 2.

MONTREAL STREET RAILWAY.—The directors of the Montreal Street Railway have been authorized by the stockholders to issue $1,000,000 of new stock, increasing the total amount outstanding to $7,000,000.

Commercial Intelligence.

THE WEEK IN TRADE.—A general survey of the trade situation shows that better weather and crop conditions in the Northwest have stimulated business in that section and the same applies to the South and Southwest. In the East a fair trade is reported, but quietness in general business is noted in New York, where buying power is restricted by long and costly labor troubles, and at Philadelphia, where textile business has not increased, as expected. The hardware jobbing trade in the West is reported to have been excellent. On the Pacific coast business is good as a whole. There are few complaints as to car shortage for the movement of crops. In iron and steel there has been a quieting down of demand where plans for restriction of furnace output are being discussed, and finished products lag. A number of anthracite collieries have been put on shorter time. Railway earnings' returns are still highly favorable, those roads reporting for the first half of September showing a gain of 10 per cent. over a year ago, and the absence of car congestion permits the more profitable conduct of business. Lumber and building materials are not so active at the East as was earlier expected they would be, strikes again interfering. At Philadelphia export lumber business is good, but domestic trade is quiet. It is noted that preparations for a large lumber cut in Maine and the Northwest are going forward. Pig iron is dull and weak at Chicago; finished products are unsettled and steel interests do not report orders as large as some time ago. Shutdowns of some Eastern furnaces are reported, due to moving operations, and steel sheet mills are reported likely to close if lower wages are not accepted. Structural plants are doing well, considering the restriction in consumption due to strikes. Copper was dull with little doing. It is stated, however, that consumers have limited supplies on hand and a more active market is looked for soon. The closing quotations were 13¼ to 13⅜c. for Lake; 13 to 13¼c. for electrolytic; 12¾ to 13c. for cathodes and 12⅜ to 12⅝c. for casting stock. The business failures for the week ending September 24, according to *Bradstreet's*, numbered 185, against 170 the week previous and 172 the corresponding week last year.

AMERICAN EQUIPMENT FOR BRITISH STEEL WORKS.—The Southwark Foundry and Machine Company, of Philadelphia, Pa., is about to make shipment of large blowing engines and other machinery for installation in the plant of the big British iron and steel firm of Bolckow, Vaughan & Company, Middlesboro, which is now being remodeled on American lines.

ADDITIONAL EQUIPMENT FOR CAUVERY FALLS.—The extension to the power transmission plant at Cauvery Falls, India, will be equipped with a 1,200-kw General Electric generator, direct-connected to a Pelton type water wheel of 2,000-hp capacity, built by Escher, Wyss & Co., Zurich, Switzerland.

FAN MOTORS FOR INDIA.—Sibley & Pitman, 26 Warren Street, N. Y., have fair-sized orders on hand for fan motors for shipment to India, and general supplies for the Cuban market.

EXPORT AND IMPORT TRADE.—The extent and volume of our commerce in 1903 and that of 1893 is shown by some figures just presented by the Department of Commerce and Labor, through its Bureau of Statistics. Imports have grown from $866,000,000 to $1,025,000,000, an increase of $159,000,000, and the exports have grown from $847,000,000 to $1,420,000,000, an increase of $573,000,000. They show that $92,000,000 of the increase in imports comes from Europe, $55,000,000 from Asia and about $5,000,000 each from North America, South America and Africa. The figures for Oceania show an apparent falling off of about $5,000,000, but this is due to the fact that the merchandise brought from Hawaii is no longer classed as imports, Hawaii being now a Territory of the United States. If this were included in the figures of imports in 1903 it would show a growth of imports from Oceania of about $20,000,000. On the export side the showing is equally interesting. Of the $573,000,000 of increase, $367,000,000 was to Europe, $94,000,000 to North America, $41,000,000 to Asia, $33,000,000 to Africa, $26,000,000 to Oceania, and $8,000,000 to South America. In case the shipments to Hawaii were included, the increase to Oceania would be about $36,000,000. In case those to Porto Rico were included, the increase to North America would be over $100,000,000.

ELECTRIC HEATING ORDERS.—The Prometheus Electric Company, 30 Cortlandt Street, New York, manufacturers of the well-known Prometheus electric heating and cooking apparatus and resistance units, reports a number of orders for large heating and cooking equipments, which have been received during the past few weeks. Among these might be mentioned the heating equipment for all the rooms of the steamships *Minnesota* and *Dakota*, now being built at New London for the Great Northern Steamship Company; also the entire heating equipment of the large new hat factory of F. Berg & Co., Orange Valley, N. J.; heating of the large town residence of John B. Claflin, New York; the heating of the sub-stations in Flushing, L. I.; curling iron equipments for several new New York theatres, etc. Several large agencies have also been established throughout the country, the New York agency having been given to R. H. Macy & Co., who have a large display of these goods in the basement of their store. Several new styles of apparatus have been placed on the market recently.

PLANT FOR SOUTH AFRICA.—Johannesburg is to have a very extensive electric light and power plant. The total electrical output is to be close upon 7,000 kw; but it has not been definitely decided by the consulting engineers in London, Messrs. Mordey & Dawbarn, whether steam or producer gas will be the motive power. Tenders are thus to be received for both systems. The one will include water-tube boilers with mechanical stokers, conveyors, etc., four 2,000-brake horse-power steam engines or steam turbines, each driving 1,350-kw generators, with four others of half this horse-power, one for operating a continuous dynamo and the three others for two-phase alternators. There will also be driven transformers and other gear. The units will be of the same size should gas motors be used, the internal combustion engines being simply substituted for the steam turbines or engines, and the gas-producing plant is to be equal to the gasifying of 7½ tons of Transvaal coal per hour, with all accessories of coal conveyors, etc. The contracts will be let before the end of the year.

MEXICAN CAR-BUILDING PLANT.—Construction work is about to begin on an extensive car-building plant, to be erected in Mexico City. The plant will be electrically equipped. The Mexican Car & Foundry Company has been incorporated under the Mexican laws for the purpose of building and operating the factory. Isaac M. Hutchison, of Mexico City, who represents the interests of the St. Louis Car Company, A. L. Ide & Sons, and other prominent American manufacturing concerns in the southern republic, is the leading spirit in the enterprise. The united capacity of the plant will be 20 cars daily. Later on electric traction cars will be turned out at the rate of a score a month. The works will have an independent power and lighting plant, whose capacity will in the first instance be 500 hp. Contracts for the electrical equipment, also for machine tools, etc., will be awarded within the next three weeks.

GENERAL ELECTRIC ROTARY CONVERTERS FOR SYDNEY TRACTION SYSTEM.—The General Electric Company has been awarded a further contract by the New South Wales Railroad Commission for the sub-stations of the Sydney City & Suburban electric traction system. The contract calls for two additional sub-station equipments consisting of 450-kw rotary converters, with the necessary transformers to convert from 6,600 to 600 volts. Five more units for installation in various sub-stations, consisting of three-phase rotary converters of 400-kw capacity each, with the necessary transformers and other machinery are also about to be ordered.

ELECTRICAL POWER PLANT FOR VENEZUELA.—Senor Antonio Para, of Caracas, Venezuela, who has been in this country for several weeks negotiating several fine beds of asphalt, which he holds under government concession on the Island of Trinidad, has received instructions to sail for home before October 1 and bring with him plans and estimates for a complete government electrical power plant presumably for the government army supply factory and arsenal. He has already received plans and estimates from several concerns in this country for the equipment of a complete electrical system of asphalt conveying machinery for the mines in Trinidad.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the "Chloride" accumulator, has, within a few days, closed contracts with the New York Edison Company and the Chicago Edison Company for additional batteries. These are in addition to the installations mentioned in a recent issue. The battery for the New York Edison Company consists of 150 cells, with a capacity of 1,480 amp hours, and makes the twenty-third installation for this company. The battery for the Chicago Edison Company makes the fourteenth battery operated by this company, and has a capacity of 2,813 kw-hours.

BRAZILIAN TRACTION PROJECT.—An electric traction system is to be built between the city of Rio Janeiro and Nictheroy, once the capital city of Brazil. The length of the road will be about five miles. It will be a metric gauge line. Dr. Carlos Cesar de Oliveira Sampaio and Antoni Julio de Oliveira Sampaio have secured the concession for the construction and operation of the system. Among the provisions of the franchise is the exemption from import duties of the material, etc., for the construction of the road and for the first three years of its working.

ANDERSON LINE MATERIAL.—The Albert and J. M. Anderson Manufacturing Company, of Boston, has lately taken a number of good-sized British orders for line material through Robert W. Blackwell & Company, Limited, of London. Orders are also in hand from Francis J. Cundill, for the British firm of L. J. Healing & Co., of Yokohama, Japan. Domestic orders received within the last few days include one from the Union Railway Company, of New York, for line material to be used in the construction of the Macombs Dam Bridge line and other extensions.

SKINNER ENGINE ORDERS.—J. Holt Gates, Monadnock Building, Chicago, western agent of the Skinner Engine Company, Erie, Pa., reports the following sales of engines: Wisconsin Bridge and Iron Company, 150-hp direct-connected; Ingersoll Milling Machine Company, Rockford, Ill., 150-hp, direct-connected; La Crosse Cooperage Company, La Crosse, Wis., 125-hp, belted; Granada Hotel, Chicago, 2 direct-connected sets; Clinton Brewing Company, Clinton, Ia., 60-hp, direct-connected set; Mueller Brewing Company, 125-hp, direct-connected.

STEEL POLES.—The Franklin Rolling Mill & Foundry Company, of Franklin, Pa., which concern is represented in New York by Chas. W. Mackey, Postal Telegraph Building, is completing its plant for the manufacture of steel poles for electric light, power, trolley, telephone and telegraph lines, and is making a bid for foreign business. Arrangements have been made with Roger Sons & Company, of London, to represent the company in Great Britain, while Isaac M. Hutchison, Mexico City, who represents the interests in Mexico of the St. Louis Car Company, will handle the poles there.

ROCHE BATTERIES FOR ABROAD.—William Roche, 42 Vesey Street, New York, reports recent receipt of several substantial foreign orders for his standard dry batteries. The more important orders have been secured from London, through the export house of S. Hoffnung & Company, Limited, 116 Broad Street, and for South Africa, China and Australia through Muller, McLean & Company, same address.

LAUNCHES FOR ST. LOUIS FAIR.—The Willard Storage Battery Company, of Cleveland, Ohio, has closed a contract with the Truscott Boat Manufacturing Company, of St. Joseph, Mich., for 31 sets of battery of 44 cells each. These batteries are to be used for operating launches at the Louisiana Purchase Exposition, at St. Louis. They will have a capacity of 140 amp.

ORDER FOR AKRON GENERATORS.—The Mantua Light, Heat and Power Company, of Mantua, Ohio, has closed contract with the Bosworth-Holding Company, Cleveland, agent for the Akron Electrical Manufacturing Company for two generators. The plant will be in operation in about two months.

"PHONO" WIRE FOR EUROPE.—The Bridgeport (Conn.) Brass Company has recently secured some fair-sized contracts for Phono electric wire, through the British electrical engineering and contracting firm of Maguire & Barcus, for use by English and German electric traction systems.

SUPPLIES FOR MEXICO.—The Trumble Electric Manufacturing Company, Plainville, Conn., has secured a fair-sized contract through its New York office, T. D. Watson, manager, from the export house of Carr Brothers, 61 Broadway. The goods will be shipped to Mexico.

BALL ENGINE ORDER.—Crofts & Reed, manufacturers of soaps and perfumes, Chicago, Ill., have purchased a 200-hp, direct-connected engine from the Ball Engine Company, Erie, Pa.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Ave., Detroit, Mich.

American Street Railway Association. Secretary, T. C. Pennington, 2020 State Street, Chicago.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, Indianapolis, Ind., June 15, 1904.

California Street Railway Association. Secretary, J. E. Morris, Oakland, Cal.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., 1904.

Connecticut State Street Railway Association. Secretary, A. E. Pond, New Haven, Conn.

Engine Builders' Association of the United States. Secretary, F. P. Ide, Springfield, Ill. Next meeting, December, 1903. Date and place to be announced later.

Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

Illinois State Electric Association. Secretary, H. E. Chubbuck, LaSalle Ill.

Indiana Electrical Association. Secretary, H. C. Kimbrough, Muncie, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, Ill., December 8, 9 and 10, 1903.

Iowa Telephone Association. Secretary, C. C. Deering, Des Moines, Ia. Annual meeting, Des Moines, March 8, 1904.

Kentucky Independent Telephone Association. Secretary, H. K. Cole, Lancaster, Ky.

Maine Street Railway Association. Secretary, E. A. Newman, 71 Congress Street, Portland, Me.

Magnetic Club, New York, N. Y. Secretary, R. J. Murphy, 195 Broadway, New York City. Annual meeting, Second Thursday in January; meetings, April, June and November.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass.

Michigan Interurban and Street Railway Association. Secretary, Benjamin S. Hanchett, Jr., Grand Rapids, Mich.

National Arm, Pin & Bracket Association. Secretary J. B. Magers, Madison, Ind.

National Independent Telephone Association. Secretary, Frank G. Jones.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting St. Louis, Mo., September 14, 15 and 16, 1904.

New England Street Railway Club. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

National Electric Light Association. Secretary, Ernest H. Davis, Williamsport, Pa. Next meeting, Boston, Mass., May or June, 1904.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, Milwaukee, Wis., Jan. 20, 1904.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, Ohio.

Ohio Electric Light Association. Secretary, J. H. Perkins, Youngstown, Ohio. Next meeting, Columbus, Ohio, October 13, 14 and 15, 1903.

Old Time Telegraphers' & Historical Association and Society of United States Military Corps. Secretary, John Brant, 195 Broadway, New York.

Pennsylvania Street Railway Association. Secretary, Charles H. Smith, Lebanon, Pa.

Southern Indiana Telephone Association. Secretary, E. W. Pichardt, Huntingburg, Ind.

Southwestern Electrical Association. Secretary, G. W. Cooper, Oklahoma City, Okla. First Semi-Annual meeting, Oklahoma City, October 9 and 10, 1903.

Southwestern Gas, Electric & Street Railway Association. Secretary, Frank E. Scovill, Austin, Texas.

Street Railway Accountants' Association of America. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y

Street Railway Association of the State of New York. Secretary, Henry A. Robinson, 621 Broadway, New York. Next meeting, Syracuse, N. Y., October 6 and 7, 1903.

Tennessee Street Railway Association.

Toronto (Canada) Railway Roadmasters' Association. Secretary, John F. Argue, Janes Building, Toronto, Ont.

United Electrical Contractors' Association of New York State. Secretary, William J. Davis, Ithaca, N. Y. Next meeting, New York City, January 19, 1904.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

Virginia Street Railway and Electric Association. President, R. P. Apperson, Lynchburg, Va.

General News.

THE TELEPHONE.

NEWPORT, ARK.—The Farmers' Telephone Company has been organized here with a capital stock of $100,000. The old Newport-Elgin line has been absorbed by the new company. A line from Elgin to Centerville and other places will be constructed in the near future.

SAN BERNARDINO, CAL.—The directors of the Home Telephone Company have authorized an issue of $100,000 bonds for the purpose of building its plant.

HAWKINSVILLE, GA.—The Southern Bell Telephone Company will build a line from Macon to Cochran.

SAVANNAH, GA.—Contracts have been signed hy the following telephone companies by which the chief cities of Georgia and Alabama will be connected by long distance lines. The Southern Long Distance Telephone Company and the Georgia Telephone & Telegraph Company of Savannah, and the Atlanta Telephone & Telegraph Company. A charter will soon be applied for by John Flanney, W. A. Bisbee and others of Savannah.

MOLINE, ILL.—The Union Electric Telephone Company will build a line from here to Milan.

CHAMPAIGN, ILL.—The Home Telephone Company has been organized here with a capital stock of $3,000.

SUMNER, ILL.—The Farmers' Mutual Telephone Company has applied to the council of this place for a franchise.

CHARLESTOWN, IND.—The Home Telephone Company has been granted a franchise to enter Charlestown.

DANVILLE, IND.—The name of the Plainfield Telephone Company has been changed to Consolidated Telephone Company, with principal office in Danville.

CRAWFORDSVILLE, IND.—The Co-operative Telephone Company, of this city, has filed the required bond and received authority to make desired changes and extensions of its lines.

LINTON, IND.—The Home Telephone Company of Linton is reconstructing its entire line and plant and will erect its own exchange building. The company proposes extending its lines to the numerous coal mines in the county.

EVANSVILLE, IND.—The citizens of Evansville are not in accord concerning the installation of a municipal telephone system until it is ascertained that there will not be a dual system. One "company and regulate it," is the slogan.

WABASH, IND.—City Clerk McLees has, by order of the council, notified the Central Union Telephone Company to remove its poles, wires and property from the streets by October 1. The company's franchise expired some weeks ago and no effort is being made to procure a new franchise.

YEOMAN, IND.—The Yeoman Telephone Company has filed articles of incorporation with the Secretary of State. This new company will build an exchange in Yeoman, construct and operate telephones and telephone lines throughout Carroll and White counties. Wm. M. McNeel is president; C. W. Steel, secretary; M. M. Baum, Wilbur Creek and G. M. Briney, directors.

GOSHEN, IND.—The State Board of Tax Commissioners have fixed assessments of telephone companies in Elkhart County as follows: American, 876.67 miles at $50 per mile, $43,833.50; Central Union, 935.25 miles at $56 per mile, $52,374.00; United States, 47 miles at $40 per mile, $1,180; Home, 460 miles at $160 per mile, $72,240; Syracuse Home, 22 miles at $10 per mile, $220; Wakarusa Home, 70 miles at $30 per mile, $2,100.

INDIANAPOLIS, IND.—A recent census of the independent telephones in this state shows that independent lines and exchanges are well established in eighty counties and partially established in the remaining twelve counties. Only two counties in the state, Clark and Vanderburg, are without independent telephone exchanges. There are 109,000 independent telephones in operation in the state. In Indianapolis the New Telephone Company has 7,536 telephones in operation and 800 applicants waiting by turn the arrival of instruments and material which cannot be procured as rapidly as needed.

KELLOGG, IA.—The Kellogg Mutual Telephone Company has been organized by C. T. Powers, H. Thorpe, Frank Coffee and others.

NEWTON, IA.—The Jasper County Telephone Company will increase its capital stock from $100,000 to $150,000, to take over six additional lines which have been lately organized.

PORTSMOUTH, IA.—The Portsmouth Telephone Company has been incorporated with a capital stock of $10,000. The officers are: President, Gus Batty; vice-president, Peter Korth; secretary, W. A. Sorrenson; treasurer, C. S. Scroggins.

KEOKUK, IA.—The Union Telephone & Telegraph Company has been incorporated with a capital stock of $1,500. Mr. J. C. Hubinger is one of the promoters of the company, which will operate telephone and telegraph lines in Iowa, Minnesota, Illinois, Missouri and other states.

WINFIELD, KAN.—The Winfield Telephone Company operates exchanges in this place and at Oxford. The Winfield board has a capacity of 600 drops, and that at Oxford has 50 drops, the number of subscribers being 570 and 44, respectively. Ericsson apparatus is used exclusively. The company has 100 miles of toll line.

FRANKFORT, KY.—The Rural Home Telephone Company of Daviess County, with a capital stock of $25,000, and the Whitley Telephone Company, with a capital stock of $4,000, have been incorporated.

UNION, ME.—The Union Telephone Company has 45 subscribers and 40 miles of toll line. It uses apparatus of the American Electric Telephone Company, the switchboard being of 25 drops capacity. The rates for toll service are $20, $15 and $12. Mr. F. A. Burkett is clerk.

ADRIAN, MICH.—The South Dover Telephone Company has been incorporated, the capital stock being $1,000.

HOMER, MICH.—The Woodbury Telephone Company of this city will build several extensions to its system during the fall.

BURR OAK, MICH.—The capital stock of the A. C. Hinebaugh Telephone Company was lately increased to $60,000. The growth of the company rendered the additional capitalization necessary.

SOUTH LYONS, MICH.—The South Lyons Telephone Company has been organized by ten business men of this place, Mr. Kingsley Calkins being president. An independent exchange will be established here.

DULUTH, MINN.—The Mesaba Telephone Company will extend its line from Hibbing to Nashwauk, a distance of 15 miles. Nashwauk is a new town on the Mesaba range.

PARIS, MO.—The Monroe County Mutual Telephone Company of Paris, with a capital stock of $4,500 has been incorporated by W. Jones, W. S. Wiley, J. M. Grigsley and others.

LINCOLN, NEB.—The Morris Independent Telephone Company, with an authorized capital stock of $5,000, has filed articles of incorporation.

CLYDE, N. Y.—The Empire State Telephone & Telegraph Company is building a trunk line from this city to Wolcott.

ELMA, N. Y.—The Elma Telephone Exchange has been organized with a capital stock of $5,000. The incorporators are Herman Judge, R. Peter Lee and Herbert B. Lee.

NEW YORK, N. Y.—It is stated that the Police Department of New York City has contracted with the New York Telephone Company for an exclusive telephone system. The contract calls for 661 telephones, the entire plant to cost between $400,000 and $500,000.

BAINBRIDGE, N. Y.—The Bainbridge Telephone Company has 100 subscribers, mostly all farmers, each subscriber being a stockholder. The company has about 25 miles of line, and charges 10 cents per message to those not subscribers. It uses Stromberg-Carlson apparatus.

DELHI, N. Y.—The Delhi Telephone Company's business is rapidly expanding. It now has 250 subscribers and 75 miles of toll line. Its switchboard capacity is 200 drops. The rate for toll service is $10 per year. The company uses Standard Telephone Company apparatus.

PENN YAN, N. Y. The Milo Telephone Company has been organized at Second Milo with a capital stock of $5,000. The directors elected the following named officers: President, A. Castner Townsend; vice-president, John A. Stone; secretary and treasurer, John W. Coolbaugh. This company will be connected with the switchboard of the Inter-Ocean Telephone Company at Penn Yan.

WAXHAW, N. C.—The Waxhaw Telephone Company, of Union County, N. C., has been chartered, its capital stock being $2,000.

CALEDONIA, OHIO.—The Marion County Telephone Company is putting in an exchange here.

SALEM, OHIO.—The business men of Salem have organized to resist the purpose of the Columbiana County Telephone Company to increase its rates.

PLATSBURG, OHIO.—The Home Telephone Company of Platsburg is building a line to Catawba and will extend throughout the county.

WARREN, OHIO.—The Burton Telephone Company is extending its line from Middlefield to Mesopotamia.

DILLONVALE, OHIO.—The Vigilent Telephone Company has been incorporated with $3,000 capital stock by J. L. Barkhurst, H. T. Roe and others of Dillonvale.

McCOMB, OHIO.—The Farmers' Mutual Telephone Company is constructing a telephone line between McComb and Benton Ridge. It is planning to build other lines.

HOLMSVILLE, OHIO.—Judge F. G. Robinson, of Ravenna, has refused an injunction restraining the Columbiana County Telephone Company from increasing its rates for service.

WAPAKONETA, OHIO.—The Buckland Mutual Telephone Company has been organized with H. D. Bowsher, president; R. W. Sharp, vice-president; T. E. Bowsher, secretary-treasurer.

TOLEDO, OHIO.—The Wellsburg Home Telephone Company of West Virginia has been permitted to conduct business in Ohio. It will locate at Toledo. The capital stock is $50,000.

PORT CLINTON, OHIO.—The Ottawa County Telephone Company is extending its system to all the farmers in this district. The company has recently completed direct connection with Toledo.

ORRVILLE, OHIO.—The Millersburg, Wooster & Orrville Telephone Company is preparing to rebuild its plant at Orrville. About 100 poles will be replaced and 9,000 feet of cable will be put up.

KIMBLE, OHIO.—The Farmers' Telephone Company has been organized here with a capital stock of $5,000, by L. P. Wirtz, S. S. Fraizer, Geo. W. Weidner, G. W. and P. O. Stiving and W. J. Ewing.

ELYRIA, OHIO.—The Elyria Telephone Company has increased its capital stock to $50,000, and has purchased property on which it will erect a new building to be equipped with a modern board of 2,000 lines capacity.

WAPAKONETA, OHIO.—The Wapakoneta Telephone Company is making arrangements to enlarge its exchange and will shortly place a switchboard extension. The company now has over 400 subscribers and its business is growing rapidly.

NEW PHILADELPHIA, OHIO.—The Crescent Telephone Company is erecting new lines between here and Browerstown and will extend to Sherodsville and New Hagerstown. It will connect with all the surrounding towns in the county in the near future.

UPPER SANDUSKY, OHIO.—The Upper Sandusky Telephone Company has elected G. W. Hale, president, L. D. Ingard, vice-president, M. H. Brinkerhoff, secretary, J. J. Huber, treasurer, and C. C. Juvenal, manager. The company has added 100 new telephones within a year.

SPRINGFIELD, OHIO.—The Springfield & Xenia Company is completing its exchange in Springfield and it will be in operation within a few days. The United States Telephone Company has built a long distance line into Springfield to afford long distance connection for the new exchange.

RAVENNA, OHIO.—The Portage County Telephone Company, which was organized six months ago, is making a remarkable showing. It has increased the number of its subscribers by 300 and has entirely rebuilt the system in Ravenna. It is building several miles of toll line in the surrounding country.

TOLEDO, OHIO.—City Solicitor Denman has submitted an opinion to the City Council that the Toledo Home Telephone Company may legally charge its patrons an arbitrary rate regardless of franchise restrictions. He holds that it may also cease to provide free telephones for city use and may prohibit the city from using its poles for carrying fire alarm wires.

CINCINNATI, OHIO.—The Philip Fitzsimmons Telephone Mfg. Company has been reorganized here, the capital stock being increased from $5,000 to $6,000,000. Mr. Fitzsimmons is president of the company and Mr. W. C. Prickett is vice-president and general manager. This is the company through which the Hamilton Telephone Company expects to reach Cincinnati.

SALEM, OHIO.—A local mercantile firm has brought suit against the Columbiana County Telephone Company to test its right to advance its rates over those stipulated in its franchise from the city. The company refused to put in a telephone at the old rate; hence the suit. It maintains that the courts have decided that a municipality has no right to establish rates for telephone service.

OKLAHOMA CITY, OKLA.—The Missouri & Kansas Telephone Company will expend $40,000 in the construction of a conduit system here.

PITTSBURG, PA.—The Ronceverte & Elkins Telephone Company has been incorporated by S. J. Payne and others. The capital stock is $10,000.

BEAVER, PA.—The Beaver County Telephone Company has been incorporated with a capital stock of $100,000. The directors are J. G. Mitchell, J. A. Mellor and H. M. Camp.

NEW BETHLEHEM, PA.—West Millville Telephone Company uses an American "Express" switchboard of 60 drops, has 50 miles of toll lines and 60 subscribers. Service costs $2 per month.

WASHINGTON, PA.—The Federal Telephone Company is securing rights of way for a line from Waynesburg to Dallas, W. Va., there to meet a line already constructed from that place to Wheeling.

NAZARETH, PA.—The magneto system is used in the exchanges of the Slate Belt Telephone & Telegraph Company, with branches at Nazareth, Bangor, Pen Argyl and Portland, Pa. The latter is a recent addition; a new switchboard has also been installed at Bath, Pa. A 500-drop Kellogg switchboard is used in the service furnished 600 subscribers, who pay $18 and $24 yearly. The Slate Belt Company has toll connections with the Keystone Company of Philadelphia and the Consolidated Telephone Company.

AIKEN, S. C.—The South Carolina Long Distance Telephone Company is rebuilding the local system in Aiken.

ABERDEEN, S. D.—At the annual meeting of the Dakota Central Telephone Company the old officers were re-elected. The company now has 3,000 miles of lines in operation, and many extensions and improvements are projected.

WARRENTON, TEX.—The Commercial Telephone Company of Houston is building a line between Carmine and Lagrange, and extensions to other places are contemplated.

WYTHEVILLE, VA.—The capacity of the Wytheville Telephone Company's exchange has been doubled in the past two years; at present there are 300 subscribers, who pay a flat rate of $15 per annum.

LEXINGTON, VA.—The Lexington Mutual Telephone Company, with its 150 subscribers and 20 miles of toll line, reports the outlook as fair and says it may make the system metallic. American Electric telephone apparatus for the most part is used.

SPOKANE, WASH.—The Interstate Telephone Company, incorporated with a capitalization of $100,000, will make connection between this city and towns in Northern Idaho. The officers of the new company are M. A. Phelps, of Spokane, president and treasurer; John Fisher, of St. Maries, vice-president and manager; P. W. Haverland, of St. Maries, secretary. The company has under contemplation many extensions in its lines.

FOUNTAIN CITY, WIS.—D. S. Schroeder is promoting a new telephone system here.

SCANDINAVIA, WIS.—The Scandinavia Telephone Company will install an exchange here.

KNAPP, WIS.—The Knapp Telephone Company has been incorporated with a capital stock of $5,000.

ALGOMA, WIS.—The Farmers' Lake Shore Telephone, Traction & Electric Power Company has incorporated with a capital stock of $3,000. Dan Hitt is one of the directors.

GREEN BAY, WIS.—The Valley Telephone & Telegraph Company has been organized here. Dr. W. E. Fairfield is president; H. H. Davenport, of Chicago, secretary, and W. H. Jones, of Chicago, treasurer. The company will build an independent system in this city.

LARAMIE, WYO.—A telephone system will be built between this city and Hanna by way of Rock River. The distance to be covered is 75 miles, and a number of big ranches will be included in the line.

MACON, GA.—A new telephone system may be established here by A. W. Zealey and David Goldberg, who have petitioned the council for a franchise.

JACKSON, GA.—It is the intention of the Jackson Telephone Exchange to build 22 miles of toll line to extend its system. It has at present 182 subscribers.

SYLVANIA, GA.—Of the 85 subscribers in the system of the Creven Telephone Company 25 were added this year. A 50-drop switchboard of the Telephone Manufacturing Company's make is used. The rates are from $1 to $2.50 per month.

TIFTON, GA.—Mr. J. J. L. Phillips, president of the Tifton Telephone Exchange, reports a good outlook with a contemplated increase of 20 telephones. A Stromberg-Carlson 200-drop switchboard is used for the 150 subscribers, who pay $1.25 for residence and $2.50 for business service.

WASHINGTON, GA.—The Washington Telephone Company which operates in Wilkes County, has 110 subscribers. Apparatus manufactured by Sumter Telephone Manufacturing Company and Telephone Manufacturing Company is used. The rate for toll service is 15c. for five minutes, 20 miles.

PASCHAL, GA.—The Union Telephone & Electric Light Company operates three exchanges. At Buena Vista the switchboard has a capacity of 135 drops, at Talbotton 165 and at Montezuma 125. There are 425 subscribers who pay $1 to $2.50 per month. The company reports a good outlook, and is contemplating an increase of from 50 to 100 subscribers.

FOREST CITY, ILL.—The Forest City Telephone Company has increased its capital stock from $5,000 to $20,000.

STEWARDSON, ILL.—The capital stock of the Stewardson Telephone Company has been increased from $2,500 to $5,000.

HOPEDALE, ILL.—H. G. Schneider, with others, has incorporated the Farmers' Telephone Company, with a capital stock of $5,000.

CHICAGO, ILL.—The capital stock of the Norstrom Lockout Telephone & Manufacturing Company has been increased from $6,000 to $10,000.

ALEXIS, ILL.—The Alexis Telephone Company has been incorporated to operate telephone exchanges; capital stock, $2,000. Incorporators: Charles Rogers, J. W. Standley and W. A. McKnight.

BETHANY, ILL.—Mr. W. S. Herman, proprietor of the telephone line at Bethany reports that he is constantly extending his service. Of the 156 subscribers about forty have been added this year.

ALPHA, ILL.—The Cox Telephone Exchange operates a 112-drop Stromberg-Carlson switchboard, has 200 subscribers, 175 miles of toll line, and charges $3 per year for service. Each subscriber owns his line.

TAMPICO, ILL.—The Tampico Farmers' Mutual Telephone Company has thirty miles of line and connects with other farmer companies throughout Whiteside and Bureau counties. The company will extend its lines to Deer Grove.

COLUMBIA CITY, IND.—The Farmers' Mutual Telephone Company has been incorporated with a capital of $25,000. R. R. Scott is one of the directors.

LIBERTY, IND.—The Liberty Telephone Company, formerly owned by Drs. Coughlin and Wilson, of Indianapolis, has been incorporated as a stock company with a capital stock of $30,000. The company will build new country lines and install a new 400-drop switchboard.

LAWRENCEVILLE, IND.—The Farmers' Home Mutual Telephone Company of Lawrence County has been granted a thirty-year's franchise by the Lawrenceville City Council. The company is installing a modern system and extending the service to many towns in Lawrence County.

MOORELAND, IND.—The Mooreland Rural Telephone Company contemplates building a few party lines, about five miles, immediately. It will have 200 telephones in a short time. A 100-drop "Eureka" switchboard is in use. There are at present 158 subscribers, and 20 miles of toll line.

BROWNSTOWN, IND.—At a recent meeting of the representatives of the Seymour Telephone Company, the Zollman, Trautman and Ruddick lines, and the Brownstown Telephone Company, arrangements were made whereby a long-distance line will be built and operated from Bedford to Seymour by way of Brownstown and Medona.

INDIANAPOLIS, IND.—The Farmers' Mutual Telephone Company of Columbia City has filed articles of incorporation with the Secretary of State. The company has a paid up capital stock of $2,500. The principal exchange and offices will be in Columbia City. The officers are: President, Robert S. Scott; vice-president. C. R. Stoner; secretary, D. W. Dranfee.

INDIANAPOLIS, IND.—From recent developments there are reasons to believe that the independent telephone system of Indiana will soon gain admission into Cincinnati, Ohio. The arrangements made recently by representatives of the New Long Distance Telephone Company of Indiana and the United States Telephone Company of Indiana, to build and connect up what is to be known as the Indiana-Ohio system will practically accomplish this result, as the United States Company has instruments in operation just outside the city limits. It is claimed that plans are maturing whereby Cincinnati will be included among the large number of towns and cities served by the independent systems.

NASHVILLE, IND.—After standing out and denying themselves of telephone service for three months in the hope of getting better terms, the citizens of Nashville have ordered the telephones replaced in their homes and business houses. Several months ago the Morgantown Telephone Company put in an exchange at Nashville, the first system the city ever had. After a time a large number of patrons demanded a lower rate for communicating with Columbus, this being denied, the telephones were ordered out by physicians, merchants, county officers and others. The company remained stubborn and the citizens have now yielded by declaring that the telephone is too much of a necessity to do without, and have withdrawn further opposition to the company's rate and ask for the restoration of their instruments.

CASSELTON, IA.—The Hunter Telephone Company has been organized with a capital stock of $5,000.

NEWHALL, IA.—Mr. James Harrington is president of the Farmers' & Merchants' Mutual Telephone Company, just incorporated with a capital stock of $1,600.

CEDAR FALLS, IA.—The Iowa Telephone Company will rebuild its exchange throughout, installing a central energy board and introducing other improvements.

COKATO, MINN.—The Cokato Telephone Company has been incorporated with $10,000 capital.

NORTHFIELD, MINN.—The Cass County Telephone Company has been organized to build a line from Leader to Motley.

CYRUS, MINN.—The Stevens County Telephone Company started business July 20 this year. It has a switchboard capacity of fifty drops and twenty subscribers. It operates 25 miles of toll line and its rates are $1.50 and $1 per month. The officers are H. L. Hulburd, president; C. R. C. Johnson, secretary and treasurer, and Z. Burt Clarke, superintendent.

ST. LOUIS, MO.—At a meeting of the stockholders of the new St. Louis County Telephone Company the following named officers were elected: J. B. C. Lucas, president; F. A. Heidorn, vice-president; D. C. Taylor, secretary; Ernest Marshall, treasurer, and James D. Houseman, general manager.

RED LEDGE, MONT.—The Rocky Mountain Bell Telephone Company has been granted permission to establish a toll line in this city. The council stood firm in favor of giving the exclusive telephone privilege to L. L. Moffit, until the latter sold his Wyoming exchanges to the Bell Company, thereby leaving Red Lodge without connection except over the Bell lines. The Bell Company has agreed to pay the expenses of a special election and to pay one-half of the $2,000 fines assessed in the city police court against the Bell Company's linemen. The special election will be held within two or three weeks.

WINSTON, N. C.—The Bell Telephone Company will string an additional circuit between Greensboro and Winston.

BENSON, N. C.—The Benson Telephone Company of Johnston County has been chartered with a capital of $10,000.

YANCEYVILLE, N. C.—The Yanceyville Telephone Company, of Yanceyville, has been chartered to build several long distance lines. B. S. Graves, of Yanceyville, is interested.

FESSENDEN, N. D.—C. E. Leslie and others were granted a franchise by the county board to build telephone lines.

TROY, OHIO.—The Bushnell telephone line will be extended to Pleasant Hill.

GREENWICH, OHIO.—The Clinton Telephone Company has secured a franchise in this place and will soon commence work on an exchange.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association has signed a contract for connection with the Independent Telephone Company of Kenton County (Kentucky).

FREMONT, OHIO.—The Fremont Home Telephone Company has increased its capital stock from $60,000 to $100,000 and is planning to make improvements. Russ J. Christy is secretary.

SALEM, OHIO.—The Salem Business Association, composed of a number of leading business men, has adopted a resolution deciding to use the Bell telephone. The Columbiana County Telephone Company, the independent company, recently increased its rates, resulting in concerted action against it.

EAST LIVERPOOL, OHIO.—The business men's associations of Lisbon, Leetonia, Columbiana and East Liverpool have adopted resolutions to fight the increase in rates announced by the Columbiana County Telephone Company which operates in all these towns. The telephone company claims to have lost $60,000 in the past three years.

AKRON, OHIO.—The Summit Rural Telephone Company, recently incorporated with $3,000 capital stock, has bought at receiver's sale the property of the Copley-Sharon Telephone Company and will rebuild the lines and improve the service. New toll stations will be installed at Montrose, Ghent and Hammond's Corners. Connection will be made with the Akron People's Telephone Company, thus securing long distance service.

BLACKWELL, OKLA.—The Blackwell Rural Telephone Company has been incorporated by William Risley and others, the capital stock being $25,000.

PIEDMONT, S. C.—On account of an increase in rates a fight is on here against the Southern Bell Telephone Company.

DALLAS, TEX.—Joseph D. Lloyd, of Wilkesbarre, Pa., has made application to the city authorities here for a franchise for the construction and operation of an independent telephone system in Dallas. He represents independent telephone interests which comprise the Fort Worth Telephone Company. Mr. Lloyd is secretary and treasurer of the latter company.

FARMVILLE, VA.—The South Side Telephone Company, recently organized in this city, has commenced the construction of its system in Prince Edward and Cumberland counties. The officers of the company are: Dr. Peter Winston, president; J. D. Eggleson, vice-president and general manager, and E. W. Venable, secretary.

WASHBURN, WIS.—The Bayfield County Telephone Company has just been organized in connection with the Home Telephone Company of Ashland, and lines have been strung between Ashland, Washburn, Iron River, Mellen and other points. The lines will be carried through to Bayfield at once, and then connection will be made with all Northern Wisconsin and long distance points.

OTTAWA, ONT.—The Bell Telephone Company has made a proposition to the city of Ottawa, in return for a five years' monopoly of the telephone service of the city, to give a service at the rate of $25 per annum for residential telephones and $45 for business telephones. The company will also give free service to the civic buildings and other concessions. The city council is considering whether to accept this proposal or install a municipal telephone service.

ELECTRIC LIGHT AND POWER.

DADEVILLE, ALA.—It was voted on Sept. 21 to issue $10,000 bonds for an electric light plant.

BENSON, ARIZ.—A great electric generating plant is to be established at the falls in the Colorado River, 25 miles below the Grand Canyon, by the Minnesota Gold Mining Company. C. T. English, of St. Paul, Minn., is engineer. More than 25,000 hp will be developed.

WATSEKA, ILL.—The Council has granted Frank Bartness & Company a franchise for an electric light plant.

CARBONDALE, ILL.—The Carbondale Water, Light & Power Company is the outcome of the consolidation of the various companies operating in that city, capital $200,000.

WEST LEBANON, IND.—The City Council has granted a franchise to Wm. H. Goodwine for an electric light plant, to run for twenty years. The plant is to be constructed at once.

CRAWFORDSVILLE, IND.—The report of the electric light commissioners shows that during the month of August the receipts of the plant were $6[illegible]5 and the disbursements $2,506.44.

RUSHVILLE, IND.—The City Council will improve the electric light plant by putting in all new machinery, changing old building, etc. Plans will also be made for buying additional machinery. A. L. Stewart is now preparing the plans and specifications.

ELWOOD, IND.—City officials are holding back bills of the Elwood Electric Light Company pending investigation of a charge that the company is not furnishing light of the required candle power. They insist that the plant be overhauled and modern machinery be installed.

INDIANAPOLIS, IND.—The Merchants' Association has adopted resolutions in favor of an all-night schedule for electric lights in this city under the proposed new contract. The specifications provide for an all-night schedule, but the moonlight schedule is also provided for, so bidders are requested to make proposals on both systems.

VINCENNES, IND.—The City Electric Lighting Company has asked the City Council for a twenty-year's extension of its franchise without change in the price of lighting. It asserts that the company contemplates expending a large sum of money in making extensions and improvements and the installation of new and up-to-date machinery, but the outlay could not be justified on the life of the present franchise.

FT. WAYNE, IND.—A peculiar condition exists in this city. The Jenney Electric Light Company asked for a renewal of its franchise. The company is now furnishing the municipal and commercial lighting. Mr. R. Woodworth and others secured a temporary injunction against the council restraining it from granting the franchise. Woodworth and his associates are in favor of the erection of a municipal plant, and say that the granting of the franchise would put this out of the question. A change of venue has been taken to Auburn. In the meantime a company of citizens have agreed to build the city an electric light plant which will furnish street lights for $70 a year and charge 10 cents per kw-hour for commercial uses. The plant is to become the property of the city in ten years, the city paying over to the company the $60,000 which has been raised by taxation for a municipal plant.

MINDEN, IA.—There is an opening here for an electric light plant.

PORTLAND, ME.—The Steep Falls Lighting Company has been organized at Portland, for the purpose of manufacturing electricity for light, heat and power purposes; capital, $10,000. Guy H. Sturgis, president, Steep Falls; Franklin B. Pease, treasurer, Portland.

MILLERS FALLS, MASS.—Sargent, Conant & Co., Boston, will soon begin work on an electric light and power plant for the town of Millers Falls.

GREENFIELD, MASS.—The State Gas & Electric Light Commissioners have authorized the Greenfield Electric Light & Power Co. to issue $100,000 bonds, $75,000 of which is for the construction of a new plant on Deerfield River.

MANCHESTER, MASS.—The Manchester Electric Company expects to put in conduits and wires for light and power, build a small distributing station, and buy current from the Beverly Electric Company. The General Electric Company will probably receive the contract.

LAWRENCE, MICH.—The question of issuing $25,000 water and light bonds is under consideration.

ALPENA, MICH.—A vote will be taken on the question of issuing $100,000 bonds for an electric light plant.

BELDING, MICH.—The Spencer Electric Light & Power Company is reported as intending to install an electric light plant at Belding.

MAGNOLIA, MISS.—The Magnolia Cotton Mills will install an electric light plant, to illuminate the mills and vicinity. Xavier A. Kramer, of Magnolia, is the engineer.

YAZOO CITY, MISS.—A new water and electric light plant is being installed here. A day power circuit will be put in and an electric railway may be built later on.

MISSOULA, MONT.—It is reported that the Missoula Light & Power Company has in contemplation the enlarging of its plant at Bonner, at a cost of $50,000.

BUTTE, MONT.—The Butte & Anaconda Power Company has been organized to furnish electrical power to the two cities named. It has filed upon 5,000,000 inches of the waters of the Missouri River at Ox Bend. A plant will be constructed at an expense of about $1,500,000. Capitalists of Pittsburg and Chicago are behind the enterprise, which is being pushed here by H. N. Conoll, of Helena, and O. Baur, of Chicago. The transmission line from the plant to Anaconda will be 100 miles in length. Condemnation proceedings have been commenced against the owners of property likely to be damaged by the high water resulting from the construction of the dam.

BRIDGEPORT, N. Y.—Dr. S. Hubbell, of Syracuse, is reported to have purchased a large water-power and milling property at Bridgeport, on Chittenango Creek. He intends to make extensive improvements to the property and will adapt it for the development of electric power, which will be used eventually for an electric railway connecting Syracuse with points along the southern shore of Oneida Lake.

GERMANTOWN, OHIO.—At a recent election it was voted to issue $6,000 bonds for the improvement of the electric light plant.

SUNBURY, PA.—The West Branch Electric Light Company has been incorporated with a capital of $1,000,000, to develop power for the electric lighting of towns from Shamokin to Williamsport. The new company is reported to have secured options on twenty electric light companies and systems.

TIMMONSVILLE, S. C.—This town is contemplating the building of an electric lighting plant.

AMARILLO, TEX.—The Amarillo Water, Light & Power Company will expend about $10,000 for electrical and pumping machinery.

GRANBURY, TEX.—The Granbury Milling Company will install an electric light plant for the purpose of furnishing the town with lights and for commercial use.

TACOMA, WASH.—Porter Bros., of Duluth, Minn., it is stated, have secured a contract from the Columbia Improvement Company, of Boston, Mass., for the development of water power on Puyallup River in Wash., 30 miles from Tacoma. The contract is reported to amount to $350,000.

ARCADIA, WIS.—The Village Council has decided to construct an electric light plant, to cost about $6,000.

EAU CLAIRE, WIS.—It is reported that the Eau Claire Light & Power Company contemplates rebuilding its electric light plant if the lighting contract is renewed. The new plant would cost about $100,000.

ORILLA, ONT.—The Ragged Rapids, on the Severn River, 19 miles from Orilla, were harnessed by the municipality for the production of electric power, at a cost of about $75,000. Some 800 horse power was expected to have been developed, but a defect in the tail race made this amount not available at present. The revenue derived is already $21,237, and the cost of running the works, with repairs, is about $7,500 adding to which the interest on the investment leaves a profit to the town of from $600 to $1,000 on the present power capacity. In addition the town has its street and municipal building lights free. The charge for power is $15 per horse power per annum.

OTTAWA, ONT.—The streets of Ottawa will be lighted by a civic plant next year, if the requisite expenditure is ratified by the ratepayers next January. It is estimated that the cost of installation of the plant, exclusive of poles, as those of existing companies can be used free, will be $40,000, and the annual cost of maintenance about $20,000. The city will buy power from one of the existing companies. The city is now paying $65 per light per annum for street lights. The cost under the operation of the municipal plant will not exceed $42 per light. The lamps will burn 4,000 hours each per year, from dusk to daylight, the moonlight schedule to be abolished. Per hour, the present cost is 2.16 cents; under the civic management it is figured at 1.05 cents.

OTTAWA, ONT.—An effort is being made to resume operations on the works of the Metropolitan Electric Company, at Britannia, six miles from Ottawa, or do something to release the capital which is tied up in the concern. Several years ago the Metropolitan Company secured a civic franchise for the supply of light, heat and power and a large sum of money was spent in the construction of a power canal at the Deschenes Rapids, Britannia, but the company did not proceed further. It is now reported that the company will complete the work or dispose of its interests to some electric power developing concern. A large amount of power is capable of being developed at this point.

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THE ELECTRIC RAILWAY.

PLAINVILLE, CONN.—The incorporators of the Plainville & Farmington Tramway Company have organized. The company proposes to operate the road already built. The stockholders are J. T. Patterson, of Bridgeport; J. B. Cornwall, of Bridgeport; Arthur Perkins, of Hartford; Howard H. Knapp, of Bridgeport; W. J. Carroll, of Hartford. They were elected directors of the company, and at the meeting of the directors J. T. Patterson was chosen president and treasurer, and W. J. Carroll, secretary. The directors voted to empower the president to make arrangements for putting the road into operation at an early date. The company is negotiating for cars and for the supplying of power.

PRINCETON, IND.—At the annual meeting of the stockholders of the Evansville & Princeton Traction Company the following directors were chosen: J. S. Heston, S. T. Heston, E. J. Baldwin, W. L. Sonntag, J. G. Legrange. The directors then elected the following officers: President, Joseph S. Heston, Princeton; secretary and general freight and passenger agent, E. J. Baldwin, Princeton; treasurer and purchasing agent, Samuel T. Heston, Princeton; general manager, William L. Sonntag, Evansville.

WASHINGTON, IA.—Articles of incorporation of the Iowa City, Kalone & Washington Railway have been filed with the County Recorder of Washington County. The company is organized for the purpose of constructing an interurban electric railway from Iowa City to Washington, a distance of about 24 miles. The capital stock is $50,000, and Washington is named as the principal place of business. The officers are George Rodman, of Washington, president; W. P. Coast, of Iowa City, vice-president; Willard J. Welch, of Iowa City, secretary; G. M. Kacvk, of Washington, treasurer.

LOUISVILLE, KY.—The Kentucky Traction Company has filed amended articles of incorporation. The capital stock is increased to $5,000,000 and the bonded indebtedness to the same amount. The company is given the right to build a line from Rock Haven to Owensboro and one from Hopkinsville to Bowling Green.

NEW ORLEANS, LA.—A large contract has been closed by Knox, George & Company, for the construction of an interurban railway line at Birmingham which will cost when completed about $800,000. The new company, which will be known as the Birmingham & Steel Cities Railway & Power Company, will construct 40 miles of road, which, while operated in the same general district as that covered by the older company, will open up entirely new territory. In addition to being the largest contract of the kind ever let to a New Orleans firm, the line, when completed, will be the longest interurban line in the South.

SPRINGFIELD, MASS.—The Springfield Street Railway Company has received petitions from the towns of Hampden, Mass., and Stafford Springs, Conn., for an extension of its lines to those places. The petitions have the support of the Springfield Board of Trade.

DETROIT, MICH.—The Hawks-Angus syndicate has sold the Lansing Street Railway to Nelson Mills, of St. Marys, and his associates. The consideration is said to have been $200,000. They will merge it with the Lansing, St. Johns & St. Louis Railway. The sale agreement gives the Hawks-Angus syndicate entry over the Lansing system for the Lansing-Battle Creek line.

SAVANNAH, MO.—The St. Joseph, Savannah & Northern Street Railway Company of Savannah has been incorporated. It is proposed to construct an interurban line between the above-named cities.

JOPLIN, MO.—An Eastern syndicate, headed by Major William Vincent, of the United States Guarantee Loan & Trust Company, of New York City, proposes to build an electric railway between Joplin and Kansas City. The road will be 170 miles long. It is the intention of the company to do a general freight as well as passenger business.

MANCHESTER, N. H.—All the directors of the Manchester Traction Light & Power Company and the Manchester Street Railway Company were re-elected at meetings of these corporations held at the Manchester office Sept. 16. They are as follows: Traction, Light & Power Company—William A. Tucker, of Boston; George H. Hood, of Boston; Walter M. Parker, Gerge B. Chandler, R. G. Sullivan, Harry E. Parker, J. Brodie Smith, of this city; S. Reed Anthony, of Boston; Stillman F. Kelley, of Boston; Billings P. Learned, of Boston; R. H. Hallowell, of Boston, and Charles M. Floyd, of Manchester. Manchester Street Railway Company—Philip L. Saltonstall, of Boston; Walter M. Parker, of Manchester; S. Reed Anthony, of Boston, and David A. Taggart, of Manchester.

NEWARK, N. J.—A part of the trolley system of the Public Service Corporation was tied up last Thursday evening by a strike of employees. A few of the lines to outlying towns were affected for a few hours. The strike seems to have been premature. The company refused to negotiate with representatives of associations, but expressed its willingness to treat with individuals or committees of employees.

JERSEY CITY, N. J.—Service out of the United States Circuit Court secured last week on the officers of the Union Railway, Power and Electric Company in Jersey City and upon co-defendants Frederick K. Day, receiver of the American Union Electric Company; George Riker, James S. Riker, William F. Bailey, Charles W. Alling, Harry W. Hungerford, Calvin G. Hungerford and Charles A. Hungerford, in the suit for foreclosure on the property of the Union Railway, Power & Electric Company brought by the McVicar Realty Trust Company, of New York. The bill of complaint notes the fact that the Union Railway & Power Company was adjudged insolvent by the Chancery Court of New Jersey, and a receiver in the person of Frederick K. Day appointed Oct. 29, 1902.

NYACK, N. Y.—The Rockland Railroad Company was granted a franchise in South Nyack on Sept. 10.

NEW YORK, N. Y.—Mayor Low has affixed his signature to the franchise granting to the Union Railway Company the right to cross Macomb's Dam Bridge and Viaduct, thus giving residents of the Bronx an outlet from their borough directly into Manhattan.

UTICA, N. Y.—At the annual meeting of the stockholders of the Utica & Mohawk Valley Railway Company the following directors were re-elected for another year: Horace E. Andrews, John J. Stanley, Alden M. Young, Nicholas E. Devereux, Charles B. Rogers, Walter N. Kernan, David H. Burrill, William E. Lewis and James S. Sherman.

NEW ROCHELLE, N. Y.—The power house of the Union Street Railway Company at Washington and Webster Avenues was completely destroyed by fire on the morning of September 19. All the trolley lines of New Rochelle and those running to Mount Vernon, Larchmont, Tuckahoe and Glen Island are supplied by the plant. It will take months to rebuild the plant, which cost over $100,000.

DELAWARE, OHIO.—The Delaware & Magnetic Springs Railway Company has commenced the erection of a power house on the Scioto River, near here. The plant will be completed shortly after the first of the year.

CLEVELAND, OHIO.—A franchise has been granted by the City Council to a proposed street railway company, which is to charge a three-cent fare. It is the first franchise of its kind in the city. Mayor Johnson is said to be interested in the new line.

CLEVELAND, OHIO.—The Eastern Ohio Traction Company is planning extensive improvements on its Garrettsville division. It is probable that the power equipment will be improved and that new rolling stock will be added. George L. Bishop, the newly elected president, is formulating the plans.

AKRON, OHIO.—The Northern Ohio Traction & Light Company has placed contracts for the installation of a 2,500-hp engine and generator to be delivered about Jan. 1. The company has placed a contract for ten new cars. It is the intention to install limited service on the line between Cleveland and Akron.

CLEVELAND, OHIO.—The Westinghouse Electric & Manufacturing Company has commenced the erection of the Elyria power station of the Cleveland & Southwestern Traction Company of the two 1000-kw alternating-current Parsons turbine sets ordered some time ago. Three 500-hp Heine boilers are to be installed. A new switchboard and transformers are also to be installed.

CLEVELAND, OHIO.—A meeting of the stockholders of the Muncie, Hartford & Fort Wayne Traction Company has been called for Sept. 25 for the purpose of financing the company. It is announced that an outside banking house has agreed to take the entire issue of bonds providing some of the issue is retired. The bonds are now held to secure a loan over and above that paid on the original underwriting for the construction of the road.

CINCINNATI, OHIO.—Construction has been started on the west end of the Indianapolis & Cincinnati Railway between Rushville and Indianapolis. The survey from Rushville to Connersville is completed, and the line from Hamilton through Oxford to Connersville is well under way. The line will be built for high speed, and it will aim to compete with the steam roads for through traffic. Charles L. Henry is president and general manager of the company.

WASHINGTON C. H., OHIO.—The Ohio River & Columbus Railway Company has filed a mortgage for $1,000,000 in favor of the Union Savings Bank & Trust Company, of Cincinnati. The mortgage secures bonds for the construction of a steam and electric road through Franklin, Madison, Fayette, Pickaway, Highland and Brown counties, Ohio. The line will extend from Maysville, Ky., to Washington C. H., where connection will be made for Columbus. The road will be constructed for handling freight trains by steam. The officers of the company are G. Baumbach, president; E. E. Galbreath, vice-president; W. G. Wagenthals, general manager. W. G. Wagenthals & Company, of Cincinnati, are the contractors for the road.

PETERBORO, ONT.—An agreement has been entered into between the corporation of Peterboro and the Peterboro Radial Railway Company, by which the latter is given a franchise to operate a street railway in the city, to extend over a period of 30 years from July 1, 1904. The company will use the tracks of the defunct Peterboro & Ashburton Railway Company, and agrees to have the system in operation not later than July next. The capitalists interested in this enterprise are those identified with the American Cereal Company, including Senator Cox, of Toronto. The company will spend $250,000 on a new dam and power house.

ALLENTOWN, PA.—The Lehigh Valley Traction Company has begun running cars through from this city to Bangor.

PALMYRA, PA.—Surveys have been made for a four-mile electric railway between this place and Valley Glen Park, in which Philadelphia capitalists are interested.

JOHNSTOWN, PA.—Surveys have been completed for the new Johnstown, Woodvale Heights & East Conemaugh Street Railway, which was chartered Aug. 31. The new line will be about four miles long.

CHAMBERSBURG, PA.—The Town Council has granted the Chambersburg & Gettysburg Electric Railway Company a franchise to build a line on East Queen Street between Main and Second Streets, thus reducing the running time between this town and Fayetteville when the line is completed.

DANVILLE, PA.—The Danville & Bloomsburg Street Railway Company, capital $36,000, was chartered Sept. 21 to build a six-mile electric railway from Danville to Bloomsburg. William F. Pascoe, of Allentown, is president of the company.

JOHNSTOWN, PA.—The Johnstown, Woodvale Heights & Conemaugh Street Railway Company was chartered Sept. 21, with a capital stock of $30,000, to build a five-mile electric railway from this city to East Conemaugh. Joseph H. Berlin, of Johnstown, is president.

HARRISBURG, PA.—The Blenside & Willow Grove Street Railway Company, capital $24,000, was chartered here Sept. 21, to build a four-mile electric railway from Keswick Avenue, Philadelphia, to Willow Grove Park. C. P. Weaver, of Philadelphia, is president of the company.

BEAVER, PA.—A charter was granted at Harrisburg, Sept 21, to the Northern Street Railway Company to build a five-mile electric railway from College Hill to Big Beaver via Homewood and Hoytdale. William Redwood Wright, of Philadelphia, is president of the company, and the capital stock is $30,000.

MORRISVILLE, PA.—A charter was granted at Harrisburg Sept. 21 to the Delaware River & Morrisville Street Railway Company, capital $60,000, to build ten miles of line from this place and across the Delaware River Bridge here to the dividing line between Pennsylvania and New Jersey, near Trenton. Samuel Rea, of Bryn Mawr, is president of the company.

MONTREAL, QUE.—The Montreal Street Railway Company has decided to increase its capital stock to $7,000,000, an increase of $1,000,000. The increase is to carry out a plan of extension of the lines and also to provide additional rolling stock.

CHATTANOOGA, TENN.—At a meeting of the stockholders of the Chattanooga Electric Railway Company to be held in the latter part of September, or early in October, decision will be reached on the contruction of an electric railway up Lookout Mountain and a line to Chickamauga Park.

CLARKSVILLE, TEX.—It is announced that the promoters of the proposed interurban electric railway between this place and Mt. Pleasant, Tex., by way of Rosalie and Bogata, have perfected the necessary financial arrangements for the early construction of the road.

FORT WORTH, TEX.—F. M. Haines, general manager of the Northern Texas Traction Company, of this city, says that the company's interurban electric road across the bottoms between Fort Worth and Dallas will be double-tracked within the next fourteen months.

HAMPTON ROADS, VA.—Application has been filed for a receiver for the Hampton Roads Railway & Electric Company by Jno. G. Powell and Brothers, of Philadelphia, they being the principal stockholders. It is alleged that the company is insolvent.

NEW INDUSTRIAL COMPANIES.

THE STERLING MOTOR COMPANY, of Binghamton, N. Y., has been incorporated with a capital of $25,000. Directors, O. S. Heller, F. H. Matthews, and H. W. Edson, Binghamton.

THE ADDISON GAS AND POWER COMPANY has been incorporated at Addison, N. Y.; capital, $50,000. Directors: M. T. Cassada, Webbs Mills; J. B. Rumsey, Oswayo, Pa.; L. H. Seibert, Coudersport, Pa.

LEGAL.

LIGHTNING OVER TELEPHONE WIRE.—In the appeal case of the Southern Bell Telephone & Telegraph Company vs. M. C. Tyer, the Supreme Court of Alabama has affirmed the decision of the lower court in favor of the plaintiff, M. C. Tyer, whose place has been struck by lightning that came in over the telephone wires. It was held that where a telephone company, having previously maintained a telephone in a store, on being requested to remove the same removed the instrument, but against the proprietor's protest neglected to remove the wires, merely twisting the ends of the wires together inside the building, and by reason thereof atmospheric electricity was conducted into the store and injured plaintiff, who was lawfully in the store on business with the proprietor, defendant's failure to remove the wires from the building was negligence per se, entitling plaintiff to recover for the injuries sustained.

TELEPHONE POLE ACCIDENT.—At Cambridge, Mass., a market wagon wheel ran into a depression in the street, the wagon lurched and came in contact with a slightly leaning pole of the New England Telegraph & Telephone Company. A rider in the vehicle was hurt by the pole, and a verdict in his favor against the company has just been sustained by the Supreme Judicial Court of Massachusetts. One of the judges dissented, however, remarking: "It will be curious to see how far the majority of the court will carry its interpretation of the statute. It frequently happens at the present time that an automobile gets beyond the control of the person in charge, and plunges into a telegraph pole outside the traveled part of the way, and the automobile or the person in charge is injured. Is the owner of the pole to be held liable? Again, an open trolley car leaves the track owing to a defective rail, and a passenger is thrown against a telegraph pole. Is the owner thereof liable? I cannot think that the Legislature intended any such consequence to result from the language used in the statute. Statutes are to be construed reasonably, and it seems to me that the construction put by the majority of the court tends to most unreasonable results."

MAY EAT PEANUTS.—The jury at New Brunswick, N. J., which heard the evidence in the suit of Alvie Peterson against the Middlesex & Somerset Traction Company gave Mr. Peterson a verdict of $400. Peterson had been eating peanuts in a car and declined to stop when ordered by the conductor to do so. The conductor, James Crossen, thereupon threw him off the car and injured him. Mr. Peterson instituted criminal proceedings against Crossen and the man was indicted, but at his trial he was acquitted. Then Peterson sued the company. Supreme Court Justice Fort, in his charge to the jury, plainly laid down the principles of the law in such cases. He said that a carrying company enters into a contract with its passengers to use a high grade of cars in carrying them, and that if an unlawful assault is made the carrier is liable for the act of its employee while the employee is acting in the capacity of employee. The company may establish reasonable rules that they may enforce on their cars, he said, but the passengers are not bound by those rules unless the rules are posted in the car or the passengers are notified of them. In the enforcement of the rules the company is not permitted to use any more force than necessary. Crossen was enforcing a rule that peanut shells are not permitted on the floor of trolley cars.

PERSONAL.

MR. D. W. COONS, manager of the Hydra Battery Company, New York, is around again after a severe and painful illness.

MR. RUDOLPH BUECKING, manager for Hugo Reisinger, New York, has gone to Europe for a short trip, combining pleasure with business.

MR. E. THURNAUER, of the French Thomson Houston Company, is again visiting this country and may be here some little time before returning to Paris.

MR. RUDOLPH MIEHLING has taken charge of the New York office of the Walker Electric Company, of Philadelphia, having come from the factory in that city.

MR. ISAAC M. HUTCHISON, of Mexico City, who represents prominent American manufacturing concerns in Mexico, is now in New York City at the Hotel Manhattan.

MR. A. E. WARSWICK, formerly chief engineer of the electric traction system of Mexico City, controlled by the London financial house of Wernher Beit & Company, has sailed for Europe.

MR. FRED. W. EWALD, former manager of the Consolidated Schools Company, and Mr. Leonard W. Seelisberg, former vice-president and secretary, have severed their connection with the company and will take up work of a different kind.

MR. RALPH D. MERSHON sailed on Sept. 25 for Europe,. He will return about the middle of November. His visit abroad is in connection with engineering work on which he has been retained by a prominent company in this country.

MR. PAUL J. KRUESI, manager of the Sunlight Lava Mfg. Company, of Chattanooga, Tenn., has been spending a couple of weeks north, visiting friends and transacting business. The concern is very busy on electrical and acetylene supplies.

MR. CHARLES S. DRUMMOND, who recently resigned the financial directorship of the British Electric Traction Company for the purpose of assuming the presidency of the Manhattan Transit Company has vacated that position. He sailed for Europe Saturday last.

MR. DE VERE STEVENS has left for South Africa in the interests of the recently reorganized Export Club of America, 9 South William Street, of which several electrical men concerned in foreign trade are members. Mr. Stevens expects to be absent about six months.

MR. J. H. VAIL, so well known in Edison circles, and for some time chief engineer of the system in Philadelphia, is now associated with the Pennsylvania Iron Works, and busily engaged on several important engineering matters for them. He was a visitor in New York last week.

MR. A. FREDERICK COLLINS has already booked for this season some twenty engagements to lecture, with demonstrations, on wireless telegraphy and telephony. His first lecture takes place this week, October 2, before the Business Men's Association of Poughkeepsie, N. Y.

MR. M. R. McADOO, formerly connected with the Pittsburg McKeesport & Connellsville electric traction system and now president of the Compania Mexicana de Traccion (Mexican Traction Company), Mexico City, has just left New York for Mexico City to start construction work.

MR. CHARLES F. JOHNSON, who has made a great success in Buffalo in dealing in new and second-hand electrical and kindred machinery, has decided on a new step which will give him broader scope. He is opening a New York office which in all probability will be headquarters, and from which it is likely his Buffalo business will be conducted.

MR. C. J. GLIDDEN.—A cable dispatch from London announces that Mr. and Mrs. Charles J. Glidden, of Lowell, Mass., have returned to London after completing an automobile Arctic tour of 6,670 miles. Mr. and Mrs. Glidden sailed from Boston in June for England, whence they began their tour through Europe, in the course of which they crossed the arctic circle.

MR. R. T. LAFFIN.—Richard T. Laffin, general manager of the great system of the Worcester Consolidated Street Railway Company, has sent in his resignation, to take effect Jan. 1. He is to go to the Philippines to be general manager of the Manila Electric Railway Light & Power Company. Mr. Laffin went to Worcester to his present position on Jan. 1, 1901.

MR. THOMAS C. WOOD, president of the Ball & Wood Company, the well-known high speed engine builders, has just returned to New York, from Europe. He visited England and the Continent, making casual observation of technical affairs; but the bulk of the time—some two months—was spent with a friend in a delightful walking tour through Switzerland. Mr. Wood finds himself greatly benefitted by this quiet and leisurely experience.

CHILDS—COFFIN.—Miss Jenny Coffin, daughter of Mr. C. A. Coffin, president of the General Electric Company, was married at Lynn, Mass., on Sept. 23, to Mr. Sterling W. Childs, of Pittsburg. Guests were present from England, Germany and many cities in this country. The ceremony was performed by Rev. G. A. Gordon, pastor of the Old South Church, Boston, who is an intimate friend of the bride's parents. It is stated that the wedding presents are valued at $250,000.

MR. EUGENE L. ASHLEY, president of the Hudson River Water Power Company was the guest of honor at a testimonial banquet tendered to him at the United States Hotel, Saratoga, N. Y., on Sept. 24. The affair was gotten up by the leading citizens of Glens Falls, South Glens Falls, Sandy Hill, Fort Edwards and other towns as a testimonial to Mr. Ashley's pluck and perseverance in carrying forward the construction of the big power works at Spier's Falls on the Hudson River.

MR. W. J. KELLY, of Guatemala City, Guatemala, one of the firm of Van de Putte & Company of that city, dealers and jobbers in machinery, is in New York getting information and estimates for electrical machinery and material for the Guatemala market. He is especially looking up small commercial plants, incandescent lamps and fans. Electrical machinery is practically admitted duty free in Guatemala, and that country offers for American made goods a fine market which heretofore has been monopolized by the Germans, French and English. Mr. Kelly is a large dealer also in farm and plantation machinery.

EDUCATIONAL.

TRAINING FOR FOREMEN.—With the object of training artisans for the position of foremen it has been decided to substitute for the advanced courses which have hitherto been given by the Lowell Institute, Boston, an evening "School for Industrial Foremen," to comprise at the outset two courses, one mechanical and the other electrical, both extending over two years. The subjects in the first year for both courses will be practical mathematics, elementary physics and electricity, elements of mechanism and gearing, and drawing. The subjects taught in the second year of the mechanical course will be mechanics, valve gears, elements of thermodynamics, the steam engine and boilers, elementary hydraulics, testing laboratory, steam and hydraulic laboratory and mechanism, and elementary machine design. The second year of the electrical course will include valve gears, elements of thermodynamics, the steam engine and boilers, steam laboratory, direct-current machinery, alternating currents, electric distribution, electrical testing and dynamo laboratory. The first session will open in October and continue through April. The instruction will be given by means of recitations, lectures, drawing room practice and laboratory exercises, and it will be given at the Institute of Technology by members of the instructing staff of that institution. To be admitted applicants must have a good knowledge of arithmetic, including the metric system, elementary algebra, plane geometry and mechanical drawing. Like all courses conducted by the Lowell Institute, the instruction is free.

FRANKLIN INSTITUTE LECTURES.—The course of lectures announced by the Franklin Institute, Philadelphia, for 1903-4 includes Mr. W. J. Hammer on radium; Prof. R. W. Wood on fluorescence, etc.; Dr. Lee De Forest on wireless telegraphy; Wm. Martin I. Wilbert on Roentgen ray therapeutics; Mr. A. A. Knudson on underground electrolysis; Dr. M. G. Lloyd on the theory of electrons; Dr. J. W. Richards on the electrolysis of water; Dr. E. F. Roeber on the electrometallurgy of iron and steel; Mr. C. J. Reed on Faraday's electrochemical work; Mr. Clarence J. Messer on telpherage; Mr. W. E. Harrington on rail bonds; Mr. W. M. Scott on circuit breakers; Mr. Mortimer Norden on electric carriage calls and electric signs; Dr. W. E. Winship on storage batteries in street railway operation.

BROOKLYN INSTITUTE.—The Brooklyn, N. Y., Institute of Arts and Sciences, has issued an excellent prospectus for 1903-1904, in which the various electrical and allied departments are well represented. In chemistry a course of six lectures is to be delivered by Prof. Harry C. Jones, of Johns Hopkins University, in which electrolytic dissociation, etc., will come up. Prof. John S. McKay, of the Packer Institute, is to deliver a course of eight illustrated lectures on "Recent Discoveries in Physical Science and their Relation to Theories of Matter and Energy." In the Department of Electricity also Prof. E. R. von Nardroff will deliver a course of six illustrated lectures on "The Electron Theory: Its Experimental Basis and its Chemical and Physical Applications." In mineralogy, Mr. W. Goold Levison is to lecture on the "Magnetic and Electric Properties of Minerals."

OBITUARY.

MR. W. H. HILL.—We regret to note the suicide of Mr. W. H. Hill, of the foreign department of the General Electric Company, at Orange, N. J. He had returned recently from Mexico after a long stay abroad, and was in very poor health. He complained of his inability to sleep, and appears to have brooded over his own condition, as well as that of his father, who has also been ill. Mr. Hill was quite a young man and was formerly at the Schenectady works.

MR. HENRY STEERS.—A sad accident occurred at Westport, R. I., on September 29, when Mr. Henry Steers, while fishing in the harbor, was drowned from his boat. He was a well-known banker, and son of the designer of the famous schooner yacht *America*, which won the Cup. He was early interested in electrical matters, giving active support to his friend, Mr. E. H. Johnson, the pioneer in so many useful new enterprises. He was a director of the Dry Dock, East Broadway & Battery Railway Company, of the Dubuque and Sioux City Railroad Company, of the Interior Conduit & Insulation Company, the New York and Boston Dyewood Company, the Rubber Goods Manufacturing Company, and the State Trust Company. He was, besides, a member of many clubs, including the New York Yacht Club, the Union, the Racquet and Tennis, and the Engineers' Club. He left a widow and a son, Henry Steers, Jr., a contracting engineer.

Trade Notes.

EXHAUST HEADS FOR LONDON.—Sixteen Burt exhaust heads were recently sent to London, England, by the Burt Mfg. Co., Akron, Ohio.

THE HEALD MACHINE COMPANY has succeeded to the business lately carried on as manufacturers of machinery and tools, at Barre, Mass., under the style or firm name of L. S. Heald & Son.

THE PITTSBURG BRANCH of the H. W. Johns-Manville Company, on account of increased business, has secured larger quarters by taking the adjoining property, and now occupies the entire building at 218-220 First Ave.

STANLEY INSTRUMENT COMPANY, of Great Barrington, Mass., has issued a four-page bulletin with regard to its Stanley recording wattmeter for alternating current circuits. The brochure is a closely printed and closely reasoned technical discussion of the principles and features of the instrument.

THE PITTSBURG TRANSFORMER COMPANY, Pittsburg, Pa., is continuing the mailing of monthly calendars. In the October publication appears a girl dressed in Colonial style, while the business part of the calendar is contained in the terse statement that more Pittsburg transformers were sold in September, 1903, than ever before.

THE EASTERN ARM & PIN COMPANY, of New Bern, N. C., is now equipping another plant to especially manufacture large, special arms for street railway and power line work. Its business in this line both for domestic and foreign consumption has grown to such large proportions that it has been obliged to separate it from its general cross arm business.

TELEPHONE EQUIPMENT.—The International Telephone Manufacturing Company, Chicago, reports having constantly increasing demand for its improved generator-call telephones and its new manual and self-restoring drop switchboard equipment. Among its recent equipments was an order for a complete public exchange outfit for E. A. Schuman, of Jacksonville, Fla.

EXCELSIOR BATTERY AT A LOW PRICE.—The Excelsior Dry Battery Manufacturing Company, 32 Vesey Street, New York, is offering to send to responsible telephone companies, on six months' approval, a 5x2 cell which it states is far more efficient than the ordinary cell. It is offering it at a very low price, and will be glad to hear from telephone companies in regard to the matter.

MR. E. L. VOGEL, formerly with the Chas. Munson Belting Company, has accepted a position with the Grafton & Knight Mfg. Company, 54 Canal St., Chicago, as special agent. The Grafton & Knight Company are well known as manufacturers of belting of the highest quality, and are to be congratulated upon having secured the services of one so well and favorably known to the belting trade as Mr. Vogel.

THE VIRGINIA LOCUST PIN COMPANY, with headquarters at New Bern, N. C., is now operating large plants in three states, Virginia, North Carolina and Tennessee. The product of its factories in northern Virginia is used for making prompt deliveries north and east, that in Tennessee for prompt deliveries west, and that in North Carolina for southern distribution. It has great advantages in the way of freights.

THE BARRIETT ELECTRIC COMPANY, Cincinnati, Ohio, has opened its own salesroom and wareroom in the Havemeyer Building, New York. Its representative, Mr. C. J. Purdy, will carry in stock a full line of motors from ½ to 10-hp, all voltages. Mr. Barriett has had a great deal of success with these machines and the stock which is to be placed in New York will give him opportunities for broadening his work and market.

THE HOBART ELECTRIC MFG. COMPANY, Troy, Ohio, has recently enlarged its factory and increased its manufacturing facilities to such an extent that it can make immediate deliveries of dynamos. As a matter of fact, on regular sizes it is willing to take telegraphic orders where it is essential that machines be secured promptly. The company is a well-known manufacturer of dynamo electric machinery and has been successful in building up an excellent business in the middle west.

ELECTRICAL SUPPLY THEFT.—The Manhattan Electrical Supply Company, New York City, had its suspicions aroused as to some of its employees, and arrests of three were made this week, two being truckmen and one an elevator man. It is stated that these persons had been stealing supplies together for some months past, with the collusion of a receiver of the stolen goods. The supplies are estimated to be worth more than $20,000, and were taken away in cases. They consisted chiefly of keys, sockets, etc.

INCANDESCENT LAMP METER.—The Talmont Electric Engineering Company, 150 Nassau Street, New York, is marketing an ingenious device for the measurement, at an incandescent lamp, of the amount of current consumed by the lamp. It consists of an ammeter built in the receptacle between the plug and socket. The ammeter is designed for direct and alternating currents, and is compact in size. The company also builds high-class instruments to specifications. It reports meeting with much success with its products.

THE EUREKA ELECTRIC COMPANY, formerly of Chicago, has bettered itself extensively by removing its plant to Genoa. It not only is in position to manufacture more cheaply, but its additional capacity has aided it to make more prompt shipments. Within the last week it has closed ten distinct contracts on telephone switchboards, not smaller than 400 capacity each, and up to very large central energy equipments. Among new printed matter may be found its high art No. 23 catalogue, as well as Bulletins No. 26 and No. 27 relating to its later switchboard products.

ORDER FOR ROOFING.—The largest orders ever given for roofing recently placed by the War Department with the H. W. Johns-Manville Company, 100 William Street, New York, for roofing to be used on the Army Buildings in the Philippine Islands. A total of 14,020 rolls of two squares, over 900 tons, was ordered; enough to cover 65 acres, or make a strip a yard wide 200 miles long. Ten bids were submitted and the award was made only after careful investigation by the War Department and the supervising architect of the Treasury. Prompt delivery was essential and it is of interest to note that one order for 11,120 rolls was completed within 30 days, and another for 2,900 rolls within ten days of receipt.

GLOBE ELECTRIC MFG. COMPANY, of Gordon Avenue, Cleveland, Ohio, has recently introduced a novel form of combination arc and incandescent headlight for electric cars. It has two circuits. On one is an enclosed arc, with mechanism for elevating the lamp out of focus with the reflector, for the purpose of dimming the light when entering city limits. A small rheostat goes with the lamp which is adjustable for 2 to 5 amp. on a drop of 300 volts. It burns ⅜ in. carbons. On the other circuit are four incandescent lamps to be thrown in when the arc is cut out, according to whether the car is within or outside city limits. The change of light is made by inserting either the arc or incandescent positive plug into the receptacle or by operating a two point switch in the vestibule of the car.

DECORATIVE LAMPS.—While incandescent lamps lend themselves very readily to decorative effects, the beauty of brilliancy and decorative illumination is frequently enhanced by the inclusion of a color scheme. It is not always worth while to buy lamps made with frosted or colored bulbs especially if the decoration is only temporary. Therefore the next best thing is to get a coloring preparation which will give all the result of a permanently colored lamp or of a frosting solution which will give similar results. Several manufacturers have placed such compounds on the market. Of one of these, Mr. Francis Granger, 26 Cortlandt St., New York, has been appointed Eastern sales manager and is now prepared to offer it in connection with the Sterling Special lamps which have become justly famous in part through Mr. Granger's aggressiveness.

PERKINS SWITCHES.—The Perkins Electric Switch Mfg. Company, of Bridgeport, Conn., has just issued a new catalogue 6½x3¾ inches, convenient pocket size, comprising 192 pages, in dark green buckram cover with rounded corners. On the front cover is shown a nickel-plated flushplate, with two rotary flush switches. On the back cover is shown the Perkins key socket with shade holder rigidly attached to the shell. The latter is one of the new goods, shown for the first time in this catalogue. No fewer than 1,200 articles are enumerated in the catalogue, each with an individual catalogue number and telegraph code word. The cuts are in half-tone, bringing out remarkably well the qualities of the goods made in porcelain. The Perkins Company will be glad to have requests for the catalogue sent to any electrical supply house in the country. The catalogue is not distributed direct to the consumer.

STANDARD VITRIFIED CONDUIT.—President B. S. Barnard, president of the Standard Vitrified Conduit Co., 39 Cortlandt St., New York City, has just issued to the trade a circular as follows: "We have on hand a large stock of multiple and single type conduits in all sizes. Can make immediate shipment. Our factories are in full operation, producing over 80,000 duct feet of conduit per day. We solicit your orders, and if any of your conduit operations are being delayed by non-delivery of conduit, communicate with us, stating style and number of duct feet required, and we will at once quote low price delivered on cars at factory or at destination. There may be rumors in the trade that we are not operating our works. If you place order with us we will prove by prompt shipment that rumors are without foundation. The excellent quality of our material is well known. Many of the largest contracts awarded during the past year have been satisfactorily supplied by us."

STOW MULTI-SPEED MOTORS. The Stow Manufacturing Company, Binghamton, N. Y., has recently issued a neat and well-illustrated bulletin of 32 pages on the subject of its multi-speed motors. This bulletin describes these motors quite clearly, both in construction and operation and shows various applications to machine tools. This method of speed variation admits of a range of speed in the ratio of 1 to 2½. It is claimed that the motor is capable of developing its full rated load at any speed within its range with practically uniform efficiency, and for this reason is well adapted for a large variety of uses. The absence of any auxiliary controlling resistances and the fact that the motor requires but one voltage only, makes the machine especially desirable in many installations where compactness, ruggedness and simplicity are required. The company will be pleased to mail copies of this Bulletin (No. 52) to any interested parties.

MOTOR BOOK.—The Robbins & Myers Company, Springfield, Ohio, in its bulletin No. 32, recently issued, illustrates and describes its complete line of power motors and dynamos. A number of improvements in these machines have been introduced during the past two years, and several sizes have been added to the list. As regards the different sizes there are 14 frames in all, 15 hp being the largest and 1-30 hp the smallest, with sufficient intermediate capacities for almost all purposes. A belt adjusting base is regularly furnished with each machine of ¼ hp and upward, and the convenience of side wall or ceiling suspension are points that appeal favorably to most conditions. Particularly valuable features of the publication are the chapters entitled "Notes on Selection of Motors," and "Installation and Care of Motors." The bulletin is well illustrated with views of type representative machines, of details, dimensions, diagrams, etc. The usual tables, code words, etc., are included.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 22, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

739,282. JOINT COVER OR KICK PLATE; Christian C. Bohn, New York, N. Y. App. filed Feb. 21, 1903. A strap plate intended to cover the joint between a wiring molding and a wall conduit.

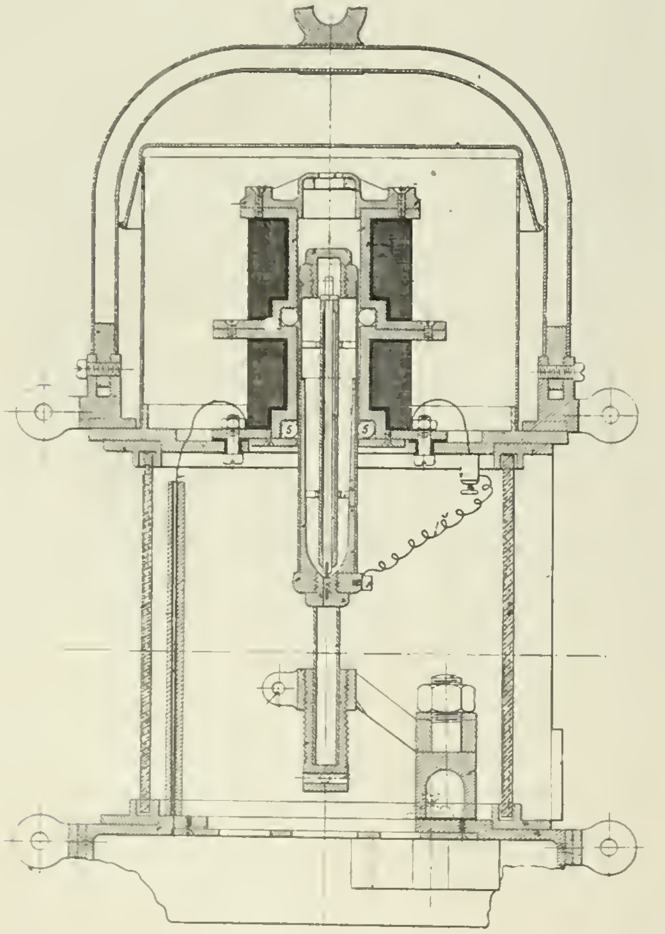
739,287. WIRELESS TELEGRAPHY; Elmer E. Butcher, North Ridgeville, Ohio. App. filed April 11, 1903. A device which automatically connects the transmitter and disconnects the receiver with the aerial conductor each time the key is depressed and vice versa each time the key lifts, thereby maintaining the receiver in circuit at all times except the instants when the transmitter is operating.

739,359. ELECTRIC LIGHT SIGNAL; Valdemar Taboulevitsch, Sselo Alexandrowskoje, St. Petersburg, Russia. App. filed May 14, 1902. Means for inserting powdered material between the pencils of an arc light to change the color of the light emitted.

739,396. ELECTRIC ATTACHMENT FOR PIANOS; George H. Davis, Orange, N. J. App. filed May 9, 1901. Among other improvements the invention includes means for changing the flow of current through the key-operating magnet helices from multiple to series to increase the resistance and avoid sparking at the contacts.

739,432. TERMINAL FOR STORAGE BATTERIES; Jacob Wilfrid Madigin, Toronto, Canada. App. filed Jan. 10, 1903. (See page 551.)

739,433. ELECTRICAL CONTROLLER; Gustave C. Marx, Elizabeth, N. J. App. filed July 2, 1903. The handle and resistance controlling lever of a rheostat are pivoted in a tight cover which protects the contacts from dust, etc.



739,359.—Electric Light Signal.

739,448. ART OF MAKING BLEACHING COMPOUND; Marcus Ruthenburg, Harrisburg, Pa. App. filed Jan. 14, 1902. (See page 551.)

739,464. RAILWAY RAIL JOINT; George A. Weber, Stamford, Conn. App. filed June 2, 1902. A pocket is formed in a plate set beneath the joint, for a bond.

739,469. INSULATED TWIN JOINT; George A. Weber, New York, N. Y. App. filed May 28, 1903. Details.

739,518. RAILWAY BLOCK SIGNALING SYSTEM; Herbert B. Taylor, Newark, N. J. App. filed Aug. 2, 1901. Details of a track circuit system.

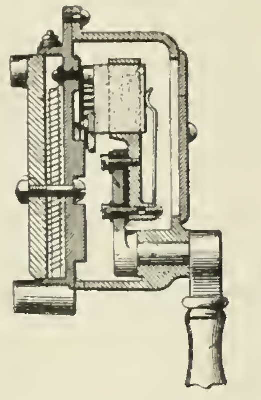
739,569. APPARATUS FOR LOCATING SHORT CIRCUITS IN ELECTRIC LINES; William W. Woodruff, Winchester, Ky. App. filed March 19, 1903. A magnetic needle is pivoted so that its opposite ends or poles stand between the abutting ends of two semi-circular electro-magnets which are respectively in circuit with the line to be measured and a branch line. The needle maintains this position as long as the two lines balance.

739,572. SYSTEM OF MOTOR CONTROL; Albert H. Armstrong, Schenectady, N. Y. App. filed June 15, 1900. A feature of this invention is the construction of the master controller in such a manner that current may be supplied from an alternating current source to the controlling circuits without at any time opening a circuit through which current is flowing.

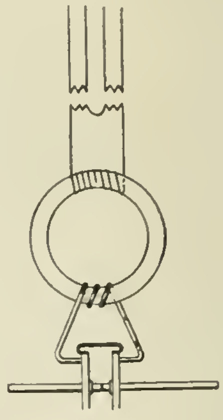
739,577. MOTOR CONTROL SYSTEM; Charles E. Barry and William O. Mundy, Schenectady, N. Y. App. filed May 8, 1902. A controller having one lever with a motion in one direction during which the control of a small motor is first effected and afterwards the proper starting and control of a larger motor is accomplished, such an arrangement of motors being commonly used on large printing presses for threading in the paper and afterwards for the regular drive.

739,588. ELECTRIC BRAKING; Frank E. Case, Schenectady, N. Y. App. filed July 6, 1900. The magnetization of the brake actuating devices can be reduced as the speed of the vehicle decreases without reducing by a corresponding amount the current generated by the motors under momentum.

739,598. END PLAY DEVICE; Henry Geisenhoner, Schenectady, N. Y. App. filed May 8, 1903. A spring pin abuts against the end of an armature shaft and causes end-play thereof.



739,433.—Electrical Controller.



739,601.—Metal Working by Electricity.

739,599. SEARCH LIGHT PROJECTOR; John L. Hall, Schenectady, N. Y. App. filed Feb. 24, 1903. The motors for moving the projector are controlled by switches in the base of the projector which in turn are operated by a master controller from any distant point.

739,601. METAL WORKING BY ELECTRICITY; Daniel E. Johnson, Hartford, Conn. App. filed March 14, 1903. An arrangement of transformers whereby the commercial polyphase systems can be utilized for metal-working purposes.

739,632. TROLLEY CATCHER AND REPLACER; James V. Ainsworth, Los Angeles, Cal. App. filed June 22, 1903. Details.

739,636. SWITCHBOARD FOR TELEPHONES; George F. Archer, New York, N. Y. App. filed Feb. 4, 1903. (See page 565.)

739,671. SUPPORT FOR ELECTRIC FIXTURES; Charles A. Hannan, New York, N. Y. App. filed May 6, 1902. A hanger consisting of a short coupling threaded at each end to fit the end of the conduit and the fixture and provided with a passage which leads laterally outward for the electrical conductors.

739,672. ELECTRIC SWITCH; John Harisberger, Seattle, Wash. App. filed Jan. 26, 1903. A non-conducting diaphragm is thrust between the separated contacts at the moment the circuit is broken.

739,685. THERMOSTATIC ELECTRIC CIRCUIT CONTROLLER; Christian Klopfanstein and Godfried Klopfanstein, Utica, N. Y. App. filed Jan. 15, 1903. Details.

739,741. APPARATUS FOR MAGNETIC SEPARATION; Benjamin H. Sweet, Brooklyn, N. Y. App. filed June 14, 1902. Magnetic cylinders arranged successively in the path of movement of the crushed ore, are driven at different speeds and are arranged with respect to each other and to various receiving compartments in a manner to effect good separation of the materials.

739,776. CONTROLLING ELECTRIC MOTORS; Harold W. Buck, Niagara Falls, N. Y. App. filed Nov. 17, 1900. The valve of an engine driving the generator is controlled automatically when a rudder has been moved to a certain point by a motor, which point is predetermined by the position of a switch-operating handle.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

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NORMAL ACTIVITY.

Note is made in our Financial Intelligence this week of the decline during September in the prices of various leading electrical securities, which in common with other stocks quoted in Wall Street, have seen the long depression accentuated by a sharp "slump." There has naturally arisen a good deal of discussion and conjecture over this state of affairs, while many have wondered as to the possible effect on general industry. Immediate effect there has been none anywhere discoverable, but it would be only reasonable to expect some sympathetic reaction in trade or commerce; while it would be equally unreasonable to expect that the increase of national wealth could be maintained forever at the abnormal rate prevailing in the last few years. We say "increase of wealth," not with reference to any Wall Street quotation of stocks, but because the undeniable fact is that real, tangible property of all kinds has been brought into existence at an enormous rate under the stimulus of expanded credit, overtime work, and an insatiable desire to get rich and to enjoy in larger degree the comforts of life.

For the time being the creation of stocks, securities and new properties to absorb the savings and spare cash has outrun the demand or the capacity of absorption, and hence the situation. In a great many respects this lull, this breathing spell, is a great boon, and will be turned to advantage. It is already checking the fever of speculation; it is already substituting conservatism for craze; it is already relegating to the rear the mere gamblers and leaving plain and industrious people in sober possession of their own and of the field. The moment has arrived for quiet and thoughtful solidification of the gains and achievements of the recent past as a new and permanent foundation for the industrial and financial triumphs of America in the future.

Whoever first sounded the cautionary halt is a public benefactor; more probably, the instinctive impulse of society for self-preservation has been finer than the shrewdest foresight of any keen individual. The cost of living was rapidly reaching the point of privation; the exactions of labor were wiping out all the inducements to capital; and the general charges on production had imperiled our status in the trade of the world, and offset all the virtues of native ingenuity and invention. But all the permanent conditions and attributes of welfare are with our country and can neither be dissipated nor dislodged nor changed. Moreover, at the instant, over and above the fierce ambition to excel and the national habit of steady labor, the abundance of raw material and the presence of a vast population of unbounded powers of consumption, we have the providential spectacle of fruitful harvests and excellent demand at good prices for the exportable products of our soil. It was a famous British statesman who, after a strenuous period of advance, gave his party the motto "Let us rest and be thankful." All periods of advance invite to repose and recuperation, but the American with a teeming continent to subdue can only say, "Let us be thankful; but we cannot rest."

RURAL TELEPHONY.

We learn that Senator Fairbanks, of Indiana, proposes to push vigorously with the Post Office Department a scheme by means of which mail delivery in the rural districts will be considerably expedited through the intervention of the telephone. It would appear that the general idea underlying this plan is to organize such a system that when the envelope is properly designated and stamped, the postmaster at any mail centre can utilize the telephone circuits, call up the person out in the country to whom the letter is addressed and communicate the contents forthwith. It would seem that such a scheme would abridge the time of delivery several hours, especially in the winter; and, in fact, we can imagine an extension of it by which the person receiving the contents of a letter could dictate to the postmaster or his clerk a telephonic reply if necessary, again paying a small fee for the privilege. Thus a whole day might be saved in the receipt and reply of a letter, and while there may be a general idea that in the rural districts such dispatch and celerity would account for little, we are under the impression that in the aggregate a great deal of new business might be created corresponding to the special delivery system already in force in cities.

It will be observed that this proposed system is predicated upon an extensive network of rural telephone wires, and it serves to call attention to the extensive development that rural telephony has enjoyed of late years; in fact, it may be doubted if the public has any idea of the extent to which telephony is modifying and has already ameliorated some of the conditions of loneliness attaching to life on the farm. We note in the New York *Sun* of last Sunday a very intelligent and well-informed article on this subject, giving many details of the manner in which rural telephony has been pushed, particularly by the independents, in the great Middle States and those of the Northwest, and giving an estimate that during the last five years telephones have been put in nearly half a million rural homes. The service very often saves money for the farmer, as well as his labor, furnishes amusement for his wife, puts the doctor and the storekeeper within quicker access, and generally knits the whole community together. It is obvious that the Fairbanks plan would prove another stimulus to this development, and we have, in fact, a suspicion that in some country places where the post office and the telephone happen to be close together, it would be found that the idea has already been tried under the stress of circumstances and found to work. We trust that Senator Fairbanks will agitate the matter further, for it is in such ways that these modern appliances are brought to their full utility; and unsuspected benefits often crop up from such trials and experiments.

A DECADE OF POWER TRANSMISSION.

Ten years ago last month the first polyphase transmission plant on this continent was put into operation. It was looked upon by many as a precarious innovation of somewhat doubtful and limited usefulness, but it was a success from the start, and from that time onward the art of power transmission has developed with sensational rapidity. We are just in receipt of a list of polyphase power plants from the General Electric Company which, although it shows the work of but a single large company, gives a most vivid idea of what a single decade has wrought. Although limited to installations aggregating more than 500 hp, the total of plants in operation or now under construction rises to 331, including those undertaken by the Canadian annex of the same great organization; and the total generator capacity now delivered or contracted for rises to the tremendous aggregate of more than *eleven hundred thousand* horsepower. So enormous a growth is startling even in this age of wonders, and doubly sensational when we realize that it represents only a part, although a very large part, of the work that has been accomplished. We can hardly realize the size of the figures, and yet they represent only the beginning of the world's opportunities in power transmission. For if all this splendid growth had been concentrated into a single year, and every plant had utilized a water power, the whole gain in harnessing the forces of nature would not have been great enough to make a perceptible change in the world's aggregate consumption of fuel. Lest we be unduly proud of the past, let us make note of what remains for the future to achieve. The world is living fast, burning the candle at both ends, and needs not only the resources of the present but increase to an hundredfold

In fact, only a part of this great record of power transmission pertains to the development of water powers. Of the polyphase plants built in the last five years no small proportion are steam driven, and employed in railway or lighting service, feeding substations with rotaries. A glance at the list before us shows how swift has been the growth of this class of service, and how far reaching has been the change in methods of electrical distribution. Nevertheless, the water power developments have been of great importance, and have marked out the way for the work of the century just begun. As time goes on water power must assume greater and greater industrial importance, and as the rising price of fuel renders longer and longer transmissions profitable, powers not now seriously considered at all will become sources of vast revenue. Even now many transmissions over 50 miles in length are in operation, and it is interesting to observe that the General Electric list contains three transmissions of 100 miles or more, while two others installed by other companies are well known to our readers. This extension of the effective radius of transmission has been brought about by additional experience in dealing with high voltages. The number of plants using line pressures of 10,000 to 12,000 volts is now so large that these may be considered as standard for transmissions of moderate length. The list, however, contains no less than 32 plants operating at or above 20,000 volts, and it is perfectly safe to say that the total number of such plants is not less than 50, of which at least a large minority are working at 30,000 volts or more. Truly the radical of to-day is the conservative of to-morrow, and the little group of engineers who were standing out for high voltage of ten years ago, now find themselves in the category of the cautious. There are not now enough plants running at 40,000 volts or more to permit a clear view of the situation at still higher voltages, but the engineer who in a reasonably good climate is content with 20,000 or 30,000 volts should be regarded as careful and conservative.

And now about the commercial success of the art. Financial data from electric plants are notoriously hard to obtain; but we know something of not a few of the properties on the list and their condition, generally speaking, is good. We will go so far as to say that most transmission plants established as investments and operated for profit have paid and will pay. Plants thoughtlessly initiated in a speculative spirit may come to grief and deserve the fate. It is interesting to run over the list before us, and to note from our knowledge of the history of some of the plants how long and carefully they have been considered before going ahead with them. Some have been under consideration for five years or more before finally getting under way, and some for even longer periods. The art has been growing year by year, and projects that once looked precarious are now on a firm basis. Every improvement has opened a new field of action, and at the present time there are plans maturing for transmissions that five years ago would have seemed without the pale of commercial possibility. He would be rash who would predict what the progress of the next decade may be; but this much is certain, that power transmission must of necessity be greatly extended in its scope, and that the growth of the past decade is only a bare beginning of what must be accomplished. Industry must go on and power must be forthcoming. Year by year the world's coal supply is diminishing, and long before, probably centuries before, it is exhausted, the price of fuel will be so high as to constitute a serious obstacle to human development. Before the close of the present century the fuel situation will be grave, and every effort must be bent toward reduction in fuel consumption. So long as there are many great water powers undeveloped the use of fuel will be a wanton extravagance, and it is safe to say that every usable stream will be harnessed and put into service. Methods may change and new economic situations may arise; but clearly the great work of electrical power transmission must go on with the impetus already given it until the list before us shall seem a mere fragment of ancient history.

ELECTROSTATIC TRANSFORMERS.

An article by Dr. Ives on page 595 describes an experiment conducted in the direction of electrostatic transformation. At the present time all our industrial and commercial transformation of energy is electromagnetic, through the medium of the transformer. In this apparatus electric energy is absorbed from a primary circuit into iron or steel in the form of magnetic energy, and transferred to an associated secondary circuit as electric energy, through magnetic energy as a connecting link. It is possible, theoretically, to absorb electric energy in the form of electrostatic energy and transfer it to a secondary circuit, through electrostatic energy as a connecting link. Thus far, however, not much success has been attained in this direction. It is easy to step down in pressure, but not easy to increase at the same time in current. Thus, if 50 one-microfarad condensers are charged in series from an alternating-current circuit of 5,000 volts pressure, each condenser taken alone will develop a pressure of 100 volts, but the current through each capable of being diverted into a shunt path is only the same as the primary current through all the other condensers. In the experiments considered, Professor Ives employed a secondary condenser metallically insulated from the primary. The power transferred to the secondary circuit does not seem to have been encouragingly large.

THREE-PHASE POWER MEASUREMENTS.

In a single-phase circuit, the power transmitted at any point varies cyclically between zero and a maximum, when the circuit is non-inductive, and between a definite negative and positive values when the circuit is inductive. An ordinary wattmeter with its pressure and current coils properly connected, indicates the integrated value, or mean value, of the power in the circuit, without any difficulty. When, however, three single-phase circuits differing in phase are collected together into a three-phase system, the voltage of the system is naturally presented in a delta, between adjacent wires, or on the sides of the systems; whereas the current is naturally measured in star, by inserting an ammeter in each wire. Under these conditions the power of the circuit is not measured so readily. If the system is all presented in star, as in the case of a star-wound three-phase generator, with a neutral point, the ordinary measurement of power can be applied by connecting a wattmeter to each branch of the system successively. Again, if the system is all presented in delta, as when loads are connected in delta to a three-phase system, a similar application can be made. But when the voltages are in star and the currents in delta, or vice-versa, the ordinary method has to be modified.

The customary method with the voltages in delta and the currents in star, is to use two wattmeters simultaneously, with the current coil of No. 1 in the *A* wire, and its pressure coil in the *AC* phase, while the current coil of No. 2 is in the *B* wire, with its pressure coil in the *BC* phase. The particular order of wires selected is, of course, indifferent, provided that the pressure is measured between the wire with the coil-bearing current and the wire that has no coil. Two wires of the system then pass through current coils, and the third wire has no current coil, but connects with both pressure coils. Under these conditions the sum of the two wattmeter readings is the total power transmitted, whether the system is balanced or unbalanced, symmetrical or dissymmetrical. The method is usually described as the two-wattmeter method. It is not, of course, essential, but merely convenient to use two wattmeters simultaneously, since one wattmeter may be connected to the two positions alternately, in swift succession. The proposition that two wattmeters, thus connected, can jointly and correctly indicate the power delivered over the three wires, is readily proved, either graphically or analytically.

On page 596 of this issue appears an article by Mr. Jeannin, in which a graphical method is given for computing the power in any three-phase system, symmetrical or dissymmetrical, when the magnitudes of the three delta voltages and the strengths of the three-star currents are all known in their proper order. That is to say, the method enables the power of the system to be computed from the magnitudes of the voltages and currents, without any direct measurement of phase-angles, or without the use of any wattmeter. It is known that any set of three-phase voltages in delta make up a triangle, whose exterior angles are the respective voltage phase-differences. It is also known that any set of three-phase currents in star, make up a triangle whose exterior angles are the respective current phase-differences. Mr. Jeannin's two methods are conjugate. In the first he plots the delta-voltages graphically to scale in a triangle. He then plots the star-currents graphically on transparent paper, having drawn their relative star-phases correctly by the aid of the current triangle. He works the transparent star-current diagram over the voltage triangle, until a position is found at which the three-star current arms emerge through the three respective vertices of the voltage triangle. The centre of the star is then marked within the triangle. This is a fictitious neutral point of the voltage system. It is such a neutral point as would produce a star-voltage system capable of supplying the observed star-current strengths and phases on non-inductive loads. If the magnitudes of the three star-voltages from this fictitious neutral point be each respectively multiplied by the star branch current in phase therewith, the sum of the three products will be the total power transmitted in the system.

The other method consists in taking the triangle of currents and working over it a transparent star diagram of voltages, until the arms of the star pass through the vertices of the triangle. The star centre then measures off star-current components that may be multiplied directly by their respective voltages and the sum will be the total power in the system. The two methods are conjugate by the ordinary law of conjugate relations between alternating pressures and currents in a connected system. The advantage of the method is that it can be readily employed in a central station where there are three ammeters constantly connected to the system, and where a voltmeter can be successively connected to the three sides of the system. The power can thus be determined without having to procure a wattmeter or wattmeters and insert coils in the lines. The disadvantage of the method is that it is a graphical method, depending for its accuracy upon the manipulation of a pair of diagrams and the measurement on a scale of the components within the diagrams. It is true that with care the work can be done with an error that is not of much commercial importance; but the three ammeter scale errors enter independently into the result, as well as the personal equation of the draughtsman. For purposes of accuracy, therefore, the wattmeter method by two successive observations is likely to be preferred, especially since the wattmeter may be checked and tested upon a continuous-current circuit.

New York State Street Railway Convention.

The Street Railway Association of the United States held an excellent twenty first annual convention at the Yates House, Syracuse, N. Y., beginning Tuesday, October 6, when about 100 delegates and others were in attendance. The programme as given already in these pages was adhered to.

President G. Tracy Rogers, whose long administration has been marked by admirable work for street railway interests, delivered, as usual, a masterly annual address, reviewing the situation within and outside the State, and offering many valuable suggestions for work by members and the Association in definite directions. In the course of the address he said:

"A subject which is of the greatest interest to cities, affecting especially at present those of the first class, and which will undoubtedly affect the other cities of the State, is the status of the law under which the public, upon paying a fare of five cents, demands a transfer as well as a re-transfer upon the lines of a system. The extent to which the net earnings are diminished by this obligation will at once be recognized as serious and militating against the best interests of street railways. Its effect is shown by the reduction of the average fare on roads in Manhattan Island to 3.46 cents, and on roads in the Borough of Bronx and Westchester to 2.64 cents, and the evidence that 30 per cent of all payers of fare request a transfer ticket. While the issuance of transfer tickets, in my opinion is of great value to the companies and undoubtedly increases their income, the law under which transfers were given has been so construed as to make it optional with a passenger as to what point and upon what lines he would ride, thus depriving the company of the exercise of the discretion which is vested in its board of directors to operate their road for the best interests of the public.

"This condition, overburdening as it does some lines and preventing the distribution of traffic upon others, which reach substantially the same point of destination, rapidly wearing out the equipment, militates, in my opinion, strongly against the best interests of street railway companies and of the public itself.

"For a number of years we have been confronted in the Legislature with a proposed mortgage tax bill, taxing our corporation mortgage. I consider it imperative to remind you of the disaster which would befall us in event the proposed law should be enacted. The street railroads are bearing, in the way of taxation, all the burdens that should be imposed upon them.

"The percentage of net income paid in taxes by the street railways of the State as shown by the last annual report of the State Board of Railroad Commissioners, for the year ending June 30, 1902, was 35 per cent.—when the Ford franchise tax bill was passed it was 28 per cent. This percentage does not include the amount of the Ford franchise tax which was assessed for 1902, but not paid by the large companies for that year, they claiming the law to be unconstitutional, but the Court of Appeals has since declared it constitutional, and the amount assessed against these companies for that year must be paid and added to the above percentage, which will very materially increase the above rate.

"Of the 99 operating roads of this State for that year but eleven paid dividends, three of these being in New York City. Of the remaining eight dividend-paying roads, three showed a deficit after so doing.

"The percentage of gross earnings paid for taxes during the year 1902, for the maintenance of State, local and municipal government, was 5 2/10 per cent. It would seem from the above figures that we are now paying our share of the tax. Should a law be passed taxing our mortgages, it would seriously affect the sale of our securities, which would result in retarding the future development of street railroads throughout our State, which development, if uninterrupted, would materially increase the assessed valuation of real estate to an extent which would largely offset the expected revenue to be derived by the enactment of a law taxing our mortgages."

Mr. Orlando W. Hart, of Fall River, Mass., read a brief but interesting paper on "Dispatchers' Duties and Electric Signals," in which he suggested the holding of a dispatchers' convention this winter to discuss the question of safe street railway operation under the train order system and to formulate a set of rules and forms for the government of all the companies represented.

Mr. C. E. Parsons, of Glens Falls, read an interesting paper on "Hydraulics in Connection with Street Railway Operation," in which he outlined the hydro-electric power development that has been going on in the Hudson and Mohawk Valleys of New York State, and from which a large trolley network already derives current. Mr. Parsons also discussed technical questions bearing upon such utilization in general, such as wheels, generating units, switchboards, etc. While admitting that a good deal of skepticism existed among street railway managers as to the reliability of water power for continuous service, he concluded that "it seems safe to predict that water power will be as reliable as steam, with the additional advantage of a saving of 50 per cent. in the cost of energy."

The sessions were concluded on Wednesday morning. Among other good papers presented were those on steam and electric crossings, by Mr. C. R. Barnes; standards, by Mr. C. L. Allen, of Utica; traffic arrangements with other interurban lines, T. J. Nicholl, of Rochester; freight and express business, by Mr. E. F. Seixas, of St. Catharines, Canada.

After nine years of service, President Rogers declined re-election in a graceful speech, on account of the pressure of his growing private business. Mr. Caryl Ely paid a deserved tribute to the services of Mr. Rogers to the Association. The officers then elected were as follows: President, Mr. E. G. Connette, of Syracuse; vice presidents, Mr. A. B. Colvin, of Glens Falls, and J. L. Heins, of Brooklyn; secretary-treasurer, Mr. W. W. Cole, of Elmira; executive committee, Messrs. C. L. Allen, of Utica; B. B. Nostrand, Jr., of Peekskill; A. B. Pouch, of Newburgh, and J. H. Pardee, of Canandaigua.

Interesting papers were also presented by Mr. J. E. Stephenson, of Buffalo, on "Interurban Ticketing," and by Mr. John E. Duffy, of Syracuse, on the "Use and Abuse of Transfers."

The hospitalities extended by local trolley interests during the week were lavish and were heartily enjoyed by all.

Over 125 Miles an Hour.

Continuing the experiments on the Berlin-Zossen military road, to which we directed special attention last week, the German electrical engineers engaged on the work have now succeeded, as we predicted they would, in pushing the speed of the car above 125 miles an hour. A cable dispatch from Berlin of October 6 says:

"An electric car on the Marienfelde-Zossen experimental line reached a speed of 125⅘ miles an hour to-day, or a kilometer more than the highest previous record. The machinery and roadbed were unimpaired. The engineers are determined to try for still higher speeds and venture the opinion that they will be able to attain the rate of 140 miles per hour. The current was between 13,000 and 14,000 volts, capable of driving the car at the rate of over 200 miles. This power is reduced by transformers to about 450 volts. The car used to-day had four motors, having together about 1,100 hp. It was the car used in the previous tests this year, and is constructed on the Siemens-Halske system. Another car of somewhat different equipment as to motors and transformers has been built for additional high-speed tests.

"The lives of all on board the experimental car were heavily insured. A large party of engineers, military men and civilians gathered at Dallwitz, where the highest points of speed are reached in these experiments. A French observer remarked that the new sensation of the power of velocity inspired by the car's flight was worth traveling from Paris to see. There were twelve to fourteen persons on board the car, all technical men. They affirm that the motion of the car was no greater than that of an ordinary express train. A curious phenomenon accompanying the car is the continuous sparking of electricity from the six trolley arms.

"While the engineers do not believe a speed of 125 miles is practicable at present on the State railroads they are prepared to recommend a speed of 93 miles an hour between Berlin and Hamburg."

New Edison Invention.

The daily papers of the current week have contained various vague items as to a new power generator that Mr. Edison is working upon, and which may cheapen power considerably. Mr. Edison himself is not known to be doing any "interviews" on the subject, but it is somewhat of an open secret that for months past he has given attention to the utilization of coal dust for power generation purposes, his experiments being based upon results observed in his cement grinding and powdering operations.

On an Attempt to Construct an Electrostatic Transformer.

By James Edmund Ives, Ph.D.

While working on condensers last winter in the Physical Laboratory of the University of Cincinnati, one of my students suggested that two condensers might be interleaved so that a charge on one would induce a charge on the other. We should then have an arrangement which would be analogous to the transformer, but the induction would be electrostatic instead of electromagnetic.

The idea appeared to me to be a good one and worthy of investigation, and the following article is the result of some experiments which have been performed with such an arrangement.

There will, of course, be a primary and a secondary condenser. The arrangement of the sheets of tinfoil is shown diagrammatically in Fig. 1. Any number of sheets can, of course, be interleaved in this manner.

If the primary is connected to a battery, the primary plates will have positive and negative charges respectively. The positive charge on the primary will induce a negative charge on the adjacent plate of the secondary. If the charges are at rest the positive plate of the primary will have a potential $+V$ and the negative plate a potential $-V$. Since the two plates of the secondary are connected by a conductor, they will have the same potential which, since it must be midway between $+V$ and $-V$, will be equal to zero.

Two methods of investigation are available: we can use a voltaic cell to charge the primary and a ballistic galvanometer to measure the quantity induced in the secondary, or we can use an alternating current in the primary and determine by means of an alternating ammeter and an electrometer the current and potential in the secondary.

I. EXPERIMENTS WITH A BALLISTIC GALVANOMETER.

Three such condensers were constructed, each having ten sheets of tinfoil, giving three primary sections, and two secondary. To distinguish them, they were called *A*, *C* and *D*, respectively. In *A* and *C* all the sheets were of the same size. In *D* the secondary sheets were only half the size of those of the primary. Their capacities are given in Table I:

TABLE I.

	A Micro-farads.	C Micro-farads.	D Micro-farads.
Capacity of primary	.040	.048	.047
Capacity of secondary	.029	.032	.018
Mutual capacity	.010	.011	.006

The sheets of tinfoil were 4 in. x 6 in., and the sheets of paraffined paper 6 in. square. The sheets of the primary and secondary were arranged at right angles to each other, as shown in Fig. 2.

To determine whether the capacity of the primary condenser is changed when the secondary circuit is closed, the ballistic galvanometer was put in the primary circuit, and the deflection noted when the secondary circuit was open and when it was closed. The deflection was found to be the same in both cases.

When the primary circuit is closed a charge appears in the primary condenser, and if the secondary circuit is closed, an induced charge in the secondary condenser. If the primary and secondary are exactly alike both in the number and size of the plates, the same charge will evidently be induced in the primary if the secondary is charged, as will be induced in the secondary if the primary is charged. But if the plates of the secondary are fewer in number or smaller than those of the primary, it is not evident that this will be so. It was, however, found to be so by experiment. The charge that is induced on the secondary when the primary has a difference of potential of one volt, may be called the *mutual capacity* of the two condensers. The mutual capacities of primary and secondary for *A*, *C* and *D* are given in Table I.

When the charges are at rest, all parts of the secondary condenser must be at zero potential, and no lines of force will pass between its plates. This is shown in Fig. 3. Lines of force pass from the positive plates of the primary to the negative plates of the primary, and from the positive plates of the primary to the negative plates of the secondary, but no lines of force can pass between the two plates of the secondary itself. If the sheets of tinfoil are close together it can be assumed that all the lines which originate on the positive plate of the primary end either on its own adjacent negative plate or on the adjacent negative plate of the secondary. But the sheets of tinfoil are equally distant from each other and the difference of potential between the positive and negative plates of the primary is twice as great as between the positive of the primary and the negative of the secondary. Therefore, since the field intensity is proportional to the space rate of change of the potential, there will be at least twice as many lines ending on the negative plate of the primary as there are on the negative plate of the secondary. This is shown in Fig. 3. This means that the induced charge on the secondary cannot be more than one-third of the total charge on the primary.

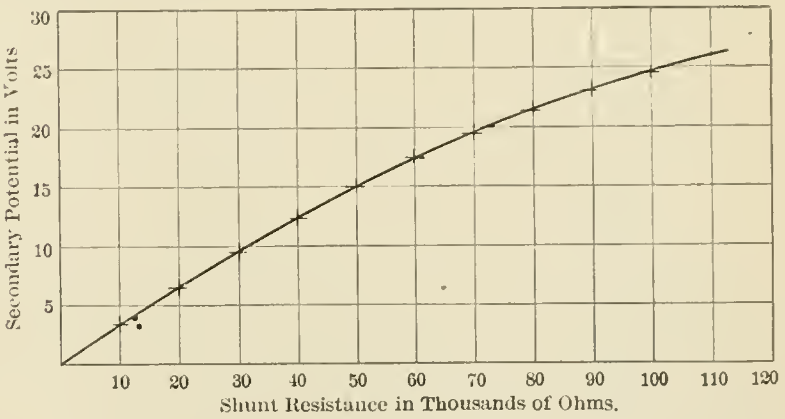
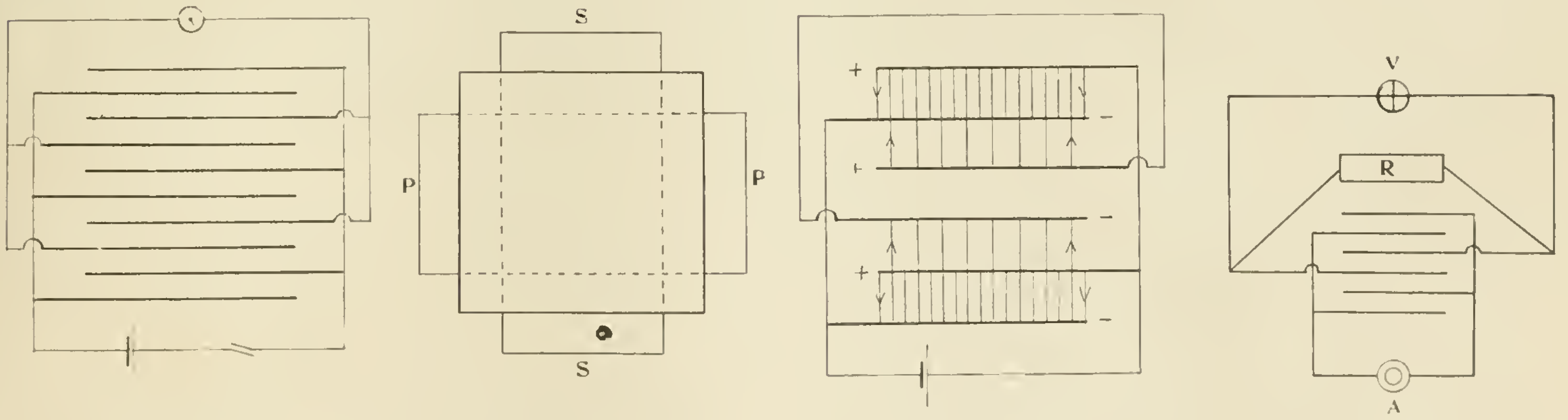


Fig. 5.—Curve Showing Results of Tests.



Figs. 1, 2, 3 and 4.—Diagrams of Electrostatic Transformers.

II. EXPERIMENTS WITH THE ALTERNATING CURRENT.

The primary was connected directly to a 115-volt commercial alternating-current circuit. The capacity of the condenser was so small that the current entering it could not be detected with an ammeter, but it could be heard in a telephone put in series with the condenser. In the same way the induced secondary current could be heard with a telephone. This shows that the secondary current exists, and that the current is capable of doing work, since it vibrates the diaphragm of the telephone. Undoubtedly if the primary and secondary condensers were large enough, a lamp could be lighted in the secondary circuit. The fact that the secondary current is capable of doing work is also shown by the rotation of the mirror of the ballistic galvanometer in the experiments made with direct current. In *A* and *C* the intensity of the sound produced by the secondary current in the telephone was one half or one-third as great as that produced in the primary.

An alternating current voltmeter, in series with the secondary condenser, failed to give any reading, but a quadrant electrometer connected idiostatically gave for the condenser, C, about 40 volts in the secondary for 115 volts in the primary. When the secondary condenser was short-circuited with a low resistance this difference of potential, as indicated by the electrometer, vanished. It appeared again, however, when the shunt resistance, *R*, was considerably increased, and gradually rose in value as *R* was increased by large increments of resistance (10,000 ohms at a time). The connections were made as in Fig. 4 and the results are given in Table II and plotted in Fig. 5. It will be noticed that the potential in the secondary approaches the limiting value of about 40 volts for an infinite resistance.

TABLE II.

Resistance, R, of the shunt in ohms.	Difference of potential in the secondary condenser in volts.
0	0.0
10,000	3.1
20,000	6.2
30,000	9.3
40,000	12.4
50,000	14.8
60,000	17.3
70,000	19.4
80,000	21.3
90,000	23.0
100,000	24.6
∞	41.1

In Fig. 4 *A* is the alternator, *V* is the quadrant electrometer and *R* is the variable high resistance.

My best thanks are due to Mr. Gordon Farnham, of the University of Cincinnati, for the assistance he has given me in these experiments.

Three-Phase Power Measurements.

By F. Hardie Jeannin.

The following article is something more than the title suggests; being in brief the development, step by step, of a method whereby an unbalanced three-phase system can be completely analyzed with no other data than the three ammeter and voltmeter readings.

With this method the entire analysis can be made in a few minutes and as certainly as can be done by the use of other instruments required by the method now in vogue, requiring several hours to connect in and read.

I have endeavored to set forth the method with such fullness that no great difficulty should be experienced in intelligently apprehending the sum of the whole matter as found subsisting in the diagram of Fig. 10.

When a three-phase system is balanced the currents and potentials are symmetrically related, the currents in all the leads and the potentials across all the phases will be equal. In this case *I* will be the currents in each leg, and *E* the potential across each two leads, and the total power will be

$$W = \sqrt{3}\, I E. \qquad (1)$$

Since this formula depends for its existence upon an unvarying relation between the currents and potentials which is true for balanced conditions only, it follows that it is not true when the system is unbalanced. If it were possible to take the average number of amperes from the total number given by three ammeters as equivalent to the current in each leg of a balanced system, formula (1) would be true for unbalanced conditions also. But this cannot be done as an example will show, for which purpose we will construct and have reference to the diagram of Fig. 1, considering the balanced condition first.

The power will be the same in both cases and taken as 6,000 watts three-phase at 100 volts between each two leads, and the load non-inductive.

Draw *A B C* to represent the potentials of a delta wound generator so that *A B*, *B C* and *C A* are equal to *E*. Then the relation of the current in the leads to the potentials will be represented by the lines *Aa*, *Bb* and *Cc*, which are found by completing the parallelograms *Ahag*, *Bfbh* and *Cgcf*, with sides equal to the current in each generator winding. This current is in phase with the e.m.f., for we are supposing a non inductive load.

Then
$$I = \frac{W}{\sqrt{3}\, E}. \qquad (2)$$
$$= \frac{6{,}000}{1.732 \times 100} = 34.642 \text{ amp.}$$

If the current *i* per coil be taken, then

$$I = i \times 1.732 = 20 \times 1.732 = 34.642 \text{ amp.}$$

This is also the average current for the three leads, and the power will be

$$W = \sqrt{3} \times 34.642 \times 100 = 6{,}000 \text{ watts.}$$

If the power were measured by two wattmeters, say one in the lead at *B* and the other in the lead at *C*, it would be equal to

$$W = (Bb \times \cos \vartheta^3 \times B\,A) + (Cc \times \cos \vartheta^4 \times C\,A). \qquad (3)$$
$$= (34.642 \times .866 \times 100) + (34.642 \times .866 \times 100) = 6{,}000 \text{ watts.}$$

The wattmeters can be placed in any two of the leads, only the free ends of the potential coils must be connected to the lead in which there is no wattmeter.

Consider now the unbalanced condition with respect to the current, noting that the current in phase with *A B* is *Ad*, or *Bd* equal to 10 amp., in phase with *B C* is *Bf*, or *Cf* equal to 20 amp., and in phase with *C A* is *Ce* or *Ae*, equal to 30 amp. Then by completing the parallelograms *Ada'e*, *Bfb'd* and *Cec'f* with the current in adjacent coils as sides, we obtain the resultant current in the lead at *A*, represented by the Vector *Aa'*, in the lead at *B* by vector *Bb'*, and in the lead at *C* by vector *Cc'*. These vectors show the present relation between the currents and potentials, and the present relation of the currents with respect to the same when the load is balanced.

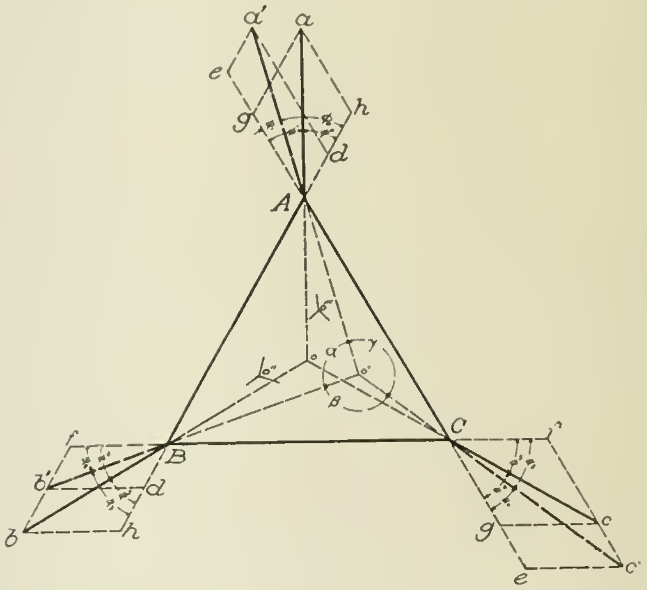


FIG. 1.

Let $Aa' = I\,A$, $Ae = a$, and $e\,a' = b$. *I A* means the current in the lead at *A*, and it will be *I B* for the current in the lead at *B*, and *I C* for the current in the lead at *C*.

Then

$$I\,A = \left(\begin{matrix} [a + b \times \cos\,(180^\circ - 120^\circ)]^2 + \\ [b \times \sin\,(180^\circ - 120^\circ)]^2 \end{matrix} \right)^{1/2}.$$

And since *a* and *b* can be any two sides of either of the three triangles, the expression becomes

$$I = \sqrt{a^2 + a\,b + b^2}. \qquad (4)$$

Substituting numerical values:

$$I\,A = (30^2 + 30 \times 10 + 10^2)^{1/2} = \sqrt{1{,}300} = 36.05 \text{ amp.}$$
$$I\,B = (20^2 + 20 \times 10 + 10^2)^{1/2} = \sqrt{700} = 26.457 \text{ amp.}$$
$$I\,C = (30^2 + 30 \times 20 + 20^2)^{1/2} = \sqrt{1{,}900} = 43.589 \text{ amp.}$$

Now the average of these is

$$I = \frac{36.05 + 26.457 + 43.589}{3} = 35.365 \text{ amp.,}$$

which is greater than the current per leg for the same power when the load is balanced. There will be a corresponding increase in the power if the calculation is made on that basis; thus by formula (1)

$$W = \sqrt{3} \times 35.365 \times 100 = 6{,}125.22 \text{ watts,}$$

which is obviously incorrect; we know the power is 6,000 watts. The two wattmeters will record the true power, and which will be

$$W = (I\,B \times \cos \phi_3 \times B\,A) + (I\,C \times \cos \phi_4 \times C\,A). \qquad (5)$$
$$= (26.457 \times .756 \times 100) + (43.589 \times .9177 \times 100) = 6{,}000 \text{ watts.}$$

Therefore, it is proved that the average of the three ammeter readings does not give true results. This is so because the phase relation that exists between the current and potential is not taken into account. This relation is taken into account by formula (5). At present there is no known method by which the power can be calculated from the ammeter and voltmeter readings only when the load is unbalanced.

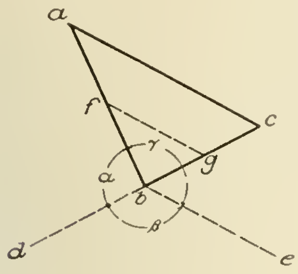


FIG. 2.

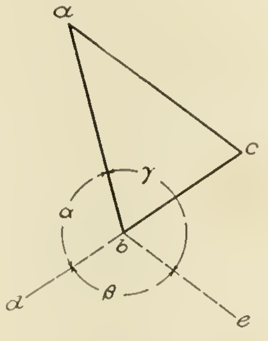


FIG. 3.

The following is a method here proposed which makes such a calculation possible with very little trouble:

Referring to Fig. 1, it is demonstrable that for balanced conditions,

$$W = (Aa \times Ao) + (Bb \times Bo) + (Cc \times Co). \qquad (6)$$

and that for unbalanced conditions,

$$W = (Aa' \times Ao') + (Bb' \times Bo') + (Cc' \times Co'). \qquad (7)$$

Since the vectors *Ao, Bo* and *Co* represent e.m.f's in phase with the current in the leads *A, B* and *C* respectively, it is evident that the point *o* can have but one location for any given set of conditions. So that when the point takes up a new position, it does so by reason of changes having occurred in the system. It is also evident that the angles α, β and γ can have but one value for any given set of conditions. Therefore, the vectors *o a, o b* and *o c* have a definite location in the diagram for every given relation between the currents and potentials. Consequently it is possible to obtain the location of the vectors representing the currents if the angles α, β and γ are known; and, according to the terms of the proposition, these angles must be obtained from the ammeter and voltmeter readings only.

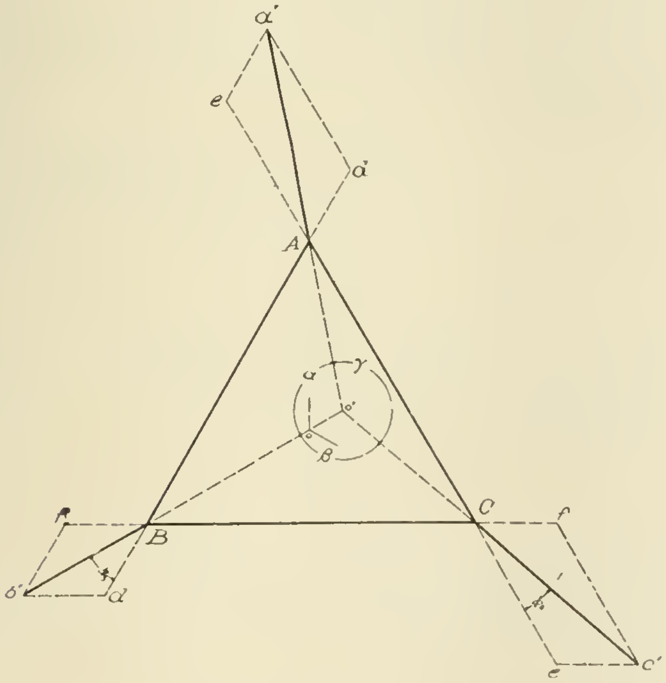


FIG. 4.

It is also demonstrably true that the vectors representing the three ammeter readings will always form a closed triangle. Taking the three unbalanced currents of Fig. 1 we get the diagram of Fig. 2, in which *a b* is made equal and parallel to *Aa'*, *b c* to *Bb'*, and *c a* to *Cc'*. Now by drawing *b e* parallel to *a c* and extending *c b*, the resulting angles, α, β and γ must be equal to the similar ones, respectively, of Fig. 1. It only remains to sufficiently extend the lines *b a, b d*, and *b e* to fit the resulting figure to the delta of potentials, as in Fig. 1, so that the lines pass through the vertices, such as *A, B* and *C*. If it be desired to know the value of the currents for any other output, and one reading is known, it is quickly done by laying this known reading off on the proper vector, as *b f* on *b a* (Fig. 2), and drawing a vector from this point and parallel to the side opposite and intersecting the remaining side. This gives the new diagram *f b g* (Fig. 2).

An example will now be adduced to show the practical application of the method so far developed. Suppose the three ammeter readings are 25.98, 39.686 and 39.686 amp., and the voltmeter readings are all equal to $E = 100$ volts. Then to some suitable scale lay off *a b* (Fig. 3), equal to 39.686 amp., *a c* equal to 39.686 amp., and *b c* equal to 25.98 amp. Extend *c b*, draw *b e* from *b* parallel to *a c*, and extend *b a*, all to a sufficient length. Next draw the delta of voltages *A B C* (Fig. 4), and fit the *Y* figure of Fig. 3 to it by passing the vectors, *o'a'*, *o'b'* and *o'c'* through the vertices *A, B* and *C*, respectively.

If the method so far is correct, the power calculated from the diagram of Fig. 4 will be without error. By actual measurement we find that the current in phase with *A B* is *Ad*, or *Bd* equal to 15 amp., in phase with *B C* is *Bf*, or *Cf* equal to 15 amp., and in phase with *C A* is *Ce*, or *Ae* equal to 30 amp. Therefore, by formula (8) the power will be

$$W = (A\,B \times Ad) + (B\,C \times Bf) + (C\,A \times Ce). \qquad (8)$$
$$= (100 \times 15) + (100 \times 15) + (100 \times 30) = 6{,}000 \text{ watts.}$$

And by formula (5),

$$W = (25.98 \times .866 \times 100) + (39.686 \times .9449 \times 100) = 6{,}000 \text{ watts.}$$

And by formula (7),

$$W = (39.686 \times 53.4) + (25.98 \times 68.744) + (39.686 \times 53.4) = 6{,}000 \text{ watts.}$$

Thus the method so far is shown to be correct. There still lacks the simplicity, however, to be desired for convenient use. But further simplification is possible.

By observing Fig. 1 we discover that i fthe triangles *Ada'*, *Bfb'* and *Cec'* are combined with *Aa'*, *Bb'* and *Cc'* as sides of a triangle as before, the diagram of Fig. 5 results. By comparing the diagrams of Figs. 1 and 5 we learn that angle $b\,c\,o = \phi_2$, $c\,a\,o = \phi_4$, $o\,a\,b = \phi_1$, $o\,b\,c = \phi_3$, $o\,c\,a = \phi_5$, and $a\,b\,o = \phi_0$. Consequently the diagram of Fig. 5 contains all the data required in order to calculate the power of an unbalanced three-phase system. The lines *a b, b c* and *c a* represent the currents, and the lines *o a, o b* and *o c* defines the phase relation of the potentials. The various angles formed by the two sets of lines give the phase relation between the current in the leads and the two potentials meeting at those leads.

In using the diagram of Fig. 5 it might appear that a little ambiguity exists as to which angles to use, for it is evident that in calculating the power from the current in, say the leads at *B* and *C*, angles ϕ_2 and ϕ_5 cannot be used, but that angles ϕ_3 and ϕ_4 must be taken, the cosine of which multiplied by *I* gives the component of the current in phase with the potentials *B A* and *C A*. But not so; the data supplied by the diagram of Fig. 5 is definite. It will be found that the two angles to be used will always be the two diverging ones as indicated by the two arrows, which will always point away from *b* to *a* and *c*, from *c* to *a* and *b*, or from *a* to *b* and *c*. Thus if angle *o a b* is chosen, the other angle must be *b c o*; and so on.

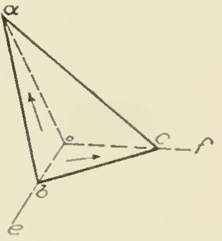


FIG. 5.

It was said that the point *o'* can have but one location for any given set of conditions, which is not true as regards the quantities involved, but is true when *A B, B C* and *C A* refer to definite armature coils. As far as the quantities involved are concerned, the point can be located at either one of three places: at *o', o''* or *o'''*. Therefore, when calculating the power only, the location of *o'* need not be considered.

Thus far the potentials have been considered as equal and balanced; that is, $E = A\,B = B\,C = C\,A$, but the principles set forth are equally as applicable to cases where the potentials are not equal. By examining Fig. 5 it is seen that with the potentials equal the lines are symmetrically related, being always 120° apart. In any case these lines are parallel to their respective potentials, so that when the potentials are unbalanced, a diagram of potentials will also have to be constructed, and from which the lines corresponding to *o d*, *o e* and *o c* are obtained. An important fact will now be noticed and pointed out in connection with Fig. 5, after which some examples will be adduced showing the practical application of the method evolved above. When E is the same for all the phases we need not concern ourselves as to which is the proper potential to use with the two angles decided upon to use in the calculation; but this data is necessary when the potentials are not equal. By comparing Figs. 1 and 5 it becomes evident that vector *o a* is parallel to and, therefore, indicates the potential to use with angles *o a b* and *c a o*; likewise, *o b* indicates the potential to be used with angles *a b o* and *o b c*, and *o c* indicates the potential to be used with angles *b c o* and *o c a*.

For the first example assume data as follows: Ammeter readings as 35 amp. each; $E = 80$ volts; $E^1 = 100$ volts; and $E^2 = 60$ volts. First, to some convenient scale draw *a b c* (Fig. 6), so that *a b*, *b c* and *c a* are each equal to 35 amp. Next draw *A B C* (Fig. 7) so that $A\,B = E = 80$ volts, $B\,C = E^1 = 100$ volts, and $C\,A = E^2 = 60$ volts; and extend *C B* to *D*, and draw *B E* from *B* parallel to *A C*. Then fit the Y-shaped figure *B A*, *B D* and *B E* to the delta of Fig. 6, which becomes *o a*, *o b* and *o c*. It is immaterial which lines pass through the vertices. For convenience in after operations, it is best to pass *B A* (Fig. 7) through *a* (Fig. 6); the letter *a* showing that *o a* is the same as *B A*. This prevents us from losing track of the different vectors, because if we know that *o a* (Fig. 6) is *B A* of Fig. 7, the others are easily identified.

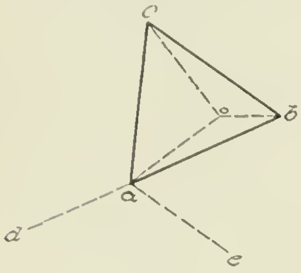


FIG. 6.

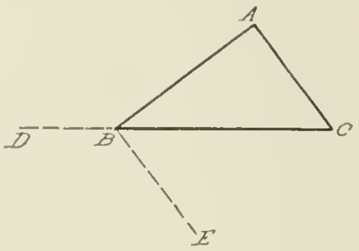


FIG. 7.

From Figs. 6 and 7 the power according to the data given can be calculated. I will remark that the lines *b d* and *b e* should be considered as though they were not, until attention is drawn to them. Angles *o a b* and *b c o* will be used first. By measurement angle *o a b* is found to be 12° 41′, the cosine of which is .9756, and angle *b c o* is found to be 16° 39′, the cosine of which is .9581. Now, the potential to use with angle *o a b* and current *a b* is $A\,B = E = 80$ volts, and with angle *b c o* and current *b c* is $A\,C = E^2 = 60$ volts. Then by formula (5),

$$W = (35 \times .9756 \times 80) + (35 \times .9581 \times 60) = 4{,}743.69 \text{ watts.}$$

To check this calculation, angles *o b c* and *c a o* will be used. By measurement angle *o b c* is found to be 35° 41′, the cosine of which is .8123, and angle *c a o* is found to be 47° 19′, the cosine of which is .678. The potential to use with angle *o b c* and current *b c* is $B\,C = E^1 = 100$ volts, and with angle *c a o* and current *a c* is $A\,B = E^2 = 80$ volts. Then by the same formula,

$$W = (35 \times .8123 \times 100) + (35 \times 678 \times 80) = 4{,}741.45 \text{ watts.}$$

Checking again by using angles *a b o* and *o c a* exhausts the means of checking by the use of formula (5). By measurement, angle *a b o* is found to be 24° 19′, the cosine of which is .9113, and angle *o c a* is found to be 43° 21′, the cosine of which is .7272. The potential to be used with angle *a b o* and current *a b* is $B\,C = E^1 = 100$ volts, and with angle *o c a* and current *a c* is $A\,C = E^2 = 60$ volts. Then by the same formula,

$$W = (35 \times .9113 \times 100) + (35 \times .7272 \times 60) = 4{,}716.67 \text{ watts.}$$

In order to check the calculations by formula (8), the diagram of Fig. 8 is constructed as before explained. This is done by drawing the potential diagram *A B C*. Then obtain the Y-shaped figure, *a c*, *a d* and *a e* from Fig. 6 and fit it to the delta of Fig. 8, obtaining the lines *o′a′*. *o′b′* and *o′c′*. The vectors *Aa′*, *Bb′* and *Cc′* of Fig. 8 are made equal to vectors *a c*, *a b* and *b c*, respectively, of Fig. 6. Complete the parallelograms with sides parallel to the proper vectors for the potentials. It will then be found that the intersections will so occur that the sides will be the components of the current in each lead in phase with the two potentials meeting at those leads. Therefore, measuring *Ah* or *Bh*, *Bf* or *Cf*, and *Ag* or *Cg* to the same scale that the currents in the leads are represented, we get the value of these components. In this case *Ah* and *Bh* are equal to 23.844 amp., *Bf* and *Cf* are equal to 12.966 amp., and *Ag* and *Cg* are equal to 25.813 amp. Then by formula (8),

$$W = (23.844 \times 80) + (12.966 \times 100) + (25.813 \times 60) = 4{,}746.87 \text{ watts.}$$

The slight differences in the results is due to the fact that the values were obtained from the diagram, and it is impossible to get absolute accuracy with the graphical method. I have not used formula (7) in this last example, but the reader can do so for himself if he chooses.

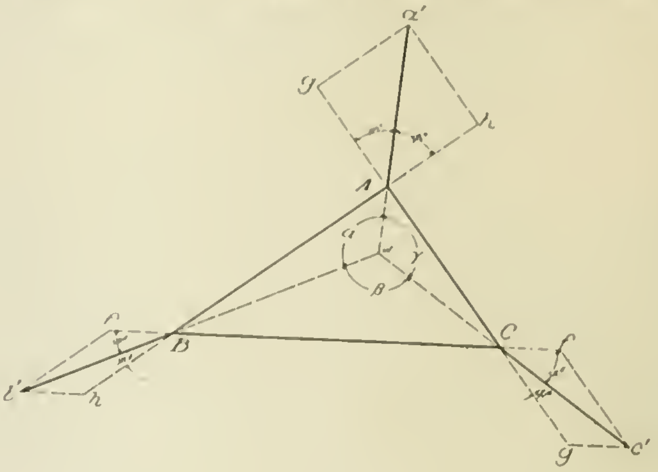


FIG. 8.

In the previous examples either the current or potential has been balanced. We will now take up an example involving unbalanced conditions for both the current and potential. This will be the last example, in connection with which two more facts will be noticed, being the last step in the simplification of the method. The following data are assumed for this example: The voltage across leads *A* and *B* is $E = 70$; across *B* and *C* is $E^1 = 90$, and across *C* and *A* is $E^2 = 100$ volts. The ammeter reading in the lead at *A* is $I\,A = a\,b = 30$; in the lead at *B* is $I\,B = b\,c = 50$; and in the lead at *C* is $I\,C = c\,a = 40$ amp.

As before instructed, construct the diagram for the voltages, Fig. 9, and currents, Fig. 10. Next obtain the Y figure, *B A*, *B D* and *B E* and fit it to the diagram of Fig. 10. In doing this it must be remembered that the data is inseparably linked with definite physical conditions and relations which must be maintained in the diagrams. That is, the vectors of the Y-shaped diagram must pass through certain vertices of the diagram of currents. In order to do this we observe that the components of, say, *a b*, are in phase with *A B* and *B C*. Therefore, *B A* and *B D* must pass through *a* and *b*, respectively, leaving *B E* to pass through *c*, thus obtaining vectors *o a*, *o b* and *o c*.

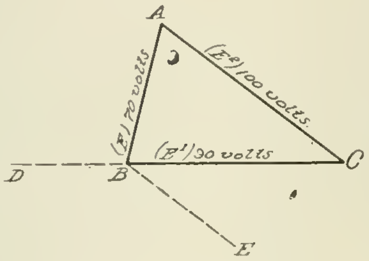


FIG. 9.

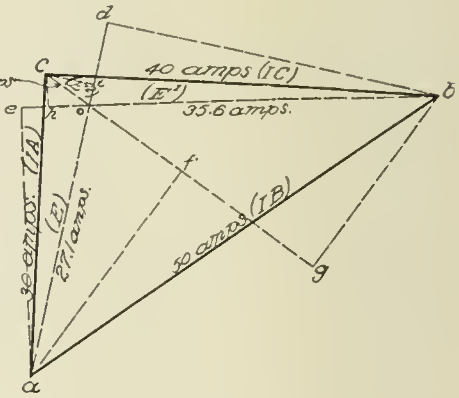


FIG. 10.

Now by reference to the diagram of Fig. 6 in connection with that of Fig. 8, it is demonstrable that *o a*, *o b* and *o c* are the components of the current to be used in connection with the potentials corresponding to vectors *o a*, *o b* and *o c*, respectively. That is, *o a* is the component to be multiplied by the potential corresponding to that vector; likewise, *o b* is the component in phase with the e.m.f. corresponding to vector *o b*, and *o c* is the component in phase with the e.m.f. corresponding to that vector. Hence, it is only necessary to measure these three components to the same scale to which the ammeter readings were laid off, and take the values thus found, in connection with their respective potentials, as indicated by the vectors for those components. Thus $o\,a$ indicates the potential $B\,A$ (Fig. 7), $o\,b$ the potential $C\,B$, and $o\,c$ the potential $A\,C$. Then $(o\,a \times B\,A) + (o\,b \times C\,B) + (o\,c \times A\,C)$ is the power in watts. By letting i, i^1 and i^2 be the three components, and E, E^1 and E^2 their respective e.m.f's, which are indicated by the vectors for those components, we arrive at the following formula:

$$W = (iE) + (i^1E^1) + (i^2E^2). \qquad (9)$$

It is to be noticed that formulas (8) and (9) are similar.

Next draw $a\,e$ and $c\,h$ perpendicular to $b\,o$ extended, $b\,g$ and $a\,f$ perpendicular to $c\,o$ extended, and $b\,d$ and $c\,i$ perpendicular to $a\,o$ extended. It is then also demonstrable that $a\,d$ is the energy component of $a\,b$ or $I\,B$, in phase with the e.m.f. indicated by $o\,a$ or E, $c\,g$ is the energy component of $I\,C$ in phase with E^2, $b\,e$ is the energy component of $I\,B$ in phase with E^1, $b\,h$ is the energy component of $I\,C$ in phase with E^1, $c\,f$ is the energy component of $I\,A$ in phase with E^2, and $a\,i$ is the energy component of $I\,A$ in phase with E. Consequently we are able to obtain the data required by formula (5) without the use of, or any reference to, the angles at all. That is, the factors "$I\,B \times \cos \phi_3$" and "$I\,C \times \cos \phi_4$" can be determined direct from the diagram by measurement, using the same scale as the ammeter readings were laid off to. For instance $(I\,B \times \cos \phi_3) = a\,d$, which is in phase with E, and $(I\,C \times \cos \phi_4) = c\,g$, which is in phase with E^2. Therefore, if we let I^a and I^b be any two energy components, and E^a and E respectively, the potentials with which they are in phase, the following formula holds true:

$$W = (I^a \times E^a) + (I^b \times E^b). \qquad (10)$$

There need be no difficulty at all in quickly determining which two energy components and e.m.f's go together, if it is remembered that the lines perpendicular to the vectors for any two components join at the same point, as $b\,g$ and $b\,d$ join at b; which shows that the vectors $a\,d$ and $c\,g$ are the two energy components that are to be taken together. And we can see instantly from the diagram that $a\,d$ is in phase with E, and that $c\,g$ is in phase with E^2.

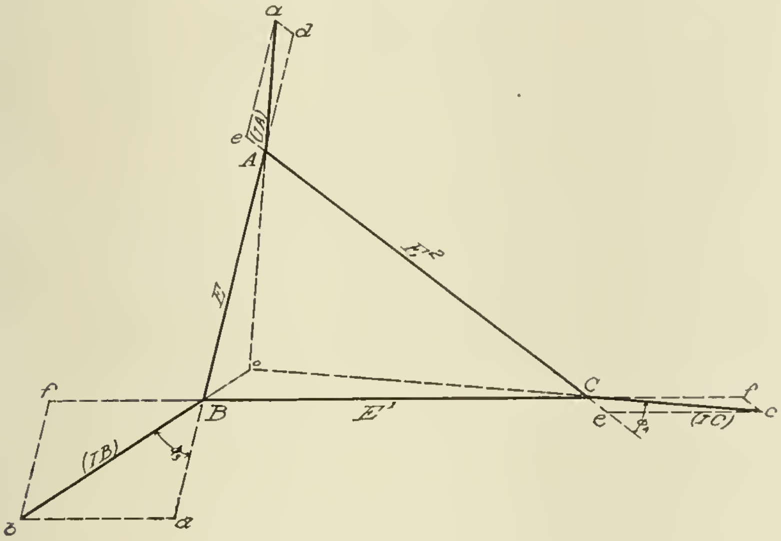


FIG. 11.

We can now proceed to make our promised calculation, using formula (9) first. By measurement, we find that $o\,a = 27.1$, $o\,b = 35.63$, and $o\,c = 5.63$ amp.

Then

$$W = (27.1 \times 70) + (35.63 \times 90) + (5.63 \times 100) = 5{,}666.7$$ watts.

And by formula (10),

$$W = (35.67 \times 70) + (31.72 \times 100) = 5{,}669.1 \text{ watts},$$

where we took energy components $a\,d$ and $c\,g$.

In order to verify the results, Fig. 11 is constructed from Figs. 9 and 10. Using formula (5),

$$W = (50 \times .712 \times 70) + (40 \times .7969 \times 100) = 5{,}679 \text{ watts},$$

which proves the correctness of the method.

After the diagram of Fig. 10 is constructed that of Fig. 9 can be discarded. And since the diagram of Fig. 10 contains all the information to be had from such a diagram as Fig. 11, it is not necessary to construct the latter one. That is to say, the diagram of Fig. 10 is the conclusion of the whole matter, and not only enables us to calculate the power of an unbalanced three-phase system with nothing more than the ammeter and voltmeter readings, but enables us to analyze the entire problem, and without additional data.

The slight discrepancy in the various results is due to the measurements being made direct from the diagrams. If greater care had been exercised the results would have been more nearly in agreement, but I preferred to use about such care as would likely be used in practice. I used diagrams small enough to go on an ordinary sheet of letter head paper, but if a drawing board is at hand, greater accuracy can be had by laying the diagrams out to a comparatively large scale. Formula (10) will perhaps prove the most convenient one to use in connection with the diagram of Fig. 10.

Electricity in Russia.

According to our Russian contemporary, *Elektritsheskij Wiestnik*, the Russian branch of the Westinghouse Electric Company at St. Petersburg recently made an offer to the municipality in which it proposed to change over all the existing tramway lines in the city now using animal traction, to electric railways. The construction work, according to this proposition, is to be carried out entirely with Russian workmen, and no material to be used not exclusively of Russian production, the work to be completed within four years. The change from animal to electric traction is to be carried out on plans which have been already adopted by the Interior Department. The cost of the project has been calculated at 27,000,000 roubles within the city limits and 34,000,000 roubles if the lines are to be extended to Sosnooka in order to connect with the city the new Polytechnic Institute of St. Petersburg. All the roling stock was to be supplied by the Westinghouse Company at a special rate, to be established by the municipality. The amount required for the motor cars, which are to number 500 at least, will be about 5,000,000 roubles. The requirement is that the work on both the existing tramway systems is not to interfere with the horse car traffic. Should the city department decide to accept the proposition, the Westinghouse Company will deposit 300,000 roubles, but with the right to withdraw that sum in case the city does not sign the contract within three months after the proposal is adopted.

The same journal states that a company of American capitalists proposes to establish an electric railroad between Warsaw (Poland) and Lodz. The syndicate has sent an electrical engineer, Mr. Drosdof, from Chicago, in order to discuss the question with the authorities. According to the project, the road is to be run in a straight line as nearly as possible, between the two points, and the profile is to be made practically level, since the line would run through a flat country. It is proposed to run the trains at a speed of 50 miles an hour. At all the points where the new line will cross other railroad lines, a number of viaducts are to be constructed.

A recent Russian report contains the following data relating to the consumption of current for light and power in Moscow and St. Petersburg: During the last year the number of subscribers in Moscow increased from 2,038 to 2,629, and the total output of current for all purposes, from 6,075 kw to 7,074, or an increase of 25 per cent. At St. Petersburg the total output of current increased from 4,829 to 5,055 kw, and the number of subscribers from 2,063 to 2,383. For Moscow the consumption of energy in kilowatt-hours figures 6,300,000, against 5,710,000 delivered the year before. The corresponding figures for St. Petersburg show a consumption of 6,810,000 kw-hours, against 6,400,000, which makes an increase of about 10 per cent. for both cities.

This small increase in the consumption of energy is attributed to the general stagnation in industry, but there is to be noticed a tendency towards a betterment of these conditions. The total receipts from the operation of the system in the two cities increased from 1,778,567 roubles during the previous year to 2,046,186 roubles. The expenditure diminished from 1,040,686 roubles to 996,478. The company is paying 1½ per cent. dividends, as against 1 per cent. during the past year.

The Imperial Russian Technical Society, which proposed to hold a meeting for discussing the question of technical and professional education at Odessa, has changed the place of meeting to St. Petersburg. The Minister of the Interior has granted the request of the society and authorized the meeting to be held at St. Petersburg in December, 1903.

According to a recent decision of the Russian Government, a new electric railway is to be installed between the city of Kief and the Borough of Brovari, in the Province of Tshernigof, with a branch to the village of Darnitza. A syndicate has been formed to construct and operate the roads which will be of standard gauge, the president being Mr. N. U. Matvieisf. The syndicate has deposited the sum of 15,000 roubles as a guarantee, which sum will be returned to the company after it has realized 50 per cent. of the amount for which the company is capitalized. In order to supply the line with current the company is to establish two generating stations, one at Kief and the second at Brovari; the length of the main line is to be about 18 miles, and that of the branch road 5 miles. According to the agreement, traffic on the line is to be established within two years. The company will have the right to operate the line, including the branch, during a period of 75 years, and after that time the government will take possession of the line and all the material of the company. All the supplies used in the construction of the plan are to be furnished by Russian manufacturers and made exclusively from Russian material. The capital of the company, 1,300,000 roubles, is to be paid in cash in one year after the decision of the government is made public, and is to be obtained by issuing of shares without the guarantee of the government. After 25 years the government will have the right to purchase the line with all the material belonging to it.

The municipality of Odessa is considering a project to change over the existing system of horse tramways to electric traction, and has submitted the following proposition to the government: 1. To commence at once preparing plans for changing over three of the horse car lines, together with plans for laying out a new park and a street. 2. To allow also private companies to present plans for the same project. 3. The admission and the revision of these different projects to be under the control of the administration and the special committee of light and animal traction. 4. The projects to be presented to the municipality before March 1, 1904. 5. For the preparatory work 25,000 roubles is to be assigned, which is to be placed at the disposition of the committee. 6. The committee is to be authorized to establish and to present a series of plans to the Minister of the Interior, showing the location of the tracks, and after the plans are accepted, to commence at once the laying of the tracks with rails of the type which are to be used in changing over the first three lines. 7. The committee is to be authorized to draw up plans for changing over and extending the whole system of horse traction, including the construction of the bridges and changing the profiles of the adjoining streets. 8. The committee is to be charged with publishing up a report for 1904, in which is to be presented a plan for the union of both systems of horse traction and to draw up a set of regulations for controlling the same. The preparatory commission for changing over the city lines from animal to electric traction has already started its work. At the first meeting of the commission it was decided to complete the staff of experts by adding a number of the best known engineers and others who have considerable experience in railway work.

The Cathedral of Kazan, which is the largest church in St. Petersburg, is shortly to be provided with electric light. The whole number of incandescent lamps necessary to light the interior will reach about 900 lamps of 16 cp, 200 of 32 cp and 6 arc lamps, which latter will be hung between the columns.

At the present time the Department of Posts and Telegraphs of Russia is undertaking the work of replacing the overhead wires by underground cables in St. Petersburg. During the last year the first main cable was laid from the central telegraph office to the Alexander Bridge; during the present year a cable is to be laid from Admiralty Place along the Nevski Prospect towards the Nicolas railway station, and during the following year the Warsaw and the Baltic railway stations will be connected with the central office. The cables used for these purposes are insulated with rubber and armored with galvanized iron wire, 4 mm. in diameter. The cables are laid directly in trenches 2 ft. deep, and to protect them during the repair of the pavements or other operations, they are covered with a layer of bricks. In order to joint the main cables and to take off branch wires, as well as to facilitate inspection, a special type of wrought iron manhole pits is used.

The first main cable contains 70 wires as far as Nevski Prospect, and after that point it contains only 29 wires. Along this main cable have been placed three of the above-mentioned manhole pits. The other cable, which has 35 wires, will be provided with four pits, which are separated by distances varying from 1,100 to 1,600 ft. The cables for this work have been made entirely at St. Petersburg by the Messrs. Felten & Guillaume (Ribon Manufacturing Company), and Siemens & Halske Company. The cost of all this work is estimated at about 300,000 to 400,000 roubles.

The city of Perm has just established a system of street lighting which is now in successful operation. A large central station has been erected for city and private lighting, a remarkable feature of which plant is that it is conducted on co-operative principles. The system is to be extended exclusively from receipts from consumers.

A delegation of Belgian engineers has visited the city of Vladikovkas to consider the project of establishing a large electric plant in that locality. The new plant is to provide for a system of electric railway lines and also for the electric lighting of the city.

Some interesting figures have recently been published relating to the operation of the telegraph and telephone lines in Russia during the year 1902, together with the development of new lines.

According to the financial report of the Postal and Telegraph Department, a credit of 4,000,000 roubles is asked for the expenditures of the telegraph and telephone systems. This total sum includes the cost of all the work undertaken in 1902 for the extension of all the telegraph and telephone lines, including the labor and erection, together with the cost of the material. The above sum is divided between the telegraph and telephone systems: 80 per cent., or 3.2 million roubles will be for telegraphic purposes and 650,000 roubles for the telephone system.

The largest part of this credit is needed for the purpose of repairing and keeping up the telegraph system, which alone contains 322,476 miles of wire, at the rate of 5.72 kopecks per mile for repairs; this rate being estimated according to the experience of previous years, which makes a total of 1,911,400 roubles. If to this work is to be added the work of changing the existing telegraph lines and running them in a new direction so as to follow the newly established railroads or post roads, also the replacing of old wires, for which 356,000 roubles has been assigned—this work also to be considered as repair work—the whole amount of the credit asked for repairs will reach 2,268,000 roubles; this will be at a rate of 7.2 roubles per miles of wire. The remaining sum of 900,000 roubles is demanded for the extension of the existing telegraph system, both for adding new lines owing to the increased use of the telegraph, as well as for erecting new lines according to the needs of the population and of the government.

As to the credit for the telephone system, this has been calculated at 653,800 roubles, and is to be used for the repair and extension of the existing 91 telephone systems which are under government control. About two-fifths of this sum is to be used for the repair of existing telephone lines, both for the city and interurban systems; the remaining three-fifths to be used for the addition of new subscribers. The average cost of repairs and maintenance of one mile of telephone line, according to the experience of the last ten years, will be 6.04 roubles per year; the addition of one subscriber to the line costs 136 roubles. On the government lines the number of subscribers in 1901 was 17,728 and the whole telephone system used 45,300 miles of cable. Besides the telephone system belonging to the government, there are already 11 systems which are under private control. These are distributed as follows: St. Petersburg, Moscow, Warsaw, Odessa, Riga, Lodz, Nishni Novgorod, Livara, Revel, Rostov on the Don and Bakou, with a total of 15,896 subscribers in 1901.

Alaskan Cable Laying.

Dispatches to the newspaper press from Tacoma, Wash., last week, state that the striking of a submerged iceberg by the United States cable ship *Burnside* did not prevent her from laying the Alaskan cable in short order two weeks ago. As a precaution against accidents the *Burnside* took several days going to Juneau from Puget Sound, lying to every night. Despite this safeguard, she struck a big submerged iceberg on the morning of September 22, and several plates were punctured, flooding her forward compartments. Examination showed that pumps could keep her afloat, and Captain Burnell, of the Signal Corps, decided to commence laying the cable at once. One object was to lighten the ship, and thereby save as much of her valuable cargo in the event of the vessel sinking as possible. Engineers made temporary repairs and kept the pumps at work so successfully that forty-six miles of cable had been unreeled when the ship arrived at Douglas City. An inspection there showed that the *Burnside's* hull could be repaired by the ship's crew. This is now being done. General Greely, Chief of the Signal Corps, is directing the laying of the remainder of the cable. He will recommend a branch cable from Juneau to Urangel and Ketchikan.

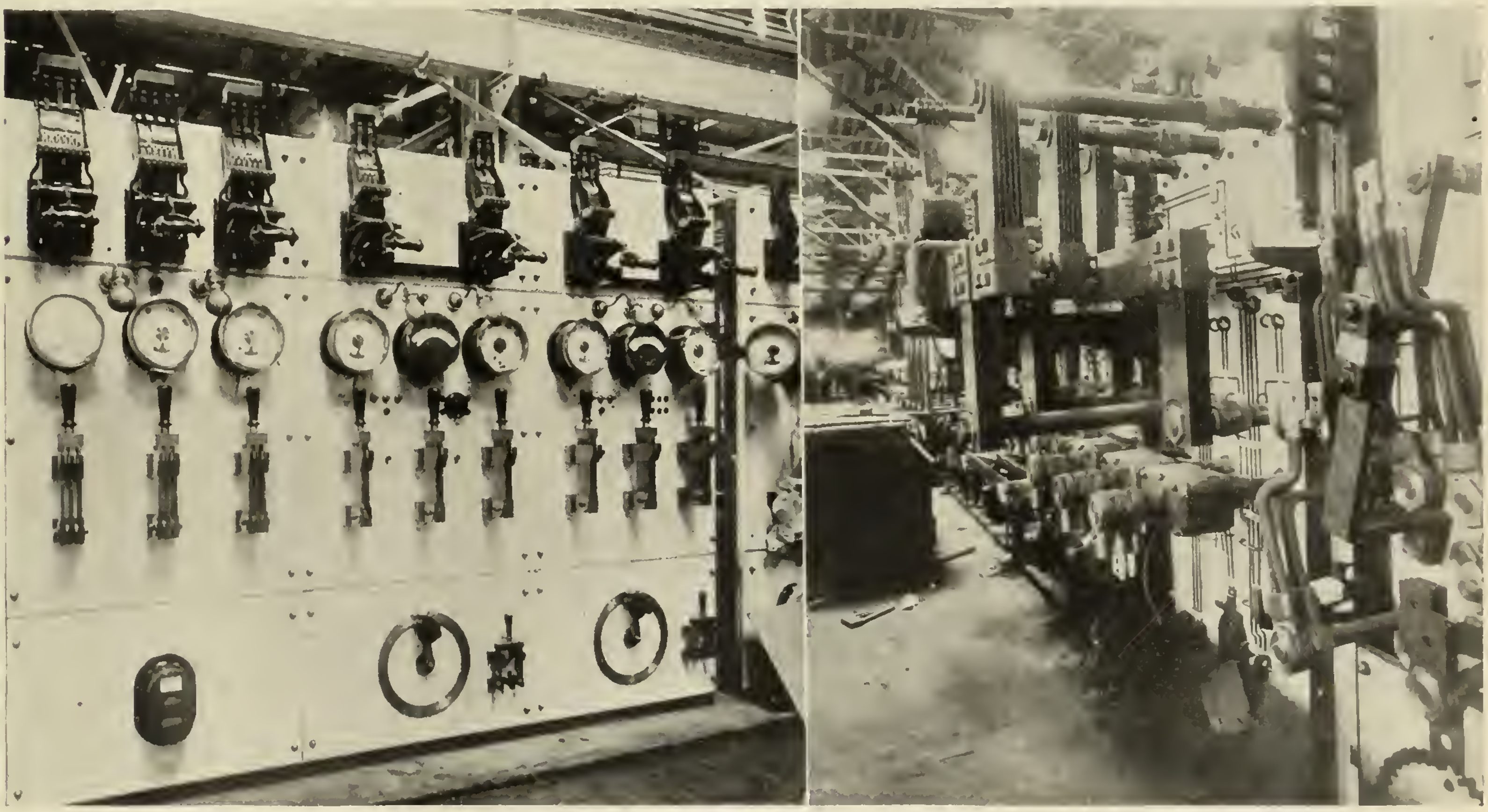
Alternating Current Switchboards—III.

By Stephen Q. Hayes.

Another type of switchboard to be considered has a framework similar to the type described in the previous article, but there is no space left between the bottom marble and the channel iron. The total height of the board is the same, namely 9 ft. from the top of the 2-in. channel iron to the top of the board. The panels are divided vertically into three slabs, the one on top 20 in. high, the middle 45 in., and the bottom 25 in. The top slab is for the circuit-breakers, the middle for the instruments and switches, and the bottom for the rheostats or other apparatus. This type of panel is intended for three different ranges of voltage: 100-600, 1,100-2,200 and 2,200-6,600.

Fig. 15 illustrates a board for the control of two 1,250-390-volt, three-phase generators and three 800-kw. delta-connected raising transformers, 390-2,200 volts. On this board the exciters are controlled by separate panels not shown. The voltmeters and synchroscope are mounted on swinging brackets at the ends of the board. With single-throw systems there are two voltmeters, one connected to the bus-bars and one which can be connected to any phase of any generator by means of voltmeter receptacles on the various panels. With a double-throw system, with two generators, there are also two voltmeters, one connected with each machine. With three or more generators there are three voltmeters, one connecting to either set of bus-bars and one for the machines. The synchroscope on a double-throw system is arranged to be connected to either set of bus-bars and to any generator by a suitable plugging system. On these panels, the capacity of which runs up to 6,000 amp., quick-break switches are not depended on to open the circuit even on 440 volts, but circuit-breakers are provided for this purpose, non-automatic on the generator panels and overload, and automatic on the feeder panels. On the two-phase panels, three-pole circuit-breakers, and on the three-phase, two-pole breakers, are used. A breaker of one less number of poles than the number of leads on the panel will satisfactorily open the circuit at this voltage, the remaining leg being opened on the switch. These breakers are arranged to be closed separately as single-pole breakers, but to trip together as two-pole or three-pole breakers, as the case may be.

The circuit-breakers shown have the arcing and current-carrying contacts in plain view, a most important feature. The copper or current-carrying contacts are broken first and the current is shunted from them by successive copper shunts to the carbon or arcing terminals. The construction of the circuit-breaker aids the natural tendency of the arc to rise, and prevents any chance of its communicating to other live parts. The brush which carries the current is made up of laminated copper and adapted to be closed under pressure against flat contact blocks, which form a part of the studs. The pressure for closing is obtained by a toggle joint lever, and this contact pressure is sufficient to throw out the swinging arm of the circuit-breaker when tripped, aiding the releasing spring instead of acting against it, as is the case with all types of circuit-breaking devices with sliding-jaw contacts. The automatic overload breaker is tripped electromagnetically and is calibrated by weight attached to the scale beam. The range of adjustment of the circuit-breakers may be set for any predetermined current between the limits of 20 per cent. less than, and 50 per cent. in excess of, their normal rated capacity. They will carry their rated current with a rise in temperature not exceeding 20° C. and successfully open the circuit in which they are connected under any condition of overload or short-circuit. These breakers are for 750 volts in one, two, three and four-pole combinations. Marble barriers are provided when necessary, between adjacent breakers.



Figs. 15 and 16.—Front and Rear Views of 600-Volt Switchboard.

The switches used on these boards have their sectional areas and contact faces of all sliding and stationary parts calculated in accordance with the latest requirements of the best practice and to fulfil every requirement of the National Board of Fire Underwriters. Blades of certain definite capacity are selected as units and larger switches of capacities which are multiples of the unit are built by combining in parallel the required number of blades; so that switches of different capacity, multiples of the same units, are built alike in length and general appearance. This is a very desirable feature in fine switchboard design. Switches constructed in this manner are very strong mechanically and give a greater radiating surface and larger area of actual contact surface per ampere capacity than any other type of switch. To facilitate closing on the larger sizes, single-pole switches are used instead of three-pole or four-pole on this type of board.

On these panels the standard arrangement is for one ammeter on generator panels, but with the necessary number of series transformers and ammeter plugs to enable the ammeter to measure the current in any phase. The connections as shown on diagram Fig. 17, are so made that all the ammeter plugs are to be closed except the one in the phase to be read. All meters used on these boards are fed from 5-amp. secondaries of series transformers.

Boards of this type are made up of two-phase generator panels, single-throw and double-throw; two-phase feeder panels, single-throw and double-throw; three-phase generator panels, single-throw and double-throw; three-phase feeder panels, single-throw and double-throw, to control a bank of three transformers connected in star or three transformers connected in delta, where it is not desired to cut any single transformer out of the circuit; three-phase feeder panels, single-throw, to control a bank of three transformers delta connected, where it is desired to cut any single transformer out of the circuit; single-phase feeder panels, single-throw and double-throw, which may be used to control one of a bank delta-connected transformers, where it is desired to cut any single transformer out of the circuit; load panels, two-phase and single-phase, single-throw and double-throw; rheostat panels to go under two-phase or three-phase generator panels.

The first four types of panels do not need any lengthy description, but the fifth one, which is used with a bank of three delta-connected transformers, where any one transformer can be cut out, merits a few remarks.

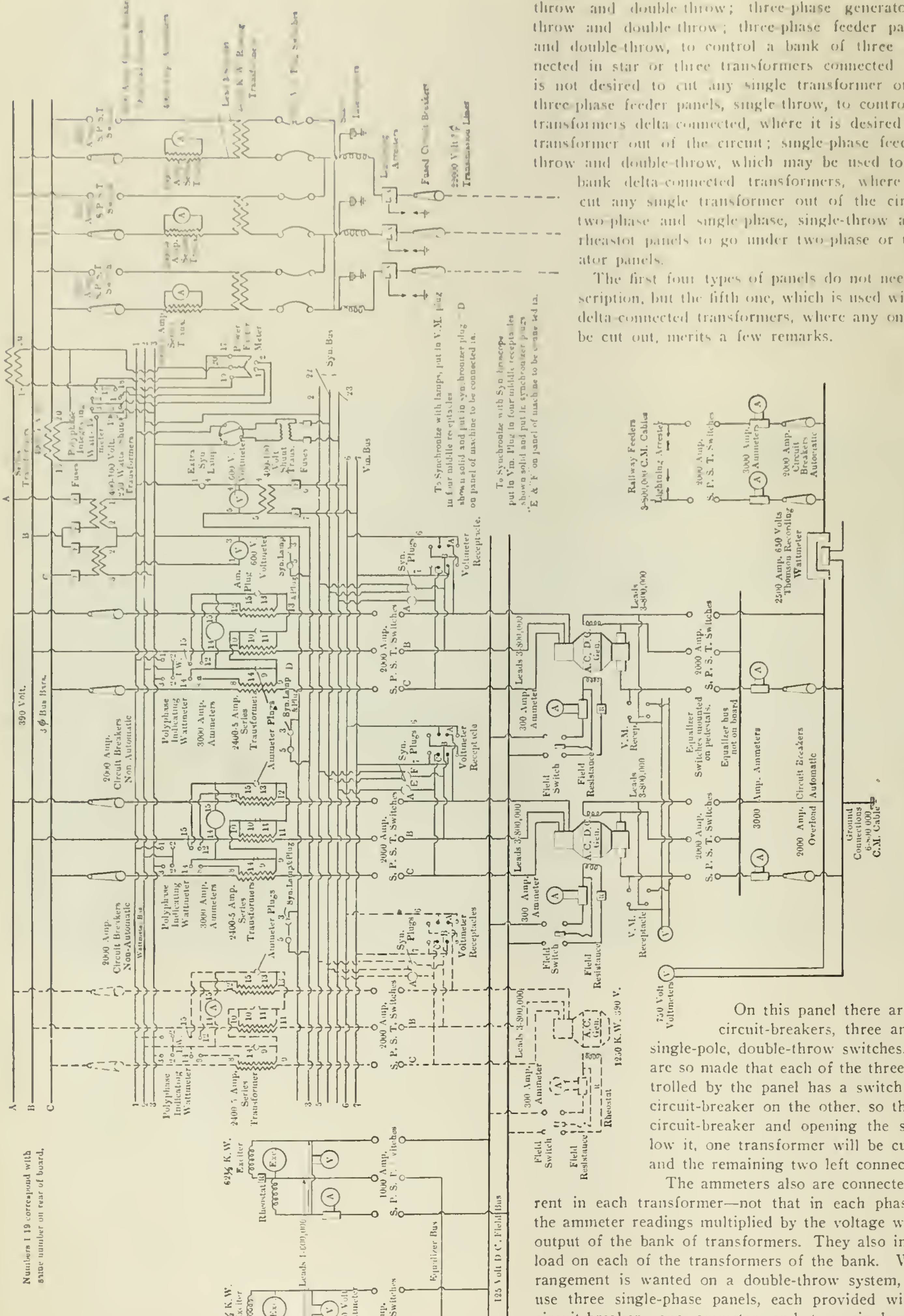

390 Volt.
3 ϕ Bus Bars.
2000 Amp. Circuit Breakers Non-Automatic
Polyphase Indicating Wattmeter
3000 Amp. Ammeters
2400-5 Amp. Series Transformers
Ammeter Plugs
Syn. Plugs
Voltmeter Receptacle
2000 Amp. S. P. S. T. Switches
Leads 3-800,000
300 Amp. Ammeter
Field Switch
Field Resistance
A.C. D.C. Gen.
V.M. Receptacle
Equalizer Switches mounted on pedestals.
Equalizer bus not on board
3000 Amp. Ammeters
2000 Amp. Circuit Breakers Automatic
2000 Amp. Overload
Ground Connections 6-800,000 C.M. Cable
2500 Amp. 650 Volts Thomson Recording Wattmeter
Railway Feeders 3-500,000 C.M. Cables
Lightning Arrester
750 Volt Voltmeters
1250 K.W. 390 V.
Rheostat
62½ K.W. Exciter
1000 Amp. S. P. S. T. Switches
150 Volt Voltmeter
800 Amp. Ammeter
Leads 1-600,000
Equalizer Bus
125 Volt D.C. Field Bus
Vm. Bus
Syn. Bus
Numbers 1-19 correspond with same number on rear of board.
To Synchronize with lamps, put in V.M. plug in four middle receptacles shown solid and put in synchronizer plug D on panel of machine to be connected in.
To Synchronize with Synchroscope put in Vm. Plug in four middle receptacles shown solid and put in synchronizer plugs E & F on panel of machine to be connected in.
Fused Circuit Breaker
Lightning Arresters
Power Factor Meter
Polyphase Integrating Wattmeter
Fuses

FIG. 17.—DIAGRAM OF CONNECTIONS 600-VOLT SWITCHBOARD.

On this panel there are three single-pole circuit-breakers, three ammeters and three single-pole, double-throw switches. The connections are so made that each of the three transformers controlled by the panel has a switch in one leg, and a circuit-breaker on the other, so that by tripping the circuit-breaker and opening the switch directly below it, one transformer will be cut out of the delta and the remaining two left connected in V.

The ammeters also are connected to read the current in each transformer—not that in each phase—so the sum of the ammeter readings multiplied by the voltage will be the apparent output of the bank of transformers. They also indicate the relative load on each of the transformers of the bank. When a similar arrangement is wanted on a double-throw system, it is necessary to use three single-phase panels, each provided with one single-pole circuit-breaker, one ammeter and two single-pole, double-throw switches. The circuit-breaker is connected between one leg of the transformer and the middle stud of the single-pole, double-throw switches, and the other leg of the transformer is connected to the middle stud of the other switch.

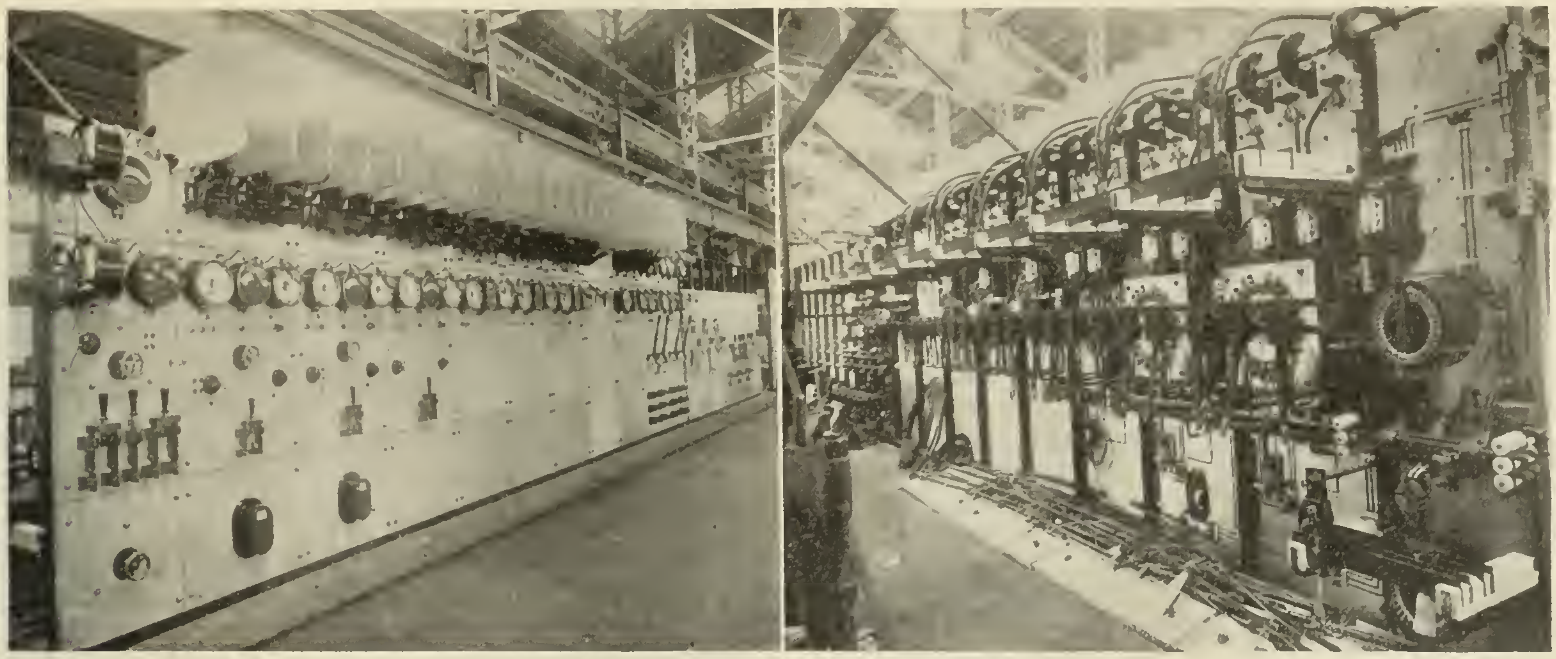
Fig. 16 shows the rear view of this same board, and indicates clearly the massive bus-bars, the heavy "adapters" on the switch, and circuit-breaker studs and the series transformers, on the studs, straps or bus. The series transformers on the bus-bars feed a polyphase integrating wattmeter that records the entire alternating-current output of the station. They also feed a three-phase power factor meter which is placed on a swinging bracket at the end of the board. On the load panels it is usual to provide an ammeter in each phase for each set of bus-bars, a polyphase integrating wattmeter for each set, and occasionally a power factor meter or polyphase indicating wattmeter in each set.

As this line of panels is used a great deal for power transmission work, static ground detectors are sometimes supplied operated from condensers in the high-tension transmission line fed from the raising transformers.

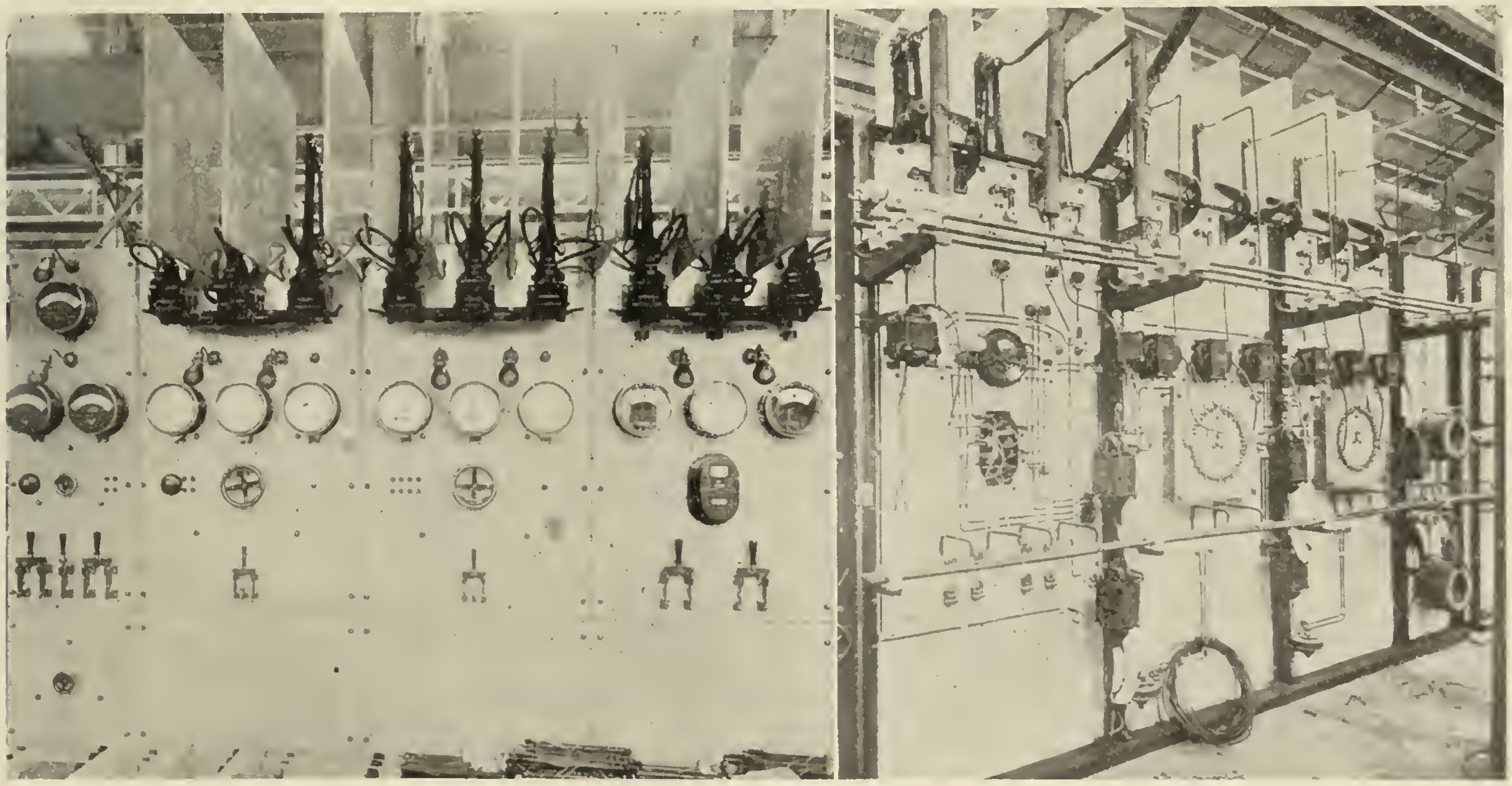
Fig. 17 shows the diagram of connections for part of this plant and illustrates the method used of connecting the one ammeter so that it can be plugged into any phase. Wiring for synchroscope, power factor meter and other instruments is also shown.

Panels of this type for 1,100-2,200 volts, as shown in Fig. 18, are built for two-phase and three-phase work and are similar in general arrangement to those used on 100-600 volts, the main difference being that, instead of brush type circuit-breakers and blade switches, stick type breakers are used both for protection and for switching, i. e., no additional switches are used. These circuit-breakers will successfully break the circuit in which they are connected on overload or short-circuit under any conditions of inductive or non-inductive load. The main or current-carrying contact is a laminated brush made of leaf copper. The contact pressure of this brush is sufficient to help the releasing spring throw out the movable arm of the circuit-breaker when it is tripped. This is a very important feature and a great improvement over other types of circuit-breakers having jaw contacts, the friction of which always acts against the releasing spring.

The current-carrying contacts of these circuit-breakers are protected by copper shunts so that, when the breaker is opened the current is gradually shunted from the current-carrying contacts to the carbons by steps of such low resistance that no arcing can occur until the final break is made on the carbons. This feature in the design obviates all possibility of "bugging" of the copper or current-carrying contacts. The length of break of opening of the circuit-breaker is proportioned to the voltage of the circuit. The arc occurs on carbon terminals above, and well removed from metal parts of the breaker. This construction aids the natural tendency of the arc to rise and prevents any possibility of communi-



FIGS. 18 AND 19.—FRONT AND REAR VIEWS OF 2200-VOLT SWITCHBOARD.



FIGS. 20 AND 21.—FRONT AND REAR VIEWS OF 6600-VOLT SWITCHBOARD.

cation to any live parts below the carbon terminals. The range of adjustment may be set to any predetermined current between the limits of 20 per cent less than, and 50 per cent. in excess of, the normal rated capacity. The breakers are built for potentials from 2,200 to 33,000 volts, in one, two, three and four pole combinations.

The same type of instruments is used on these panels as on the type described in the previous article, but as machines of 1,100 2,200 volts are often used for lighting purposes, while the 600 volt ones are almost invariably used for power, there is one ammeter in each phase, and on the two phase panels, two single phase indicating wattmeters are used instead of one polyphase. As a rule, the rheostat face plate is mounted on the back of the main 45 in. generator panel with the hand wheel and direction dial on the front, and the field switch is also located on this same slab. However, the rheostat and switch can be placed on the lower 25 in. slab if it is necessary to provide room for additional apparatus.

Fig. 19 gives a rear view of a typical 2,200-volt switchboard of this type, slightly modified from the standard by omitting two of the three ammeters and putting in polyphase integrating wattmeters on the lower slabs of the generator panels. One of the most prominent features of this type of board is the use of marble barriers between the various poles of the circuit-breakers. As almost every engineer has some personal ideas as to leaving off or adding apparatus to what is usually considered necessary, difficulty is met in exactly illustrating a standard panel by a photograph of a board actually built.

As mentioned before, 2,200-volt panels of the type forming the subject of this article are often used with two-phase generators for lighting work, and are then adapted for two single-phase feeders. In connection with single-phase feeders and occasionally with two or three panels, it is necessary to use regulators, and these are usually mounted on the bottom slabs underneath the feeder panels. This same type of board is also used for three-phase, 6,600-volt work, and only differs from those for 2,200-volt in the size of the circuit-breakers and barriers used. Fig. 20 illustrates a board of this class which differs from the standard in that the upper slabs are not divided. The polyphase indicating wattmeter and field ammeter have been omitted on the generator panels and two ammeters have been left off of the feeder panel; but a polyphase integrating wattmeter, a pair of static ground detectors and two low-voltage lighting switches have been added. Fig. 21 shows the rear of the same board and indicates the bus-bar construction used, the condensers for the static ground detectors and the series and shunt transformers used with the meters. It also shows the rheostats for the exciters and the face plates of the generator rheostats.

Meeting of the Indiana Electrical Association.

The third annual meeting of the Indiana Electrical Association was held in Indianapolis, September 25. The meeting was called to order by President T. C. McReynolds, of Kokomo. Mr. McReynolds received the condition of the association and deplored the lack of interest manifested by the members. He said there was no prepared programme for the meeting, it being deemed advisable to confine the business of the session to matters of vital importance to the association. There was a free discussion of the proposition to enlarge the scope of the association, and in consequence the name was changed to that of the Indiana Public Utilities Association. The by-laws were ordered changed so as to make persons connected with the following businesses eligible to membership in the association: Electric light, water, gas, street and interurban railways, telegraph, telephone companies, fire alarm and all allied services. Agents of outside companies or representatives of supply houses traveling in Indiana are also made eligible to membership. The dues were fixed at $2 per annum.

It was agreed to put forth a united effort to infuse new life into the Indiana Association, and many valuable suggestions were made, which, if carried out, will make the association far more useful to those engaged in developing and managing the public utilities throughout the State. Heretofore the assocation has confined its membership to electric light men exclusively.

The following officers were elected for the ensuing year: President, J. H. Harding, Laporte; vice-president, H. D. Haring, Indianapolis; secretary-treasurer, A. M. Barron, Indianapolis.

An Object Lesson in Telephone Receivers.—IV.

By Arthur V. Abbott, C. E.

RECEIVER OF THE WESTERN TELEPHONE CONSTRUCTION COMPANY.

THE receiver of the Western Telephone Constr. Co. is shown in Figs. 53, 61, 67 and 68. Fig. 53 is the receiver assembled, while in Fig. 61 it is dissected. The case is of three parts, consisting of a body, a diaphragm cap and the tail piece. The magnetic system consists of a U bar .627 in. wide, .24 in. thick and 3½ in. long, with a lead filling as shown in Fig 61. The pole pieces are .459 in. wide, .09 in. thick and .97 in. long and are bolted to the magnet by means of a bolt that extends through a non-magnetic composition filling piece, which is cast between the adjacent surface of the magnetic system. This pole piece carries a screw thread, which engages with a similar thread on the inside of the case and in this respect this model closely resembles one form of the Kellogg receiver. A lead casting is cast between the face of the magnet in order to give sufficient weight to retain the hook switch in its proper place. The coil spools are of brass .42 in. wide, .83 in. long and .37 in. deep. The winding is No. 36 and the resistance from 95 to 100 ohms. The tractive effort is 1.188 pounds (553 grams).

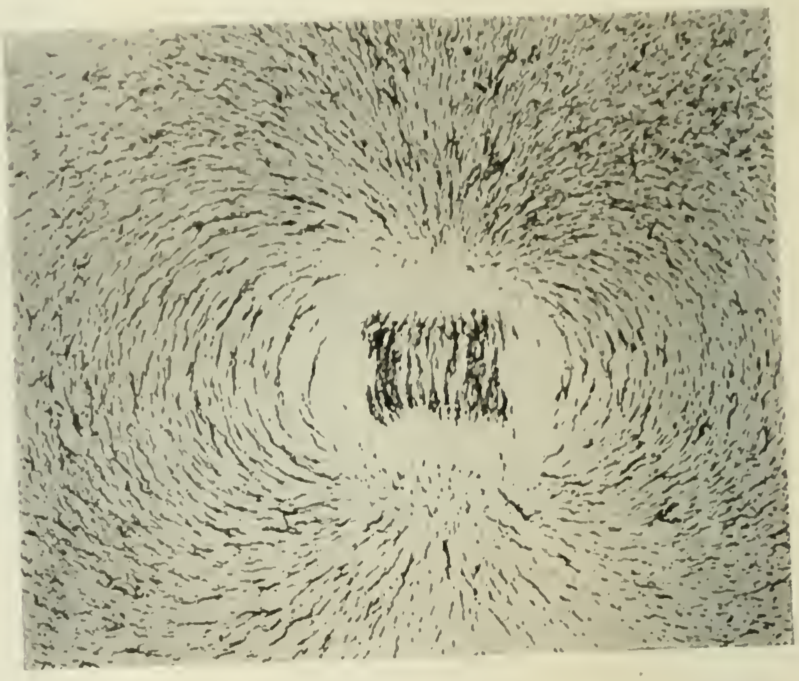


FIG. 67.—PHANTOM OF WESTERN TELEPHONE COMPANY RECEIVER, DIAPHRAGM REMOVED.

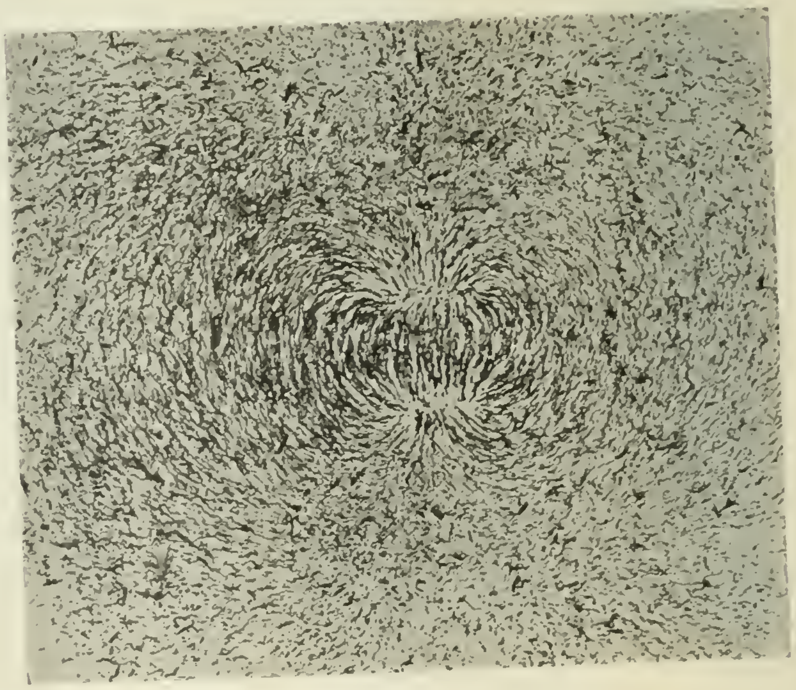


FIG. 68.—PHANTOM OF WESTERN TELEPHONE COMPANY RECEIVER, DIAPHRAGM IN PLACE.

This corresponds to a tractive effort of 964 grams per sq. cm., and an induction in the pole pieces of 9,680 gausses; the remenance is 4,000 gausses. The diaphragm is flat, of tinned sheet iron .011 in. thick, 2.13 in. in diameter over all, and 1.93 in. diameter free. The leading-in wires are rubber-covered okonite and extend upward to the line spools from the rear of the case and are there attached to two screws in a partition between the end of the body and the tail cap, after the fashion of the Kellogg receiver. The receiver cord passes through the tail cap and is there knotted and attached to the same screws. The phantoms of this receiver are shown in Figs. 67 and 68. Fig. 67 is the phantom of the diaphragm removed, showing an exceedingly uniform and well-distributed field. In Fig. 68 the diaphragm is in place and it is quite evident that it is fully saturated, as the location of the poles and the surrounding field may be clearly traced.

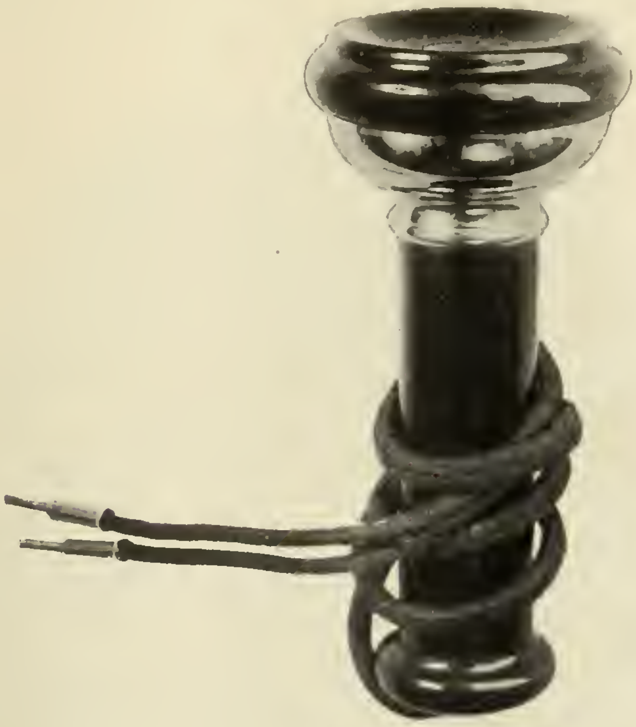


FIG. 69.—SWEDISH-AMERICAN RECEIVER ASSEMBLED.

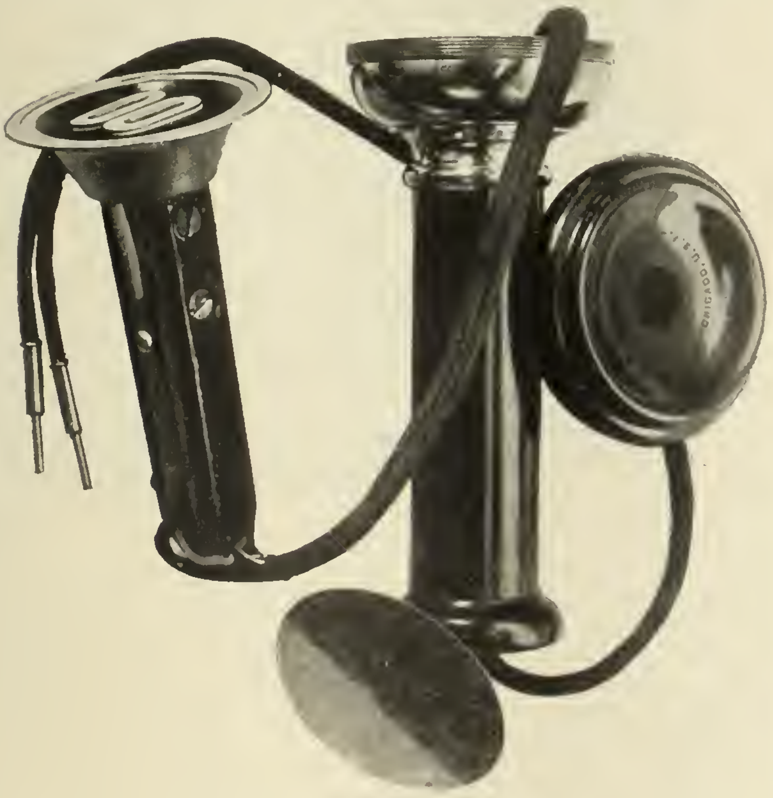
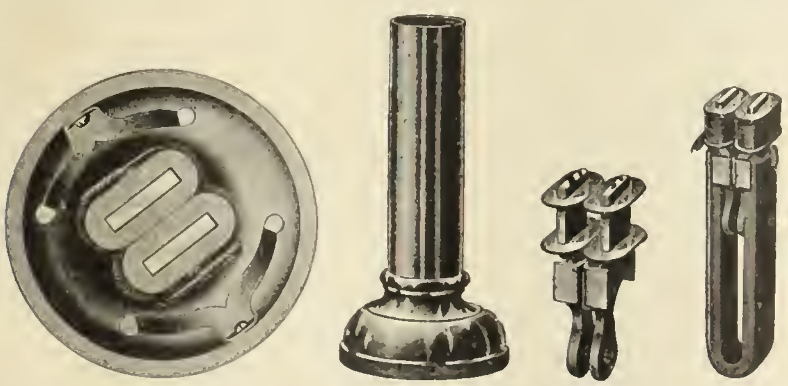


FIG. 70.—SWEDISH-AMERICAN RECEIVER DISSECTED.



FIGS. 71, 72, 73 AND 74.—DETAILS OF SWEDISH-AMERICAN RECEIVER.

SWEDISH-AMERICAN RECEIVER.

The receiver of the Swedish-American Telephone Company is shown in Figs. 69 to 76, inclusive. In Fig. 69 the receiver is assembled as it would appear in ordinary use. In Fig. 70 it is dissected, while Figs. 71, 72, 73 and 74 are details. In general design this receiver somewhat resembles that by the Erickson Company, as it consists of a substantially pressed metal case over which a tube of insulating material is slipped to form the necessary handle. The magnetic system consists of a U bar and is shown in Figs. 70 and 74. This bar is .623 in. wide, 3 in. thick, of D-shaped steel. The distance between the face of the bar is .25 in. The magnet is 3.25 in. long. The pole pieces are .625 in. wide, .120 in. thick, 1.31 in. long, and are secured by two brass bolts which pass through the magnet bars, the pole pieces and the filling piece, which is interposed between the faces of the magnet bars. The coil spools are .43 in. wide, .92 in. long, .43 in. deep and are made of brass. The winding is Nos. 34 to 36 wire to a resistance of about 70 to 80 ohms. Underneath the line coils is a wash bowl-shaped brass casting. The face of this casting is machined to be .02 to .03 in. in advance of the pole

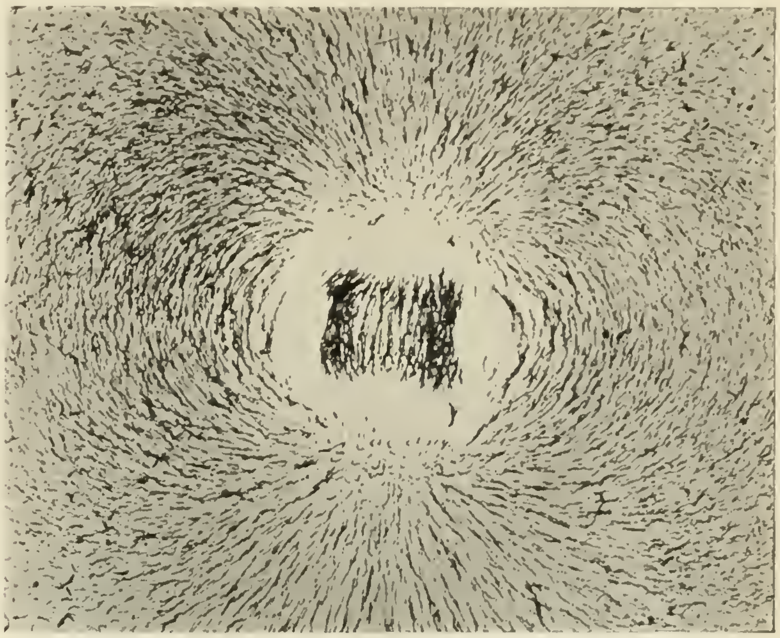


FIG. 75.—PHANTOM OF SWEDISH-AMERICAN RECEIVER, DIAPHRAGM REMOVED.

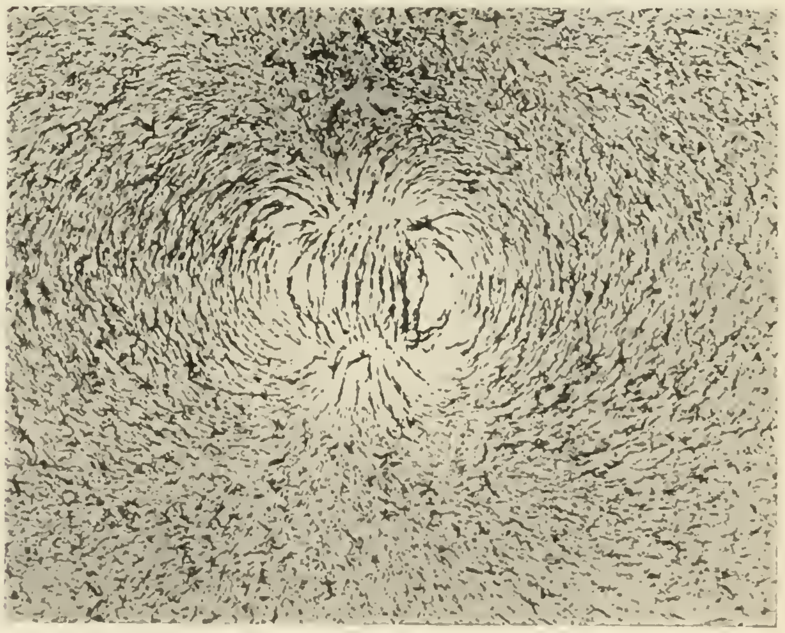


FIG. 76.—PHANTOM OF SWEDISH-AMERICAN RECEIVER, DIAPHRAGM IN PLACE.

pieces, and the diaphragm is laid flat upon the face of this casting. Then the entire system is slipped inside of the case and the diaphragm cap screwed down to a bearing. When the cap is home, the diaphragm and brass casting are pinched firmly to the metal of the case. There is, therefore, in this receiver, no adjustment between diaphragm and the pole pieces, subsequent to a final assemblage. The diaphragm is flat, of sheet iron, tinned .014 in. thick, 2.10 in. in diameter over all and 2 in. free diameter. The tractive effort is 1.685 pounds (761 grams). This is equivalent to 705 grams per sq. cm., giving an induction of 8,800 gausses and a remenance of 4,500 gausses. Fig. 72 shows the interior metal shell of the receiver before the insulating tube is slipped in place. In Fig. 73 one method that has been adopted for building the pole pieces and line coils, while in Fig. 74 the assembled magnet, pole pieces and spools are indicated. Fig. 71 is a front elevation of the receiver assembled and shows a model in which two damper springs are used for the purpose of checking the vibrations of the diaphragm. Figs. 75 and 70 are the phantoms of this receiver. Fig. 75 shows the phantom with the diaphragm removed, while Fig. 76 is taken with the diaphragm in place.

The Curtis Steam Turbine.

At a meeting last week of the New England Cotton Manufacturers' Association, Mr. Austin R. Dodge, of Schenectady, N. Y., read a paper entitled "Advantages of Steam Turbines for Textile Mills," from which we extract the following portions relating particularly to the Curtis turbine. The author of the paper is particularly well qualified to treat of the subject, having been connected with the development of the Curtis turbine from the time it was first taken up by the General Electric Company.

FIG. 1.—GENERAL VIEW OF INTERIOR OF NEWPORT STATION.

Following a discussion of the De Laval turbine, the Curtis turbine is described as a type which, in addition to nozzles delivering steam at high velocity to a single wheel, has also stationary vanes which redirect the steam discharged at considerable velocity from the first wheel, due to the relatively low bucket speed, into the second wheel. The velocity of the jet leaving the nozzle is about 2,000 ft. per second, about half the velocity of the De Laval under the same conditions of exhaust pressure, while the peripheral speed of the vanes in the Curtis is proportionally much less, about 400 ft. per second, instead of 1,200 ft. per second. By this process of fractional abstraction the speed of revolving vanes need not be excessive to secure maximum economy; in other words, to bring the direction of the jet discharged from the last set of vanes parallel to the shaft, this satisfying the necessary condition. With this high steam velocity only a minimum of revolving vanes are necessary, and they rotate in steam which has a lower density, due to the considerable drop in pressure from one stage to the next. There is a large clearance between outer wall of revolving vanes and the shell, reducing friction due to water of condensation. End thrust is eliminated, as there is abundant opportunity for the pressure to equalize on each side of the revolving discs, and the entrance and discharge angles of the vanes are the same.

In the larger sizes of the Curtis type the shaft is vertical and floats on oil under sufficient pressure to balance the weight of the revolving element, which rises a few thousandths of an inch until the clearance is sufficient to permit the discharge of the oil delivered at the center of the supporting block. That there is no end thrust in this turbine is shown by the fact that the oil pressure necessary to float the revolving element does not change under any condition of load. This vertical arrangement affords great compactness and greater uniformity of expansion due to heat.

The clearances between stationary and moving parts have proven thoroughly commercial, as shown in several months' operation of vertical 500 kw units. In cases in which the oil pressure has failed in the vertical type of this unit during the use of a temporary belt-driven oil pump, there has been no damage to the revolving or stationary vanes. Any contact which may occur is due to the lifting of the revolving element owing to formation of ridges on the step bearing surface. The weight of the revolving element, therefore, tends to neutralize any tendency to injury. As the vanes are less in width than the metal from which they are cut, nothing more serious happens than a polishing of the solid part of the wheels. Even the step bearing blocks can be faced off and used again. When using the standard direct-driven oil pump a failure of oil supply to the step bearing is highly improbable.

The 500-kw type has two sets of nozzles, each delivering steam to a set of three revolving discs, carrying the vanes, which are machined from the solid disc. Governing is affected by operating a series of valves which control the admission of steam to the nozzles on the first stage. This insures a constant velocity in the first stage nozzles, while the pressure in the first stage diminishes with the steam flow until at no load it is nearly equal to the vacuum in the second stage, a desirable condition, as it reduces the density of the steam in which the first stage wheels rotate, and renders unnecessary adjustment of the valve controlling the second stage nozzles.

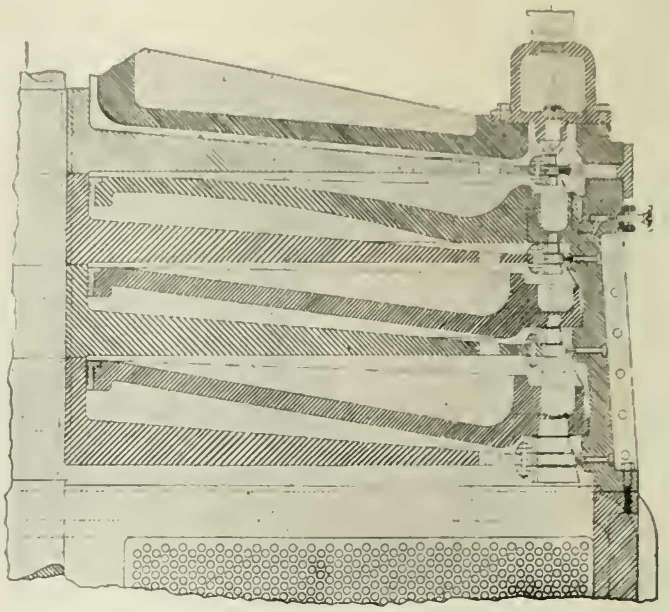


FIG. 2.—ASSEMBLY OF 5,000-KW FOUR-STAGE TURBINE.

After referring to the desirability of an electric drive for cotton mills, and the advantages in this connection of the steam turbine through its obviating the necessity of changing reciprocating to rotative motion, Mr. Dodge took up the matter of first cost of a turbine installation. A Curtis turbine requires only 7 per cent. of the floor space taken by a horizontal cross-compound engine of the same capacity, and the cost of foundations is in about the same proportions in favor of the turbine. The weight is from 15 per cent. to 25 per cent. that of the engine. There is no wear with a moderate amount of superheat resulting from the action of the steam jet on the vanes, even at a velocity of 2,500 ft. per second, as shown by long continued tests.

One of the great advantages of a turbine is due to the entire absence of internal lubrication. Consequently the condensed steam can be returned to the boilers, saving the cost of oil and feed water, often 10 per cent. the cost of fuel. As no boiler scale is formed while using the same feed water continuously, tube cleaning is unnecessary and the boilers are maintained at the highest efficiency without withdrawal from service.

It is estimated that the saving in attendance charges will average 25 per cent. on the entire station pay-roll. A turbine having but one moving part requires no adjustment, unlike a reciprocating engine with a large number of moving parts, which must be carefully inspected at frequent intervals by a skilled engineer. The economy, therefore, remains constant, which is not true of a reciprocating engine.

One of the principal requirements of textile mills is uniform speed. A turbine has a large amount of stored energy in its revolving parts and is, therefore, well adapted for work requiring close regulation. In Fig. 4 is plotted a curve which indicates the regulation of a 20-hp Curtis turbine, when full load is suddenly thrown on and as suddenly removed. The variation in speed of the larger units is within two per cent., when the load is varied from no load to full load. Flywheels are not required on any type, as the driving force is always transmitted without angular variation; a desirable condition when generators are operated in parallel.

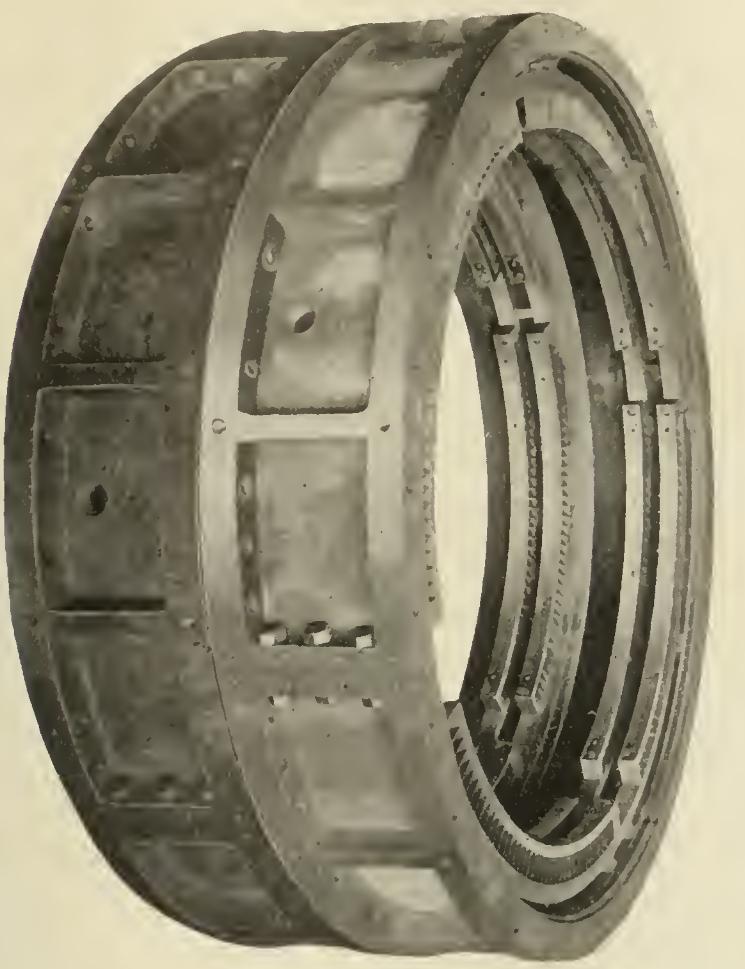


FIG. 3.—TWO INTERMEDIATES FOR SECOND STAGE OF A 500-KW TURBINE.

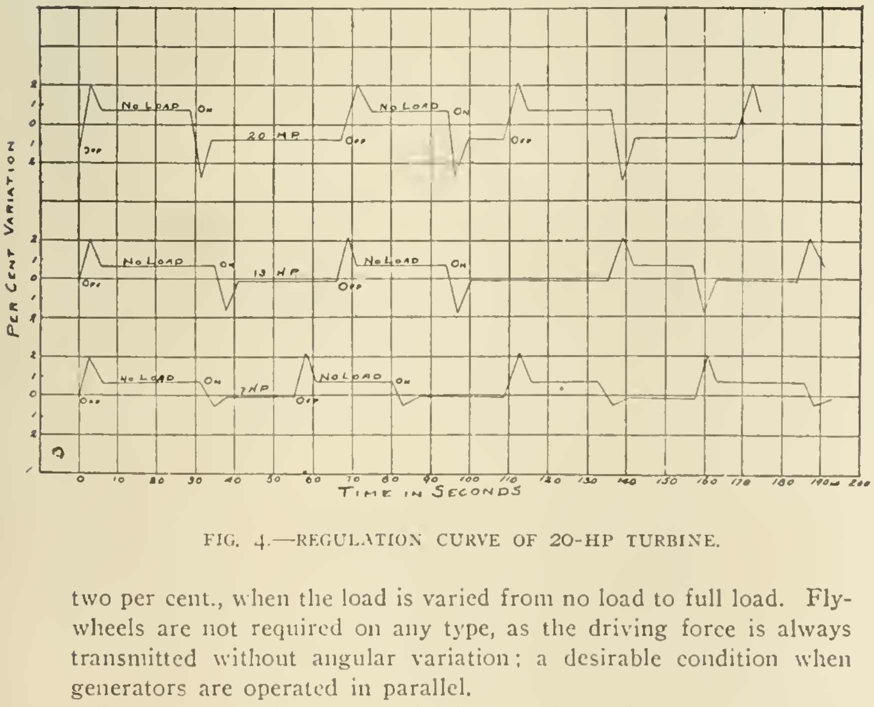


FIG. 4.—REGULATION CURVE OF 20-HP TURBINE.

The absence of internal lubrication permits a high degree of superheat. In the Newport plant the superheat of the turbine has been raised to 250° F. without increasing the temperature of any part of the revolving wheels or surrounding casing, except the admission valves. The conditions in an engine operating at this high temperature would not be as favorable. Actual experience in commercial operation has shown that water carried over from the boilers in large quantities does no injury to any part of the turbine, a serious condition when reciprocating engines are in use.

The first vertical turbine engine to be installed in this country was at Newport, R. I., and few engines of this capacity, even when new, can show as high efficiency at full load. The motors required to operate the circulating and air pumps for the condenser are driven from the turbine generator and this power, about 20 kw, is included in the output of the machine. Analysis of the velocities obtained indicate that the result from the first vertical unit will be materially reduced. Lighting, railway and arc load are all carried on the same unit without difficulty. Minor troubles have developed, but no more than with every radically new device, and these have in turn been corrected as rapidly as possible under commercial operation. The station is arranged for four turbines, two of which have been put in service.

Similar plants have been installed at Scranton, Pa., Dover, N. H., and within the past year orders have increased to such an extent that 200,000 hp of Curtis turbines are under contract. A 600-kw horizontal unit has been in continuous service at Schenectady for two years, operating for two periods of about four weeks each without a single shut-down.

A 1,500-kw Curtis unit is in successful operation at Port Huron, Mich., carrying a mixed load of motor power, railway and lighting. This turbine has the standard clearance of .03 to .05 in. between stationary and moving parts, and can be started cold and brought up to full speed in half an hour. It is easily brought into synchronism with other three-phase generators driven by cross-compound engines. One 800-hp and one 500-hp engine, both tandem compound, and also one 500-hp cross-compound engine, all condensing, have heretofore carried the load, about 750 kw, requiring two 500-hp and one 250-hp Sterling boilers. With the turbine alone carrying the same load, one of the 500-hp boilers is cut out.

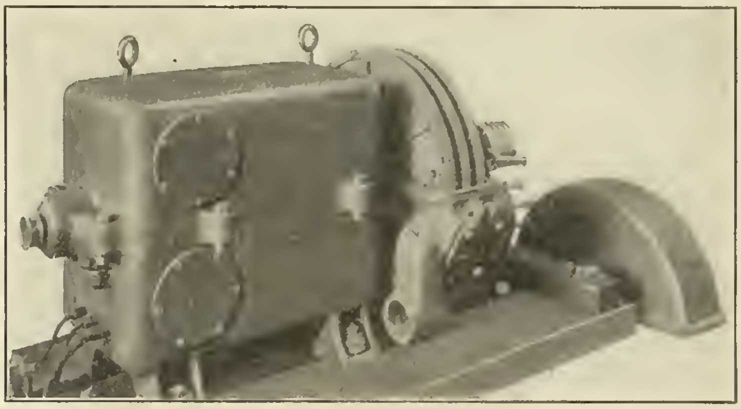


FIG. 5.—15-KW TRAIN LIGHTING SET.

A 5,000-kw Curtis turbine has recently been installed at the Commonwealth station, Chicago, where provision has been made for fourteen similar units. This machine, the first of its size, has been operated continuously for several periods of eight hours each on a water rheostat load of 5,000 kw and will shortly be put in commercial service. On account of water leaks around the condenser tubes, no reliable economy tests have yet been made.

In textile mills the first units to be installed are three 500-kw Curtis turbines at the Lane Cotton Mills, New Orleans, and two similar units at the Fulton Bag & Cotton Mills, Atlanta, Ga.

Speaking Evil of Corporations.

In signing a conduit franchise for the United Electric Company at Orange, N. J., and meeting criticism freely offered, Mayor Stetson says, in approving the ordinance in a written statement: "There is always more or less clamor against corporations merely as corporations. This sentiment is found everywhere, and while in many instances it is well grounded, it is often based upon shallow prejudice, and cannot survive the test of reason, justice and sound common sense. An irresponsible individual may freely inveigh against corporations and contracts which municipalities may make with them, but an officer sworn to impartially perform his duty to all, whether corporation or individual, must go beyond the consideration of mere prejudice and general objections when he is called upon to act in such matters, in which corporations or others are involved."

Recent Electrochemical Developments.

SPARK DISCHARGES THROUGH GASES.

The chemical effects due to spark discharges through gases are gaining steadily greater importance; and while ozonizing apparatus is already in commercial uses in Europe for the sterilization of water, the best known process of this type in this country is that of Bradley and Lovejoy for the fixation of atmospheric nitrogen. The mechanical problem to be solved in all such processes is to bring every particle of gas into the most intimate contact with the spark. In two patents granted on September 29 to Mr. Harry Pauling, of Brandau, Austria, two different devices are described for this purpose.

In the one the positive electrode is of pointed shape, as shown in Fig. 1, and the negative is of disc shape, whereby the discharge sparks are conical with the base directed towards the disc and its apex at the discharge point. The blowing in of the gas is effected through this point in the direction of the spark cone in such a manner that the greater part of the gas current coincides with the spark path. The outlet of the gases after treatment preferably takes place through openings in the disc electrode.

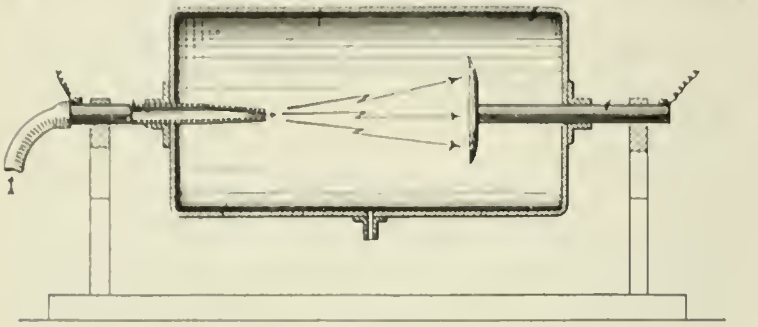


FIG. 1.—SPARK DISCHARGES THROUGH GASES.

In the other device the sparking surface is drawn out in band shape and the gases are blown or sucked through the spark-gap so formed. A band-shaped sparking surface can be produced, for instance, by allowing the points between which the spark has to pass to make a rapid lateral displacement. The apparatus for this purpose is shown in Fig. 2. Around a cylinder of insulating material, a conducting wire is wound in form of a helix, the ends of this wire being connected to the shaft. At a suitable distance from the cylinder a metal strip is arranged parallel to the shaft, shown in the figure at the top. This metal strip is connected to one pole of an induction coil, while the other pole is connected with the shaft of the cylinder. A set of nozzles, supplied by a common pipe, is arranged between the metal strip and the cylinder. By revolving the cylinder at a sufficiently high speed, a continuous spark band between the metal strip and cylinder is produced, so that every part of the gas passing from the nozzles comes into contact with the sparks.

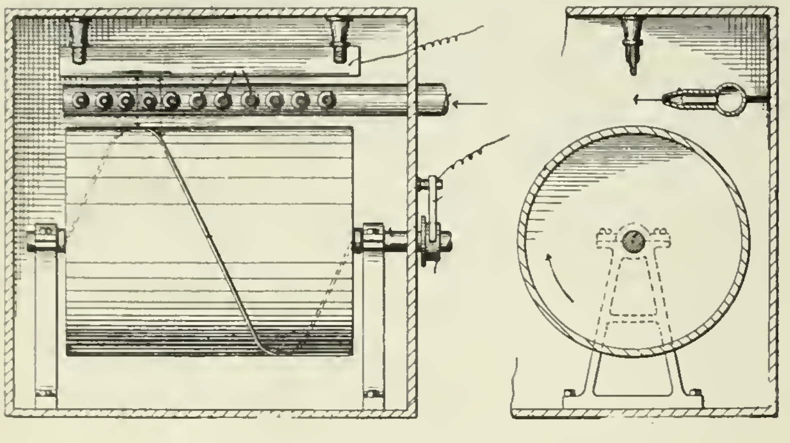


FIG. 2.—SPARK DISCHARGES THROUGH GASES.

TREATING ANIMAL HIDES OR SKINS.

A patent for this purpose was granted on September 29 to Mr. George D. Burton, of Boston, Mass. A tank contains the electrolytic solutions, such as any suitable unhairing solution (for instance, a mixture of quicklime and red sulphide of arsenic in water), the two electrodes of inert material being suspended across the bath at the two ends of the tank. The skins to be treated are suspended on longitudinal rods (i. e., perpendicular to the surface of the electrodes). The electrolyte is stirred by passing air through it. While it seems not at all clear from the specification what the effect of the current is, it is claimed to set up an electrolytic action in the solution "which causes the destruction of all germs therein, at the same time preserving the gelatine matter in the skins. The electricity has a tendency to raise the hair and permit a free circulation of the liquid around the hair cell." This treatment is completed in about three minutes.

The skins are then submitted to a drenching solution and are afterwards again suspended in the tank, which is now filled with a tanning solution. The current is turned on again and its effect is now claimed to be "to open the pores and permit a free circulation of the solution around them, causing a quick penetration of the tanning material and a hardening of the gelatinous matter, thereby preserving the gelatine in the hides or skins so treated."

STORAGE BATTERY INVENTION.

In a patent granted to Mr. Job Thomas Niblett, of Greenwich, London, England, the suggestion is made to make use of the highly absorbent and acid proof nature of "kieselguhr" or infusorial earth in connection with storage battery plates. By incorporating a certain proportion of infusorial earth with the active materials and also with the materials from which the separators between the electrodes are made, the porosity of the active material and the separators is stated to be improved.

PLATING METAL SHEETS.

A patent was granted on September 29 to Mr. Charles R. Fletcher, of East Greenwich, R. I., for apparatus for coating iron or steel sheets with copper or brass or other metals. The sheets to be plated are attached to a cylindrical skeleton cathode frame which is revolved between interior and exterior anodes, so that both surfaces of the iron sheets are simultaneously exposed to direct electrolytic action. The rotation of the cathode serves to stir the electrolyte.

The Pennsylvania Railroad New York Tunnel.

The Pennsylvania Railroad Company has finally decided upon the methods by which it will build its tunnels under the North and East Rivers and Manhattan Island. The construction beneath the North River will consist of two single cast-iron tubes, entering this city at the foot of West Thirty-second Street, and running under that street. They will be built by the shield process. Among the precautions arranged to make the tunnel safe will be two concrete sidewalks built inside the tubes on a level with the car windows, and the plans provide that the tubes must be roomy enough to allow ample width for these walks. The object of the walks is to provide exits for passengers in case of accident. Every car, it is claimed, will be fire-proof. The tunnel itself will be fire-proof. The signal system will be the most perfect known. The lighting current and circuits will be separate from those for the locomotives, and there are to be numerous hydrants and hose nozzles ready in the event of fire.

The Pennsylvania North River tunnel will rest on screw pile foundations, the reason being that the great electric locomotives, weighing something like 1,000 tons, are too heavy, in the judgment of the engineers, to permit of allowing the tubes to rest in the natural soil. In the case of the New York and Jersey Railroad tunnel, where trolley cars only are to be operated, it was decided that there would not be enough weight in the tubes to necessitate artificial foundations.

Under the East River the railroad's tunnel will consist of four cast-iron tubes resting directly on the rock bed of the East River. The great underground station in New York City will extend from Seventh to Ninth Avenues, and from Thirty-first to Thirty-third Street. The plans just completed provide that it shall be about 40 ft. below the street level. From the streets to the waiting room level, 20 ft. down, will be driveways of ample width and gentle slope. Although entirely underground, the station will be the largest in the world, in respect to both width, length and trackage.

The power to be used in the tunnel, as required by both the States of New York and New Jersey, will be entirely electricity, used through electric locomotives. In the Hackensack Meadows will be a station, where the trains will exchange their steam engines for the electric ones. The arrangements for the change will be made so that the time of the stop will be not more than one minute. On Long Island there will be a similar changing station in the yards near Thompson Avenue.

The Colombia Cable Dispute.

It would appear by advices from Washington that the interference by the United States in the controversy between the Government of Colombia and the West Indies and the South American Cable Company is likely to maintain communication between Washington and Bogota, notwithstanding the threat of the cable company to shut its Buena Ventura office. The experiments of the Director of Telegraphs for Colombia with the Marconi system of wireless telegraph has hardly proved adequate to menace the company.

The real bone of contention is the refusal of the Colombian Government to grant an extension of the cable company's franchise for twenty years, with modifications which would give the company a monopoly of cable communication on both the Atlantic and Pacific coasts and across the Isthmus of Panama. It is in regard to the latter point that the United States is chiefly interested. The grant of such a monopoly in advance of the conclusion of an agreement between the United States and Colombia in regard to the canal franchise would greatly prejudice the interests of the United States on the Isthmus.

The company now has the exclusive right to land a cable on the Pacific coast, and Buena Ventura is the terminus in Colombia. From there communication is by the government lines for a distance of 400 miles to Bogota. Colombia has threatened that unless the company continued its services extreme measures would be resorted to in retaliation. The company shut down the Buena Ventura office in August for two weeks, and the Colombian Government gave notice that unless the office was opened and communication re-established the Panama office would be seized. The company promptly opened the Buena Ventura office, and there has been no trouble since. The Panama office is doing a business of $2,000 a day, and the Colombian Government threatened to seize it again if the cable line was shut down on October 1.

When the facts were laid before the State Department Minister Beaupre was instructed to protest, and the representatives of the company in New York were communicated with and the consequences of shutting off communication just at this time with Bogota were explained. The company has, therefore, notified the State Department that the line will be operated as usual until further notice.

CURRENT NEWS AND NOTES.

FIRE AT SNOQUALMIE FALLS.—A correspondent informs us that the plant of the Snoqualmie Falls Power Company, near Seattle, Wash., was damaged by fire recently to the amount of $40,000.

VILLAGE COUNCIL ON A STRIKE.—Owing to local quarrels the village council of Buchannan, Michigan, has not met for six months to pay bills for street lighting and other purposes. Mr. Charles A. Chapin, of Chicago, who owns the lighting plant, has caused the street lights to be cut off, and the town is now in darkness.

ELECTRICAL WORKERS.—At the recent convention in Salt Lake City of the International Brotherhood of Electrical Workers, F. J. McNulty, of Newark, N. J., was elected grand president; W. H. Sherman, of Washington, grand secretary, and F. J. Sheehan, of New Britain, Conn., grand treasurer. The next convention will be held in El Paso, Tex.

BRAZILIAN UNDERGROUND ROAD.—It is stated that the Brazilian Federal Government has granted permission to several engineers to form a company, with the right to construct an "underground" railroad, to be operated by electricity, connecting the federal capital with the city of Nietheroy. The data are not very clear, but we should not be surprised to learn that the road is not "underground," but of the underrunning conduit type.

INFLUENCE OF ELEVATED TRANSFERS.—Figures on the traffic of the Chicago elevated lines for September show that the system of universal transfers adopted by the Chicago Union Traction Company has resulted in a material decrease in the traffic on the Metropolitan lines. The Northwestern, although running through the territory of the Union Traction Company, shows a gain as compared with the previous month. The South Side Elevated shows the best gains of any of the elevated lines.

AUTOMATIC TELEPHONY IN CHICAGO.—The automatic exchange of the Illinois Telephone & Telegraph Company, which was described in Electrical World and Engineer recently, is now in successful operation. The last directory, which has just been published, contains the names of 1,200 subscribers. Connections are being made as fast as it is possible to install equipment on the customer's premises. It is expected that 4,000 subscribers will be connected before the first of the year, as a greater number of contracts than this have already been secured.

SEEK RADIUM IN COLORADO.—A company is being organized to mine radium in Routt County, in Colorado. Specimens of ore have been passed upon, it is said, by Professor and Madam Curie and Professor Becquerel, the discoverers of practical radio-activity, and the Routt County ore was pronounced by them the best in the country for the purpose of producing radium. The ore was found to be almost entirely free from gold, and was reported to be carnotite, in combination with uranium, vanadium, copper, baranium and polonium. It is said that J. A. Munroe, freight traffic manager of the Union Pacific Railroad and Stephen T. Lockwood, of Buffalo, N. Y., are interested in the project. Note was recently made of this discovery in our columns.

OLD-TIME TELEGRAPHERS.—At the recent annual meeting in Milwaukee of the Old-Time Telegraphers' Association, C. C. Adams, of Atlanta, Ga., was elected president; J. M. Stephens, of Atlanta, first vice-president, and W. H. Adkins, of Atlanta, second vice-president. Mr. John Brant, of New York, was re-elected secretary. It was decided to hold next year's meeting at Atlanta, Ga. At the meeting of the United States Military Telegraph Corps at the same time and place 25 telegraph veterans of the Civil War, and four ex-Confederate operators were present. The present officers were re-elected, as follows: W. B. Wilson, of Philadelphia, president; W. L. Ives, of New York, vice-president, and J. E. Petitt, of Chicago, secretary-treasurer. This association, which is practically identical with the Old-Time Telegraphers' Society, will also meet in Atlanta next year with the latter.

THE VICTORIA FALLS.—It is well known that proposals are afoot for utilizing electrically the Victoria Falls, South Africa, and promoters of the enterprise are now visiting this country to study up Niagara and long-distance power transmission. The Victoria Falls on the Zambesi River, are approximately one mile wide by 420 ft. high. The near approach of the Cape to Cairo Railroad, which is planned to cross the Zambesi just below the falls, makes it probable that some small portion of this vast power will be utilized as indicated in the speech by the chairman of the African Concessions Syndicate, Limited, who will execute the scheme. The power obtained is to be transmitted electrically all over the iron and copper fields in the immediate district, and further afield to the gold mines within 400 or 500 miles of the power stations; there is talk of even supplying a country whose area is not limited by 1,000,000 square miles.

FLEECING PUBLIC CORPORATIONS.—Another one of the many grade-crossing accidents which are occurring at Chicago, has brought to light a new method of fleecing public corporations, which, except for its ludicrous outcome, would appeal to the public only because of its sad nature. Six race-track employees were killed and eleven others were badly hurt when a west-bound Wisconsin Central limited train struck a Chicago Consolidated Electric Company car at the Fifty-seventh Avenue crossing in Hawthorne. In his zeal to be appointed administrator of the estates of these men, who, it was averred, left no surviving widows, heirs-at-law, next of kin, or creditors in this State, the public administrator applied for letters of administration for the estates of five men who never existed, as was later disclosed upon identification of the bodies, and whose only personal estate consisted in rights of action against the Wisconsin Central Railway Company and the Chicago Consolidated Traction Company. What makes the case still more amusing is the fact that the statutes of Illinois explicitly stipulate that "amounts received in every such action shall be for the exclusive benefit of the widow and next of kin of such deceased."

AMERICA'S LEAD.—"The United States," writes the *Economiste Français*, in discussing American industrial problems, "will be surpassed by no other nation in the application of electricity to trade. The immense hydraulic forces which the nation owns guarantee it a brilliant future. If the new motive force which, along with steam and the utilization of oil as fuel, produce this century an industrial revolution, the American republic will certainly not be the sufferer."

EDISON AND ELECTRIC MOTORS.—It was recently stated in the newspapers that at his Stewartville (N. J.) cement works Mr. Edison had abandoned the use of electricity and adopted steam, "and this change is said to remove the liability of explosion." As we supposed, this statement is slightly in error; and one of the officials of the cement company writes us: "In the new coal plant, we are using steam for driving the machinery, but in the other parts of the plant we still have something like 130 motors in use."

ENGLISH EDUCATORS COMING.—The American liner *Philadelphia* has sailed from Southampton having among her passengers a number of the members of the Educational Commission sent by Alfred Moseley to study the school system in the United States. As noted already, these include Prof. W. E. Ayrton, who has not been over here for some years. In an editorial article on the approaching visit the *London Times* says: "We lack systematic organization and facilities to bring the best education within the reach of all. * * * The best and most efficient technical instruction fails in its object if the intelligence is insufficiently developed. It is here, we suspect, that the United States, as well as Germany, have the advantage over us. The very freedom from old traditions and associations, such as encircle our public schools and universities, rendering them sometimes almost impervious to the breath of change, gives special interest to educational experiments in America."

BLOCKING A TROLLEY.—The modern trolley extensions often revive the old physical wars of steam railroad development. Last week, near Trenton, N. J., in order to prevent the Pennsylvania Railroad from interfering with its work while it put in a new trolley crossing over the tracks of the railroad company on a siding of the Belvidere Division in that city, the Johnson Trolley Company, building links between New York and Philadelphia, erected a barricade of Belgian blocks and ties on the tracks. As soon as the local railroad officials heard of it they had a freight train made up at Coalport, two miles distant, and backed at full speed against the barricade. The effort was successful in stopping the work. The two rear cars were wrecked, but the barricade went down like paper cards and the cars plunged through, tearing up the trolley company's crossing. Head officials of each company were called and both sides stopped work pending an agreement by which the trolley can cross the tracks.

NEW LIZARD LIGHTHOUSE.—A cable dispatch from London, of October 3, says: An important change is the great improvement in the flashlight from Lizard Point, which was put in operation Thursday night. As all American travelers know, the Lizard light is the first they see from the ship on approaching the English coast. For more than one hundred and fifty years the familiar double lights have been shown from this promontory, but henceforth only one electric light will irradiate the sea. The light exhibits a flash every five seconds, and the concentrated intensity of each flash is such that the new Lizard light is said to be more powerful than any other lighthouse light in the world. It is expected that the increased power of the light will enable it to be seen a greater distance, even when the atmosphere is dimmed by haze. The light will now show also more effectually to eastward vessels, and westward bound craft will find it easier to keep clear of the dreaded Manacles rocks and the outlying dangers of Lizard Point.

MAGNETIC ROCKS IN ALASKA.—Note is made in the English papers of the discovery of a considerable stretch of magnetic rocks off the coast of Alaska, where compasses have been inclined to go wrong. It is remarked, however, that Alaska has no monopoly in magnetic rocks that distress the mariner and surveyor. Not long ago a party of Russian explorers found their needle swing round 180 degrees. Parry, in his second voyage in the *Fury and Hecla*, observed a considerable local deviation of the compass when off the shore of Igloolik. At Bluff Harbor, South Island, New Zealand, there is a focus of magnetism on the summit of the bluff; and during the survey of South Island the officers of H. M. S. *Acheron* had to abandon the use of compass bearings. A similar disturbance was observed by Captain Creak when surveying near Port Walcott, Northwest Australia. He came across a submerged square mile of rock, which made the needle of his compass hop about 50 degrees and more from where it should have been. Upon the Norwegian coast in the Joedern province is a magnetic mountain, about a thousand yards long, but of no great height. Its influence is such that vessels venturing too near the coast lose their bearings, and some are wrecked.

GIRL DISTRICT MESSENGERS.—The Kansas City *Journal* quotes Mr. Murphy, of the Western Union Telegraph Company, as follows, as to the district telegraph girl messengers: "The plan is working well, and it will be a success. Since the plan was started I have had thirty two girls employed, and only three have given up their places. These three girls had fathers who were union men, and they quit because they were required to work more than eight hours. The girls all like their work, and we find that the messenger service has been improved upon. The improvement consists in the willingness of the girls to work. There is only one woman on the force, and she is a widow, aged 23 years. She does the work of two boys, and is much more satisfactory. The boys used to get lazy and insolent, but it is not so with the girls. When they carry messages they are prompt and do not loiter on the way. At first the customers were loth to accept the girls, but they are now favoring them. Girls are employed at the sub-stations only. There are six at the Board of Trade, and they have done so well that business men have tried to take three of them away from us. It is my purpose to protect the girls, and they are not sent to any place of questionable character. An incident happened at the Board of Trade the other day that is significant of the way in which the girls are treated. One of the messengers had gone to the wrong floor and was looking for a number, when she asked one of the men on trade to tell the way. 'I'm going up to the next floor,' said he. 'I'll take it for you.' The girl gave him the message and it was not long until the man returned and gave her the slip that was to be receipted by the person who received the message."

ELECTRICITY AND SHADE TREES.—The Hatch Experiment Station of the Massachusetts Agricultural College has just issued a bulletin on the injury to shade trees from electricity. The pamphlet discusses the subject from various aspects, and illustrates damage due to current from railway and lighting circuits. Data are also given as to the resistance of trees. The results are thus summarized: The adverse conditions with which shade trees have to contend, in cities and towns, constitute a serious drawback to their development. A considerable amount of damage occurs to shade trees by wires, causing abrasions, destruction of limbs and leaders, burnings, and necessitating much injudicious pruning. The greatest amount of damage caused to trees by alternating and direct currents is by local burnings. The higher the e.m.f., the more injury is likely to occur to trees. There is practically little or no leakage from wires during dry weather. In wet weather, however, when a film of water is formed on the bark, more or less leakage is likely to occur, and if the insulation is insufficient and contact with the tree exists, grounding takes place, and burning due to arcing results. No authentic cases have been observed where the alternating current, employed for lighting service, has killed trees, though there are authentic cases, extremely rare, where the direct current, used in operating street railroads, has killed large shade trees. This has been accomplished by reversing the polarity, causing the positive current to traverse the rail and the return current the feed wire, which usually carries the positive. The high resistance offered by trees and plants in general serves as a protection against death from an electrical contact. The least resistance in trees occurs in the vital layer (cambium), and those tissues adjacent to it. Electric currents of whatever nature, when applied to plants of a certain intensity, act as a stimulus. The physiological effect of the direct current on vegetable life differs from that of the alternating: the latter current acts more as a stimulus to the plant than the former. There is evidence to support the idea that a current, of not sufficient strength to cause burning, may over stimulate the plant and cause a retardation of its activities which will subsequently result in death. Earth discharges during thunderstorms are more common than generally supposed, and they are known to disfigure and cause the death of trees.

LETTERS TO THE EDITORS.

Theory of Ons.

To the Editors of Electrical World and Engineer:

Sirs:—The paper of Mr. R. R. Bowker on "Theory of Ons," published in the Electrical World and Engineer, of September 26, is very stimulating to a tired imagination. When so complete a theory of the possible and the perhaps can be set forth in 100 short lines and contain only 61 distinct assumptions or might be's, it certainly shows that a vast field—an unexplored realm—is within the grasp of every one who can, for a moment, disentangle himself from commonplace facts and give his imagination rein. Mr. Bowker has conceived the happy expedient of creating ponderable matter out of imponderable ons by the exceedingly simple hypothetical process of putting them together and giving them energy. When some one else shall succeed in creating energy by a similar process we shall have solved the great question of the origin of the universe For surely, after having created matter and energy out of nothing, it will not be difficult to create *nothing*, the raw material.

The most serious objection to Mr. Bowker's generalizations, in his opinion, seems to be that in several distinct respects his assumptions *are in accordance* with the principles of the conservation of energy. This need not, however, give him any worry, as the so-called conservation of energy is merely a statement of fact and cannot be claimed or dignified as a theory. The same may be said of the doctrine of the conservation of matter, which is another form of expression for Dalton's law of individual and unchangeable atoms. All such mere statements of fact are easily brushed aside as the cobwebs of science by the hand of the theory-builder.

Mr. Bowker is evidently a past master in the art of designing theories. But if the ions and the electrons are to be resolved into "ons," what will become of the numerous recently started manufacturers of fool's gold, who depend upon electrons for their raw material?

Philadelphia, Pa. C. J. Reed.

Water Purification, Not Filtration.

To the Editors of Electrical World and Engineer:

Sirs:—In you issue of January 17 you give the first trustworthy and complete account of the ozone process of purifying public water supplies published in this country, and one which should be of great interest to all engineers, and officers generally, of city governments.

So long and so persistently has water filtration been spoken of in American engineering reports and literature as though it were synonymous with water purification, that the impression of its being the only method of water purification worth examining, is at present fairly well established in the mind of the average citizen of the United States. Nevertheless, a rational consideration of the situation should for years have been ready to welcome a process more perfect in the analysis of its operation than filtration. Such a one is the ozone process, which has thus presented itself from its very beginnings. If a small part of the money that has been voted under advice by cities in this country for experimental *filtration* plants had been spent in experimental *purification* works, there can be no doubt that the ozone process, and perhaps others, would by this time have been firmly established in the United States. We might thus have done the experimental work done by Siemens & Halske, of Berlin, at the cost of over a million marks ($250,000), or done better. As it is, we are obliged now to go abroad to learn how to purify water for domestic uses by this up-to-date method.

Your January 17 illustrated article described the ozone purification works built for Wiesbaden and for Paderborn in Germany, by Siemens & Halske, a 1,500,000-gallon plant, and reported in successful operation. All this was news in the United States on account of the exclusiveness above referred to, with which for years, whenever it became a question of purifying water, only sand and mechanical filtration processes had been considered by the engineering profession in this country, or by those who have made a business of advising filtration, and of advising on matters connected with it. From any professional standpoint this is surprising, and has, no doubt, done downright harm in the United States. That it will cease there can be no question, but it should never have come to pass, as the simplest theoretical considerations will prove.

Sand filtration consists of a delicate operation which, to be successful, must be well and skilfully conducted, with a delicately constructed, expensive apparatus, never failing and continuously.

Mechanical filtration may be described in precisely the like terms, added to which comes the fact that it includes a dosing of the water supply, requiring for its proper performance a change in manipulation, during the hours of each day, in conformity to the results of a continuous chemical analysis of the water to be treated. Also a most careful and expensive handling of the product after filtration, and until it is consumed in covered reservoirs, or else the filtered water will spoil and become foul.

In the natural course of events our American cities, from time to time, undergo political overturns or revolutions. Call them as one will, most of our cities, not infrequently, put their municipal works for years into the hands of unworthy servants. It would seem madness to entrust delicate operations, like those above described, in which negligence alone will suffice to corrupt the whole domestic water supply, into the hands of a changeable body like our city governments and its employees, or into hands that cannot even be trusted to keep the streets clean, let alone to properly provide the water we drink. I do not know which is the most dangerous, viewed from the standpoint just taken, sand filtration or mechanical filtration, in which the one is liable to let into the drinking water of any one day, the accumulated and concentrated filth of a week or a month, while the other by error in makeup by excess of dose, or by other negligence would directly infect the water with chemicals deleterious to the public health.

But so much must appear clearly by contrast, that a process of water purification which puts in nothing that is harmful, is better than one that puts into the water harmful matter, and a process that directly and instantaneously burns up animal and vegetable matter, is better than one that strains it out and accumulates it in its various degrees of putrifaction until it gets rid of it, partly by nitrification, but also largely by mere surface skimming.

Probably a dozen or a score of filters for family use have been put on the market in the United States every year for the past twenty or thirty years. Of course, we all know that none is used to any material extent in spite of plenty of typhoid fever scares, but instead the public is advised to boil their drinking water. So that here is a process constantly represented in the market by a score of devices, which the most intelligent family cannot be allowed to endeavor to make practically useful, but which the employees of changeable municipal governments are expected to operate faithfully, diligently and ably every hour and day of every year.

In comparison to this the ozone process from the beginning has offered nothing but success. Lack of knowledge or diligence can never render the water worse than it naturally is; excess of ozone makes the water sparkling, or passes off into the air; uniform attention to simple duties burns out of the water all animal and vegetable matter, whether nauseous or only discoloring, and converts the same into harmless gases, that pass off or are absorbed.

Earthy matter will for the great majority of cases be taken out by subsidence, before the ozone treatment, and can also be removed by processes in aid of subsidence, depending on the nature of the water to be treated. The preliminary operations, as a rule, remain the same, whether the water is to be filtered, or purified, but the ozone process takes the place of the final filtration, whether it be the only treatment of the water or the last one of a series.

Accounts of filtration and of their allied sewage treatment works while they are new, and while their personnel is unwearied in good effort, are not to be trusted. They differ greatly from the true history of the working of such plants for the ten years or more that follow. Many such plants go out of use, or are replaced by other sources of water supply, or of sewage treatment.

The very same public officers, who have gone furthest in their study of filtration, when put to it to select drinking water for their own community, select initially purer water, at a greater cost, rather than water made better by filtration, at a less cost. "Innocence," they tell us, "is better than repentance." Thus the Massachusetts State Board of Health in 1895 state that although a filtered supply from the Merrimac River could be procured for the Metropolitan District for a sum of money 10 per cent. smaller than the same quantity of water would cost if taken from the Nashua River, and although "waters polluted as those of the Merrimac River at Lawrence can be effectually filtered and rendered safe for domestic use," they recommend the building of works to take water from the more expensive source of supply, now being constructed.

This is not written by one having an interest in any ozone purification process, except such as every good citizen or professional man should have in favor of progress to be made.

Two ozone processes for purifying the domestic water supply of cities are in use in Europe, that perfected by Siemens and Halske, already spoken of, and the Otto process, whose promoters have entered into contracts for the purification of water with the municipalities of Paris and Nice. That American workers in this field could do equally well, and possibly better, is not to be doubted. A large field of operation awaits their efforts.

Several years ago the writer became convinced that the ozone process had a beneficent future before it, and that its introduction into the United States should be worked for. He has been desirous of seeing it at least experimented with, or what would be much better, to see it exploited, in a business way, in the United States.

It may be that on a business basis of this sort only can the desirable work of water purification make true progress in the United States, and if so, the more such forces are at work the better.

NEW YORK CITY. CLEMENS HERSCHEL.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Comparison of Dynamo Designs.—HOBART.—The author proposes a term "specific output," as a basis of comparison, of the merits of dynamo designs. By taking L as the length in centimetres of the armature over the end connections and D the armature diameter in centimetres, the cylindrical surface of the armature becomes $\pi D L$. The rated output in watts equals W, the speed in revolutions per minute = r.p.m.; then the "specific output" equals $W/\pi D L \times$ r.p.m. In order to show that the "specific output" is a true criterion of the degree of commercial economy attained in a given design, the author constructs curves representing the total factory costs of lines of direct-current generators, manufactured by four different firms. They should present a straight line if the cost were truly proportional to $D \times L$, and the author holds that the agreement between them and the plotted points is amply satisfactory to justify the assertion that the total factory cost of modern direct-current, barrel-wound generators for a given type and voltage, is directly proportional to $D \times L$. Such a machine is, therefore, considered to be of the most economical design, in which, when complying with a given specification, the maximum "specific output," i. e., the maximum watts rated output per revolution per minute per square centimetre of armature surface, is obtained. The author illustrates the application of the "specific output" constant by compiling a table for a number of machines and plotting curves for slow and high-speed designs.—Lond. *Elec.*, September 11.

REFERENCES.

Armature Testing with a Milli-Voltmeter.—CALE GOUGH.—The author describes a method of testing armatures with a milli-voltmeter and presents a number of diagrams showing the different windings and combinations. He claims for this method that its use will eliminate much of the uncertainty now existing regarding the faults in armature winding and prevent mistakes in connecting and winding railway armatures.—*St. R'y Jour.*, October 3.

Vector Diagram of the Single-Phase Induction Motor.—SUMEC.—A mathematical article of some length, with diagrams, in which the author describes a method for the construction of the vector diagram. He was not able to carry out practical experiments in order to verify his theoretical conclusions.—*Zeit. f. Elek.*, September 6.

LIGHTS AND LIGHTING.

REFERENCE.

Bremer Arc Lamp.—A note on the proposed amendment of the British patent No. 14,704 of 1899, granted to Hugo Bremer. The complete specification is printed, indicating the passages which are proposed to be amended.—Lond. *Elec.*, September 11.

POWER.

Bridge Plant.—A long, well-illustrated article containing a description of the new bridge plant of the Pennsylvania Steel Company, near Harrisburg, Pa. All the machine tools are driven by a 440-volt alternating-current; the overhead cranes are operated by a 220-volt direct-current and a 110-volt current is used for the lighting service. All of the machine tools are operated by three-phase induction motors, most of them of the enclosed type. The air used for operating riveting tools, hammers, etc., is compressed in air compressors driven by electric motors. The alternating-current apparatus includes two 1,500-kw, one 180-kw and two 75 kw alternators, six 300-kw and two 200-kw rotaries and about 100 motors of from ½ to 350 hp. The direct-current apparatus includes one 7-kw arc light generator, two 45 kw generators and about 150 multipolar motors of from 2 to 75 hp each.—*Eng'ing Record*, September 26.

REFERENCES.

Steam Turbines.—PERKINS.—An illustrated article on recent European activity in the steam turbine field. The author gives a brief description of several installations.—*Electricity*, September 9.

Oil Engines for Electrical Use.—WALSH.—An article discussing the advantages of oil engines. Attention is called to the use of such engines in connection with portable electric light plants for the use of contractors, etc.—*Elec. Rev.*, September 19.

TRACTION.

Combined Railway, Lighting and Power System.—An article describing the property of the West Penn Railway & Lighting Company. The new system combines several smaller properties and furnishes service for what is known as "the coke region," in Allegheny and Westmoreland Counties, in Western Pennsylvania. There is a central generating station in Connellsville and a number of sub-stations located at convenient points throughout the district. The plant may be said to be divided into two distinct parts, one of which is used for furnishing current for railway operation and the other for lighting and power plants. At present the railway current is supplied by three vertical cross-compound engines direct-connected to 1,000-kw alternators of the revolving field type. Three steam turbine units of 1,000 kw each are now being installed and these will be utilized for the lighting service. The power station at present has a capacity of 6,000 kw, but it can be readily enlarged to meet any additional demands. An interesting feature of this plant is the opportunity which it will afford for comparison between the turbo-generating and the reciprocating engine equipments. The actual space required for the turbine unit is 59 per cent. of that required for the engine unit. In the present layout, turbine condensers included, the total floor space for each turbine as compared with that for each engine, favors the turbine by 37½ per cent. The difference in head room required for the two prime-movers is about 7 meters, and the cost of foundations shows a considerable difference in favor of the turbines. It is proposed to make a comparative performance test when the equipment is complete. All the high-tension apparatus are located in a separate building which has been especially designed with the view of isolating fires resulting from high-tension disturbances or possible ignition of transformer oil. The ground floor of this building is used for transformers, those for the railway system being arranged along one wall and those for lighting along the other. The high-tension switching apparatus occupy the third floor. The route of the transmission line avoids the coke ovens as much as possible, as it has been found difficult to preserve insulation in this district owing to smoke deposits upon the insulators. Both the lighting and railway lines are carried upon the same poles, transposition being resorted to in order to prevent induction. In the sub-stations all the high-tension apparatus is isolated in what is known as the high-tension tower, including transformers on the main floor and selector switches, poles and fuse switches, and static interrupters upon the upper floor, the equipment being identical with the main station except in point of size. Current for the operation of cars is supplied through an overhead trolley, a single 0000 hard-drawn wire being used.—*St. R'y Jour.*, September 5.

Electric Tramways in New Zealand.—An illustrated description of the extensive electric railway system in and about Auckland, which city will be the first in New Zealand to have electrically-operated tramways throughout. The lines will extend to neighboring suburbs, serving a total population of about 70,000. Center-pole construction is employed wherever the streets are wide enough and in other parts of the city side poles and span wires have been adopted. Span wire construction is uniformly used for curves and junctions. The power house equipment comprises 4 boilers, 3 horizontal cross-compound Corliss engines directly connected to direct-current compound-wound railway generators, the maximum engine capacity being about 2,000 hp.—*St. R'y Jour.*, September 26.

REFERENCES.

Auburn & Syracuse Electric Railway.—A description of a new interurban railway system connecting the cities of Auburn and Syracuse, in New York State, which is chiefly interesting because it parallels and enters into direct competition with the New York Central's steam line.—*St. R'y Jour.*, October 3.

Expansion of Electric Railways in Massachusetts.—Adams.—A statistical article in which the author compares results obtained with electric traction to those with horse traction.—*Scien. Am.*, September 19.

Electrolysis of Water Pipes.—A note on the electrolysis of water pipes in the Boston Metropolitan district, with a statement on the subject from the report of the Metropolitan Water and Storage Board, describing the efforts made to overcome the trouble.—*Eng'ing Record*, September 26.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Measurement of Velocities of Rotation.—Sartori.—The author describes a stroboscopic method used by him for determining the changes in speed of rotation of alternators in parallel. The method depends upon the use of two stroboscopic discs with narrow spiral slits. If the spirals are arranged in opposite direction on two discs, the intersection of two slits will give a luminous point, and the respective vector will depend on the position of the two discs. If one of the discs is turned through a certain angle, the vector also increases, and the distance of the luminous point from the center gives exactly the position of the two discs with respect to each other. If one of the discs is fixed to the shaft of the machine to be tested and the other disc is turned by a motor running at constant speed, and the two discs move in the same direction, the luminous point will present a fixed circle, if the discs have the same speed. But if the one disc constantly changes its speed, the luminous circle will alternately contract or expand. The author describes tests made with this method on two three-phase, 250-kw, 42-period alternators, connected in parallel, the maximum angle deviation being found as 190/100. The author mentions several other cases where the method might be used to advantage.—*Zeit. f. Elek.*, August 23, 30.

Large Generating Sets.—An illustrated description of the large generating sets now in course of erection in the new electricity works of the Manchester (England) Corporation. Particulars of the engines are given. There are two of them, of a normal output of 6,000 ihp each, and an emergency output of 6,500 ihp for two hours. They are of the triple-expansion vertical type, with four cylinders and four cranks each. They are said to be the largest engines yet installed for electrical generation in England. The alternators are of the three-phase type, generating at 6,300 to 6,500 volts, at 50 cycles. The normal output is 3,750 kw, with a power factor of 0.87, and 4,250 kw with a power factor of unity, while the emergency load for half an hour is 4,900 kw. The armatures are of the stationary type, the magnets being carried on the periphery of the fly-wheel. The magnet poles are provided with amortisseurs to facilitate parallel running and to prevent hunting. The temperature rise of any part of the machine above that of the surrounding air, after 24 hours' run at full normal current, is not to exceed 70° F. The mean fall or rise of pressure between no load and full load or vice-versa, is not to be greater than 7½ per cent., with a power factor unity, or 18 per cent. with a power factor of 0.87. The armature must stand a dead short-circuit for two minutes without injury and the current must not exceed four times the normal. The alternators must be able to endure an overload of 15 per cent. on emergency for half an hour and are to be capable of running in parallel with each other and with the existing machinery on non-inductive and inductive loads and at all loads.—Lond. *Elec. Rev.*, September 18.

New Forms of Resistances.—Vogelsang.—A long article in which the author describes some of his recent constructions of rheostats for continuous connection and for transient loads. An apparatus of the first type shows a number of spirals, each mounted on a porcelain roller and arranged on both sides of a sheet of iron. The latter effects a very favorable distribution of the heat generated in the rheostat so that the spirals can be loaded much more than usually. Other constructions are described in detail. A construction of the second type depends upon the use of thin metallic tubes, having a thin interior lining of asbestos. The resistance spiral is introduced into the tube, so that it fixes itself against the wall. The tube is then filled with burnt cement and closed with porcelain stoppers of peculiar form. Several forms of apparatus are illustrated.—*Elek. Anzeiger*, September 6, 13.

REFERENCES.

High-Voltage Switchboards and Apparatus.—Kinsbrunner.—An illustrated description of several types of constructions. The last part is devoted to a description of the Ferranti system of cellular switchboard construction, illustrations of which are given. The advantages of this system over the others are set forth.—*Zeit. f. Elek.*, August 30.

Regulation of Transmitted Power.—Adams.—The author discusses the different conditions which are required in the regulation of transmitted power owing to the nature of the load. He considers various cases of distribution from a common center with regard to the advisability of establishing or omitting sub-stations at the points of distribution of the consumers' circuit. He then reviews the various methods for the regulation of the voltage of transmission at the generating stations and the final regulation at the sub-stations.—*Elec. Rev.*, September 12.

Electric Station Practice.—Radcliffe.—The continuation of the serial previously mentioned in the Digest. The various conditions governing the location of a central station are considered, after which the construction of the building is discussed at some length.—*Electricity*, September 16, 23.

Trend in the Development of Sub-Station Apparatus.—Miller.—An article reviewing the development of the apparatus at the subscribers' end of the telephone connection and the gradual elimination of devices, which had to be operated by the subscriber. The advantages gained by this procedure are enumerated.—*Telephony*, September.

Central Station at Brussels.—The second part of the article previously noted in the Digest, containing a description of the electrical equipment in the new station.—*L'Ind. Elec.*, September 10.

WIRES, WIRING AND CONDUITS.

Aluminum as an Electrical Conductor.—Kershaw.—A paper read before the recent meeting of the British Association for the Advancement of Science. The author deals briefly with the production and price of aluminum, the relative costs of copper and aluminum and the installations of aluminum for conducting purposes. He then gives the results of durability tests of aluminum and other metals under atmospheric exposure for nearly three years. Rods and wires cut into 2-ft. lengths, were tested by placing them upon glass insulators in a horizontal position and exposing them on a roof. In summarizing the results, the author states that all the samples of aluminum gained in weight during exposure, and that all were pitted and corroded, especially on the under sides, where the water drops had collected and dried. The rods appeared to have suffered rather less than the wires and the author considers it, therefore, probable that in the process of drawing down into wire the aluminum undergoes physical change. Galvanized iron wires though unchanged in appearance, gradually lost in weight, the loss being a progressive one and greatest in the third year. Copper and tinned copper wires stood the exposure best, but the latter had lost nearly the whole of its tin covering by the end of the second year. In conclusion the author states that he does not wish to base any unfair conclusions upon the results obtained in these exposure tests. It was, however, only a fair deduction to assert that aluminum manufacturers have yet to prove the metal to be a satisfactory and durable substitute for copper in bare overhead transmission lines, or for electrical work which involves exposure to climates near the coast. In the discussion following the paper, Hopkinson stated that he had used aluminum for tramway purposes, but it had to be discarded. The principal difficulty was encountered on account of the high coefficient of expansion of the metal, the wire sagging down to a serious extent in hot weather.—Lond. *Elec. Rev.*, September 18.

ELECTRO-PHYSICS AND MAGNETISM.

Contact Potentials.—HESEHUS.—An abstract of an article giving the author's investigations of the influence which the degree of polish and the superficial density of bodies have on the difference of electric potential produced by their contact. The author arrived at the following conclusions: In all cases, that one of the two surfaces of a particular metal, which is most polished, becomes positive. If two different dielectrics are brought into contact, the hardest one ordinarily becomes positive; the contrary takes place with the metals; the numerous exceptions can be easily explained. A body of hard material, but which presents on account of its structure, few points where contact is possible, behaves like a soft substance. Glass wool, for instance, becomes negative in contact with cloth, ordinary absorbent cotton, porcelain and glass. Hygroscopic surfaces, poorly dried, become positive like the water itself. A body which easily crumbles into dust, or a glue-like body, which leaves traces on the surface with which it was in contact, always becomes negative. This fact explains numerous variations in the sense of electrification of the same pair of bodies, through contact or by rubbing them against each other. Ebonite, for instance, becomes negative when in contact with emery paper, but it is positively electrified when it is rubbed with the paper in order to polish it. Two pieces of quartz, of sugar or of pyrite, which give a phosphorescent light when knocked against each other, are both positively electrified. The particles produced by the knocking, however, if allowed to fall on an electrometer, charge the latter negatively.—*L'Eclairage Elec.*, September 5; from *Journal de la Societe Physico-Chimique Russe*, T. 34. p. 1-14.

REFERENCE.

Iron-Clad Magnets for Braking Purposes.—HELLMUND.—An illustrated article on the construction of such magnets. The author considers the action of the stray field, which for small lifts can be disregarded, but has to be taken into consideration for larger ones. The effects of a dissymmetric distribution of the field are also disadvantageous as leading to more or less losses by friction. A mathematical calculation is given for the determination of the most favorable diameter of the core.—*Elek. Zeit.*, September 3.

ELECTRO-CHEMISTRY AND BATTERIES.

Lead Salts by Electrolysis.—ELBS AND NUEBLING.—An article containing a description of the work of the authors on the production of various lead salts by electrolysis. They succeeded best in obtaining lead tetrachloride. The vessel used for this purpose consisted of a receptacle of glass with a porous cell arranged therein. In the cell there was suspended a lead plate, serving as cathode; on both sides of the cell strips of lead were fixed which served as anodes and on the bottom of the glass vessel there rested a carbon plate, serving as auxiliary anode. The liquid in the cathode cell was dilute hydrochloric acid of about 1.1 specific gravity, while a 1.8 specific gravity acid was used in the anode compartment. The temperature must be below 10° C. The idea of using different anodes is that dichloride of lead is formed at the regular anodes, while free chlorine is generated at the carbon anode, which chlorine then affects the conversion of the dichloride of lead into the tetrachloride. The authors isolated various double salts of this substance. They also worked with hydrobromic, hydroiodic, chromic, phosphoric and hydrofluosilicic acid as electrolytes.—*Zeit. f. Elektro. Chem.*, September 17.

Industrial Electrolysis of Water.—SCHOOP.—An article reviewing the processes for the electrolysis of water, which are used in practice. The Garuti, the Schmidt and the Schoop processes are described briefly. The Garuti process, as carried out by the Societe Oxhydrique in Brussels, has been recently noted in the Digest. The apparatus of Schmidt consists of bipolar iron electrodes, connected in series, the apparatus having an outward appearance similar to a filter press. These two systems use alkaline electrolytes. Schoop works with an acid electrolyte and uses tubular electrodes of lead. The voltage taken by each cell amounts to 3.3 to 3.6 volts. The author states that the generation of oxyhydrogen gas is absolutely excluded in this process. Extended results on a practical scale have shown that one electric horse power hour furnishes 48.75 liters of oxygen and 97.5 liters of hydrogen, equivalent to a consumption of 6.2 to 6.8 horse power hours per cubic meter of oxyhydrogen gas. The gases are very pure, but the oxygen contains a considerable amount of ozone. The greater part of the article is devoted to a discussion of the industrial and therapeutical applications of hydrogen and oxygen, the welding of metals being described and illustrated. Aluminum is stated to be easily welded by means of the oxyhydrogen flame. The welding is autogenous, no solder of any kind being required, not only for aluminum, but also for other metals.—*Electrochem. Zeit.*, September.

REFERENCES.

St. Louis Exposition and Electrochemistry.—An article stating that the present space requirements of the electrochemical exhibits exceed 10 per cent. of the exhibit area of the Palace of Electricity; complete processes will be shown in operation. An historical exhibit will be made by the American Electrochemical Society. This society will be in charge of the electrochemical section of the International Electrical Congress.—*Electrochem. Ind.*, September.

Pioneers in Electrochemistry.—The continuation of this serial contains an account of the life and work of Charles S. Bradley, with his portrait.—*Electrochem. Ind.*, September.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Discontinuous Mercury Arc.—KALLIR.—The author describes an apparatus which permits taking a discontinuous current from a source of direct current. The apparatus is illustrated in the adjoining figure. It consists of the tube, *K*, with the globular bulb, *V*, into which is inserted a metallic rod, *M*. The mercury is contained in *V*, and a vacuum can be maintained therein. The construction is such that the metallic rod is movable enough to be brought nearer to or further away from the mercury. *B* is a source of direct current of about 110 volts, *J* a hot-wire ammeter, *C* a direct-current ammeter with permanent magnet, *E* a hot-wire voltmeter, Δ a direct-current voltmeter, also with permanent magnet, *R* a rheostat, L_1 and h_2 two inductive resistances, which can be short-circuited if desired. The passage of current with this apparatus under the proper conditions is discontinuous, as the indications of *J* and *C*, *E* and Δ are not the same, but show higher values on the hot-wire instruments. Discontinuous passage of current takes place only when the current flows in the direction from mercury to the rod. The author explains the phenomenon as follows: By the first passage of the current, mercury is vaporized and a vapor layer is formed between the rod and the mercury. This is non-conductive for the direction of the current from the mercury to the metal, like in the Cooper Hewitt apparatus, and the current is, therefore, interrupted. As the formation of vapor ceases, metal and mercury come into contact again, and the operation is repeated. There appears, therefore, a phenomenon like the one in the Wehnelt interrupter. With the opposite direction of current a constant passage of electricity takes place, just as in the Cooper Hewitt apparatus when the arc is struck from metal to mercury. A pressure of 22 to 70 mm. of mercury was found to be most favorable. The author concludes by describing a contrivance by which he was enabled to measure the periodicity and the kind of interruption.—*Zeit. f. Elek.*, August 30.

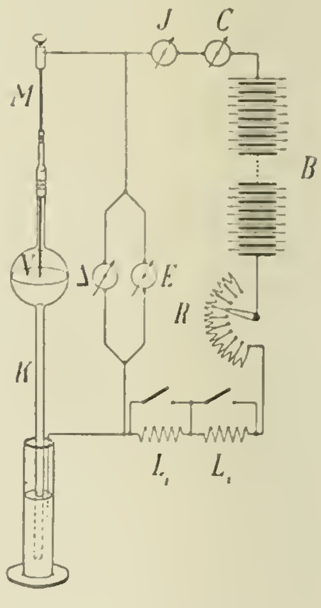


DIAGRAM OF APPARATUS.

Testing Method for Magnetic Metals.—FRAICHET.—An article illustrated by diagrams, in which the author describes a method for testing magnetic metals for mechanical properties. The principle of the method depends on the variation of the reluctance of a steel bar subjected to a pull in a strength testing machine. The test bar is pulled with "a constant speed," and it is arranged as the core of a coil with two superposed windings, comprising a primary circuit connected to the terminals of a battery and a secondary circuit connected to a galvanometer. This latter circuit is, therefore, traversed by a variable flux, which is closed through the test piece and the frame of the testing machine, and the variation of this flux is measured at every instant by the galvanometer deviation. The flux varies on account of two distinct reasons: 1st, the continual modification of the dimensions of the test bar, that is, increase of length and decrease of cross section; 2d, the change of the molecular structure of the metal, under the influence of the variable pressures. The author claims that this method of testing makes it possible to easily obtain exact data on the mechanical qualities of the metal subjected to test, and on the treatment which it has undergone (annealing, forging, hardening, tempering). The molecular deformations produced by the pulling of the test bar are in some way rendered visible and particularly the passage from the elastic to the plastic period admits of observations relative to the degree of homogeneity of the metal.—*L'Eclairage Elec.*, September 5.

REFERENCES.

Testing Insulators.—Ritter.—A long illustrated article describing the electrical installations at a German insulator manufacturing plant, for the purpose of testing their insulators with very high potential, before they leave the works. Insulators for 5,000, 10,000, 20,000 and 50,000 volts are tested with 20,000, 30,000, 50,000 and 100,000 volts, respectively. The arrangement of the appliances for testing is described in detail.—*Schweiz. Blaett. f. Elek.*, July 8, 22, August 8.

Direct-Current Measuring Instruments.—A didactic article dealing with direct-current measuring instruments. The construction of voltmeters, ammeters, recording voltmeters and recording ammeters is described, diagrams of connections are given and the various uses of the instruments are explained.—*Amer. Elec.*, September.

Telegraphy, Telephony and Signals.

Telephone Cables with evenly distributed Self-Induction.—Holezalek and Ebeling.—An article containing the result of an investigation undertaken for the purpose of ascertaining how far it is possible, by surrounding copper cables with iron wire, to prevent the damping of the current waves and whether this method of increasing the induction would be able to enter into competition with the Pupin system of interrupting the conductor at predetermined places and inserting coils of high self-induction. Of the different methods for increasing self-induction by surrounding cables with inductive material, only the covering with iron is practically available. As telephonic currents are alternating currents of high frequency, the use of a tubular cover is impossible on account of eddy current losses. Therefore, the iron must be divided up as much as possible, and it would be best to use rings of thin sheet iron. On account of practical constructive considerations, however, the covering of the cables is accomplished by winding the cables with a coil of this iron wire. The authors give a mathematical investigation of the electrical constants of such cables and their influence on the damping of the current waves. From this calculation they find that the self-induction increases in a linear ratio with the logarithm of the diameter of the iron covering, and therefore the enlarging of this covering beyond a certain small thickness no longer gives any practical advantage. As far as the capacity is concerned, they calculate that the iron covering has a very unfavorable influence by increasing it. The authors then investigate the influence of the iron covering on the damping of the telephonic current waves and calculate the theoretical damping constants for various cables with and without iron covering. They then give the results of measurements on cables which had been constructed for this particular purpose, and were several hundred meters long. A table is given containing the results of these measurements, which show a very close agreement between the results calculated theoretically and obtained practically. A table is also given of a number of measurements to ascertain the influence of the number of windings of iron wire per meter length. As a comparison of the efficiency of covered cables and cables with induction coils (Pupin), the authors calculate a practical example, from which they deduce that the damping constant of the cable with coils is nearly three times smaller than that of the iron-covered cable. As the length of cable over which sufficient communication is possible, is inversely proportional to the damping constant, the cable with coils can transmit to three times greater distances than the iron covered cable. The general conclusion to which the authors arrive is that the cable with coils is not only in efficiency, but also in economy of constructive material quite considerably superior to the iron-covered cable. It results therefrom that the use of iron-covered cables cannot come into consideration for ordinary telephone cables, which are laid in the ground or in tubes. The authors think that for sea cables also the use of iron covers will soon be abandoned, and cables with coils employed, as the technical difficulties in the construction of the coils are not great.—*Elek. Zeit.*, September 17.

The Rowland Telegraph.—Picconi.—A short article relative to the recently completed installation of the Rowland system on telegraphic lines between Rome and Naples. The author gives his observations on the practical working of the apparatus, and discusses various advantages of the system from the operator's standpoint. He states that he was able to transmit, in regular business, fifty telegrams an hour, after hardly a week's practice, not exceeding two hours a day. Although the apparatus cannot yet be said to be perfected, it is already able to give good results. The work it is actually doing, with a staff as yet imperfectly acquainted with it, may be calculated at a figure much superior to that of a Baudot quadruplex. The system was recently described at length in the Electrical World and Engineer.—*Giornale dei Telegraphisti*, July.

Miscellaneous.

Magnetic Separation of Ores.—Fabre.—An illustrated article in which the author describes the latest progress in the magnetic separation of ores. He describes especially several recent types of the Witherill separator, as built by the German licensee, the Metallurgische Gesellschaft of Frankfort. The first machine has two south poles opposed to one north pole, which construction permits obtaining a very concentrated field. The ore is carried past the poles on a moving belt; the wear and tear on these belts is said to be very small, one outfit lasting for 30 days of 20 working hours, which represents an expenditure of 0.00255c. per 1,000 kilograms of material treated. To separate spathic iron ore from zinc blende, one hectowatt-hour is required for 1,000 kilograms of ore. Several other types are briefly described and illustrated, and a table is given of experimental results obtained.—*L'Eclairage Elec.*, September 5.

Plant for Westinghouse Foundry Company.

The completion of the plant of the Westinghouse Foundry Company at Trafford City, Pa., marks another step in the development of the great industrial organization known collectively as the Westinghouse Companies. Formerly these companies obtained their supply of castings from foundries located in Cleveland, O., Allegheny, Pa., and Pittsburg, Pa. Hereafter all of this product will be supplied by one foundry plant located at Trafford, 17 miles east of Pittsburg, on the P. R. R., and connected with the Westinghouse factories in East Pittsburg by a single track railroad of standard gauge and heaviest type of construction. This road, which has been built by the Westinghouse Companies and named the Westinghouse Interworks Railroad, also intersects the town of Wilmerding, situated

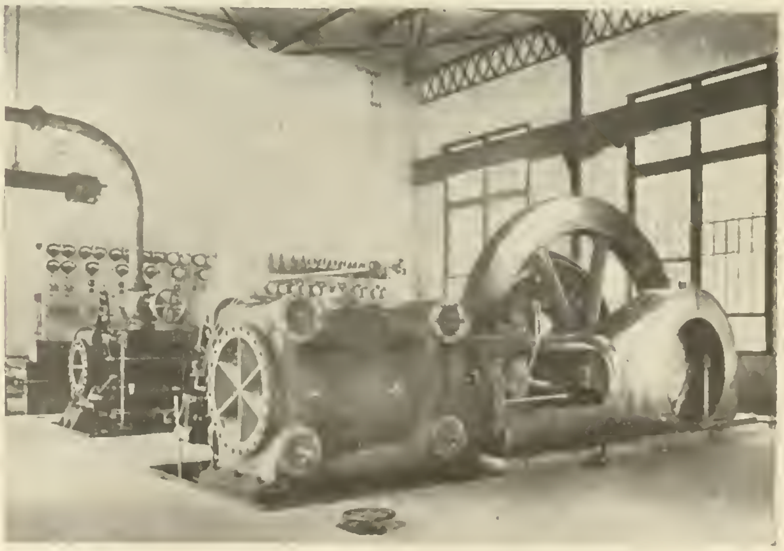


FIG. 1.—ENGINE ROOM.

about half way between Trafford City and East Pittsburg, where the great works of the Westinghouse Air Brake Company are located.

The entire tract of land purchased at Stewarts Station (now Trafford City) by the Westinghouse Companies consists of 600 acres, of which 130 acres were allotted for the foundry site. This provides sufficient room for the present foundry buildings, including the iron foundry, the brass foundry, the pattern shop, the pattern building and power house, all of which are now completed, and offers room for the future construction of additional manufacturing plants.

The power house is 320 ft. long by 56 ft. wide, with a chimney 7 ft. inside diameter and 170 ft. high. The boiler plant at present consists of 5,000 hp of Babcock & Wilcox boilers, with ample remaining space for double this equipment when the future growth of the plant requires it. The furnaces are supplied with Roney automatic stokers and the coal is handled by a "Link-Belt" conveyor.

The engine room is sufficiently large to accommodate two horizontal cross-compound Westinghouse-Corliss steam engines, having a capacity of 1,000 hp. One of these is now installed and direct connected, as shown, to a 600-kw alternating-current, three-phase generator. A Westinghouse vertical gas engine, having a capacity of 175 hp, is also in place, and is direct connected to a 120-kw double-current generator. This engine draws its supply of gas from a well 1,900 ft. deep, built on the property in addition to the plant.

The current from the steam-driven plant is used during the day for operating the cranes and other power motors about the factory, and for such electric lighting as may be necessary during the day time. The gas engine plant is used for lighting and power at night only. An underground tunnel 6 ft. square and thoroughly waterproof connects the power house with the various buildings, and in this are installed all electric light conduits and piping for steam, air and water.

The machine shop is equipped with tools and such other appliances as are required in the maintenance of a great plant of this character. The pattern shop and storage building is 605 ft. long by 80 ft. wide; the pattern shop occupies 160 ft. of the north end, and is two stories high. It is supplied with the most complete equipment possible of tools and appliances for woodworking, and particular attention has been paid to the matter of lighting. The general artificial illumination is by arc lamps and the direct illumination for the tools and work is effected by means of Nernst lamps.

The first building for foundry purposes, which is now erected and in operation, adjoins the pattern shop with a space of 100 ft. between them. It is of brick and stone construction on concrete foundations, and is 612 ft. long by 184 ft. wide, the walls being 36 ft. at the eaves and 80 ft. at the peak. As will be seen in the accompanying illustration, Fig. 4, it is divided transversely into three bays, the center being 80 ft. wide and those on either side 60 ft., 6 in. wide. The bays are transversed by three traveling cranes, the centre being of 100 tons, and the two others of 60 tons capacity, all of the Sellers two-trolley type. Each of the side bays has three cranes of the Morgan type of 20 tons capacity each.

In addition the centre bay has on either side special runways underneath those for the cranes just mentioned, and these accommodate four traveling jib cranes, two in each runway. These cranes, which are illustrated in the accompanying engraving, Fig. 2, reach out into the centre bay about 35 ft. As the largest molds will always be arranged close to the side bays, they are thus intended to handle all the work of setting and drawing patterns, setting cores; in fact, doing all the work of the foundry except that of the very heaviest nature. A track from the main railroad system runs through each end of the building to co-operate with the larger cranes in the transportation of raw material to and from the foundry, and a narrow-gauge railway transverses the side bays from end to end and works conjointly with the smaller cranes above mentioned. To serve the storage yard for handling flasks and heavy apparatus connected with the foundry operations, runways are provided equipped with double trolley traveling cranes of 50 tons capacity.

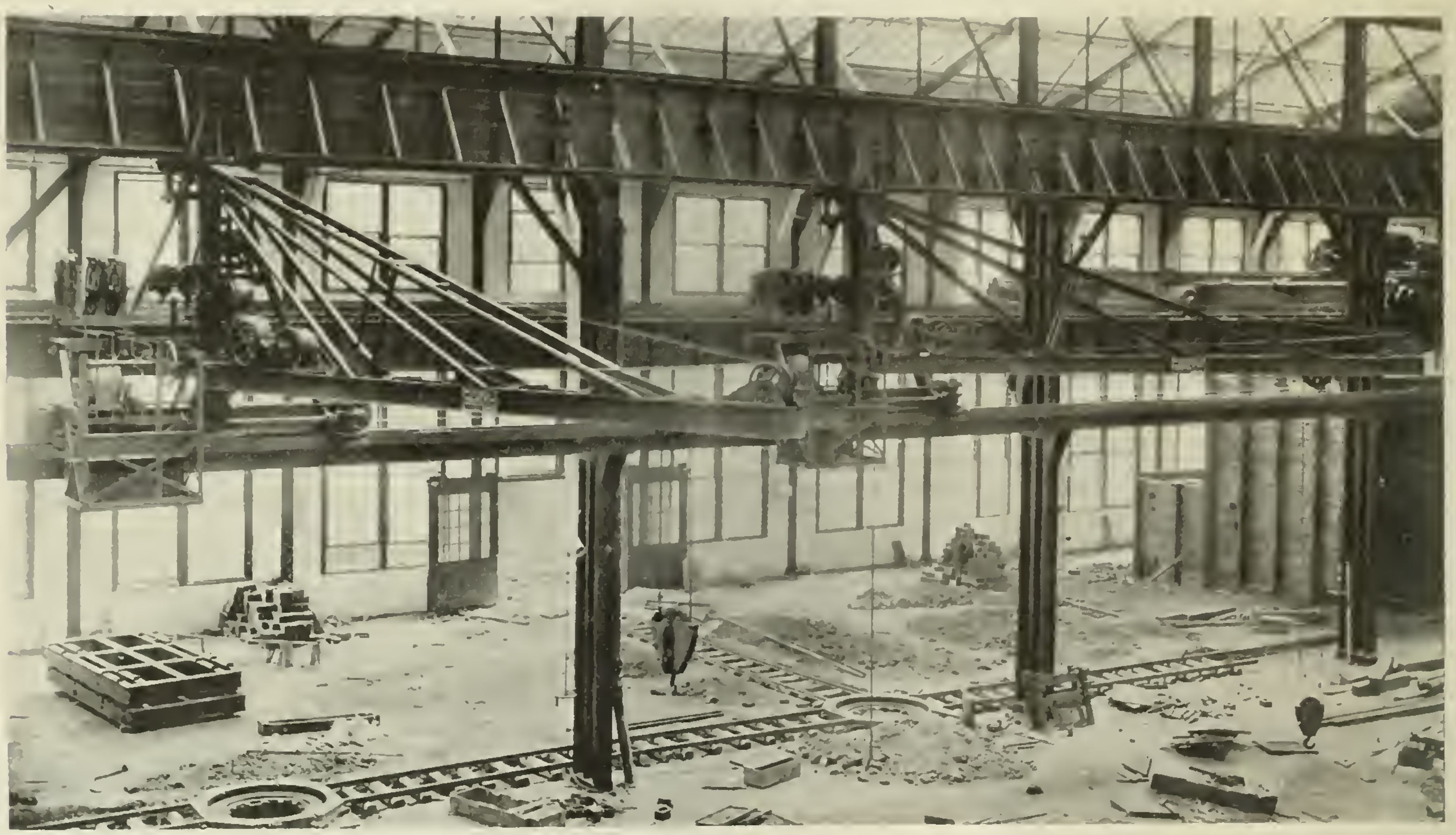


Fig. 2.—Partial View of the Foundry, Showing Traveling Cranes.

The molding equipment consists of three cupola furnaces of 18 tons capacity per hour, each served from platforms to which the raw material is raised on lifts operated by hydraulic power supplied from the power plant. As it is not an uncommon practice in foundry work to hold molten metal for three hours or more, it would easily be possible with this equipment to pour a casting of 200 tons in weight should this ever be necessary. By the use of the air furnace method of melting iron, metal 50 per cent stronger than that from the cupola may be obtained, so that all large and important castings are usually made of the former metal. The core ovens are situated opposite the melting plant and crosswise of the building. These are arranged to be heated either by coke or natural gas.

Adjacent to the main approach to the foundry buildings is a brick building of two stories in height in front, which is occupied on the first floor by the business offices of the Westinghouse Machine Company's foundry department, and the superintendent and his staff. The second floor is used as a draughting room, and the rear of the building, which is only one story in height, serves as a brass foundry, the space being 40 ft. by 80 ft., and containing six pit furnaces. Other buildings are a sand house and the laboratory and lavatory building. The normal number of employees in the foundry is about 600, but in busy times as many as 1,000 can be readily accommodated.

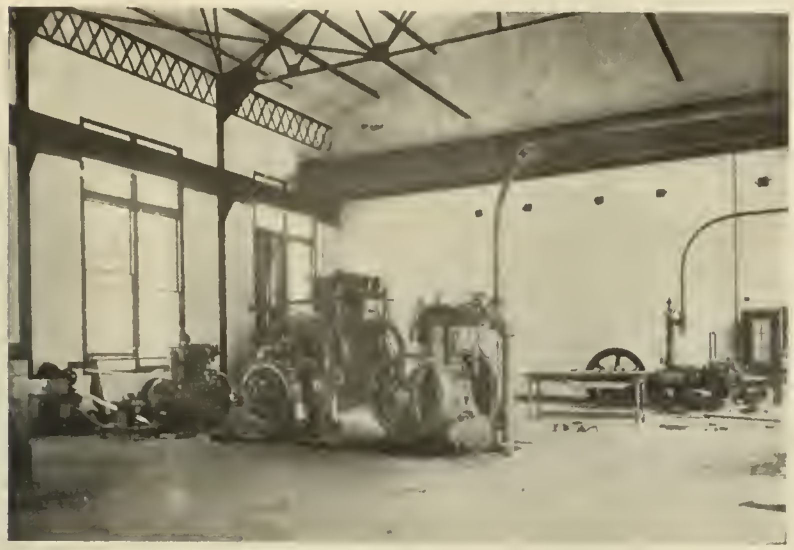


FIG. 3.—VERTICAL GAS ENGINES.

The location of the works in a locality somewhat distant from the Pittsburg labor market, has given rise to a neighboring industrial town, which is rapidly growing in population. One of the unique features of the town is that it is built on several terraces which nature, aided by the landscape gardener, has cut from the hill in front of the factory. It may here be mentioned that the English Westinghouse Works are located in a district of Manchester, England, known as Trafford Park, and doubtless the present town thus derived its name. One of its most interesting buildings is Trafford Inn, which is designed to fill not only the requirements of a first-class hotel, but to supply also many of the features of a casino. The building has been handsomely constructed of pressed brick with stone trimmings, and is of a sufficient size to accommodate 75 guests. The general internal arrangement is on the bachelor club plan, the idea being to provide to the well-to-do employees of the foundry who have no families such comforts and accommodations as will render occupation at the Trafford plant most desirable. A large reading room on the first floor adjoins the dining-room, and these two rooms by being thrown together can be used for meetings and entertainments. The town has been laid out for about 2,000 building lots, and space has been left for several parks, all of which are thickly wooded. A large number of houses have already been erected. These are of brick and stone construction, and vary in size from six to nine rooms each. The regular purchase price of these houses and lots has been based on the cost of building in large numbers at one time without profit to the projectors, thus placing them within the range of employees with the idea of inducing them to live adjacent to the plant rather than in other towns on the line of the railroad.

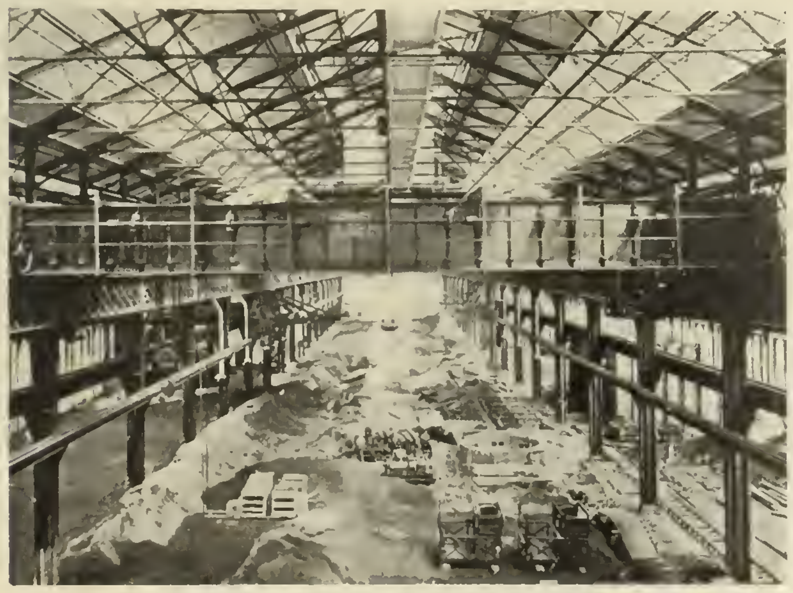


FIG. 4.—GENERAL VIEW OF INTERIOR OF FOUNDRY.

Power Factor Indicator.

The accompanying illustrations show a power factor indicator made by the General Electric Company for use on balanced systems only, either three-phase, three-wire or two-phase, three or four-wire, and particularly adapted for the needs of generating and sub-station systems operating rotary converters. In appearance the instrument corresponds to horizontal, edgewise alternating-current instruments made by the same company.

The instrument is so designed as to involve small loss of energy. Capacities up to and including 200 amperes do not require current transformers when for use on potentials of 2,500 volts or less. Above 200 amperes or for use in connection with systems in excess of 2,500 volts, one current transformer is required for each instrument. Instruments for use on systems of 750 volts or less may be operated without potential transformers In excess of this voltage, two potential transformers are required for use in connection with each instrument.

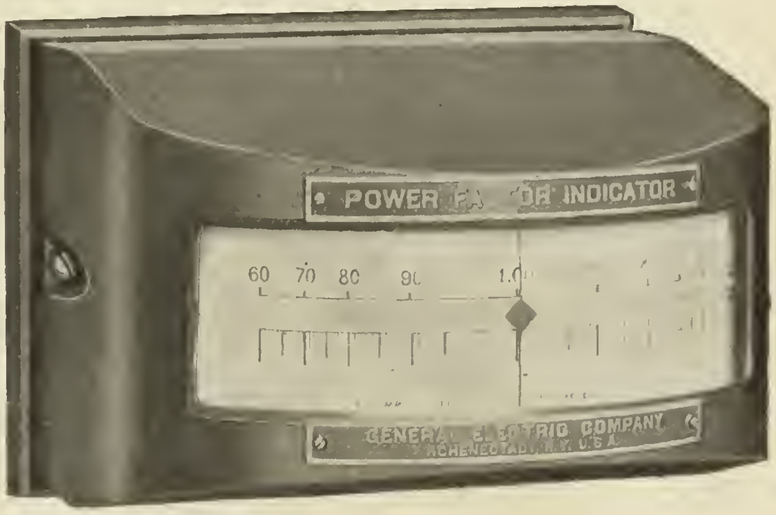


FIG. 1.—POWER FACTOR INDICATOR.

Current and potential transformers already in use on existing boards of General Electric manufacture, and used at the standard secondary ratings established in connection with the same company's alternating-current instruments, may be utilized in operating power factor indicators, provided the addition of the power factor indicator does not increase the total load on the secondary of the current or potential transformers beyond the specified limits. The power factor indicator may be regarded as adding the same load as would a second indicating wattmeter. The instrument is manufactured with one standard scale, .60-1.00-.60, indicating down to 60 per cent. power factor for leading or lagging current.

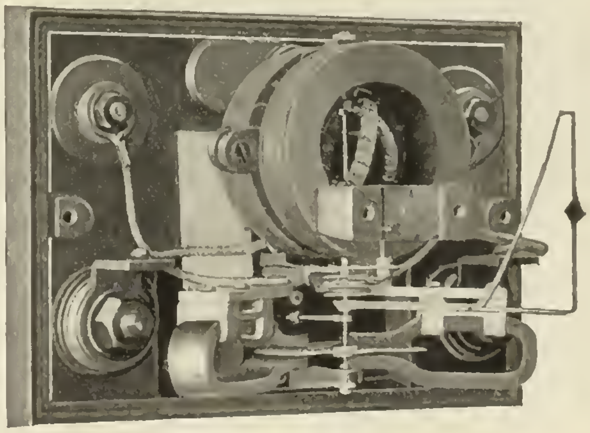


FIG. 2.—POWER FACTOR INDICATOR.

Equipment for Canadian Copper Plant.

Electricity will be largely utilized for the purpose of operating the plant of the Canadian Copper Company, which is now under construction at Copper Cliff, Ont. The company is controlled by the International Nickel Company, 74 Broadway, New York.

The power plant has been designed with a view to the ultimate installation of a 1,000 kw equipment, but in the first instance only 400 kw will be put in. The contract for the generators calling for two alternating current machines of 200 kw capacity each has been awarded to the Canadian General Electric Company. They will be direct connected to tandem compound condensing engines of 300 hp capacity each, which are to be built by the Robb Engineering Company, of Amherst, Nova Scotia.

The Aultman & Taylor Company, of Mansfield, O., has secured the contract for the boilers through Thayer & Co., 39 Cortlandt Street, New York. The condensing equipment will be built by the Alberger Condenser Company, 95 Liberty Street, New York. Two electric cranes of 40 tons capacity each have yet to be ordered, and eventually the company's mines will be electrically operated, which will necessitate the purchase of several motors, etc. The power house is being constructed and equipped under the supervision of the Engineering Company of America, 74 Broadway, New York.

Six Pole Enclosed Type Direct Current Motor.

The Emerson Electric Manufacturing Company, of St. Louis, long and well-known for their success in the field of alternating-current motors, have of late been developing a line of direct-current motors, and are now introducing these machines to the market. These motors are particularly adapted for the purpose of operating individually driven machinery in accordance with one of the most marked tendencies of the day in electric power development. We are enabled to illustrate herewith a six-pole entirely enclosed type of Emerson direct-current motors for slow and medium speeds, the complete motor being shown in Fig. 1, and the details in Figs. 2 and 3. These motors are built in four sizes of frames, developing from ⅛ to 2½ hp, and are, in fact, the outgrowth of a line of smaller multipolar motors, a large number of which are now in service under severe and varying conditions.

One of the new features of this motor, as shown in Fig. 2, is that the armature and commutator are mounted on a cast-iron sleeve, self-contained, instead of being assembled directly on the shaft in the usual manner. The shaft is pinned into this sleeve, as will be seen, and can be readily removed and replaced by an extended shaft of the driven machine if desired. In this way couplings are dispensed with and the change can be effected without disturbing the relative position of the armature to the commutator. The armature itself is of the small engine type, having closed slots and no band wires. It is built up of toothed laminations of mild steel, with coils dipped and baked and well insulated from each other and from the armature core. These motors may be reversed by simply changing the connections of the armature on the binding post plate without removing the motor covers. Each plate is stamped "shunt" or "series" to indicate the winding of the motor, and also bears the word "reverse" close to the armature leads. For convenience in reversing the direction of rotation, the armature leads may be conducted to a special switch at some convenient point, as a single adjustment of the rocker arm may be secured, at which the motor will operate satisfactorily without sparking

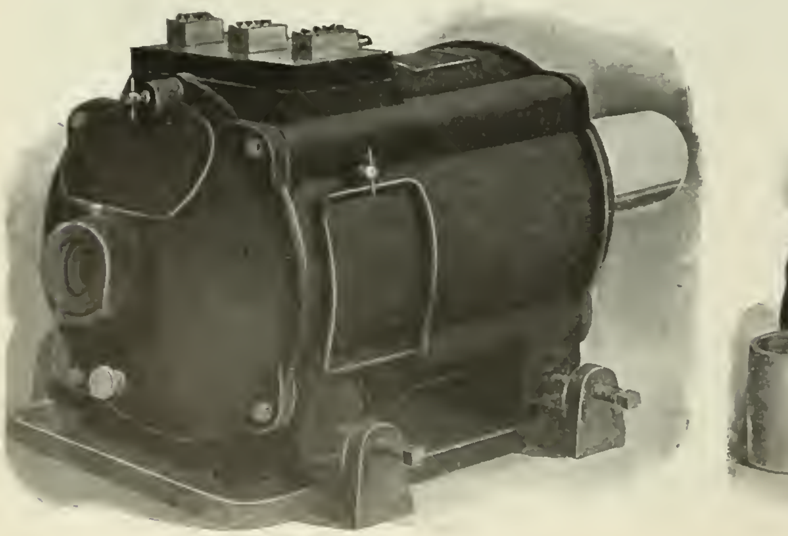


FIG. 1.—ENCLOSED MOTOR.

The field is composed of mild steel laminations of high magnetic quality, which are specially treated before being placed in the motor frame. The field coils are form wound and heavily taped to prevent mechanical injury.

The commutator is unusually large and is made from hard-drawn copper bars and best mica. As noted above, both armature and commutator are mounted on a ventilated sleeve surrounding the shaft, so that in case the shaft becomes worn or cut it may be removed and replaced without disturbing the bars of the commutator or the armature coils. Motors of the ¼ and ⅓-hp sizes are fitted with ¾-inch tool steel shafts accurately ground to size, running in self-aligning phosphor-bronze bearings of the wick oil type. Larger motors are equipped with self-aligning oil ring bearings and proportionately larger shafts.

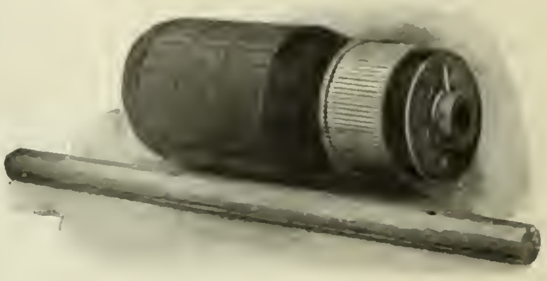


FIG. 2.—ARMATURE.

The end housings of these machines, shown in Fig. 3, are concentric, and may be moved one-quarter or one-half way around, keeping the oil wells upright; if it is desired to operate the motor in an inverted or semi-inverted position, on wall or ceiling.

Carbon brushes of the radial type are supplied. The brush holders are mounted on fibre insulating plates, which give a long break for possible grounds likely to be caused by oil and dirt in a small enclosed motor. Owing to the design of the brush-holders the motor may be reversed without readjusting the brushes. The rocker arm is set to the point of best commutation after test, but if necessary the brushes may be readjusted by loosening the thumb nut outside the cover.

The brush-holder springs are of tempered steel wire, and owing to their design, give practically an even tension throughout the entire range of the brush. As they are fastened directly on the fibre insulating plates holding the brush-holders, they carry no current and cannot become heated from that cause.

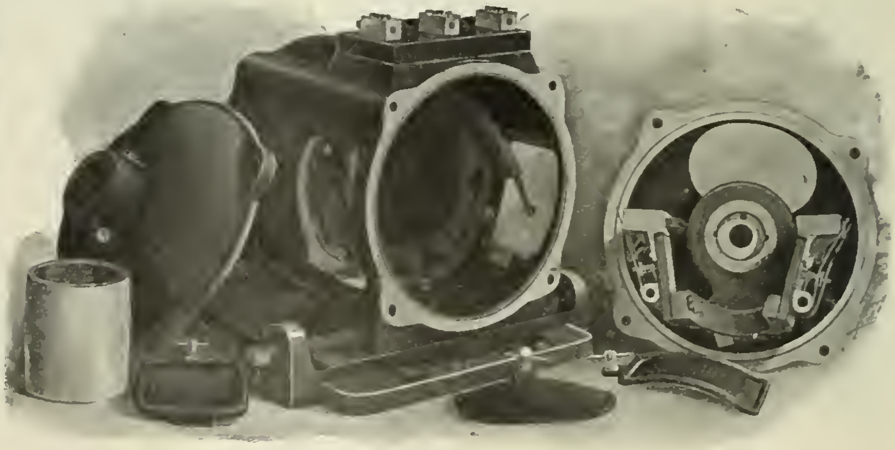


FIG. 3.—ENCLOSED MOTOR WITH ENDS OF CASING REMOVED.

These motors in sizes up to ½ hp are furnished with 3-inch iron-flange paper pulleys for 2-inch flat belt, and with removal bases, slotted to permit of belt adjustment. Frames larger than ½ hp are equipped with crowning face, iron pulleys, 4-inch diameter, 4-inch face and oil pan bases, complete with slide rails and set screw adjustment. The smaller motors are finished in black japan, and the 1 and 2-hp frames are filled and finished with a high-grade machine enamel paint, almost equal to japan in lustre.

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The Electrical Pole Industry.

It is probable that the pole will long remain one of the most prominent and typical features of electrical development, and that the various public services, such as the trolley, the telephone, the electric light and the telegraph will long be insatiable in their demands for a support of aerial wires. In fact, even the wireless telegraph seems to run more strongly to poles, and big ones at that, than any of the precedent arts. The result is that one of the large businesses closely allied to electrical applications is that of furnishing poles, and no one who has missed the chance to see them can form an accurate idea of the magnitude of the pole yards, or the vast scope and extent of the pole plant in general.

A couple of views presented herewith are somewhat instructive and interesting in this respect. Figs. 1 and 2 show piles of sorted poles and the method of loading poles into cars. These views are from the yards of W. C. Sterling & Son, of Monroe, Mich., wholesale producers of all kinds of cedar since 1880, whose industry with all its remarkable facilities for supply is in itself an exemplar of conditions relating to poles. They have fourteen yards in Michigan, the most central and largest sorting yard being at Omer. Situated on the Rifle River, this plant gives the firm the advantage of "driving" the river, as well as of appropriating some of its water power. Fig. 1 illustrates a small section of the pole yard there, showing the poles piled ready for loading. Fig. 2 illustrates a car being loaded with poles, and the manner in which a pole is hoisted into position to be placed on the car.

A further idea of the rate at which electricity alone helps to use up the forests is given by the fact that this one firm has closed several contracts of great size of late, and still has about 75,000 to 100,000 poles, as well as several thousand ties, such as are used on trolley roads, ready for shipment. These figures represent in themselves a tidy little area of cleared forest. The firm ship cedar to nearly every State in the Union, as well as making foreign deliveries, one of which recently went as far as Egypt. One would expect to find large yards, but even then can hardly realize that some of the piles contain as many as 10,000 poles. When the timber comes in cut for poles, but does not fill the specifications, it is immediately manufactured into posts, ties or shingles. There is a large tie and shingle mill combined, so that all the timber not available as good poles can at once be worked up in the other forms. Hence the sorting yard and the general scene take on a brisk air of activity. The firm has considerable standing cedar timber. It has a good many "lookers" out prospecting, and keeps all its forces in movement. At the sorting yard poles, ties, posts and shingle timber are continually coming down the river or in on cars and wagons, and loaded cars to fill orders are going out on the other side, while all the intermediate processes of sorting, inspecting and manufacturing are in full swing. The importance of such work in relation to the lumber industry is shown by the fact that all the later census schedules relating to electrical industries, such as trolleys, telephone, etc., require data from the local companies as to their poles and methods of using them.

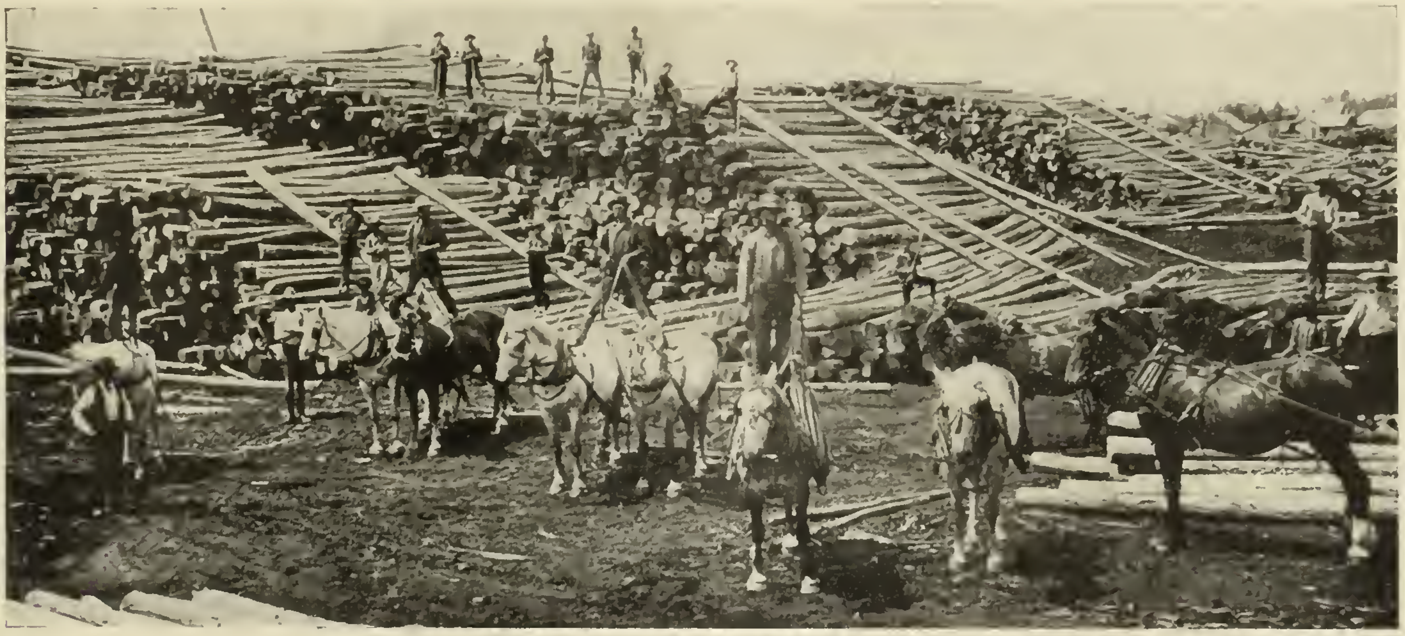

Fig. 1.—Poles Ready for Loading.

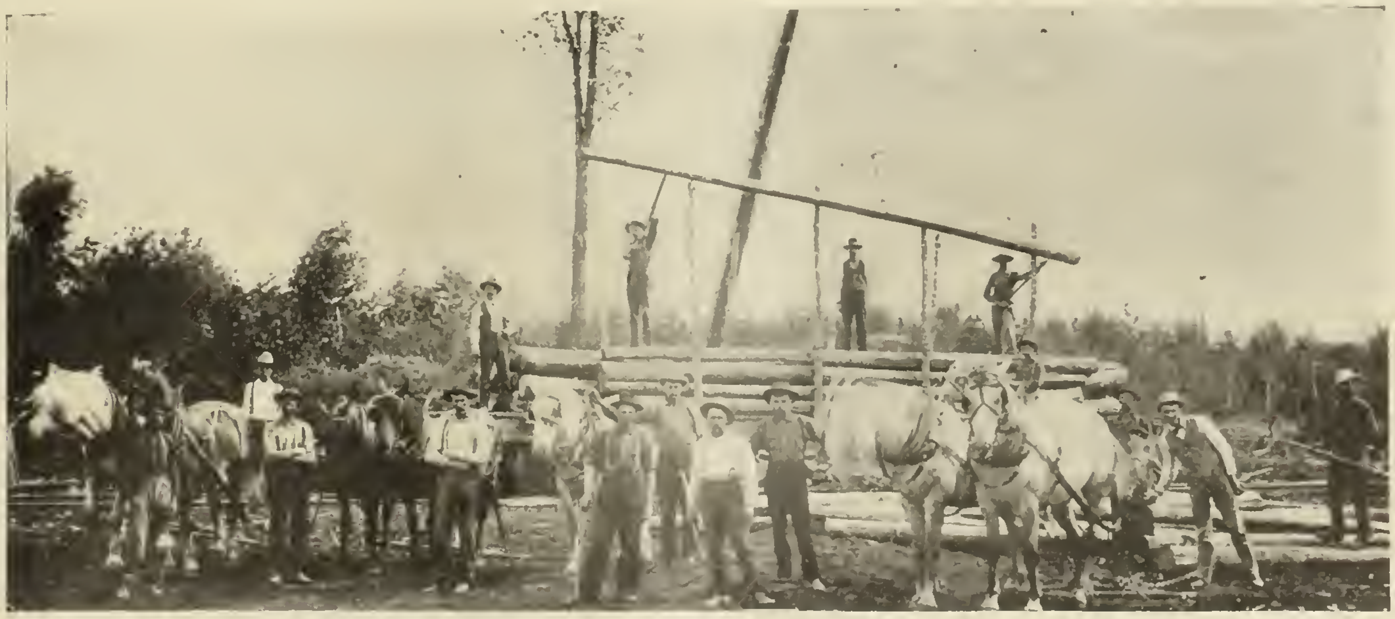

Fig. 2.—Method of Loading Poles on Cars.

Motor Equipment for N. Y. Telephone Repair Shop.

The New York Telephone Company's repair shops are to be installed with a unique motor equipment, the contract for which has just been secured by the Holtzer-Cabot Electric Company.

Three motors are to be suspended from the ceiling and direct-coupled to line shafts turning at 250 r.p.m. The frames of the motors will be of 20 hp size, but the machines are wound to deliver only 7½ hp each. Connected with the woodworking machinery will be five dust-proof motors of 3 hp capacity each.

The motors for driving the woodworking machinery can be started by push buttons attached to the motors. The automatic starters, of Cutler-Hammer manufacture, are to be grouped on a specially built switchboard. The time saved by having the control at the motors, it is said, will more than pay for the additional expenditure as compared with the ordinary starting device.

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Electric Automobile Test Run.

In a test run made by one of the Fischer Motor Vehicle Company's five-ton electric motor gasoline trucks to Morristown, New Jersey, the following results are reported to us. The truck left the factory at Hoboken at 8:45 A. M., on September 18, running to Jersey City and arriving there at 9.15, where 4 tons and 2 cwt. of sash weights were loaded. The vehicle started on her way to Morristown at 11.05, and arrived there at 6.25 that evening. After having made several stops in the course of the trip, including one hour for dinner, the total time lost on the various stops was 1 hr. 30 min., making the actual running time 5 hrs. 50 min. The distance covered was 31½ miles, and eighteen gallons of gasoline were consumed. Taking the total ton miles traveled for the trip, they amount to 129, and with gasoline at 12¼c. per gallon it would figure out 1¾c. per ton mile for hauling the useful load. The truck being a five-ton one, if loaded with its maximum, would have used but very little more oil, and would have reduced the cost of operating per ton mile by fully 20 per cent.

In the course of this trip they encountered a number of long hills, one of them being about a mile in length, and in some places these hills were very steep, the grades reaching as high as 12 per cent. The truck left Morristown on September 19 at 8.25 A. M., and arrived at Hoboken at 1.20 P. M. Several stops, amounting in all to twenty minutes, are to be deducted from this time, which would show 4 hrs. 35 min. to be the actual running time for the return trip. Twelve and one-half gallons of gasoline were consumed. The company is busy finishing orders for the large 'busses for London, and has also several orders for five-ton trucks in the United States.

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Electric Power Development at Buford, Ga.

The Winding Shoals Electric Power Company, a company recently incorporated at Buford, Ga., will install a 6,000-hp hydroelectric plant on the Chattahoochie River, four miles west of Buford. The location selected for the dam and power house is a most advantageous one, lying between high bluffs which are composed almost entirely of solid granite. The plans contemplate the construction of a crib dam, for which an abundance of material can be secured in close proximity to the plant. The power house will be of stone and concrete construction. Details of the power house machinery equipment have not been fully worked out, but it can be stated definitely that the first equipment of wheels and generators will be for about 3,000 hp. ultimately increasing it to 6,000.

A portion of the power will be utilized by local factories in Buford, which is the largest leather manufacturing district in the South, and for the Atlanta, Buford & Gainesville Railway, for which a survey is now being made. The remainder of the power will be transmitted to Atlanta and surrounding towns; the bulk of it will most likely be taken to Atlanta, Ga. The Electrical Equipment Company, Monadnock Building, Chicago, Ill., of which Mr. J. W. Peterson is president, is preparing the plans and specifications, and will soon be ready to receive bids for the machinery equipment and construction work. Mr. Peterson is one of the officers of the company, and has personally had charge of the engineering details in connection with the work. He has associated with him in the company several prominent men of Atlanta, Gainesville, and Chicago, and it is their intention to start construction as soon as the contracts can be let.

Electrical Method of Locating Minerals.

The subject of locating minerals by aid of the electric current is not an entirely new one, but to devise means for so doing that are applicable to quick and accurate measures and in which a simple direct current may be used has until recently been one of considerable thought and study. To avoid the electrolytic formation of gases at the rods driven in the earth where a direct current of small voltage is employed, and thereby insure accurate measurements, the Electric Mineral Survey Company, Pasadena, Cal., employs a method whereby this gas formation is neutralized.

In taking measurements for locating an ore body stakes are driven as represented in the diagram, these stakes in practice being one of hard drawn copper and the other of iron or steel. The stakes are then withdrawn and a small amount of sulphate of copper solution poured into the hole made by the copper rod and the rod is then replaced in the hole. The iron stake is then treated in a like manner with sulphate of iron. This forms a two-fluid battery in the earth with the earth acting as the porous cell. It is practically a Daniels battery, in which the hydrogen has a reducing action with the formation of a deposit of copper on the copper rod and an oxydizing action at the iron rod, which is changed to a sulphate by the liberation of sulphuric acid.

The instrument used is some form of direct-reading milliammeter, and in the case are contained from one to three cells of dry battery and a rheostatic arrangement to compensate for variation of voltage, owing to difference of temperature at different times of the day and season. These batteries are joined up in series with the ammeter and the earth battery. In each case the measurements are taken through the entire length of wire on a spool, so that the circuit above ground is always of the same resistance. There is thus only the variation of resistance in the earth part of the circuit, and as this decreases as the mineralized condition increases actual resistance can be disregarded and comparisons made in terms of current so long as a standard of e.m.f. is adhered to and saturated solutions of the earth battery are maintained.

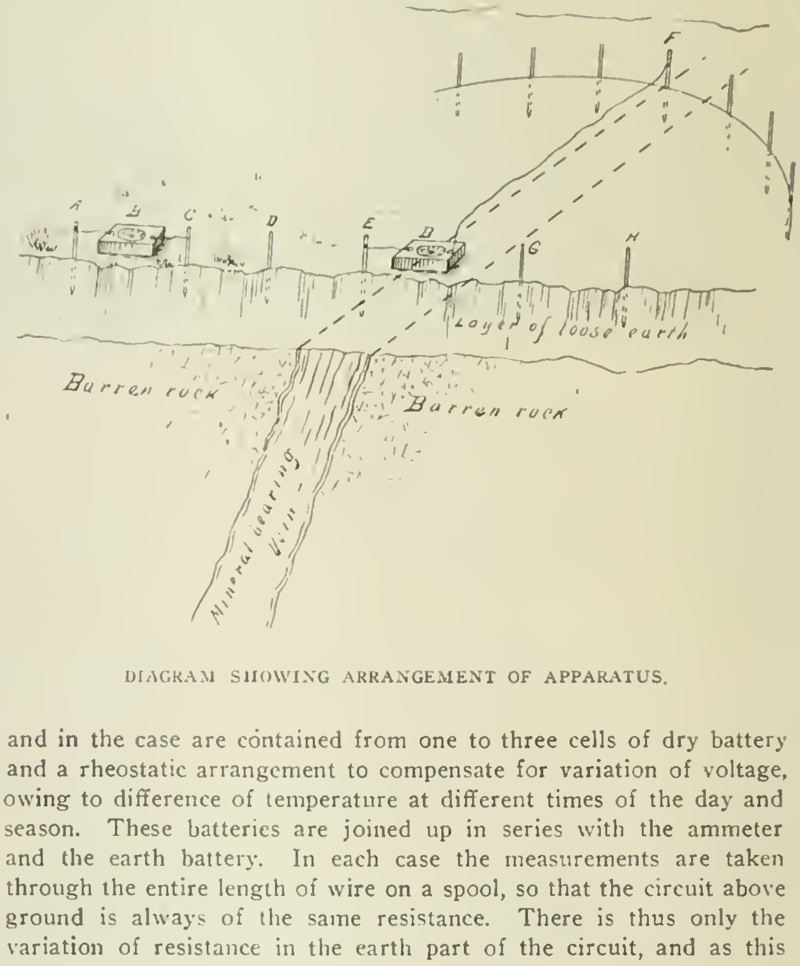

DIAGRAM SHOWING ARRANGEMENT OF APPARATUS.

Referring to the diagram, measurements are taken and compared at various points across the formation, as between *A* and *H;* the most favorable is selected as at *E,* and then another set of measurements is taken as between *E* and other stakes driven in a circle. If between *E* and *F* is the highest reading taken, it indicates the most highly mineralized zone between *E* and *F.*

Various conditions may be ascertained regarding a vein of mineral by modifications of this system, such as determining approximately the inclination, width, most highly mineralized portion of a vein, and in some cases the depth from the surface. This system has been in use by the Electric Mineral Survey Company, of Pasadena, Cal., for the past two years and it makes claim to a record of many successful locations.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was fairly active, and at the close held the improvement shown on prices made early in the week in spite of the actual or rumored financial troubles at other cities. Support from large interests and covering by bears were responsible mainly for the rally, public buying being still restricted. The Steel stocks were steady on covering, the new bonds being irregular, however, on sales by participants in the syndicate. The electrics and tractions showed decided improvement, and in most all cases closed with substantial advances, although there was no particular reason for the strength shown in these securities. General Electric closed at 150, being the highest point of the week, and a net gain of 5 points, the lowest quotation being 136. Westinghouse common closed at 146, ex-div., this being a net loss of ½ point, while the preferred closed at 166, ex-div., being a net gain of 8½ points. In the tractions, Brooklyn Rapid Transit closed at 34⅜, which was practically the highest point of the week, the lowest being 29¼. This represents a net gain of 2⅝ points. The transactions in this stock aggregated 100,940 shares. Metropolitan Street Railway advanced to 107, and closed at 106½, the net gain being 2¼ points. During the week this stock made a "low" record, touching 99⅞. Other closing quotations were: Western Union, 82; American Telegraph & Cable, 80, a net loss of ½ point, and Commercial Cable, 149¼, a net loss of 3¾ points. Commercial Cable at 149¼ is the lowest quotation for the year, the highest having been 176. In this connection it may be interesting to note the net losses of the principal electric and traction stocks for the month of September, during which time the market was under a severe strain, there being a continuous pressure of liquidating sales and heavy shrinkage in the prices of all classes of securities: American Telephone & Telegraph, 5¾; General Electric, 21; Westinghouse common, 25; Westinghouse preferred, 10; Western Union, 2⅛; Brooklyn Rapid Transit, 15½; Metropolitan Street Railway, 15. American Telegraph & Cable made a net gain of ¾ point in the same time. Trading on the curb during the week was marked by some violent fluctuations, both up and down. Following are the closing quotations of October 6:

NEW YORK.

	Sept. 29	Oct. 6		Sept. 29	Oct. 6
American Tel. & Cable	78⅜	78¼	General Electric	143	147
American Tel. & Tel	125½	127	Hudson River Tel	..	..
American Dist. Tel	24	25	Metropolitan St. Ry	103¼	105
Brooklyn Rapid Transit	32¼	38⅛	N. E. Elec. Veh. Trns	..	..
Commercial Cable	140	..	N. Y. & N. J. Tel	140	..
Electric Boat	15	15	Marconi Tel	..	..
Electric Boat pfd	40	40	Western Union Tel	81	81½
Electric Lead Reduction	1¼	1¼	Westinghouse com	138	142
Electric Vehicle	4¾	4	Westinghouse pfd	160	165
Electric Vehicle pfd	7	6			

BOSTON.

	Sept. 29	Oct. 6		Sept. 29	Oct. 6
American Tel. & Tel	125¾	127½	Western Tel. & Tel. pfd	79	*80
Cumberland Telephone	*115¾	....	Mexican Telephone	1⅜	1⅛
Edison Elec. Illum	225	231	New England Telephone	*124	121¼
General Electric	142	145	Mass. Elec. Ry	18	20
Western Tel. & Tel	10	10	Mass. Elec Ry. pfd	77	77½

PHILADELPHIA.

	Sept. 29	Oct. 6		Sept. 29	Oct. 6
American Railways	42	42	Phila. Traction	94	94
Elec. Storage Battery	*51½	50	Phila. Electric	5⅜	6¼
Elec. Storage Battery pfd	*51½	48	Phila. Rapid Trans	11	12½
Elec. Co. of America	7½	7¾			

CHICAGO.

	Sept. 29	Oct. 6		Sept. 29	Oct. 6
Central Union Tel	..	..	National Carbon pfd	*89½	88
Chicago Edison	145	140	Metropolitan Elev. com	17	18
Chicago City Ry	165	170	Union Traction	4	4
Chicago Tel. Co	112	115	Union Traction pfd	30	30
National Carbon	*20	*20			

* Asked

OUTPUT OF BELL TELEPHONES.—With regard to the recent apparent decline in Bell telephone output, an official of American Telephone & Telegraph Company says: "It is a mistake to consider the instrument statement of our company as an unfailing index of business conditions. While it may throw some light on the question, there are other considerations peculiar to the telephone business itself, which materially reduces its value as a business indicator. At the present time the sub-companies of the American Telephone & Telegraph Company are operating under a new royalty system which makes it a disadvantage for them to keep in stock any instruments for which they have not immediate use, and so these companies are returning such instruments to us. The taking back of a large number of instruments is now reflected in an unusually large number of 'returned' instruments which to that extent makes the present net output abnormally small. Then again the present unsettlement in financial affairs has induced a more conservative policy on the part of the sub-companies in their fight with competitors for new business. They are not offering the same liberal inducements for the sake of getting business, and this let-up in the quest for new business is, of course, showing itself in a falling off in the demand for instruments."

GENERAL ELECTRIC STATUS.—General Electric stock was lower recently on the laying off of some hundreds of hands at Schenectady, and went up again on the statement that orders were being accepted subject to eight months' delay, in heavy lines. A director is quoted as follows: "The General Electric Company had on the last day of August more than $1,500,000 in bank. It has gained on that this month. The company seems to have $3,000,000 cash. Its orders up to the 19th inst. were well ahead of last year and or the last week. Its business last month was the heaviest of its existence. It will get more cash by sales of securities when it wants to sell them. It sold a handsome lot of them in September. I think that fewer large lots will come for a while, but its steady business is very large. Of course it can buy raw material at lower prices against its existing orders. The price of the stock is dependent wholly upon the individual necessities of the holders."

ELECTRICAL EXPORTS.—In the export trade in iron and steel machinery, builders' hardware, electrical machinery, locomotives, tools, firearms, etc., the returns for August compare favorably with August, 1902. Increases are shown in the trade with the United Kingdom, Belgium, France, the Netherlands, Colombia and Argentina, while decreases are shown with Mexico, Germany and Italy. The exports of electrical machinery for August this year and last were:

August, 1902	$558,826
August, 1903	413,396

For the eight months ending August 31, the total was $3,553,315, compared with $3,896,547. The exports of builders' hardware for August last were $972,394, compared with $944,822 in August, 1902. For the eight months of this year the total was $8,251,928, compared with $7,405,152 the first eight months of 1902.

DIVIDENDS.—The Cincinnati, Newport & Covington Light & Traction Company has declared the regular quarterly dividend of 1⅛ per cent. At a meeting of the directors of the Union Switch & Signal Company, the regular dividend rate on the stock of the company was made 10 per cent. yearly on the preferred and 8 per cent. on the common, these having been respectively 9 per cent. and 6 per cent. A quarterly dividend was declared at these rates.

Commercial Intelligence.

THE WEEK IN TRADE.—The favorable feature of the general business outlook was the improvement in collections West and Northwest, which is regarded as the reflection of the beginning of the movement of delayed crops to market. Otherwise the situation presented is that of ordinary conditions. Among the great industries iron and steel show the effects of threatened over-production in proposals for a 20-per cent. reduction of Northern furnace output, rumors of like action by Southern producers, and quiet demand for finished products. Lumber is showing a seasonable quieting down, but building trades are still active. Railway earnings for September thus far available exceed those of 1902 by 8.4 per cent., and surpassing the earnings for 1901 by 19.3 per cent. The copper market shows no improvement, and is practically lifeless. In the absence of demand the "official" quotations of the New York Metal Exchange remain unchanged, and are nominally as follows: Lake, 13¾@13⅞c.; electrolytic, 13⅝@13¾c.; casting stock, 13¼@13½c. As regards business failures, *Bradstreet's* states that for the nine months of this year they are the smallest in number reported for twenty years past. The liabilities, however, are larger than last year by 15.8 per cent., but 9.2 per cent. less than those of 1901. The failures for the week ending October 1 numbered 153, against 185 the week previous and 164 the corresponding week last year.

HOLTZER-CABOT NOISELESS GENERATORS. — The Board of Education, New York, has just placed a contract with the Holtzer-Cabot Electric Company, of Brookline, Mass., through H. J. Brewer for several noiseless generator couples, consisting of ½-hp motors, direct connected to ¼-hp ringers, and ¼-hp noiseless generators. Current is to be taken from the noiseless generator and transmitted directly on the transmitter lines of telephone systems. These outfits will replace storage batteries.

AMERICAN ENGINES AND BOILERS. Mr J E. Proffit, United States Consul, Pretoria, Transvaal, writes: "It is with no pleasure that I report the fact that frequent complaints are received at this consulate from the importers of our goods, and it would perhaps interest the Associations of Implement and Vehicle Manufacturers to know that these complaints are confined almost entirely to the classes of wares which they manufacture. The importers complain that American goods, especially in the machinery line, do not meet representations Nine new boilers of American make, invoiced at about $30,000, were recently condemned and thrown out on the veldt near Johannesburg as absolutely worthless. A lawsuit grew out of the transaction, and the newspapers gave wide publicity to the fact. The electrical, mining and mechanical engineers on the Witwatersrand gold fields are, for the most part, Americans, and through them our manufacturers have built up a large trade, especially in boilers and engines; but instances like the above create a detrimental prejudice not only against the article condemned, but against American goods in general. A letter of complaint from one of the largest dealers in electrical supplies in this city has been received since this report has been in progress."

THE PELTON WATER WHEEL COMPANY, of San Francisco, reports good business in the manufacture of water wheels. Its plant is working night and day to keep up with the orders. Among the important contracts closed during the past few months for hydro-electric plants are the following, which aggregate 56,400 hp: American River Electric Company, Placerville, Cal., head 575 ft., two double Pelton units, each of 2,500 hp capacity; Pike's Peak Hydro-Electric Company, Colorado Springs, Col., head 2,200 ft., three Pelton wheels, each of 1,500 hp capacity; Columbia Improvement Company, Tacoma, Wash., head 850 ft., four Pelton units, each of 7,500 hp capacity; Vancouver Power Company, Vancouver, B. C., head 390 ft., three double Pelton units, each of 3,000 hp capacity; Northern California Power Company, Anderson, Cal., head 1,150 ft., two double Pelton units, each of 3,000 hp capacity; Rock Creek Power & Transmission Company, Baker City, Ore., head 960 ft., two Pelton units, aggregating 1,760 hp; Columbus Consolidated Mining Company, one Pelton unit, 494 ft. head, 660 hp capacity.

ARTIFICIAL NIAGARA AT ST. LOUIS.—An immense artificial cascade has been determined upon by the authorities of the Louisiana Purchase Exposition as the centerpiece of the semi-circular lay-out of the principal buildings. The cascade itself will be divided into three parts; a large middle cascade with a smaller one at each side, the water flowing directly into the head of the Grand Basin. In all, about 90,000 gallons of water per minute will be supplied at a head of 159 ft., forming the greatest artificial water effect ever attempted. The water will be taken from the Grand Basin itself, and will be raised to the top of the cascade by a pumping station located under Festival Hall. The pumping machinery will consist of three 36-in., single-stage, turbine centrifugal pumps, purchased from Henry R. Worthington, of New York City, each driven by a 2,000-hp Westinghouse alternating-current motor. The total horse-power utilized will thus be 6,000, making this the largest electric pumping station in the world. The pumps and other pieces of machinery for this plant are now being installed at St. Louis.

SUCCESS OF BRAZILIAN TROLLEYS.—The Sao Paulo Tramway Company, of Sao Paulo, Brazil, which was organized by F. S. Pearson, has made a wonderful record of earnings since its organization two years ago. At that time $6,000,000 of 5 per cent. bonds were sold largely to Toronto interests at 90, with a 100 per cent. bonus in stock, and such investment now shows 90 per cent profit, the bonds selling at 95 and the stock at 85. At the top of the Toronto boom the stock sold as high as 118. Earnings have just been published for the first six months of this year. They show net receipts of $436,949, compared with $326,787 for the same period of 1902, a gain of $110,162, or 34 per cent. During the six months operating expenses were reduced $20,000, or 9 per cent. Earnings of the Sao Paulo Company now equal 8½ per cent. on the $7,000,000 of capital stock ($1,000,000 of new stock having been issued last year at par $100.)

RIDGEWAY ENGINE AND DYNAMO ORDERS.—The Ridgeway (Pa.) Engine & Dynamo Company, through its Eastern sales agents, McClave, Hamilton & Co., has obtained an order for a 175-hp high-speed automatic engine for operating a 100-kw generator to be installed in the Paterson (N. J.) silk mills of J. A. Hall & Co. The St. Clair (Pa.) Coal Company has ordered a 100-hp belted engine for lighting the mines. The Pennsylvania Stove Company, of Laquin, Pa., has ordered a 30-kw Ridgeway set for lighting purposes. The Hodgman Rubber Company, of Tuckahoe, N. Y., has requisitioned for two 25-kw dynamos for direct connection to 45-hp engines and two 10-kw dynamos for direct connection to 20-hp engines. The latter outfits are for the company's Mount Vernon factory.

EQUIPMENT FOR BIG BRIDGEPORT PLANT.—An extensive electrical equipment is to be installed to operate the machinery and light the main and additional plants now under construction at Bridgeport, Conn., by the Eaton, Cole & Burnham Company, manufacturers of steam fittings, etc. G. K. Hooper, Bowling Green Building, is acting as consulting engineer in the matter. About 2,500 hp will be installed A three-phase system will be employed. A 400 kw Westinghouse turbo generator has already been ordered. Several motors averaging 100 hp capacity will shortly be contracted for. The Case Manufacturing Company, of Columbus, O., has secured a contract for a 5 ton electric crane and another is about to be contracted for

ELECTRIC TRAIN LIGHTING —Mr. A. Sanford Adler, general manager of the United States Light & Heating Company, says, in relation to its contract with railways: "Our system is now in operation on the New York Central, and we are equipping cars for the Delaware, Lackawanna & Western. We have orders from the Delaware & Hudson, Southern Railway, Chicago Short Line, Boston & Albany, Butte, Anaconda & Pacific, and additional orders from the New York Central. We have foreign orders from the Lancashire & Yorkshire, Great Western and Great Northern roads in England. We also have orders from the Sheffield Works of Sheffield, England, and also have orders booked from South America."

EQUIPMENT FOR PRINCETON UNIVERSITY.—Considerable equipment is to be installed for lighting purposes, etc., at Princeton University. The engines will be built by the Reeves Engine Company, Trenton, N. J. New York offices, Singer Building. Two will be 15 in. by 26 in. by 18 in. cross-compound verticals, and the third will be a 12-in. by 20-in. by 14-in. machine. The two larger engines will be direct connected to Westinghouse generators of 210 kw capacity each, while the smaller engine will run a 110-kw General Electric generator.

ELECTROLYTIC COPPER REFINING PLANT.—The De Lamar Copper Refining Company, which is building an extensive electrolytic copper refining plant at Carteret, N. J., is placing considerable contracts for equipment, etc. The boilers will be built by the Babcock & Wilcox Company, Singer Building, New York. A 3,000 hp outfit has been ordered. The condensing equipment will be built by the Alberger Condenser Company, 95 Liberty Street, New York.

BARRIETT ELECTRIC COMPANY, of Cincinnati, O., formerly the Cincinnati Electric Motor Company, has just shipped a 5-hp 500-volt motor to the University of Arkansas to be used in its laboratory. It has also shipped a 5-hp machine to the Chicago University to be used for a similar purpose. Mr. S. L. Barriett was recently in New York, arranging with Mr. C. J. Purdy to carry a stock of his motors for prompt local delivery.

EQUIPMENT FOR CARBON PAPER WORKS.—The engineering firm of McClave, Hamilton & Co., 85 Liberty Street, has secured a contract for the complete power, lighting, heating and ventilating system to be installed in the Parkridge, N. J., plant of Mittag & Volger, manufacturers of carbon paper, inks, typewriter ribbons, etc. A 100-kw generator will be ordered for direct connection to a 175 hp each. Eight motors aggregating 125 hp will also be put in. The boiler capacity will be 320 hp in two units.

EQUIPMENT FOR SAND-LIME BRICK FACTORY.—The Northern Electric Manufacturing Company, Columbia Building, 29 Broadway, New York, has received a contract from the Schwarz System Brick Company, Maritime Building, New York, for a number of dynamos and motors to be installed in a sand-lime brick factory now in course of erection under the Schwarz system.

WHEELER CONDENSER CONTRACT.—The Wheeler Condenser & Engineering Company, 120 Liberty Street, has secured a contract for condensers and Edwards triplex air pumps to take care of 5,000 hp. This equipment is to be installed in the Quincy station of the Old Colony Street Railway Company, Newport, R. I.

GEORGE C. TOWLE MANUFACTURING COMPANY.—The stockholders of George C. Towle Manufacturing Company will meet October 19 to vote on certain propositions. One of these will be to increase the capital stock of $50,000, and the other is to change the name of the company to the Fidelity Electric Company.

BALL ENGINE ORDERS.—The Eaton Sugar Company, Eaton, Colo., has recently purchased a direct-connected unit of 60 hp from the Ball Engine Company, Erie, Pa. The Welch Grape Juice Company, Westfield, N. Y., has bought a direct-connected unit of 60 hp from the Ball Engine Company.

THE AMERICAN ASPHALTUM & RUBBER COMPANY, with offices at 721 Woman's Temple, Chicago, announces the organization of an insulating-compound department. Mr. A. D. Chandler, who is well known to the trade, will be in charge of sales.

NEW HARLOE INSULATOR FACTORY.—The Harloe Insulator Company, of Elmer, N. J., whose general agents are W. H. Frisby & Co., 24 Vesey Street, New York, is building a new plant at Hawley, Pa., which will have a daily capacity of 35,000 insulators.

General News.

THE TELEPHONE.

MOBILE, ALA.—On October 15 the Home Telephone Company expects to install a new Ericsson central-energy switchboard. The company has 600 subscribers, and anticipates an increase of about 200. Business telephones are $30 per annum; residence $25.

DOTHAN, ALA.—The Dothan Telephone Company reports through its manager, Mr. R. T. Ghent, that it will begin work at once making the exchange full metallic, using Stromberg-Carlson central-energy telephones. There are 124 subscribers who pay $24 annually for a single telephone and $36 for two telephones. A connection is soon to be made with the Blakely Telephone Company connecting Dothan with Albany, Ga.

ROANOKE, ALA.—Mr. H. H. Cauthen, manager of the Roanoke Telephone Company, says: "Our exchange is growing every day. We give first-class service, owing to the fact that we have the best instruments that we can get and keep instruments and lines in perfect order. Twelve months from date expect to have 200 or more telephones in operation." This company uses Sumter Telephone Manufacturing Company's apparatus and has a switchboard of 100 drops, with 98 subscribers. The rate for service is $1.50 per month.

FLAGSTAFF, ARIZ.—The common return metallic system is operated by the Flagstaff Mutual Telephone Company which has 83 subscribers. Standard Telephone & Electric Company apparatus is used. The rates are $1 per month for residences and $1.50 for business.

SEARCY, ARK.—American Electric Telephone apparatus is used by the Searcy Telephone Company which operates 10 miles of toll line and has 130 subscribers. The rates are $1.50 for residence and $2.50 for business.

STUTTGART, ARK.—An extension of 40 miles of toll line and one new exchange is projected by the Stuttgart Telephone Company which at present has 140 subscribers. Manager A. A. Tindall says the outlook is promising and satisfactory.

BLACK ROCK, ARK.—It is proposed to enlarge the telephone plant of the Lawrence County Telephone Company by the addition of a 100-drop switchboard. This company at present operates American Electric apparatus and has 125 subscribers. The outlook is very good.

WINSTED, CONN.—Mr. C. K. Hunt, proprietor of the telephone exchange at this place operates a 200-drop switchboard, and furnishes service to 415 subscribers, all local. The rates are $12 for residence and $18 for business.

WILMINGTON, DEL.—The Delmarvia Telephone Company has connections with the United Tel. & Tel. Company, Keystone State Tel. & Tel. Company and Maryland Tel. & Tel. Company. At present there are 1438 subscribers. Western and Couch & Seeley apparatus is used. A new switchboard and additional underground lines will shortly be built.

TAMPA, FLA.—The Peninsular Telephone Company operates exchanges at Barton, Braidentown, Palmetto, Lakeland and Plant City, in addition to the one at Tampa which has 1,150 subscribers. The exchange at the latter place was opened in November, 1902, and has a North switchboard of 1,000 drops. The rates are $1.50 for residences and $2.75 for business offices.

CARROLLTON, GA.—Messrs. Cheney & Mandeville operate the exchange at this place; they have 160 subscribers, and use Sumter apparatus.

BOSTON, GA.—Beginning with 30 drops 18 months ago, the Boston Telephone Company now has 108 subscribers. Viaduct apparatus is used.

FORT VALLEY, GA.—The Fort Valley Telephone Company numbers 130 subscribers; there has been an increase of about 14 telephones each year and a good increase is expected for 1904.

COLUMBUS, GA.—An Automatic Electric Company's switchboard of 1000-drop capacity will be in working order at the exchange of the Columbus Automatic Telephone Company, about November 1. It is expected to start with 1,000 subscribers.

COMER, GA.—The Danielsville & Comer Telephone Company, of Madison County, uses "Imperial" and "American" apparatus. The company has recently added 25 miles of toll line; numbers, at present, 93 subscribers, and reports a promising outlook.

BLAKELY, GA.—"Getting business faster than we can take care of it," is the report from the Blakely Telephone Company, which is projecting 90 miles of toll line. There are 251 subscribers who use the Telephone Manufacturing Company's "Imperial" apparatus.

FORT GAINES, GA.—The Fort Gaines telephone system connects with exchanges at Arlington, Blakely, Cuthbert and Shellman, Ga., and at Doth, Ala., and with independent switchboard at Eufaula, Ala. At Fort Gaines there are 100 subscribers, who pay $18 per annum for service.

CONYERS, GA.—Mr. A. Whitaker, Jr., proprietor of the Conyers Telephone Exchange, writes: "The telephone business is becoming more popular and is increasing as to subscribers and toll line business. At Lawrenceville I use switchboard manufactured by Sumter Telephone Manufacturing Company and that exchange has Bell receivers and transmitters." A ten-mile line from Lawrenceville to Logan is projected. The exchange at Conyers has 110 subscribers; at Lawrenceville there are 45 subscribers.

ATLANTA, GA.—A new switchboard has just been installed by the Atlanta Telephone & Telegraph Company which is now putting in about $35,000 worth of underground cable and doing considerable construction work. New telephones are being installed as fast as possible, and the company expects to have long distance connection with all the principal cities in the state before very long. There are between 2,200 and 2,300 subscribers at the present time, who pay $42 for business and $30 for residence service. A 3400-drop Stromberg-Carlson switchboard is in operation.

CORDOVA, ILL.—The Cordova Creamery Telephone Company operates a 60-drop American switchboard, and has 100 subscribers who pay $13.50 per annum each.

CLINTON, ILL.—The Farm & City Telephone Company operates exchanges in six counties, and has 1000 subscribers and 200 miles of toll lines. Sterling apparatus is used.

AUGUSTA, ILL.—A 400-drop Kellogg switchboard is operated by the Augusta Mutual Telephone Company, into whose office seven different lines enter. There are 200 subscribers.

CASEY, ILL.—The Shimel Telephone Company uses Kellogg and Sterling apparatus, metallic system; has 260 subscribers and 161 miles of metallic lines. The rates are $12 and $18 per annum.

AVA, ILL.—There are 120 subscribers to the Ava & Southern Illinois Telephone Company, which uses a 100-drop American Electric Telephone switchboard. There are 65 miles of toll line.

DANVILLE, ILL.—The Vermilion County Telephone Company operates nine exchanges, and has a total subscription list of 2,100. It is now installing an underground system. Sterling apparatus is used.

CHESTER, ILL.—An encouraging outlook is reported by the Gordon Telephone Company, which is putting in 5,000 feet of cable and changing to copper metallic circuit. Stromberg-Carlson apparatus is used by the 300 subscribers.

DES PLAINES, ILL.—The Des Plaines Telephone Company looks for a large increase in the number of its subscribers during the coming year. There are at present 200 patrons who pay $1 for residence and $2 for business service per month.

AUBURN, ILL.—A new distributing board and toll board, as well as a 21-mile toll line to Springfield are under consideration by the Auburn Telephone Company, which has 221 subscribers and operates a 200-drop Western Telephone Construction Company's switchboard.

BRIMFIELD, ILL.—An extension of ten miles of new line and service to 25 more subscribers is contemplated by the Brimfield Telephone Company which has 178 subscribers at present, about 60 of which have been added recently. The rates are $18 and $12 per annum for party lines.

BRADFORD, ILL.—The Milo & Bradford Telephone Company uses Stromberg-Carlson apparatus. It has 190 subscribers, who can connect with about 300 telephones, including subscribers on their own as well as on other lines. The company contemplates building a number of short lines and adding some more telephones.

ANNAPOLIS, ILL.—Mr. J. H. McGovern, of the Crawford County Telephone Company, informs us that its system is giving entire satisfaction; that it has one toll line with 26 Swedish-American telephones which is working well. The company has recently added 20 miles of line, and reports 150 subscribers at present.

CHENEYVILLE, ILL.—The Cheneyville Telephone Company is a farmers' line organized in March, 1897. Nearly every farmer has a telephone, for which he pays $3 to $7.50 per year according to the number of towns he gets free service with. There are 20 miles of toll line and 100 subscribers. American Electric apparatus is used.

JACKSONVILLE, ILL.—The Illinois Telephone Company reports a very promising outlook and rapidly increasing business, the number of subscribers having doubled in the past year. It is planned to build toll lines to Springfield, Ill., and St. Louis, Mo. The system has 250 miles of toll line at present and numbers about 2,000 subscribers.

BIGGSVILLE, ILL.—A Eureka switchboard and Stromberg-Carlson telephones are used by the Farmers' Telephone Company of Henderson County. This system numbers 520 subscribers. A subscriber is entitled to call any of about 1200 telephones without paying toll; he pays toll after leaving Monmouth. Twelve dollars per annum is the rate.

CHADWICK, ILL.—The Carroll County Independent Telephone Company is building new trunk lines in every direction and expects to increase its subscription list 1000 within another year. The system includes exchanges at Savanna, Milledgeville, Mt. Carroll, Lanark and Shannon, and numbers 2000 subscribers. The rates are $18 and $24 a year.

BUNKER HILL, ILL.—The system of the Bunker Hill Telephone Company is full metallic, the company having recently completed re-building it at a cost of $4000. It owns its exchange building and has about 5500 feet of cable. One hundred and thirty-four subscribers, who use American apparatus, pay $18 for business and $12 per annum for residence service.

CORINTH, ILL.—Mr. J. L. Roberts, secretary Crab Orchard Telephone Company, furnishes the following information: "Ours is a union of farmers' party lines, who put in a switchboard uniting their lines and by which they can exchange with neighboring systems. We rent to some 20 persons who live on or near our lines, at $1 per month, or 50c. per month if they furnish their own telephones. These revenues meet our operating expenses and 10% per month; each shareholder has kept our repairs up."

COLUMBUS, N. C.—The Polk County Telephone Company, of Columbus, contemplates building a line to Rutherfordton, N. C.

WILMINGTON, N. C.—The Bell Telephone Company at Wilmington has announced an advance in rates of from 25 to 60 per cent. upon the completion of its new service. The advance is meeting much opposition.

WHITEVILLE, N. C.—The property of the Columbus Telephone Company, of Whiteville, has been sold at auction to E. G. Empie. The company owns 170 miles of long distance connections. Mr. Empie's bid was $2500.

CHILLICOTHE, OHIO.—There are 530 subscribers using the service of the People's Telephone Company, which operates American, Kellogg, and Stromberg-Carlson apparatus.

CHARLESTON, S. C.—The Mt Pleasant Telephone Company of South Carolina has been commissioned with $2,500 capital to build a line to Christ Church in Charleston County.

SOUTH ROYALTON, VT.—A 30-drop switchboard made by the Utica Fire Alarm Telegraph Company is in operation at the exchange of the Rapid Telephone & Telegraph Company which has 110 subscribers. The rates are $15 and $22 per annum, and business increases yearly.

MIDDLEBURY, VT.—The Addison County Telephone Company is erecting a new exchange building which will be ready in December. Mr. A. F. Calhoun, treasurer, reports a large development of the system which now has 300 subscribers. Western Telephone, Kellogg, and North apparatus is used.

PORT WING, WIS.—A. L. Johnson and others have incorporated the Port Wing Telephone Company. The capital is $5,000.

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ELECTRIC LIGHT AND POWER.

DADEVILLE, ALA.—Bids are wanted Oct. 15 for furnishing for the electric light and power plant; two 60-kw single phase, 133-cycle, slow-speed, belt-driven alternators of 2300 volts, with switchboard and station transformers complete; 16, 20, 50 and 100 light transformers; 15 110-volt, 6 amperes arc lights; also one pair 20-in. twin water wheels to work under 385 ft. head. J. R. Hall is the engineer.

BENSON, ARIZ.—C. T. English, of St. Paul, Minn., has prepared plans for an electric generating plant for the Minnesota Gold Mining Company to be constructed at the fall in Colorado River, 25 miles below the Grand Canyon.

LOS ANGELES, CAL.—The Pacific Light & Power Company, of this city, has made application for a franchise to construct and operate an electric light and power system in Alhambra. A. C. Balch is manager.

SAN FRANCISCO, CAL.—The Nimshew water power electric plant, which has been constructed by the Valley Counties Power Company, a sub-company of the California Gas & Electric Corporation, is now ready for operation. It will tie in with Bay Counties Power Company's transmission line and it can supply about 3,000-hp. The plant has been in course of construction nearly two years and its capacity will be increased as the work goes on.

SAN FRANCISCO, CAL.—The Mutual Electric Light Company, of San Francisco, in which D. O. Mills, P. B. Cornwall and Alvinza Hayward are interested, has decided not to enter the gas and electric lighting combination. In accordance with the merger plan the electric and gas plants owned by Claus Spreckels were purchased by the San Francisco Gas & Electric Company and the arrangements for the actual consolidation of the offices and harmonious operation of the several plants are progressing favorably. The Mutual Electric Light Company has issued bonds to the amount of $400,000 which will provide for the construction at once of a modern steam power, electric generating station, which, it is claimed, will give the best results with the heavy competition.

DOUGLAS, GA.—The citizens have voted to issue $20,000 bonds for water works and an electric light plant.

HILLSBORO, ILL.—The capital stock of the Hillsboro Electric Light & Power Company has been increased from $18,000 to $20,000.

FT. WAYNE, IND.—Hubbell & Company, of Xenia, Ohio, have submitted a proposition to the Council to construct an electric plant for the city.

TELL CITY, IND.—The City Council has decided to either buy or lease the electric light plant. The company owning the plant asks $10,700 for it.

GREEN CASTLE, IND.—It is reported that the two electric light companies and the gas company of this city will be consolidated and operated under one management.

ELKHART, IND.—The Elkhart Power Company has filed articles of incorporation with a capital stock of $500,000. Governor Durbin, Walter Brown and Vernon W. Van Fleet, of Elkhart, are interested in the company.

SHOALS, IND.—The Indiana Hydraulic Power Company has filed an instrument of appropriation to condemn sufficient land for the construction of a hydraulic plant to generate electricity. It is proposed to dam White River at Hindostan Falls.

OWENSVILLE, IND.—An electric plow manufactory is being built in this city by Evansville capitalists. A four-share plow capable of breaking ten acres of land in ten hours, at a cost of $5, will be manufactured. The company is incorporated with a capital stock of $1,000,000. George P. Heilman is secretary and treasurer.

NEWCASTLE, IND.—The Newcastle Light, Heat & Power Company has authorized the issuance and sale of $15,000 of preferred stock of said company, for the purpose, it is stated, of securing funds with which to make extensive improvements and the installation of new machinery. John S. Hedges is president and L. F. Wayman, secretary.

INDIANAPOLIS, IND.—A portable electric outfit for farmers' use was exhibited at the Indiana State Fair. It consists of a gasoline engine of 4-hp, a dynamo, switchboard, wire, etc. The equipment will give a farmer fifty lights for his home and provide power to run fans, grind feed, pump water and supply hot water for the bath from a tank on the engine. The equipment costs $400.

JUNCTION CITY, KAN.—The stockholders of the Junction City Electric Railway, Light & Ice Company have voted to increase the capital from $100,000 to $300,000. This increase was made necessary by the company's plans to improve its plant to carry out contract with the government for lighting Ft. Riley.

VIDALIA, LA.—The citizens have voted to issue $12,000 bonds for water works and an electric light plant.

MITTINEAGUE, MASS.—Casper Ranger, of Holyoke, has secured the contract for the power house of the Worthy Paper Company. A 350-hp engine will be required.

NORWOOD, MINN.—Bids will be received Oct. 19 by Ernest Meyer, Village Recorder, for $4,000 lighting plant bonds.

WELCOME, MINN.—Bids are wanted Oct. 10 for $9,000 water and lighting bonds. R. P. Child is the Village Recorder.

MANKATO, MINN.—On Sept. 24 the city awarded the contract for lighting the city to the Mankato Gas & Electric Light Company for 10 years at the following prices. 100 or more enclosed arcs 2,000-cp, $65 per year, 50 or more 32-cp incandescents, at $19 per year, to be all night service on Philadelphia schedule.

MARYVILLE, MO.—The Maryville Light, Heating & Improvement Company is reported incorporated, with a capital of $200,000, by Richard M. Bradbury, Chas. C. Graves and others. The new company will operate in Maryville and other points on the line of the new electric railway. It will furnish light or power.

SOUTH RIVER, N. J.—The Sayre & Fisher Company, of Sayreville, has secured the contract for constructing the electric light plant at a probable cost of $6,500.

FORT BAYARD, NEW MEX.—An electric light plant is to be installed at this United States government post. It will have a capacity of 1,200 incandescent lights. Capt. H. M. Powell, Q. M., U. S. A.

SHELBY, N. C.—The Lily Mill & Power Company, which proposes to develop a big water power for electric purposes near Shelby, has been organized. The plant will cost $200,000. J. H. Ransom, of Lincolnton, N. C., was elected secretary and treasurer.

CHARLOTTE, N. C.—It is reported that the Charlotte Consolidated Construction Company, of which E. D. Latta is president, may inaugurate a big water power development on the Catawba River at Mt. Island for electrical transmission to Charlotte. It is stated that the Highland Park Manufacturing Company, of Charlotte, will also develop a $100,000 water power on Sugar Creek.

OAKHILL, OHIO.—D. C. B. Harrison has secured a franchise for water works and an electric light plant.

LOCKLAND, OHIO.—An ordinance has been introduced in the Council granting a franchise to the Cincinnati Gas & Electric Company.

ELRENO, OKLA. TER.—It is stated that the Elreno Light & Power Company will make extensive improvements in its power plant. John A. Masters is general manager.

BRISTOL, TENN.—The United Gas & Electric Company, New York City, is reported to have purchased an interest in the plants of the Bristol Gas & Electric Company and the Bristol Belt Line Railway. It is stated that the new company will expend about $200,000 in improving the gas plant and railway. Electric wires are to be extended throughout the city, and service generally improved.

GRANBURY, TEX.—It is reported that the Granbury Milling Company will install an electric plant, to furnish the town with light.

MILFORD, TEX.—The Milford Milling & Ginning, Ice, Light & Power Company, of Milford, has been incorporated; capital, $10,000. R. F. Tozier, of Milford, is one of the incorporators.

CORPUS CHRISTI, TEX.—The Corpus Christi Electric Light & Power Company has been incorporated, with a capital of $20,000, by W. B. McCampbell and E. P. Gibson, of Corpus Christi, and M. R. Boen, of New Orleans, La.

AUSTIN, TEX.—The state of Texas will not establish its own water and electric light plant as was provided for by the Legislature at its last regular session and for which an appropriation of $155,000 was made. A careful investigation by the State Board which had charge of the matter led to the conclusion that it would be cheaper for the state to obtain its water and light supply from the city of Austin than to establish a plant of its own. A contract for a period of six years has therefore been entered into with the city for furnishing and hanging lighting fixtures in the state capitol. D. B. Garrison

OLYMPIA, WASH.—Bids will be received Oct. 10 by the State Capitol Commission for installing and erecting an electric lighting and power plant, and furnishing and hanging lighting fixtures in the State Capitol. D. B. Garrison is secretary.

TACOMA, WASH.—Several prominent men at Cape Nome are interested in a project to supply the entire Seward peninsula with electric and water power for mining on a large scale. It is proposed to utilize several mountain streams which have an estimated aggregate of about 100,000-hp. Electric power will be transmitted to Nome and all mining districts on the Seward peninsula. At present steam plants are being used, but the cost of machinery and fuel is very high and they can be only employed where the ground is very rich.

MADISON, WIS.—The Great Northern Power Company, incorporated under the laws of Minnesota with a capital stock of $100,000, has filed articles to operate in Wisconsin. The capital represented in Wisconsin does not exceed $25,000.

KENOSHA, WIS.—The plant of the Kenosha Gas & Electric Company was destroyed by fire on Sept. 20. It is proposed to rebuild at once at a cost of from $10,000 to $15,000, exclusive of building which is in course of construction.

SAN LUIS POTOSI, MEX.—D. J. Spillane and associates have under consideration the establishment of a large electric generating plant at a waterfall situated on the Tanchachin hacienda which they recently purchased. This waterfall is 272 feet high and of large volume.

SHERBROOKE, QUE.—Ross & Holgate, Montreal, have prepared plans for the development of water power of St. Francis River at Westbury Basin. The probable cost of the work is $200,000.

WINNIPEG, MAN.—The Council is considering propositions to develop water power in the Assiniboine made by the Great Falls Company and the Winnipeg Power Company.

THE ELECTRIC RAILWAY.

REDWOOD CITY, CAL.—A franchise of fifty years has been granted to W. A. Clark and H. P. Bowie for both electric and steam railways from San Mateo across the mountains to Half-Moon Bay.

BRISTOL, CONN.—The Bristol & Plainville Tramway Company has voted to increase its capital from $100,000 to $150,000 to carry out contemplated improvements. The present stockholders will be given first opportunity of purchasing.

HOOPESTOWN, ILL.—The Hoopestown Street Railway & Light Company has been incorporated to operate street railways and electric light plants. Capital, $10,000. Incorporators: James H. Dyer, John L. Hamilton and Jacob C. McFerrin.

KEWANEE, ILL.—The Kewanee Short Line Electric Railway Company will probably begin the construction of its line this winter, as one link will run to the company's new mine between Kewanee and Annawan. Power to operate the road will be secured from the Kewanee Mining & Manufacturing Company. None of the other details have been worked out. The officers of the company are F. H. Davis, president; H. S. White, secretary; W. V. Eddy, treasurer and electrician.

SOUTH McALESTER, IND. TERR.—The Indian Territory Traction Company has completed its electric railway to South McAlester. The line will be extended to Hartshorne, Ind. Ter. It is the first electric road to be built in Indian Territory.

MARION, IND.—Arrangements have been made for the merging of the Marion Light & Heat Company with the Indiana Northern Traction Company; that it is building an electric railway from this city to Wabash and other points south of Chicago. According to plans agreed upon, a mammoth power house will be erected in North Marion sufficient to furnish power for the traction lines and also to furnish to present and future patrons light, heat and electric power. A contract has been let for the building of the road.

HAMMOND, IND.—At a spirited meeting of the Council, Russell B. Harrison, who represents the Chicago, Michigan & Indiana Traction Company, made an effort to obtain a fifty-year franchise. Charges were made that the company is simply trying to obtain the franchise so that it may sell out to the South Chicago City Railway Company. Besides the old company there are four others that are interested. The Chicago, Indiana & Michigan Company is one; another is the Indiana Union Traction Company, which is building interurban lines throughout the Hoosier state, and which recently obtained a fifty-year grant from the Council. J. A. Hanna, of Cleveland, is behind the Air Line road, so-called. It wants a fifty-year grant from the Hammond Council. A street railway builder named Sam A. White, who is constructing a line in Laporte County, is also attempting to secure privileges from the Hammond Council.

IOWA CITY, IA.—The Iowa City, Kalona & Washington Railway Company has been incorporated with $50,000 capital stock.

DES MOINES, IA.—The Burlington Interurban Railway Company has filed articles for the construction and operation of a line running west from Burlington through Des Moines, Lee, Henry, Van Buren and adjacent counties. It is capitalized at $200,000. Its officers are: President, Carl Leopold; first vice-president, W. W. Copeland; second vice-president, Charles Blaul; treasurer, Charles Armknecht; secretary, J. W. Topping.

WICHITA, KAN.—The question of issuing $30,000 in bonds to aid in the erection of the Arkansas Valley Interurban Railway will be submitted to the vote of the people.

LOUISVILLE, KY.—The Louisville & Southern Indiana Traction Company has leased the New Albany Street Railway Company for twenty-five years. The consideration is that the Louisville & Southern Indiana Traction Company shall pay an annual rental of $500 a year, commencing Aug. 1, 1903; that the company is to assume the payment of $250,000 bonded indebtedness of the street railway company guaranteed by the United Gas & Electric Company, of New Albany and Jeffersonville, together with the 5 per cent interest on such bonds which were issued Aug. 1, 1902, and that the company is to pay all taxes and fixed charges on the street railway system.

BOSTON, MASS.—The Boston & Northern Street Railway Company has petitioned the Railroad Commissioners for authority to issue additional capital stock to the amount of $380,000 for the payment of floating indebtedness and the purchase of additional equipment.

LOWELL, MASS.—The Boston & Northern Street Railway Company has begun preparations for a double track between Lowell and Lawrence. Surveys have been made and German rails have been ordered. It is expected that with the double track the trip between the two cities will be made in 45 minutes.

ST. JOSEPH, MO.—The St. Joseph, Savannah & Northern Street Railway Company has filed articles of incorporation, with a capital stock of $10,000. The stockholders and directors are Charles F. Booher, Isaac Williams, Collins F. Newton and Willis G. Hine. All live in Savannah.

BATTLE MOUNTAIN, NEV.—Articles of incorporation of the Reno Suburban Railway Company have been filed. The incorporators are T. F. Dunaway, W. J. Westerfield, H. J. Gosse, A. J. Clark and John Wagner. The capital stock is placed at $100,000.

NEWARK, N. J.—The Public Service Corporation, which controls all the electric railways in Essex, Hudson, Union and Passaic counties, has entered into an agreement with the Amalgamated Association of Street Railway Employees of America providing for a uniform wage rate of 22 cents per hour for motormen and conductors, an increase of three cents.

NEW YORK, N. Y.—It is reported that the Pennsylvania Railroad Company is behind the Hudson & Manhattan Railroad Company and the two tunnels it proposes to build from Cortlandt Street and Fulton Street to Jersey City. The Hudson & Manhattan Railroad Company was organized under the New York laws with a capital stock of $3,000,000, and William G. McAdoo is president.

GLOVERSVILLE, N. Y.—The Mountain Lake Electric Railroad Company, of Gloversville, which was reorganized after the wreck last year, is about to increase its capital stock in order to secure funds for extending the line into the city of Gloversville. The cost of the extension will be about $40,000. New cars and additional equipment for the power house will be purchased.

CENTERPORT, N. Y.—An agent representing a syndicate of capitalists is canvassing the property holders along the highway with a view to obtaining their consent to a right of way for the purpose of building an electric railway from Oyster Bay along the shore front through Centerport to Northport. Ultimately the road will be extended in both directions, starting at Flushing and reaching eastward as far as Orient, it is claimed. Papers of incorporation, it is said, are to be filed within a short time.

CLEVELAND, OHIO.—The promoters of the Muncie, Hartford & Fort Wayne Traction Company have placed the contracts for the construction of the Bluffton branch. It is the intention to have the branch in operation this winter.

YOUNGSTOWN, OHIO.—The Pennsylvania & Mahoning Valley Railway Company is installing a new unit of 300-kw capacity with which to take care of the increased load added through the building of the new Mahoning Avenue line and the new line to Struthers.

PROSPECT, OHIO.—The plant of the Prospect Electric Light Company has passed into the hands of the Columbus, Delaware & Marion Railway Company. The new owners are planning to enlarge the plant, with a view to providing power temporarily for the northern division of its railway system.

CLEVELAND, OHIO.—As the result of the change of control of the Cincinnati, Dayton & Toledo Traction Company the general offices of that company have been removed from Cleveland to Cincinnati. The executive committee of the company held a meeting recently and decided to enter into negotiations with the Interurban & Terminal Company for the use of that company's terminal station on Sycamore Street for the freight and express department of the Cincinnati, Dayton & Toledo. It was also decided to bring the Cincinnati, Dayton & Toledo cars directly into the city either by building a new line on a street not now occupied by the Cincinnati Traction Company or by laying a third rail on one of the city lines.

CLEVELAND, OHIO.—On Sept. 15 sleeping cars were placed in commission on the interurban line between Indianapolis, Ind., and Columbus, Ohio. Orders have been placed for twenty-four cars, sleeper and combination sleeper and diners, and within eighteen months the routes covering Ohio, Pennsylvania, New York, Wisconsin, Indiana, Michigan, Illinois and West Virginia will be equipped with the cars. Buffalo is at present the Eastern terminus of the Appleyard interurban electric roads; Milwaukee, the northwest terminus; St. Louis, the southwest, and Chicago, Terre Haute, Indianapolis, Cincinnati, Dayton, Springfield, Zanesville, Wheeling, Pittsburg, Columbus, Cleveland, Toledo, Detroit and Port Huron are the principal cities to be reached by the syndicate.

MONONGAHELA, PA.—Donora capitalists have organized a new company, to be called the Monongahela & Clairton Street Railway Company. The directors and officers are: President, J. M. Mullen; secretary, Oliver S. Scott; treasurer, Herbert Ailes; directors, William H. Burns, B. W. Castner, John Ailes, Paul McCully, John G. Parke, Jr.

BANGOR, PA.—The Northampton Traction Company is installing a 200-cell battery near this place to help the cars on this end of the Easton line. The battery will be housed in a building 30 ft. x 70 ft., and the whole equipment will cost about $10,000. The power house is located along the Bushkill, below Tatamy, 12 miles away, and the additional current is needed on the long and heavy grades in this section.

PHILADELPHIA, PA.—At the annual meeting of the Union Traction Company the old board of directors was re-elected with the exception of Charles O. Kruger, who was succeeded by Robert A. Balfour. The board is made up as follows: William L. Elkins, Alexander M. Fox, John B. Parsons, William H. Shelmerdine, J. J. Sullivan, P. A. B. Widener, George D. Widener, George W. Elkins, Robert A. Balfour, John M. Mack, George H. Earle, Jr., Joseph E. Widener. The Philadelphia Rapid Transit Company elected two directors, John B. Parsons and George D. Widener, for four years, as under the by-laws of the company only two directors are required to be elected each year.

HOUSTON, TEX.—The City Council has granted a franchise for twenty-one years for the interurban electric railway between Houston and Galveston.

BEAUMONT, TEX.—It is stated by H. F. Thayer, of New Orleans, representative of the Carnegie Steel Company, that another interurban electric railway system is projected by a syndicate of capitalists which is being organized for that purpose. The proposed system will center in Beaumont and will extend to several adjacent towns.

JAMESTOWN, VA.—The Jamestown, Island Park & Land Company of Virginia proposes, among other extensive improvements, to build an electric railway from Jamestown to Williamsburg, Yorktown and other points; also a branch line from Gloucester Point to Mathews Courthouse. Part of the route will be completed by November 1. The capital stock of the company will be $2,000,000.

SNOHOMISH, WASH.—The City Council has passed an ordinance granting a franchise to W. M. Snyder for an electric railway through the city. Mr. Snyder represents the company of Snohomish citizens formed some time ago to build a trolley line from Snohomish to Cherry Valley, taking in the city of Monroe en route.

VERA CRUZ, MEX.—J. W. Miles, chief engineer of the Mexican Railroad, is making a survey for an electric railway line that is to be built here. It is reported that a syndicate of English capitalists are interested in the project.

NEW INDUSTRIAL COMPANIES.

THE SAFETY THIRD RAIL COMPANY has been incorporated in New York to manufacture electrical apparatus, etc. The capital stock is $500,000, and the incorporators are Lauron Ingels, John G. Miller, of New York, and H. S. White, of Brooklyn.

THE FEDERAL ENGINEERING AND CONSTRUCTION COMPANY has been incorporated in Jersey City with a capital stock of $125,000. The incorporators are Bissing Reed, W. Riley Weaver, Baltimore, Md., and F. P. McDermott, Jersey City, N. J.

LEGAL.

MARCONI LITIGATION.—The Marconi Wireless Telegraph Company and Reginald Fessenden, a resident of Virginia, are defendants in two suits for infringement instituted in the United States Circuit Court at Trenton, N. J., on October 5, by the International Wireless Telegraph Company. The plaintiff claims to have purchased from A. Emerson Dolbear, of Somerville, Mass., certain patents for a system of wireless telegraphy granted on Oct. 5, 1886. Dolbear in an affidavit sets forth that he was the original inventor of the system. He charges that the Marconi Company has been aware of his patent rights and has been repeatedly warned that it was infringing them. The International Company seeks an injunction and damages.

WESTERN UNION RAILROAD POLES.—A further step was taken on October 3 in the fight between the Pennsylvania Railroad Company and the Western Union Telegraph Company, when Judge Joseph Buffington, in the United States Circuit Court at Pittsburg handed down an opinion in an equity case in which the telegraph company was plaintiff and the Pennsylvania lines west defendant. The Court says: "After full consideration we are of the opinion the present agreement conveyed no intent or easement in realty. We are also of opinion the relation between the parties was one of joint ownership, but the extent of that ownership or interests is not here involved or determined." The decree sustains the demurrer of the railroad, but the court's ruling of joint ownership will prevent any attempt at cutting down the poles.

PERSONAL.

MR. E. R. KNOWLES, E. E., has just been retained as consulting engineer by the Federal Refining Company, of New York.

MR. FRANK JONES, a veteran telephone manager in South America, is again visiting this country, but leaves immediately for London, where he makes his headquarters.

MR. L. W. SERRELL, M. E., has an interesting review in *Cassiers Magazine* for October, of the electric railways of the United States, showing succinctly the financial and technical results of 15 years.

MR. C. W. BARTLETT, the Nebraska representative of the Stromberg-Carlson telephone interests, is now located at 1635 South Twenty-Second St., Lincoln, Neb. His previous address was at Kansas City, Mo.

MR. I. McMICHAEL, District Superintendent of the Western Union Telegraph Company, with headquarters in Minneapolis, has resigned to accept the vice-presidency and general managership of the Northwestern Telegraph Company of Canada, with headquarters in Toronto.

MR. ISIDOR STERNFELD, who was formerly head of the electrical department of the Mexican house of G. and O. Braniff, Mexico City, which represents the interests of the Westinghouse people and other prominent American manufacturing concerns, is now the general manager of the firm. He has succeeded H. J. Bischoff, who has retired.

MR. HENRY RUSTIN, chief electrical and mechanical engineer, World's Fair, St. Louis, has recently returned to his work after a six weeks' vacation in Colorado, etc. He is said to have been greatly run down by his arduous task in making preparations for the vast plant and for its operation next year; but it is some satisfaction to report his resumption of duties.

MR. HENRY W. GOODE, president of the Portland General Electric Company, of Portland, Oregon, recently left San Francisco for a trip to the Eastern States in the interests of the Lewis & Clark Exposition, of which he is director general. The Exposition will be held at Portland in 1905. There will probably be some unique electrical effects at the big historical fair.

MR. JULIUS H. WEST, consulting telephone and telegraph engineer, of Berlin, Germany, is now visiting this country, not having been here since 1893, when he attended the World's Fair at Chicago and the Electrical Congress. Mr. West will now spend probably a couple of months here looking up telephone, fire alarm, burglar alarm and police call development in particular.

MR. P. JUNKERSFELD, of the Chicago Edison Company, is recovering from a somewhat prolonged illness, which was brought on to a great extent by a too close application to work. The members of the Institute will be glad to hear that Mr. Junkersfeld will soon be able to again take an active part in the work of the Institute, of which he was elected local secretary last spring.

HOLBROOK-JOHNSON.—Announcement is made of the marriage in Milwaukee of Miss Jennie Johnson to Mr. Frederick M. Holbrook, technical expert of the Chicago branch office of the Crocker-Wheeler Company. Mr. and Mrs. Holbrook are now on an extended trip, embracing Niagara Falls and the White Mountains of New Hampshire, and are visiting relatives in New York State.

MR. C. P. ELIESON, of London, England, a well known advocate of the Plante type of storage battery as well as an indefatigable inventor in that field, is again in this country on matters connected with some of his latest work in batteries. It may be remembered that in 1892-3 Mr. Elieson equipped an experimental storage battery line at Mt. Vernon, N. Y., on which some interesting trials were made.

MR. THOS. E. CLARK, president and general manager, and Ackland Stiling, advertising manager of the Thos. E. Clark Wireless Telegraph-Telephone Company, of Detroit, Mich., have been on a trip to St. Louis, Mo., on matters pertaining to the company's exhibit at the St. Louis Exhibition. It is their intention to have one of the most attractive exhibits in the electrical line, embodying many features of novelty.

MR. W. H. ZIMMERMAN, for the past two years on the engineering staff of the Arnold Electric Power Station Company, of Chicago, and a graduate in mechanical engineering of the University of Illinois, class of '97, has accepted the position of general manager of the DeKalb-Sycamore Electric Company, of DeKalb, Ill. This company operates lighting plants at DeKalb and Sycamore, and also six miles of road between the two towns.

HON. GARDINER C. SIMS, of Providence, R. I., has recently been a visitor to New York, a city where he has not often been seen of late years, although he still manages to keep in touch with many old electrical friends. His work in helping to break the big trolley strike at Pawtucket is not forgotten; while as a police commissioner of Providence he has been doing splendid work along broad and rational lines of reform and business administration.

GENERAL HENRY IDE WILEY, who is consulting engineer for the Yaqui Copper Company which is to build a large hydraulic power plant to operate its mines, etc., in the State of Sonora, Mexico, is now in Mexico preparing plans. Shortly after his return to New York, Oct. 25, some important contracts are expected to be awarded. The capacity of the plant will be at least 5,000 hp. The company's offices are in the Broadway Maiden Lane Building.

MR. W. NELSON.—A special telegram from Canajoharie, N. Y., of October 3, says: While trying a new motor attachment for a bicycle which he himself had made, William Nelson, an employee of the General Electric Company of Schenectady, fell from the machine on a hill opposite the home of his father-in-law, William H. Sterling, at Mapletown, this afternoon, and was instantly killed. Nelson was regarded as an inventor of much promise. He was only twenty-four years old.

SIR CHARLES H. T. D. METCALFE, the well known railroad builder in South Africa, and I. F. Jones, manager of the Chartered Company, have sailed from Liverpool on the Campania on an important mission to the United States. They intend to spend a month investigating the industrial and railroad methods employed in America, and especially to examine the system by which the power of Niagara Falls is utilized, with a view to applying similar methods in harnessing the Victoria Falls on the Zambesi River, in South Africa.

MR. L. C. VAN NESS, general manager of the Lincoln (Neb.) Gas & Electric Company, has been asked by President Edgar to report to the twenty-seventh convention of the National Electric Light Association, to be held in Boston next May or June, on lost and unaccounted-for current. Mr. Van Ness made a report on this subject at the Chicago meeting. He has been giving the matter considerable further study since that time, and hopes to make the next report much more valuable and interesting than any former ones.

MR. V. A. KAJEVNIKOFF, formerly chief mechanical engineer of the Chinese Eastern Railroad, in which capacity he has visited the United States twice within the last two years and placed contracts for electrical equipment, machine tools, etc., representing an expenditure of considerable over $1,000,000, is expected to arrive on this side again very shortly with a view to closing some substantial contracts for the Trans-Caspian railroad of which he is now the chief constructing engineer. Prince Hilkoff, the Russian minister of ways and communication, has passed on the specifications which call for the expenditure of more than $50,000,000.

MR. W. MARCONI was a passenger for Liverpool on the Cunard Line steamship *Lucania*, which sailed on October 3. Special apparatus was installed on the ship by means of which Mr. Marconi hopes to receive messages from the land stations in England during the entire trip. An invention which he completed recently will be tried for the first time. If it is successful, the inventor says, it will demonstrate further the commercial value of wireless telegraphy. The apparatus on the ship has been altered to make it as near as possible to that of the land stations, with the wires vertical where formerly they have been rigged horizontally. Mr. Marconi will conduct the tests in person.

MR. C. T. FREID.—Advices from West Orange, N. J., state that Mr. Calvin T. Freid, once an assistant of Thomas A. Edison, has made a demonstration of an invention of his which he calls a "non-cavitating, balanced screw propeller." Mr. Freid has on exhibition at his laboratory a dry ore separator, the essential part of which is the propeller, or rather a modification of it, and by its use he says he can reclaim 95 per cent. of the ore. It is intended to be operated in regions where the hydraulic system is impracticable because of lack of water. It is said that the propeller can also be used in hat making processes, for the propulsion of vessels, for which it is primarily intended, and in ventilating plants. Mr. Freid was for five years a master mechanic at Mr. Edison's laboratory and left to take up his private line of investigation.

OBITUARY.

MR. FRANK V. CLARK, master mechanic of the Varley Duplex Magnet Company, of Phillipsdale, R. I., died last week from injuries sustained at the crossing there of the East Providence of the Consolidated Railroad, near the American Electrical works. He was struck by a locomotive before becoming aware that it was upon him, and his wounds and fractures were too serious to permit recovery. He was only 28 years of age and had been three years with the Varley Company.

EDUCATIONAL.

THE UNIVERSITY OF CALIFORNIA is represented in the field of college technical journalism by the *California Journal of Technology*, which enters into its second volume with the September issue. Mr. Robert Sibley, of the class of 1903 is editor-in-chief, and Mr. Arthur H. Halloran, of the class of 1904 is manager. The current issue gives an excellent description of the Mariposa County high tension transmission system by the editor-in-chief. Other articles are on the quantitative determination of lead and the interference of calcium and barium, by W. H. Radcliffe, Jr.; tests of two Santa Fe locomotives, by M. C. M. Hatch, and the refining of California petroleum, by Dozier Finley.

WORCESTER POLYTECHNIC INSTITUTE.—While in New York last week, President Engler had a conference with a number of the leading foundrymen from different parts of the country respecting the building and exhibit which the latter propose to have at the St. Louis Exposition next year. At that time it is proposed to erect and operate a model foundry, fully equipped with all necessary apparatus, and exhibiting in operation all the processes of modern foundry practice. An advisory committee consisting of many of the prominent foundry interests in the country has been appointed to organize the work, and of this committee President Engler is a member. The Worcester Polytechnic Institute has been invited to prepare complete plans for the building, having in mind special reference to ideal conditions as to light, heat, ventilation and sanitation, and to a maximum of economy and efficiency by convenience of arrangement and use of the best modern devices in machinery and methods. Besides furnishing space for all ordinary operations in iron, brass, aluminum, steel and lead, the building is to provide accommodations for a chemical laboratory, an exhibition room, a library and reading room, toilet room and shower baths. This foundry exhibit is designed to be primarily educational in its character, and during the entire time of operation at St. Louis it will be under the direction and charge of the Institute. The invitation to design the building comes as a result of the erection, a little over a year ago, of the new foundry building at the Institute which is acknowledged by all to be one of the very best and most complete plants of its kind in the United States.

Trade Notes.

THE CUTLER-HAMMER MFG. COMPANY has issued a neat blotter about automatic field regulators on which an illustration of the instrument appears.

LARGE EXHAUST HEADS.—The Burt Mfg. Co., Akron, Ohio, recently shipped two 15-inch, and one 12-inch Burt exhaust heads to the American Steel & Wire Co., Worcester, Mass.

THE FERRACUTE MACHINE COMPANY, Bridgeton, N. J., write us, we regret to state, that on Sunday, September 27, their building and the contents were completely destroyed by fire.

PAYOT, UPHAM & COMPANY announce the removal of their establishment in San Francisco to their own new building opposite their former quarters at Pine and Battery Streets.

THE EMPIRE ELECTRIC SUPPLY COMPANY, 57 W. Jackson Blvd., Chicago, is handling a full line of electric light, telephone and gas engine supplies, such as magnetos, spark coils, jump-spark coils, batteries, etc.

THE STANDARD UNDERGROUND CABLE COMPANY announces the removal of its San Francisco office, Oct. 1, from the Mills Building, to more commodious quarters in the Crossley Building, at Mission and New Montgomery Streets.

"FEMCO" REFLECTOR LAMP.—In a handsome circular just issued, the Franklin Electric Mfg. Company, of Hartford, Conn., points out the advantages of the "Femco" reflector lamp, which are illustrated by a curve showing the excellent distribution of light its use assures.

THE STANLEY ELECTRIC MFG. COMPANY, of Pittsfield, Mass., announces the opening of two new sales offices, one at Cincinnati with headquarters in the Perin Building, in charge of Mr. O. H. P. Fant and the other in the Century Building, St. Louis, Mo., in charge of Mr. F. Johnson.

IRON-ARMORED CONDUIT.—The second edition of Bulletin No. 411 of the Sprague Electric Company comprises 48 pages, and its numerous illustrations render the publication a complete pictorial epitome of the art which it covers. A useful section is one illustrating all kinds of tools used in installing conduit.

CHANGE OF ADDRESS.—The Chase-Shawmut Company announces that it has purchased and equipped a new factory at Newburyport, Mass., at which place its main office will also be located on and after October 19. In the new quarters the company will have increased facilities to insure the prompt filling and shipment of orders.

UNITED TELPHERAGE COMPANY, 20 Broad Street, New York City, has issued Bulletin Nos. 39 and 40, the former devoted to the electrical handling of miscellaneous freight, by telpher, at railroad stations, wharves, etc., and the latter to the handling of coal, ashes, etc., by the same appliance. Some very interesting data are given on both subjects.

THE ROYSE-BATTY ELECTRIC COMPANY has incorporated at Indianapolis, Ind., with a capital stock of $10,000. The company will engage in the manufacture, sale and installation of electrical machinery, apparatus and appliances. The principal office will be at 26 West Maryland Street. Walter A. Royse is president and J. W. Batty, secretary.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has added two new catalogues to its list. The No. 19 is a telephone catalogue most complete in everything pertaining to telephone work. No. 20 lists the complete general line of electrical supplies, electric light, street railway, construction, etc. An up-to-date price list accompanies each catalogue.

IMPERIAL INCANDESCENT LAMPS.—The Bryan-Marsh Company has issued a circular calling attention to the merits of the new Imperial lamp, a valuable property of which is that it maintains its candle-power to the end of its useful life, when the filament burns out—the "smashing point" being thus automatically indicated and the lamp "smashed."

WIRELESS TELEGRAPHY.—The Thos. E. Clark Wireless Tel. & Tel. Company, of Detroit, Mich., has just issued Bulletin No. 9, giving data and facts relative to its apparatus. It also includes an article by Mr. Clark discussing the subject with the aid of diagrams. The apparatus is also shown in detail with cuts. Copies of this pamphlet can be obtained from the company on application.

THE U. T. HUNGERFORD BRASS & COPPER COMPANY, New York, is sending out a very handsome catalogue of its different lines of brass and copper goods. The catalogue is one of the most complete we have recently received and is indexed in such a manner that anything in the brass and copper line can readily be looked up. In this catalogue is also to be found tables of weights and measures and a special telegraphic code. Altogether it is a very useful publication.

ELECTRIC HEATING AT MACY'S.—One whole window at Macy's big store on Thirty-Fourth Street, New York City, is devoted to electric heating apparatus and has a large sign to that effect. The appliances shown are those of the Prometheus Electric Company. In the basement of the store is also a display of domestic aluminum utensils, and these are used in connection with the Prometheus goods, which thus enjoy a double demonstration of their value and utility.

RURAL TELEPHONY.—The North Electric Company, Cleveland, Ohio, has sent out through its advertising department a most tasteful and interesting pamphlet entitled "The Rural Telephone." It deals with a field of telephone work in which the North Company has been conspicuously a pioneer with a lot of good work to its credit; and to some extent this brochure reveals how the success was achieved, by enterprising methods, creditable apparatus and the satisfaction of a large number of persons to whom it would have been disastrous to entrust apparatus that was not able to stand much wear and tear and unintentional but serious hard usage.

BELT CONVEYORS.—The Link-Belt Engineering Company, Nicetown, Philadelphia, Pa., has recently brought out a new pamphlet describing its shallow trough belt coal and coke conveyors. This company has given careful and extensive study to this subject and has determined by actual experiments how belts for this class of work should be made, and of what material, to give the longest life and best results. The publication contains several half-tone views of plants in which these belt conveyors have been installed, and a table enumerates some of the more recent installations, the size and the class of material handled. All those interested in the transportation of materials about a factory or works will find in this pamphlet information of value and interest.

AUTOMATIC TELEPHONY.—The Automatic Electric Company, of Chicago, has just issued a very interesting and striking pamphlet devoted to its telephone system, its exchanges, its offices, its factory, and its apparatus and the processes of manufacture. An exterior view is shown of the new factory, corner of Morgan and Van Buren Streets, Chicago, and this is supplemented by a variety of interior views showing the automatic system in all its details of construction and assemblage. Views are also given of the exchange at Dayton, Ohio, and of other work. The company is already employing 800 hands in its factory and has a paid-up capital of $3,000,000 with no debts. Its system has lately been adopted for a number of large independent exchanges.

THE EUREKA ELECTRIC COMPANY, at its new factory, which is now running in full force, at Genoa, Ill., is manufacturing telephone receivers of bipolar type in various styles at the rate of one thousand a day. The Eureka Company claims this to be the largest output of telephone receivers of any factory in the world. It is quoting very interesting prices, owing to its large output of these goods which are illustrated in its catalogue No. 23. Its new full bulletins, two, No. 26, illustrate its large line of switchboard apparatus, central energy switchboards, line equipments, etc., together with the regular line of switchboard apparatus. Bulletin No. 27 illustrates its new devices and telephone apparatus not shown in No. 23 catalogue. It will be pleased to send this printed matter to concerns interested, upon application.

"HELLO, CENTRAL!"—That hazy "Central"—the place so long heard, but so seldom seen is not a modern Babel, delivered over to jarring voices, ringing bells, and general pandemonium. "Behind the Scenes at Central," the title of a lively article in the October *Booklovers Magazine*, describes minutely the wonderful and vastly expensive system now prevailing in a first-rate telephone exchange, with numerous photographic illustrations from actual scenes. Every step in the process is made clear, as well as the severe training which "the telephone girl" undergoes to fit her for swift and almost automatic action, and the opportunities given her for rest and recreation. The reader of this article is likely to have a much clearer and more sympathetic appreciation of the cost and effort expended in giving good telephone service.

STROMBERG-CARLSON LITERATURE.—The Stromberg-Carlson Telephone Mfg. Company, of Chicago, has just issued its bulletins Nos. 6 and 7. They are excellent trade literature, full of interesting and valuable data, and a number of good features have been introduced in the preparation of the bulletins. The loose leaf scheme has been adopted, with back pegging, so that each sheet stands alone and is detachable. Opposite each half-tone view of a telephone cabinet is shown a corresponding detail sectional drawing of it, adding greatly to a clear understanding of the subject. At the back of the book is a summary sheet which will be of great assistance to the purchaser in determining what he wants while enabling the manufacturer to make a price quickly. In No. 7 bulletin the jacks and keys relating to the generator call switchboard have been coded, which is a useful aid to the purchaser and net prices are also quoted on switchboard parts, which also appears to be quite a novelty.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 29, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

739,816. CONTACT STUD AND FIXING FOR USE WITH SURFACE CONTACT SYSTEMS OF ELECTRIC TRACTION; Benjamin H. Bedell, London, England. App. filed May 12, 1903. A contact stud of magnetic material having a movable block at its lower end which is attracted toward the conductor to make electrical contact therewith when a magnet carried by the car is presented to the stud.

739,819. ELECTRIC TRAMWAY OR RAILWAY RAIL; Henry M. Bigwood and Horace Bigwood, Wolverhampton, England. App. filed April 14, 1903. The tread is a separate piece from the web of the rail and a bonding plate is inserted between the two parts at the joints of the rail lengths.

739,823. PROCESS OF TREATING ANIMAL HIDES OR SKINS; George D. Burton, Boston, Mass. App. filed Nov. 8, 1898. (See page 608.)

739,845. ILLUMINATED SIGN, Samuel Evans, Oakpark, Ill. App. filed April 27, 1903. A cylinder carrying rows of lamps is rotated while a switch successively cuts the rows of lamps into circuit as they are presented at the front of the sign.

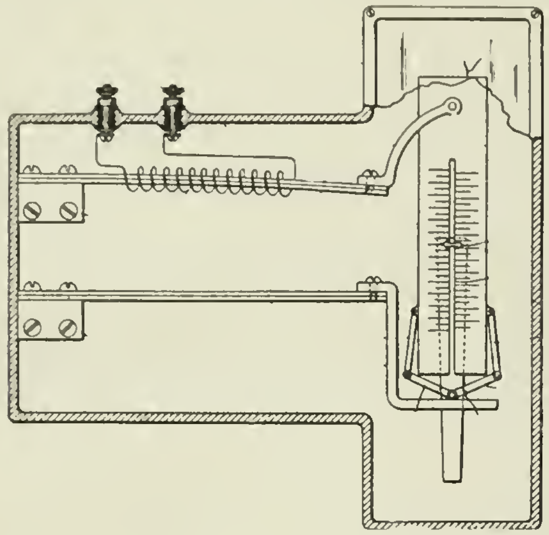
739,853. CONDUIT SECTION FOR MANHOLE TERMINALS; Guy M. Gest, Cincinnati, Ohio. App. filed July 12, 1902. A special construction of flaring mouth for the terminal of the conduit.

739,858. DOUBLE WALL BLOCK; George F. Hagerman, Chelmsford, Mass. App. filed May 11, 1903. A short verticial rod securely fixed in a bracket and having an insulator knob at each end, to which the two wires of a circuit are secured.

739,920 and 739,921. APPARATUS FOR TREATING GASES; Harry Pauling, Brandau, Austria-Hungary. App. filed April 2, 1902. (See page 608.)

739,947. CIRCUIT BREAKER; Emmett W. Stull, Johnstown, Pa. App. filed Jan. 2, 1902. A resetting magnet and its armature have co-operating portions which are substantially in contact with each other when the magnet is dead, but which separate to introduce the resistance of an air gap into the magnet circuit as the armature closes.

739,967. MAXIMUM OR INDICATING METER; James Wohl, Brooklyn, and Egisto U. Giovannoni, New York, N. Y. App. filed Dec. 12, 1902. Two parallel deflecting thermostats acting uniformly under variations of atmospheric temperature; one of them having means for applying a measurable quantity of heat thereto and means for measuring the resulting relative deflection.



739,967.—Maximum or Indicating Meter.

739,973. ELECTRIC LIGHT MOUNTING; Samuel H. Anderson, Los Angeles, Cal. App. filed Feb. 12, 1902. A spring clamping arrangement for fixing an arc lamp to a ceiling and at the same time making the electrical connection.

739,977. ELECTRIC ARC LAMP; Andre Blondel, Paris, France. App. filed March 26, 1902. In a lamp in which light-producing salts are introduced between the electrodes, an inverted pan is arranged above the arcs for the reception and condensation of the mineral vapors arising from the arc.

740,005. INSULATOR BRACKET; James F. Gilliland, Adrian, Mich. App. filed Dec. 11, 1902. The bracket has a longitudinal groove in its attaching face, which permits water to pass freely through, whether the bracket be fixed to a flat or curved surface.

740,034. STORAGE BATTERY; Job Thomas Niblett, Greenwich, London, England. App. filed Aug. 8, 1902. (See page 608.)

740,037. TROLLEY; Jacob M. Olinger, Vienna Crossroads, Ohio. App. filed Aug. 1, 1903. Details.

740,038. ELECTRIC CLOCK; William E. Palmer, Tonbridge, England. App. filed Nov. 24, 1902. Details.

740,062. ELECTRIC IGNITION DEVICE FOR GAS BURNERS; Henri De Thiersant, London, England. App. filed Oct. 10, 1902. Details.

740,074. MULTIPLE CONTROL SYSTEM FOR RAILWAY VEHICLES OR TRAINS; Louis M. Aspinwall, Wilkinsburg, Pa. App. filed Feb. 6, 1903. The invention relates to electro-pneumatic controlling systems, the main object being to provide improved means for insuring automatic step by step operation of each controller.

740,077. NON-REFILLABLE LAMP; Frederick W. Bartlett, New York, N. Y. App. filed June 21, 1902. An incandescent lamp provided with disruption means applied after the initial installation of the filament to prevent another installation of a filament.

740,101. METHOD OF OPERATING ELECTRIC MOTORS; William A. Dick, Wilkinsburg, Pa. App. filed Dec. 29, 1902. Operating a motor at variable speed from circuits of different voltages by supplying a low voltage to the armature and to a portion of the field winding for low speed, then introducing resistance into the field circuit, then cutting out the resistance and supplying a higher voltage to the armature and to all the field coils in series and finally introducing resistance into the field circuit.

740,105. TROLLEY RESTORING DEVICE; Charles W. Dowling, Newark, Ohio. App. filed Jan. 31, 1903. Details.

740,125. ELECTRIC HEATER, Josef H. Hallberg, New York, N. Y. App. filed Nov. 8, 1902. Metallic concentric cylinders through which water circulates, have secondary currents induced therein from a primary winding.

740,131. METHOD OF PRODUCING INSULATED ELECTRIC CONDUCTORS, John A. Heany, Philadelphia, Pa. App. filed May 9, 1902. The conductor is covered with an adhesive substance containing flocculent asbestos.

740,132. ELECTRIC ARC LAMP, John A. Heany, Philadelphia, Pa. App. filed Jan. 7, 1903. Details.

740,144. TROLLEY POLE, Phineas F. King, Cleveland, Ohio. App. filed Aug. 23, 1902. The trolley pole is locked at an inclined position in case the wheel leaves the wire.

740,166. ELECTRIC HOIST; Martin B. McLaughlin, Malden, Mass. App. filed March 29, 1902. The motor armature is contained in the drum of the hoist, the latter serving as the field magnet core and the invention being concerned particularly with the manner of carrying the conductors through the bearings to the armature.

740,171. CONTINUOUS AND PULSATORY CURRENT ELECTRIC MOTOR; Chester M. Palmer, Fond Du Lac, Wis. App. filed Sept. 23, 1901. A field magnet provided with two coils of the same magnetic direction and a source of continuous current connected with one coil and with intermittent current connected with the other.

740,173. VOLTAGE REGULATING APPARATUS; John S. Peck, Pittsburg, and Harve R. Stuart, Wilkinsburg, Pa. App. filed Oct. 13, 1902. An apparatus for raising and lowering the voltages of alternating current circuits where the currents or voltages are so high that they cannot be safely handled by the regulators ordinarily employed in such service.

740,174. MEANS FOR VARYING THE VOLTAGE RATIO OF TRANSFORMERS; John S. Peck, Pittsburg, Pa. App. filed Feb. 28, 1903. A transformer having a number of corresponding portions of one of its windings provided with interconnected leads, in combination with a switch connected to the leads for symmetrically varying the voltage ratio of the transformer.

740,175. RHEOSTAT; Thomas S. Perkins, Wilkinsburg, Pa. App. filed Nov. 13, 1902. A resistance structure comprising a set of grids of zig zag formation each of which has end limbs of relatively large cross section and terminating in bosses having plain surfaces perpendicular to the planes of the grids for connection purposes.

740,205. TROLLEY WIRE CROSSING; Oliver Vanorman, Los Angeles, Cal. App. filed June 2, 1903. Two members pivoted together each having oppositely disposed arms which are provided with channels for the reception of the feed wires.

740,240. ELECTRIC HEATER FOR LIQUIDS; Fernan O. Conill, Roxbury, Mass. App. filed April 9, 1903. A cylinder containing a core around which a heating resistance is wound, the structure being attached to a handle and intended to be thrust into a body of liquid to heat the same.

740,248. MEANS FOR LOCKING INCANDESCENT LIGHT BULBS; Chas. W. Dabb, and Chester E. Macduffee, New York, N. Y. App. filed Feb. 19, 1903. A key-operated lock is used to secure the base of the lamp in the socket.

740,254. THERMOSTAT; Leonard H. Des Isles, Cambridge, Mass. App. filed Jan. 19, 1901. Details.

740,260. LEAD-IN WIRE FOR ELECTRIC LAMPS; John C. Entriken and William S. Everett, Malvern, Pa. App. filed Aug. 21, 1903. A platinum coated leading-in wire is used in place of the solid platinum wire and the ends of the coated wire are sealed to prevent air from passing along the wire into the exhausted bulb.

740,261. ELECTRIC SIGNAL; Howard A. Fessenden, Detroit, Mich. App. filed May 6, 1902. Combined transmitting and receiving instruments at each station so constructed that the operation of the key at one station will indicate the signal adjacent to the corresponding keys at another station, while the operation of the latter key will indicate the return signal adjacent to the first operated key.

740,272. TROLLEY POLE CONTROLLER; Charles Harter, South Pasadena, Cal. App. filed July 9, 1903. Pneumatic cylinders are arranged to control the movements of the trolley pole.

740,284. EQUALIZING ELECTRIC COUPLING; Joseph Klopfenstein, Paris, France. App. filed Aug. 9, 1902. A system whereby low voltage lamps can be used with economy on high voltage circuits.

740,312. SIGNALING MECHANISM; John L. Ricketts, Philadelphia, Pa. App. filed Aug. 21, 1902. Details of a railway signaling system.

740,313. TROLLEY CATCHER; Charles B. Robertson, Ottumwa, Iowa. App. filed Dec. 13, 1902. Details of a pawl and ratchet and spring drum retriever.

740,314. INSULATOR; Charles B. Robertson and John J. Robertson, Ottumwa, Ia. App. filed Jan. 12, 1903. The head of the insulator is formed with angular slots for locking the wire in plate.

740,326. CABLE HANGER; Justus J. Smith, New York, N. Y. App. filed Feb. 4, 1903. Details.

740,357. CIRCUIT CONTROLLER FOR ELECTRIC FLASH SIGNS; Joseph H. Eastman and George L. Weaver, Boston, Mass. App. filed Jan. 8, 1903. A resilient connection is employed between the fixed and moving parts of the controller in order that the connection in each section of the controller may endure beyond the time corresponding to the actual position of the moving part and the transition to the next connection be made abruptly.

740,358. ELECTRICAL CONTACT CLAMP; Frederick J. Esmond, Vancouver, Canada. App. filed July 10, 1902. Details.

740,359. METHOD OF ELECTRODEPOSITING METALS; Charles R. Fletcher, Boston, Mass. App. filed May 28, 1900. (See page 608.)

740,369. SWITCHING MECHANISM FOR DOUBLE FILAMENT ELECTRIC LAMPS; John McCullough, Newark, N. J. App. filed Dec. 10, 1902. The lamp base is connected with the socket by a bayonet joint of such character that the rotation of the lamp to switch the filaments into and out of circuit does not separate the joint.

740,379. ELECTRIC FURNACE FOR THE MANUFACTURE OF FILAMENTS; William L. Voelker, Erie, Pa. App. filed March 13, 1902. The filament is passed through the furnace in a plane slightly eccentric to that of the electrodes, provision being made for deflecting the arc into the path of the filament.

Electrical World and Engineer

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THE GAS ENGINE AT THE ST. LOUIS EXPOSITION.

What promises to be one of the most interesting and important features of the St. Louis Exposition is the section that will be devoted to gas engines and gas engine producers. European manufacturers appear to have arrived at the conclusion that this country affords an excellent field for this class of prime-mover, and at least two of the leading makers have taken large space for exhibits. One of these is the celebrated Cockerill Company, of Seraing, Belgium, which will exhibit a 3,000-hp engine of the type utilizing blast furnace gas. A 600-hp gas engine of this type exhibited by the Cockerill Company at Paris in 1900 was generally considered one of the "clous" of that exposition. Another is the well-known Borsig Company, of Tegel, Germany, which will show a 1,500-hp Oechelhauser engine operated from a Pintsch gas producer plant of 2,400-hp capacity. In addition to this producer plant will be one from England of 3,000-hp capacity and a Wood American plant of 2,000-hp capacity. In Europe the gas engine for some time has occupied the place before the engineering public that the steam turbine has lately assumed in this country, and the faith in its future is indicated by the great expense which manufacturers there are willing to incur in seeking publicity for its merits. In view of this situation we hope that American gas engine and gas producer manufacturers will not allow themselves to be left in the background at St. Louis.

HIGH-SPEED SENSATIONS.

At the beginning of the last century, the Royal College of Bavarian Physicians sought to forbid steam railway travel, because it would induce delirium furiosum among the passengers and drive the spectators crazy; while an English quarterly said that it would as soon expect the people to suffer themselves to be tied to one of Congreve's rockets as to trust themselves to the mercy of a locomotive going at the prodigious rate of twelve miles an hour. This is about the tenor of some of the remarks we see and hear in respect to the Berlin-Zossen electric train running at the rate of over 125 miles an hour; and we begin to wonder just what is the speed that ought to provoke mental and physical difficulties on the part of the passenger and the spectator. We fancy there is a good deal of relativity about it, and some subjectivity. If people expect to enjoy weird and curious sensations because they are traveling at an unusual rate, those are the very sensations they are likely to get; but if speed is steadily increased by a vehicle without the passenger being aware of the fact, a gain of twenty or even forty miles an hour will not make much perceptible difference to him, provided the run is straight and the roadbed is good.

In the reports coming from Germany, we note this tense expectancy and hence it is no surprise to hear that the speed at Zossen "confused the senses and produced a sensation that was unlike any that even the imagination had pictured. Had it not been for the steel edged-like spirals of air that shot through every crack and crevice, scorching and burning and even seeming to pierce the flesh, we might have been detached objects forced through space at lightning speed." Then, too, the landscape got blurred, with "a peculiar effect on the eyes, seeming to catch hold of them and drag them backward," which is very interesting; but this keen and sensitive observer rather gives himself away by remarking that the passengers, after squirming at an annihilation of distance past comprehension, "asked themselves why it might not have been 225 miles an hour just as well." Exactly; and we venture to believe that when the great electric railroad systems of the future settle down to their 200-miles-an-hour stride, or whatever the speed may be at which the vehicles will hold together, the passengers will take it very complacently and wonder how we antediluvians endured anything less.

◆

The Electrolysis of Water Vapor.

A paper on this subject was read by Mr. F. A. Lidbury, at the recent convention of the American Electrochemical Society, which tends to show that electrolysis in gases may be a more complex process than electrolysis in liquids, so far as relates to the quantities of matter decomposed. The conclusion is drawn that in the partial decomposition of water vapor by electric discharges, the hydrogen and oxygen liberated tend to separate and to take up different positions in the tube, the hydrogen collecting at both anode and cathode, and the oxygen in the middle of the tube. This result is so anomalous by comparison with the action that takes place when discharges pass through water, instead of water vapor, that further experimental research should be directed to this matter. At first sight the result seems very improbable. In dealing with water vapor subjected to electric spark discharges, it has to be remembered that the heat of the discharge may be capable of decomposing the vapor into its constituent gases, and that complex results may occur when thermal dissociation is superposed upon electrolytic dissociation.

◆

Electrical Supply for St. Louis.

There is no more disheartening and thankless task than taking in hand the aggregated blunders of past years and trying to rectify them into a homogeneous whole. The report which we publish elsewhere of the electrical situation in St. Louis is typical of the conditions found in many large cities, and discouraging as the combination might look at first sight, it will doubtless be worked into satisfactory shape in the end. We never look at such a situation without devoutly wishing that some extraneous potency might, without causing loss of life, or of other property, step in and wipe out of existence all the existing systems, leaving nothing but the task of reconstruction. Such a catastrophe would save money in the long run and would give a chance at last for the lighting of a large city to be arranged without damaging compromises. As the case now stands, St. Louis has a fairly good, but terribly heterogeneous group of systems which have wisely been united. Competition in the electrical supply of large cities is nearly always a cut-throat sort of business, when it really exists far from likely to result in the best of service and quite certain to injure the business by encouraging shifty rates. By gathering all the supply companies into one it will be possible to set and maintain fixed and equitable rates, probably lower than the average rates are now, and by economies in production and distribution to bring even from lowered rates a better return on the capital invested than is now obtainable.

The engineering of such a proposition is always fraught with difficulties, and particularly where the component factors operate on different systems and at different voltages, as is generally the case. The main existing networks are single-phase, three-wire, with 110 and 220 volts in the secondaries, and a direct-current, three-wire network at 235 and 470 volts. There are also 500-volt, direct-current motor circuits, series direct-current arc lights, and a miscellaneous lot of isolated plants waiting to be taken on. Out of this chaos some sort of organization must be brought. A new power house is under construction, to be equipped with large three-phase generators, the current from which will be distributed at 6,600 volts and used as may seem expedient. The engineers follow the practice of the day in adopting the 25-cycles, thereby crippling their power of utilizing the big generators directly; but they are at least in the fashion, and if five years from now there has to be a change, why the same old "necessary improvement" plea will probably again meet the emergency.

The International Electrical Congress of 1904 at St Louis.

The International Electrical Congress of St. Louis is now definitely outlined, and its success will largely depend upon the support that American electricians and electrical workers will lend to the movement. The International Electrical Congresses of the past have done much for the advance of the science and arts of electricity. The British Association for the Advancement of Science appointed a committee, in 1861, to report on the selection of electrical units. The committee reported from time to time up to 1874, formulating the centimetre-gramme-second, or C. G. S. system of units, and also the quadrant eleventhet-gramme-second, or Q. E. S. system. The former was the fundamental scientific system, and the latter was a modification intended for practical use, with the ohm and volt as units. In 1881 (September 20), the first International Electrical Congress was held at Paris. It accepted and adopted the C. G. S. and Q. E. S. systems, created the farad, the ampere and the coulomb, and appointed a commission to redetermine the concrete value of the ohm. In 1884 another International Electrical Congress convened at Paris. It confirmed the volt, ampere, coulomb and farad and adopted a provisional concrete value for the ohm, called the legal ohm. A third International Electrical Congress was held at Paris in August, 1889. This congress created the joule and watt. It also defined the terms period, frequency, impedance, mean and effective currents and electromotive forces used in alternating-current technology. The next International Electrical Congress was held in the United States, at Chicago, in conjunction with the World's Fair of 1893 (21st to 25th August). At this congress the ohm, ampere, volt, coulomb and farad were confirmed and defined concretely under the title of "international" units to distinguish them from the "legal" or "B. A." values of preceding congress definitions. The henry was also adopted. The fifth International Electrical Congress was held at Paris in conjunction with the Exposition Universelle of 1900 18th to 25th August). It adopted the maxwell and gauss as titles for two C. G. S. magnetic units.

In addition to the official international work accomplished by these congresses in the establishment of units and standards, a very large amount of valuable work has been accomplished by them in the meetings of their sections. At Chicago thirty-three papers were read, twelve of which were presented by authors from abroad. There was also an important topical discussion. Owing to an imperfect preliminary organization, no funds were secured in advance for publishing these transactions. The transactions would have sunk into oblivion if the American Institute of Electrical Engineers had not assumed the tasks of printing and financing the publication. The transactions were published in 1894 in a handsome volume of 489 pages. The proceedings of the Paris Congress of 1900 have been published in two volumes, the first of 526 pages, which appeared in 1901, and the second of 318 pages, which has very recently been issued from the press. There were 920 members of this congress, of whom 469, or just about one-half, were French, while only about 42 were from the United States. The remainder, 409, were from various other parts of the world.

The transactions of an International Electrical Congress represent the permanent record of its achievement, and also represent the principal—almost sole—expense incurred in its work. It is highly desirable for the prestige of electrical America, that the International Electrical Congress to be convened at St. Louis next year, should be successful not only in its conventions and proceedings, but also in its records and published transactions. Ample accommodation has been promised by the St. Louis Universal Exposition for the congress and its sections, during the week September 12-17. We understand, moreover, that the section officers are being, or have been, appointed. The list will no doubt be published as soon as it is complete. Not only the American Institute of Electrical Engineers, but also various other national associations connected with electrical applications, have signified their intention to assist in the development of the congress. Invitations are now being issued to all who are interested in electrical progress, requesting their membership. The membership fee not only will entitle the member to attend any or all of the meetings of the congress, but will also secure a copy of the transactions which are to be subsequently published. We understand that the invitations to join the congress will be issued first to all members of national electrical organizations in this country and abroad, and second to libraries and societies who may naturally desire to secure the transactions without necessarily taking direct interest in the sessions.

It is stated that the committee of organization of the congress is about to send invitations to a number of prominent electrical workers in this country and abroad requesting the favor of specially-prepared papers to be presented in the section meetings at St. Louis, as the basis of discussion and subsequent publication; also that the State Department will be requested to invite the home and foreign governments to appoint official delegates to the congress. It is expected that at least ten thousand invitations to join the congress will be issued, about half of which will be to individuals and associations in the United States. If a prompt and adequate support is returned, there is every reason to expect that the impetus which past congresses have given to electricity and its applications will be successfully followed by the convention at St. Louis. It is fitting that the first International Electrical Congress held in America at the World's Fair of 1893 should have a worthy successor in connection with the St. Louis Exposition of 1904. It would be a great pity if the good example left by Paris in 1900 could not be followed successfully on this side of the Atlantic, and its influence further extended as an incentive to yet more fruitful results.

EXPERT TESTIMONY.

An interesting and somewhat amusing paper was that read before the recent Saratoga convention by Michael Brennan, Esq., dealing with some of the abuses conspicuous in actions of tort against corporations. His strictures are mainly against "damage lawyers" and incidentally against the expert testimony they invoke. There is no doubt that the damage lawyer and his expert are sometimes responsible for scandalous proceedings, but Mr. Brennan's suggested remedy is so naive as to be positively delicious. He suggests the revival of the old English statutes against maintenance and champerty, these being forms of malicious venal support of a suit brought by another, in which class Mr. Brennan would include the prosecution of damage suits on a contingent fee. It is obvious that such a step would simply license wealthy persons and corporations to accidentally maim or kill any member of the community too poor to employ eminent counsel, who as a class are seldom distinguished by a desire to work for nominal fees. Incidentally the knife would turn the other way and eviscerate the casualty companies, whose chosen business it is to defend, for a suitable stipend, suits against those insuring with them. It seems to us that there is a far easier remedy in the inculcation and enforcement of a sterner code of morals in the legal profession. A lawyer who seeks out damage cases to prosecute on shares with the help of perjured evidence certainly deserves disbarment if the offense can be proved. If it cannot be proved then it seems to us that Mr. Brennan is making rash accusations against his fellow members of the bar. With so potent a remedy as disbarment at hand, to say nothing of the statutes against perjury, it would seem that examples might well be made of a few offenders if the offense is as frequent as intimated.

The trouble is that counsel for the defense in such cases is very prone to assume that all cases are fraudulent and all damnatory expert evidence is perjured. We have, first and last, heard a good many tort and other cases involving expert testimony and have never yet been able to discern any difference in quality between the expert evidence for the plaintiff and that for the defendant, or between the moral codes of the respective counsel. The trouble lies very largely with the modes of procedure and the rules of evidence now in vogue. The latter seem specially suited to keeping the actual facts in the case from reaching the ears of the jury, and the former are admirably designed to encourage shady operations. There are doubtless expert witnesses to be found ready to support almost any fairly plausible contention, but as a matter of fact deception is often adroitly fostered by counsel in framing the questions. Under present practice the expert witness in a court case does not have the concrete case laid before him for his opinion, but is compelled to answer a hypothetical question involving just so much of the case at issue as counsel chooses. He is sworn to answer such a question truthfully, and so far as our observation goes, generally does so. His answer may or may not accord with the real facts in the case at issue, but this point he is not allowed to raise, being rigorously confined to the form of question asked. In cross examination he has to reply to still other hypothetical questions, skillfully framed to squint in the other direction, and often almost impossible to answer truthfully without conveying an impression almost wholly false to the casual listener. The result is that the experts for both sides, who on a joint investigation of the facts would probably agree very closely, are often compelled to support positions which seem to be diametrically opposite to the jury. Sometimes, of course, there may be honest differences of opinion, but many, perhaps most, of the apparent differences are due to adroit shading of the hypothetical questions for which the witness is in no wise responsible.

We heartily agree with Mr. Brennan that expert procedure ought to be radically changed, but in just what way is a question difficult to answer. We have sometimes thought that some relief might be obtained by removing the examination of experts from the hands of counsel entirely and placing it directly in the hands of the court. Even better seems the French procedure referred to by Mr. Brennan, in which the court, when technical questions arise, may direct their reference to a commission of experts acting in a quasi-judicial function under direction of the court as regards the issues to be considered. This method of action would certainly get at the facts and would give a weight and dignity to the opinions which they now generally lack. The present status of expert evidence is in every way unsatisfactory, both to the legal profession and to the experts themselves. In electrical cases, with which our especial interest lies, the abstruse nature of many of the considerations which arise renders expert testimony given in the usual way particularly unsatisfactory. Even in patent causes in which the procedure is far more direct than anywhere else, the expert testimony is generally needlessly elaborate and tedious, particularly in the cross examinations, which are usually wearisome and fruitless. A commission appointed by the court would be likely to lead to far more valuable results; and, lacking this, if the experts were merely directed to prepare technical briefs for submission with those of counsel, the court would be in a far better position than at present. Now the unfortunate justice has to wade through a technical slough of indefinite extent or trust to the more or less garbled extracts that find their way into the briefs. We hope that better days are at hand, but it seems difficult to get a reform started.

The Steam, Gas and Fuels Building at the St. Louis Exposition

Over a year ago Mr. Moore, chief of the machinery department of the Universal Exposition of 1904, claimed that the steam boiler, boiler appliance, gas producer and fuel handling exhibits would be adequately and creditably housed in a spacious building and that this building would be found in the center of the grounds and at the intersection of the main thoroughfares connecting the northern and southern and the eastern and western sections of the Exposition. To the outsider there seemed very little basis for this claim, but the physical evolution of the Exposition appears to substantiate Mr. Moore's prediction. What at first was a boiler house about 100 x 75 is now the Steam, Gas and Fuels Building, a steel construction, fireproof structure 320 x 300 ft. This building is over 60 per cent. completed and the installation of boilers in it is already progressing. The structure is particularly light and airy and all the arrangements are to contribute to the programme for making this building attractive not only to the engineering fraternity, but to the general public. It certainly is located at a point where, by the prominence of its location and the character of its surroundings, it can easily attract a full audience for its exhibitors.

The exhibits to be installed are intended to illustrate the most modern methods and economics in steam and gas generation and the handling and treatment of fuels. The illustration commences with the coal in 50-ton, hopper-bottom, self-cleaning steel cars controlled and operated by the Exposition. These cars bring the coal from the mine to the Steam, Gas and Fuels Building, where it is dumped and automatically conveyed to and from bunker and crusher, or either, and thence to the mechanical stokers, gas producers and briquetting machines. Over 2,200 lineal feet of conveyor lines are required in this automatic coal handling system. Bituminous coal, anthracite coal, briquettes and crude oil will all be availed of with the purpose of providing lines for comparison and to illustrate as fully as practicable the broad subject of the use of fuels for power purposes.

In both hand-firing and mechanical stokers, particular attention is being paid to the avoidance of the smoke nuisance. The stoker builders are afforded an opportunity to substantiate their claims in this direction, for on installations of 1,500 hp or over a separate stack is to be furnished by the Exposition for each installation and thus a line for practical demonstration and comparison is established. In hand firing, briquettes will be largely availed of and the claim of the possibility of smokeless combustion from their use can be substantiated or refuted.

Boilers have been drawn from Europe as well as from American shops, and particular attention is being paid to marine water tube boilers. The standard marine types of boilers are less familiar than the standard stationary types to the average engineer, and it is believed that where economy of space is an essential, they may demonstrate advantages. In any event, opportunity for direct comparison between the various water tube marine type boilers operating side by side and under the same conditions will be interesting and instructive. Different groups of boilers are to be operated at different pressures and practice, from 125 pounds to 250 pounds illustrated.

Owing to the central location of the Steam, Gas and Fuels Building and in deference to the architectural harmony, it is impractical to establish natural draft boiler stacks, and consequently mechanical draft will be availed of. This affords the blower builders an opportunity to exploit their systems.

The water supply in St. Louis is not without features which are objectionable in boiler practice, and this condition is very generally being availed of by the builders of water purifying apparatus to exploit the practical value of their systems.

The installation of a number of independent steam generating systems carries with it the possibility to illustrate a variety of accessory items, such as feed water pumps, feed water heaters, injectors, traps, valves, gauges and various steam specialties.

In gas producers the range is from a capacity to supply an engine of 50 hp to a capacity for a 3,000 hp unit or collection. The most notable producer units are as follows: One of 2,400 hp, direct-suction system, from Julius Pintsch, of Berlin; one of 3,000 hp, Duff-Whitfield system, from W. F. Mason & Co., of Manchester, England, and one of 2,000 hp, from R. D. Wood & Co., Philadelphia. Both of the latter will avail of tanks or holders. A Thiessen gas scrubber built by the John Cockerill Society, of Seraing, Belgium, will be shown in operation. The installations of the latest gas producers serving the latest types of gas engines driving alternators and operating side by side on the same load with steam boilers at the one end and steam reciprocating and turbine engines on the other end, will go far toward a determination of the claim by the gas engine advocates that the gas producer gas engine proposition has in efficiency and first cost and operating expense great and universal advantages over the steam boiler steam engine system.

The programme announced, and already so far carried into effect, that we may reasonably look for its complete fulfilment, certainly demands consideration and no small amount of admiration. If Mr. Moore succeeds in doing what he has planned he will deserve great thanks from the engineering world and in any event every assistance and encouragement should now be extended to him.

Figures of Electric Street Traction in New York City.

The Interurban Street Railway Company, of New York City, the greatest system in the world of electric street railway traction, has just issued its first annual report since taking over the Metropolitan, Third Avenue and allied properties. The Interurban Company now controls all the surface street railroad lines in Manhattan and Bronx, excepting one unimportant line. During the year 14.18 miles in Manhattan have been electrically equipped and 31 miles are under construction in the Bronx, thus adding 45 miles to the electric system. The system now covers 478 miles of roadway. In the past three years the Union Railway has constructed 53 miles in the Bronx and reconstructed 25 miles of old lines. By the close of the present fiscal year all the current required for operation of the system will be supplied from the company's two power stations, thus saving considerable cost.

The transfer system has been extended between Metropolitan and Third Avenue lines. Of the total of 622,071,723 passengers carried last year, 433,608,524 paid cash fares, while 188,463,199 used transfers.

The track mileage shows as follows:

	Electric.	Horse.	Total.
Metropolitan	133	91	224
Third Avenue	228	26	254
Total	361	117	478

Passengers carried were:

	Fare.	Transfer.	Total.
Metropolitan	323,491,446	145,691,999	469,183,445
Third Avenue	110,117,078	42,771,200	152,888,278
Total	433,608,524	188,463,199	622,071,723

The consolidated balance sheet showed total assets of $182,150,753, and the liabilities account showed a profit and loss surplus of $4,123,503. The capital stock is given as $67,582,100 and funded debt as $88,097,000. Other liabilities are real estate mortgage, $950,000; Interurban 10-year notes, $3,465,000, and Metropolitan Securities Company, $12,132,500.

Gross earnings increased $618,377 during the year. Subway construction and inconveniences arising therefrom prevented the increase from being larger, as also did the work of changing motive power. Operating expenses were increased by abnormally high prices for coal and advanced wages. Fixed charges were increased by interest on $11,000,000 Metropolitan Street Railway bonds issued.

No provision is made in the income account for the franchise tax.

In view of the uptorn condition of New York streets in every direction, entailing serious expense and loss of traffic, the showing is remarkably good and encouraging as to the future.

The consolidated income accounts show the earnings of the entire system as follows:

Gross	$21,549,545
Operating expenses	11,389,109
Net	$10,160,436
Other income	573,408
Total income	$10,733,844
Charges and taxes	7,366,189
Surplus	$3,367,655
Dividend on Metropolitan Street Railway stock	3,639,791
Deficit after dividend	$272,136

The Electric Light and Power Situation in St. Louis.

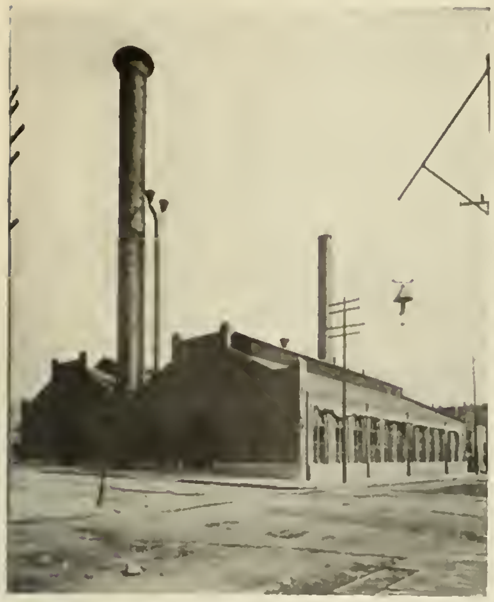


FIG. 1.—EXTERIOR VIEW STATION A MISSOURI-EDISON ELECTRIC COMPANY.

ST. LOUIS is attracting widespread attention at the present time as the place of the next World's Fair, the Louisiana Purchase Exposition. Many of those who will be drawn thither to learn of the progress made in the arts and sciences will be impressed with the increasing importance of St. Louis as an industrial center. Situated as it is, in the Mississippi Valley, at the center of a great railway system, it may be truly termed the "Gateway of the West." Considering the time of its incorporation as an American city as its birthday, St. Louis is the youngest of the four great cities of the United States; but its percentage of commercial growth during the past ten years was greater than that of any of the others. It is not only the fourth city in point of population, but the fourth in point of manufactures as well. It is one of the great railroad and commercial centers of the country, and in fact is a distributing center for the West, and the great Southwest in particular, which section is so rapidly being developed. The last United States census credits St. Louis with a population of 575,238, whereas the last local count shows that the 700,000 mark has been passed. The city covers an area of over 60 square miles, and has a frontage on the Mississippi River of nearly 20 miles.

The bank clearings of a city indicate perhaps more forcibly than any other statistics the condition of trade. During the past year the clearings of the St. Louis banks and trust companies amounted to $2,506,804,320, an increase of over 10 per cent. over 1901, while the combined capital and surplus of the 30 banks and trust companies is $87,267,173, with deposits amounting to $209,522,208.

St. Louis, although foremost in several lines of trade, is essentially the home of many and varied industries. There are approximately 7,200 different manufacturers in the city and its immediate neighborhood, employing 115,000 persons, paying $62,000,000 annually in wages, ,and producing a product of an estimated value of $390,000,000 annually. St. Louis holds first place as a jobber of shoes, of which it manufactured in 1902 1,151,000 cases. It is the largest drug market in the country, and the largest distributor in the West of dry goods and kindred lines. It is one of the largest mule markets in the United States, perhaps in the world. The city is also noted for a very large wholesale business in groceries, implements and woodenware, and the manufacture of plug and package tobacco and of beer. The coming World's Fair is a monument to the energy and the progressiveness of its citizens, and indicative of the resources of St. Louis.

In the past St. Louis has appealed to the investor and the central station manager as a most promising and profitable field for the exploitation of the electric light and power business. Recent events will serve, no doubt, to instill still greater confidence in existing and proposed investments, and in the possibilities of the business under the new conditions. In fact, it has been said that the possibilities of the central station business have been recognized by but few. Although the electric light on a commercial scale has been before the public for more than a decade, the greater part of the business secured so far has virtually been thrust upon the companies, and is not the result of a systematic, aggressive campaign. Investments have been made to take care of a natural increase rather than to develop the business to its fullest possible extent.

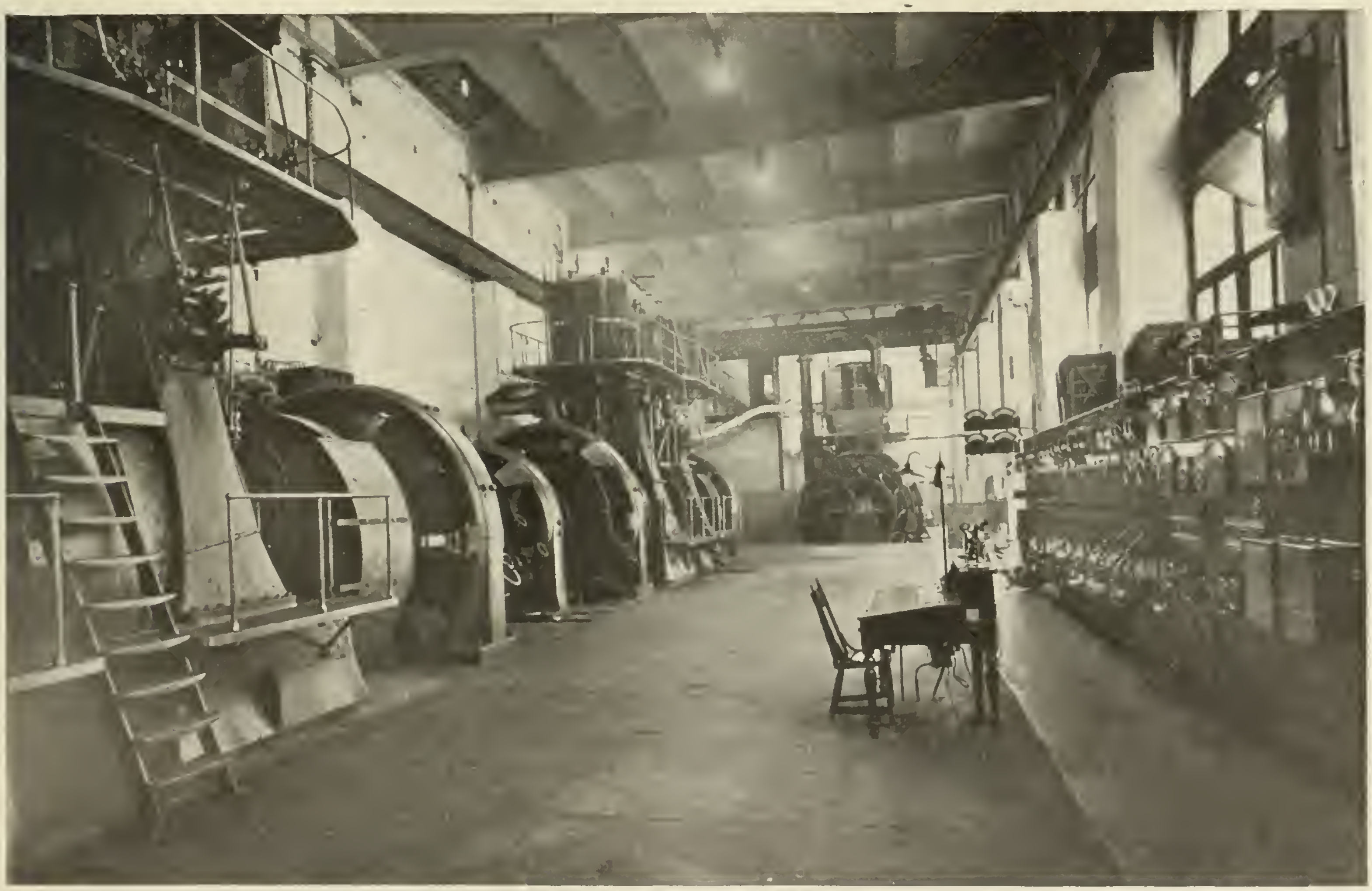


FIG. 2.—ENGINE ROOM IMPERIAL ELECTRIC LIGHT & POWER COMPANY.

In recent years several large water powers at some distance from industrial centers have been developed, with what success is too well known to the public in general, to need extended comment. These in cases have been promoted without any legitimate business reason. It is true that some industries which were not dependent upon local markets, have been attracted by the comparatively cheap rates charged for power, but as is well known even at Niagara

Falls, several years were required to dispose of the total output of the plant. The fact seems to have been overlooked that our great industrial centers offer a field for the electric light and power business which cannot be excelled elsewhere. The large and the small manufacturer in the many branches of industry, the merchant, the tradesman, offer opportunities for immediate and extensive development. It is not necessary to offer special inducements for these to locate at any particular point where they can be served. It requires but a catering to their wants at a cost which will not prove excessive, to secure an amount of business which will give profitable returns on a large investment.

The ancient history, so to speak, of the electric light business in St. Louis, is no doubt a repetition of that in other large cities in the country. Several small plants were at first installed, representing the various systems then in use. In the course of time the "survival of the fittest" was inevitable. By consolidation, there remained two or three companies in the field to compete for the business. Even these were eventually united. This course possibly may be construed as having worked to the disadvantage of the public at large. In fact, it has been the commonly accepted opinion that competition is the life of business. To the student of everyday problems, however, the fact has been brought home more and more that such is not true in case of quasi-public corporations. Although some of the public may have been benefited temporarily, nevertheless it is the public at large and the public only which eventually must foot the bills for costly experiments in the duplication of physical plants and in ruinous competition.

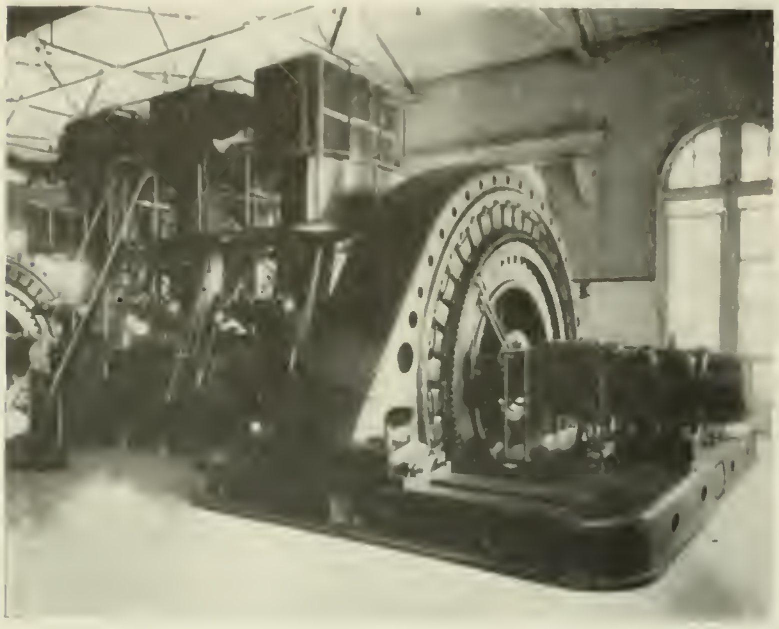


FIG. 3.—ENGINE ROOM STATION A MISSOURI-EDISON ELECTRIC COMPANY.

The determination of the city of St. Louis in 1896 to force underground all overhead wires in the business district of the city, a course which in itself was commendable, resulted in the passing of an ordinance by the municipal assembly, by virtue of which it was possible for new interests to build underground systems in the down-town district and secure franchises for the operation of plants in connection with the former. Previous to that time the field had practically been covered by the Missouri-Edison Electric Company. A formidable competitor which now entered the field was the Imperial Electric Light & Power Company. The Citizens' Electric Light & Power Company at that time contented itself with the installation of an underground system, which course was also pursued by several subway construction companies. A further complication was introduced by the Laclede Gas Light Company, which in 1890 embarked in the electric light business, having secured a ten-year contract for the lighting of alleys, public parks and buildings north of Washington Avenue. Two other small companies had also engaged in the business, confining themselves either to a limited territory or a particular branch of the business. It will thus be seen that a condition of affairs existed which naturally led to evil results. Competition of a demoralizing character unavoidably resulted, which moreover did not necessarily benefit the consumer entitled to a reduction. Duplication of physical property was unavoidable. Operating and executive expenses necessarily were higher for the combined output than would otherwise have been the case with one operating company. Extensions were not made to the greatest advantage. The loss in income caused by the reduction in rates in certain districts was naturally made up by a corresponding increase in other sections. On the whole, a condition of affairs resulted which prevented a development of the business to the best advantage, and retarded rather than aided a natural growth.

When these facts are taken into consideration, as well as others, it seems to have been a most opportune time for the consolidation of the various interests. The Citizens' Electric Light & Power Company was about to become an active competitor, having designed and commenced the erection of a modern power plant. The power plants of the Missouri Edison Electric Company and that of the Imperial Electric Light & Power Company were loaded down to the limit of their capacity, and were about to require extensive additions to their equipment. The first steps looking to a consolidation were taken when the Imperial Electric Light & Power Company, on May 20, 1902, united with the Citizens' Electric Light & Power Company, under the name of the Union Electric Light & Power Company. A controlling interest was also subsequently obtained in the Missouri Edison Electric Company. The consolidation of the two large lighting companies on the 11th of last month under the name of the Union Electric Light and Power Company, is, therefore, in reality a mere technicality, as both are dominated by the North American Company, of New York.

The consolidation of the various interests has resulted in the inauguration of a broad and liberal policy, which contemplates the division of economies resulting from such a course with the consumer, to the ultimate benefit of all concerned. In fact, the consumer is to profit at once by economies which will be realized later as the commercial departments of the various companies are merged into one, the physical property developed as one unit and the new power house put in operation which will make possible the production of electric current at a low figure. It is only as a broad view of the situation is taken that success is assured. A large market and low production costs are of little avail unless a liberal policy is pursued. It is with this in view that a uniform system of rates for the entire system is being considered, which, based on the experience gained at other large cities, it is proposed shall make a charge for service that will be equitable under all conditions. As is readily understood, the systems of rates which have been in force differed from each other, and furthermore were influenced to a great extent in many cases by competition. This resulted in the charging of a high rate for certain classes of business in some districts, which, although bringing up the gross receipts of the companies, was a check to growth, while on the other hand a large part of the business was taken at an unprofitable figure.

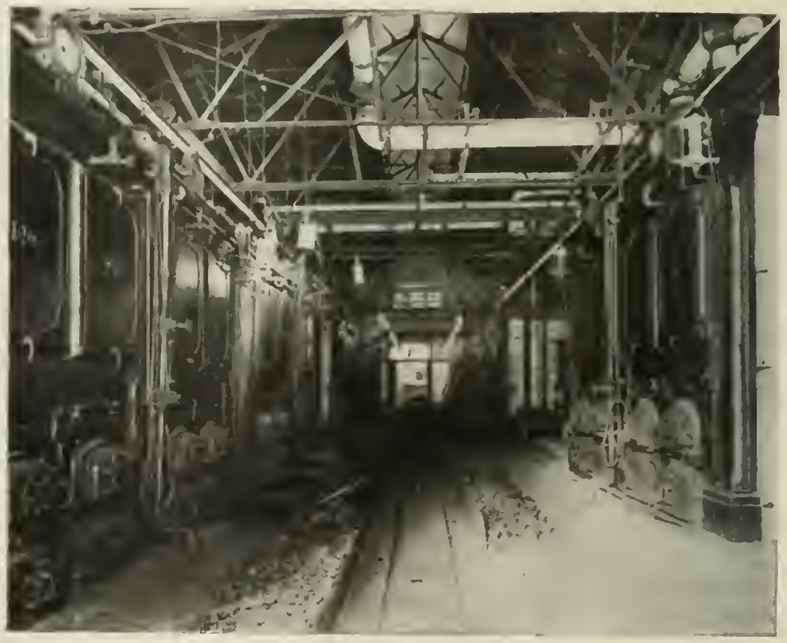


FIG. 4.—BOILER ROOM STATION A MISSOURI-EDISON ELECTRIC COMPANY.

As soon as it is possible to do so, the various commercial departments will be merged into one. It is self-evident that such a course will materially reduce the executive and general office expenses for a given output. The consolidation of the physical properties, however, although under consideration, will require a greater length of time. This of necessity has to be accomplished with the system in

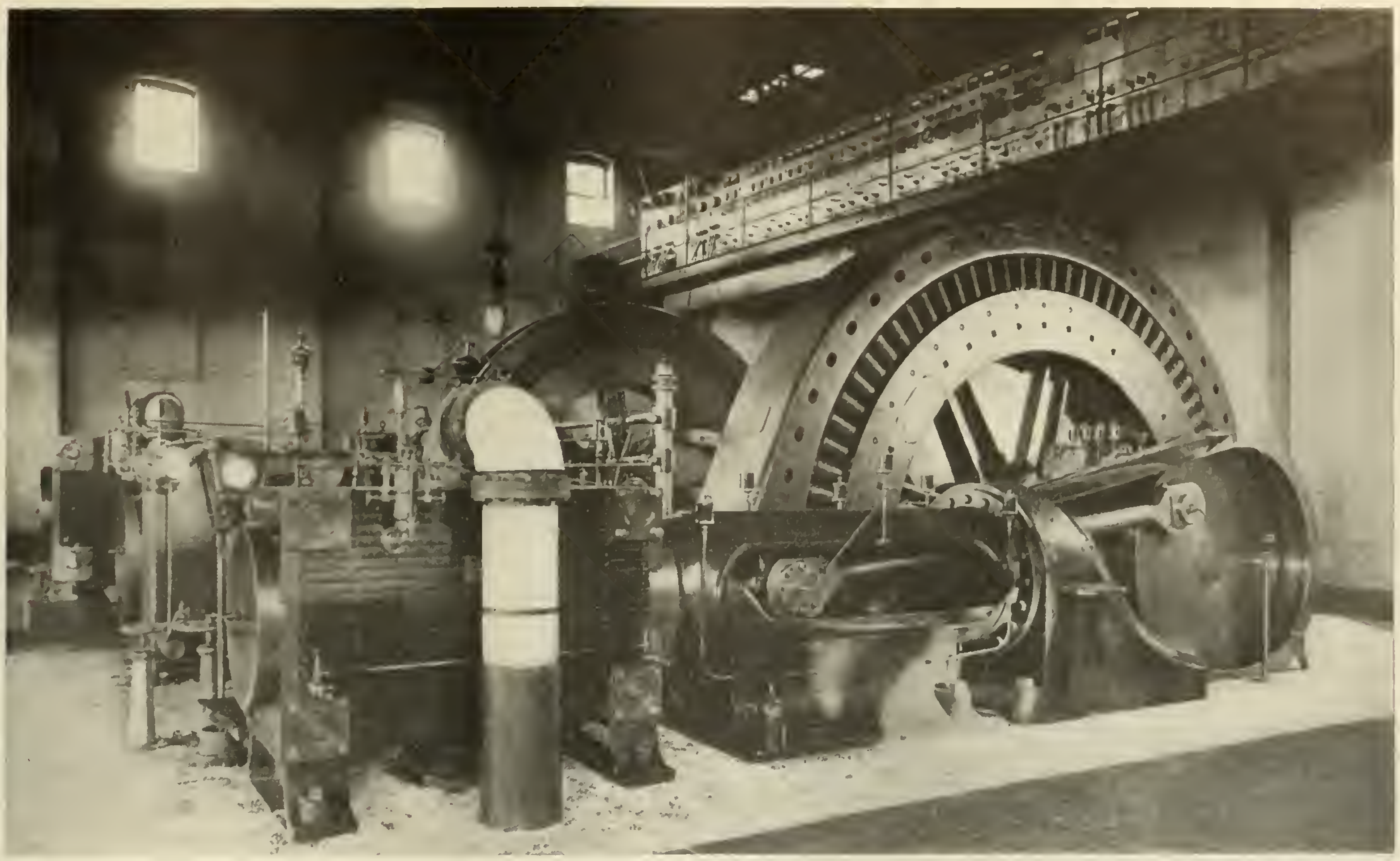


Fig. 5.—Engine Room Station B Missouri-Edison Electric Company.

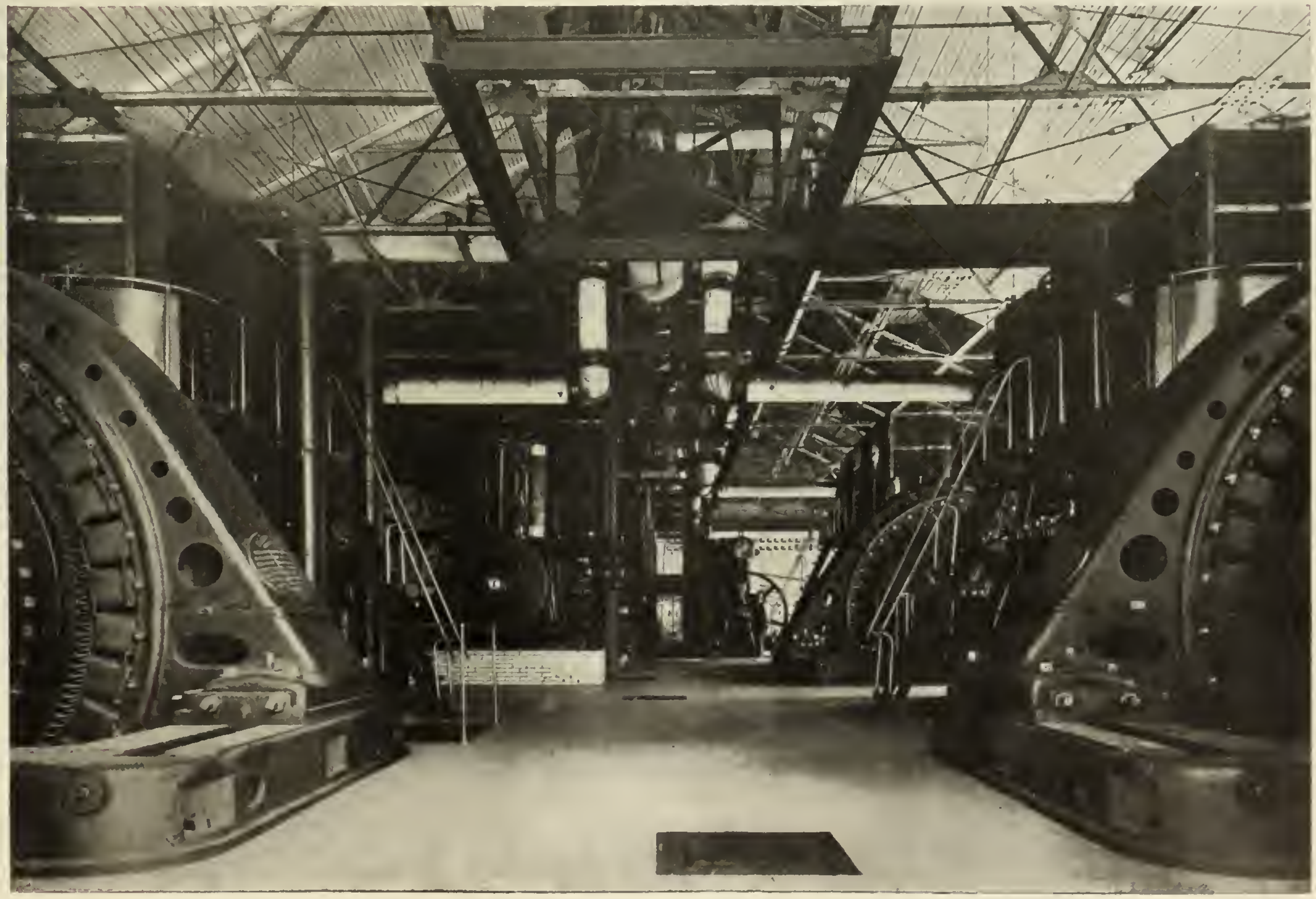


Fig. 6.—Engine Room Station A Missouri-Edison Electric

operation. At the present time the former Missouri Edison Company is operating a three wire, 110 and 220 volt alternating current system in the underground district, as well as 500 volt, direct-current circuits for power purposes. The same territory is also covered by the three-wire, 235 and 470 volt direct current system of the former Imperial Electric Light & Power Company. To simplify the situation and prevent the duplication of lines, it will be necessary gradually to change over to an entirely new system, or to either one of the others already in use. It is possible that as soon as the new power house is in operation, temporary expedients may be devised to transfer the load to the latter. Arrangements have already been made whereby all of the 500 volt circuits in the underground district will be fed from the power house of the Imperial Electric Light & Power Co. at Tenth and St. Charles Sts., except at times of the lap load, when several units at Station B of the Missouri-Edison Electric Co. at Nineteenth and Gratiot Streets will be thrown in parallel with the load, as this station has an excess capacity of boilers. As the various plants will be fully loaded this fall, arrangements have been completed whereby in case of an accident, power will be obtained from the St. Louis Transit Company. Two 500-kw rotary converters through step-down transformers will convert three-phase currents at 25 cycles and 6,600 volts to 500-volt direct current. The outlying districts are also to a great extent covered by lines of the Missouri Edison Co. and of the Imperial Electric Light & Power Company. The former are 1,000 volts alternating, while the latter are 500 volts direct-current. Several systems for supplying this and other outlying territory with current from the new power house now building, are under consideration. Sub-stations will be located at various points, which will feed direct current at 235 and 470 volts into a network of overhead mains; or alternating-current feeders at 2,300 volts will be run, the secondary being a three-wire system operated at 110 and 220 volts, with banked transformers.

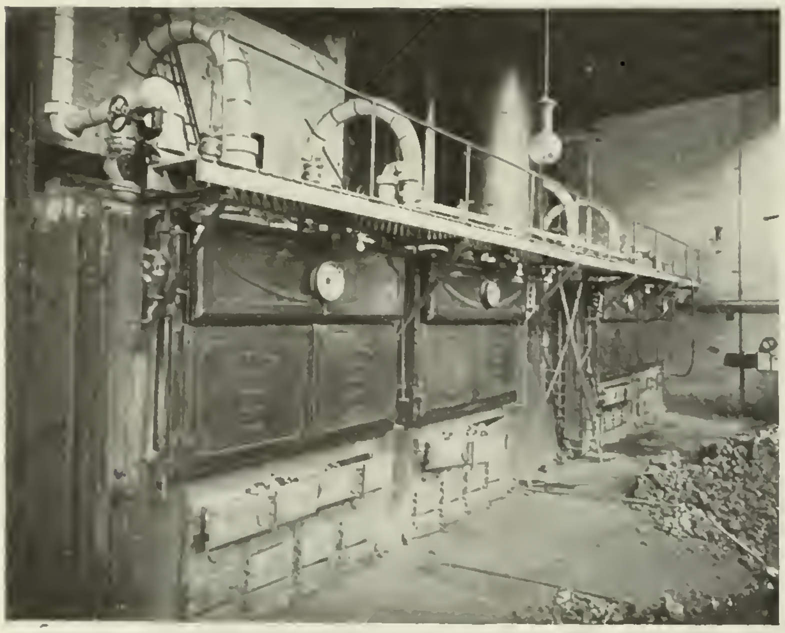


FIG. 7.—BOILER ROOM IMPERIAL ELECTRIC LIGHT & POWER COMPANY.

The power houses now operated not being very economical, the load on these will be transferred to the new one now building, as soon as it is possible to do so. In fact, the plants of the former Missouri Edison Electric Company are operated to a great extent, non-condensing, and that of the former Imperial Electric Light & Power Company has not sufficient capacity to operate the plant condensing under all loads. The apparatus in the former is not very modern, and does not permit of operation under favorable conditions. The rated capacity of the former Imperial Electric Light & Power Company's plant, at Tenth and St. Charles Streets, is 4,600 kw. The equipment consists of 500-volt direct-current generators, direct-connected to vertical cross-compound condensing engines. A 1,500-kw unit is operated by a horizontal cross-compound non-condensing engine. The plant includes a storage battery with a capacity of 1,000 amp. at the one-hour rate. The city arc lighting is done by twelve 110-light series direct-current arc light machines, driven by 500-volt motors. The boiler room equipment includes water tube boilers, which are hand-fired, and economizers.

Station A of the former Missouri-Edison Electric Co. at Nineteenth and Locust Streets is an alternating station which supplies the underground district in the business portion of the city. The normal capacity of this plant is 2,700 kw. The equipment consists of two-phase, 1,100 volt alternating current generators, direct-connected to vertical compound engines. The nature of the apparatus in this as well as in Station B is such, however, that the generators cannot be run in parallel, and in consequence each one carries separate circuits. The boilers are of the water tube type and hand fired. Both of these stations, A and B, are the result of a gradual growth, and as a consequence, the arrangement and character of the apparatus is such as to prevent economical operation. Station B, which is situated at Nineteenth and Gratiot Streets, has a normal capacity of about 4,100 kw. The generators are single-phase, operated in part by simple and in part by cross-compound Corliss engines. The boiler room, which is located on the opposite side of the street from the engine room, contains water tube boilers which are hand-fired. The three plants which are now being operated, although not economical enough to warrant their continuance for any length of time in the future, nevertheless are in excellent condition to carry the lighting and power loads until such a time as it is possible to transfer these to the new power house now being erected.

At present there are in use nearly 160 miles of pole line, 95 miles of series arc circuits, 76 miles of feeders, 192 miles of two-wire mains and 60 miles of three-wire mains. In the underground district there are 37 miles of series arc light circuits, 10 miles of feeders and 22 miles of mains.

The new power house, as will be seen from the accompanying illustrations, is well under way, the construction being pushed as rapidly as possible. It is expected that part of the equipment will be in operation next April, and the remainder will be completed as soon as possible. It is estimated that the cost of the power house, including building and real estate, will be in the neighborhood of $2,000,000. Preliminary work of preparing the ground for the foundations was first commenced in February of last year. After two months, however, an injunction was secured by the city preventing any further work on the river front, as it was claimed that the power house would project beyond a line established by the city. The question was taken up with the United States Government, and after a vexatious delay the matter was settled in favor of the company, a new harbor line having been established which placed the building within the required limits. Further delay was occasioned by a very high stage of water of the Mississippi River, which continued during the entire season. This caused nearly a year's delay, although work proceeded on the engine room and the engine foundations.

The site is located near the center of the city, a short distance north of the Eads Bridge. It occupies an entire city block, and with a present length of building of 322 ft., allows for an extension of 100 ft., with additional space for storage. The building is of the steel skeleton type, supported by concrete walls resting on rock foundations, with terra cotta columns and brick curtain walls. Steel window and door frames are used, a fire-proof construction having been adopted throughout. The roof is lighted by five skylights, running crosswise of the building.

The power house equipment has been located and arranged with a view to securing the most economical operation of the plant. The current generated will be three-phase, 25 cycles, at 6,600 volts, and will be transmitted to the various sub-stations in the city for transformation. The current will not only be used for electric light and power purposes, but for the operation of the street railway system of the St. Louis Transit Company as well. At present the generators will be driven by reciprocating engines, although the use of the steam turbine for extensions is being considered.

The engine room is 322 ft. long and 81 ft. wide. The interior is finished with brown enameled brick to a height of 10 ft. from the main engine gallery, and above that height with white enameled brick. The only floors will be those at the sides of the foundation for the support of heavy parts which may be moved. Otherwise, all parts of the room will be reached by a series of galleries and stairways. The engine room consequently will be unobstructed from the basement floor to the roof, and will be served by a 50-ton traveling crane with a ten-ton auxiliary hoist. This will be operated by induction motors from the same circuits as the motors for the motor-driven exciter sets. All of the electrical equipment is of Westinghouse make.

The equipment at present will include two 1,500-kw alternators of the revolving field type, each direct-connected to a vertical cross-compound Reynolds-Corliss engine made by the Allis-Chalmers Company. There are three further units of 3,000-kw capacity each. There will be three engine-driven exciters of a capacity of 100 kw at 125 volts each, and two motor-driven sets of the same capacity.

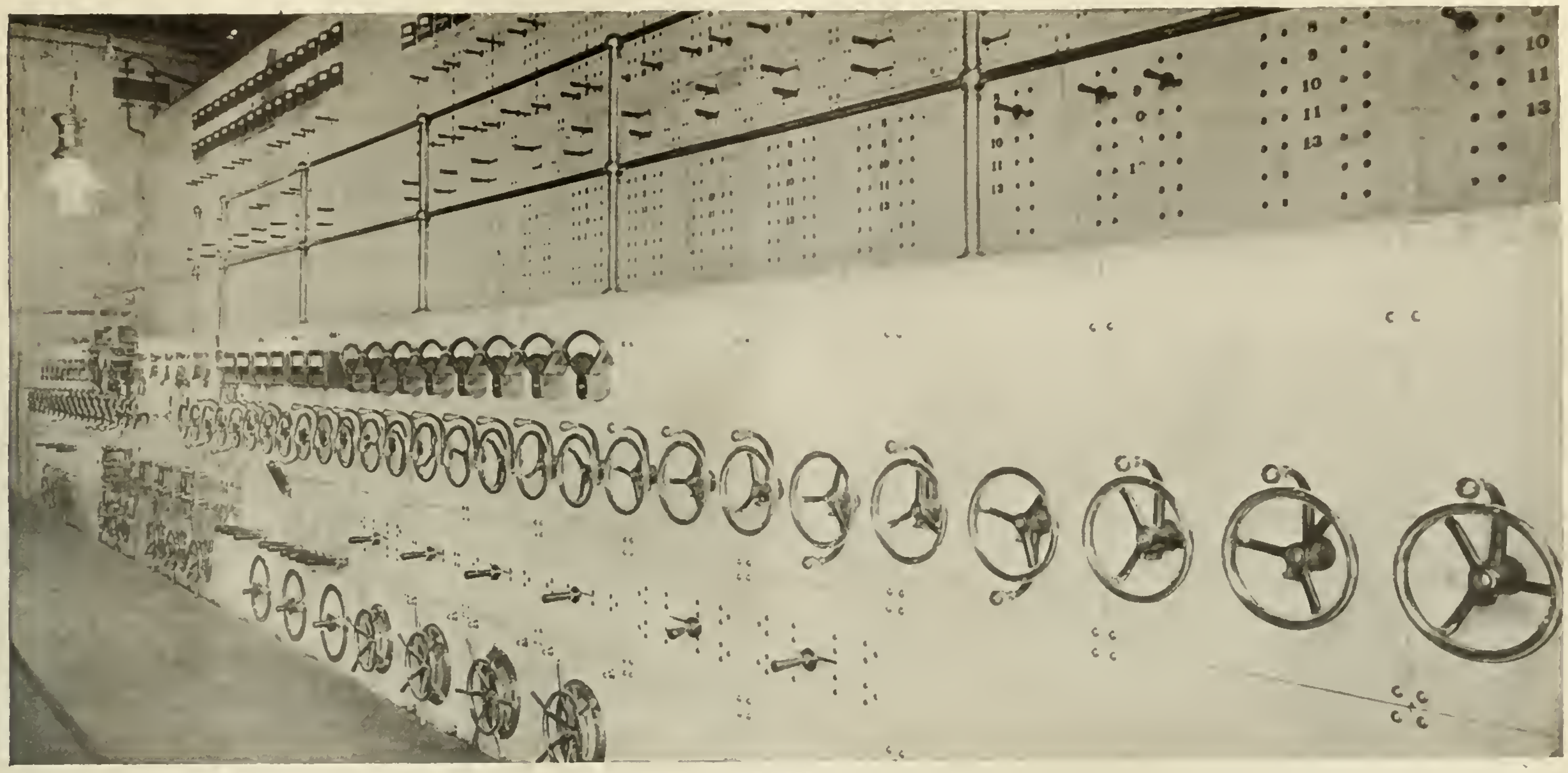


Fig. 8.—Switchboard Station A Missouri-Edison Electric Company.

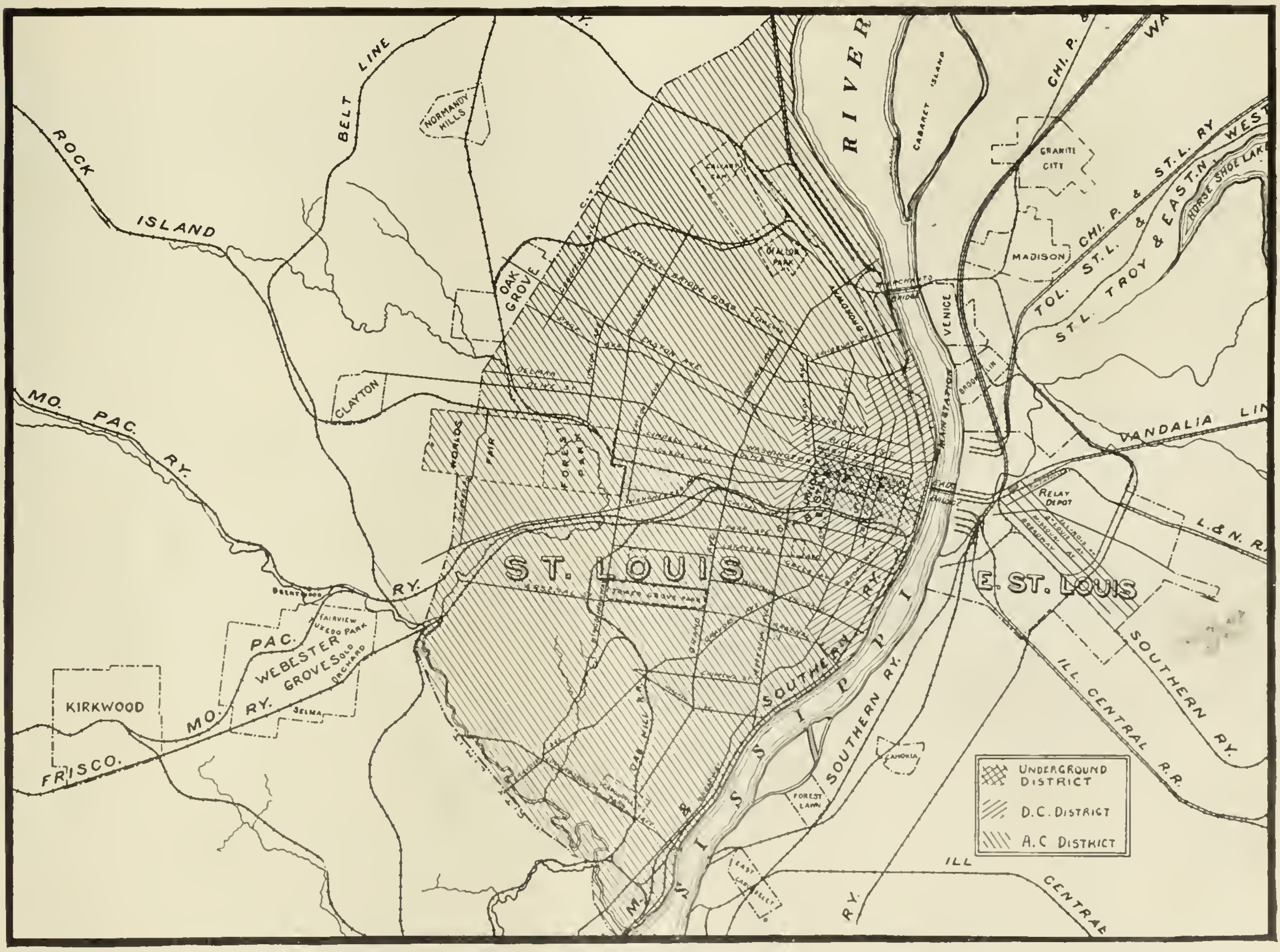


Fig. 9.—Map Showing Areas of Underground, Direct-Current and Alternating-Current Districts, St. Louis.

A switchboard of blue Vermont marble will be installed in several galleries located at one end of the engine room. This will provide for the control of two 1,500 and three 3,000-kw generators, four 125-volt, 100-kw exciters, and twelve feeders. Each generator will be connected to a separate auxiliary bus. These auxiliary bus-bars will be connected through oil break switches and high-tension hook switches by duplicate sets of cables to a duplicate set of high-tension bus-bars. The twelve feeders are connected to the former through interlocked selector switches.

The boiler room, although of the same length as the engine room, will be 94 ft. wide. The equipment will consist of 26 internally-fired boilers of the Scotch marine type, with the combustion chamber at the center of the boiler. These are 11 ft. 7 in. in diameter and 25 ft. in length. Two of the furnaces are 48 in. in diameter and one 52 in. Each will be equipped with a Jones underfeed stoker. Two brick stacks 200 ft. high and 14 ft. in diameter of Custodis construction, will be erected. Green's economizers will also be installed. The boilers will be placed in two rows, facing each other, and each pair will be connected with the steam header. Four boiler feed pumps of the Admiralty type will be used. The feed water heaters will be of the closed type, of special design. A Wheeler condenser will be installed for each unit, two of which will be placed between two engines, and so connected that either one can be used for either engine. The circulating water is pumped from the river by centrifugal pumps, which discharge into a large main leading to the condensers. From the latter the condensing water will overflow into the river. Both the circulating and the air pumps will be driven by steam engines.

On the east side of the boiler room, between two parallel walls, one of which will form the river wall, are located the coal bunkers and the settling tanks, which will be utilized for removing all suspended matter from the feed water, which is taken directly from the river. From these coal bunkers the coal will be taken into cars in the basement, which deliver the coal to the boot of a large elevator. This elevator places the coal in large tanks at either end of the building, under which passes the crane which delivers the coal to the spouts of the stokers. The same cars which handle the coal in the basement, also take the ashes from chutes underneath the boilers. The coal storage compartment delivers the coal into the cars at about the elevation of the boiler room floor. Above the coal storage, on top of steel girders which rest on the parallel walls already mentioned, is the track for the railroad cars. Either side or bottom dump cars will be available for unloading coal. Arrangements have also been made whereby coal can be unloaded from barges on the river. The coal storage space, which is of the same length as the engine and boiler rooms and about 20 ft. wide, will hold about 6,000 tons of coal. The ultimate storage capacity of the plant will be equivalent to about ten days' supply at the maximum rate of the plants.

In conclusion it may be said that the liberal policy inaugurated by the Union Electric Light and Power Company has already resulted in a considerable expansion of the business. It furthermore shows the possibilities which can be developed in such an industrial center as St. Louis when the conditions are thoroughly understood. What is without doubt the largest single contract in the history of the electric light and power business in the United States was secured from the St. Louis Transit Company. This calls for 9,000 kw 18 hours a day for a term of 10 years. The latter company had previously already closed contracts for the equipment of a new power house which was urgently required to supply the increasing demand of power for its system. Recognizing the value of such a consumer, negotiations were successfully brought to a close whereby the St. Louis Transit Company relinquishes the plan of building its own power house, and obtains all of its current from the Union Electric Light and Power Company. A further important contract is that with the Louisiana Purchase Exposition Company, which calls for a capacity of 6,000 kw during the period of the World's Fair. Further evidence of the liberal policy pursued can be adduced from the number of isolated plants which have shut down since the consolidation. These are 22 in number, and ranged in capacity from 15 to 165 kw, with an aggregate capacity of 1,575 kw.

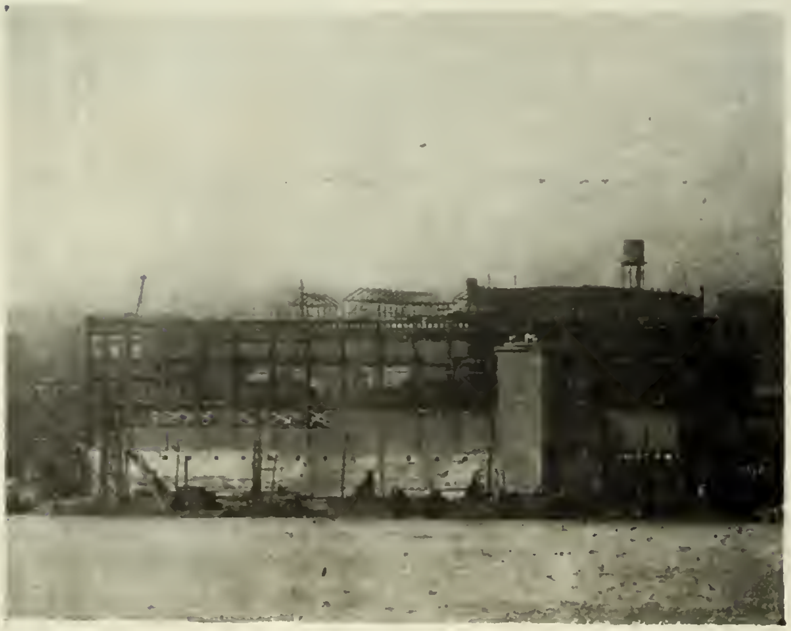


FIG. 10.—NEW POWER HOUSE UNION ELECTRIC LIGHT & POWER COMPANY, ST. LOUIS.

FIG. 11.—LOOKING ACROSS THE MISSISSIPPI RIVER FROM NEW POWER HOUSE.

From the accompanying map it will be noticed that the greater part of the area of St. Louis is reached by one or the other of the company's lines. This possibly will produce the impression that the territory is already covered, but such is not the case, when the foregoing is considered. Although a large number of isolated plants have already been shut down, a large number are still in operation. Although within the last five years the gross receipts of the combined companies have increased 50 per cent., and the total during the past year was nearly $1,500,000, a consideration of the results obtained since the inauguration of the new policy will lead to the conclusion that the business secured in the past is but a small part of that which awaits development.

Twelfth Annual Convention of the Pennsylvania Street Railway Association.

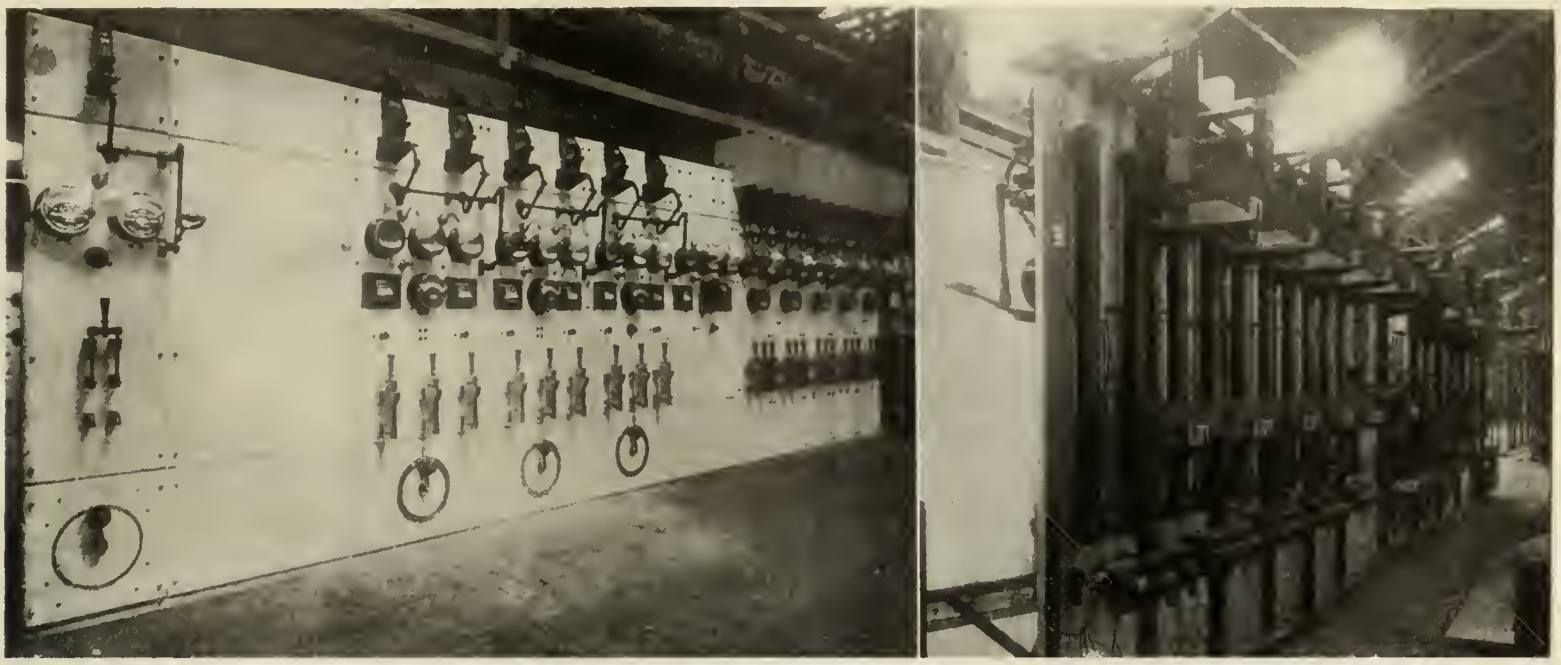
The Pennsylvania Street Railway Association held its twelfth annual convention in the ball room of the Park Hotel, Williamsport, Pa. The convention was called to order by President Ernest H. Davis, who, after responding to the Mayor's welcome, laid particular stress upon the question box idea, and expressed the hope that through the hearty co-operation of the members the feature would prove of valuable assistance to street railway men. In referring to the development of interurban railways, Mr. Davis said that their construction had been greatly hindered, owing to unnecessary restrictions in State laws, and he called upon the members to use their utmost influence to secure more favorable legislation for interurban railways.

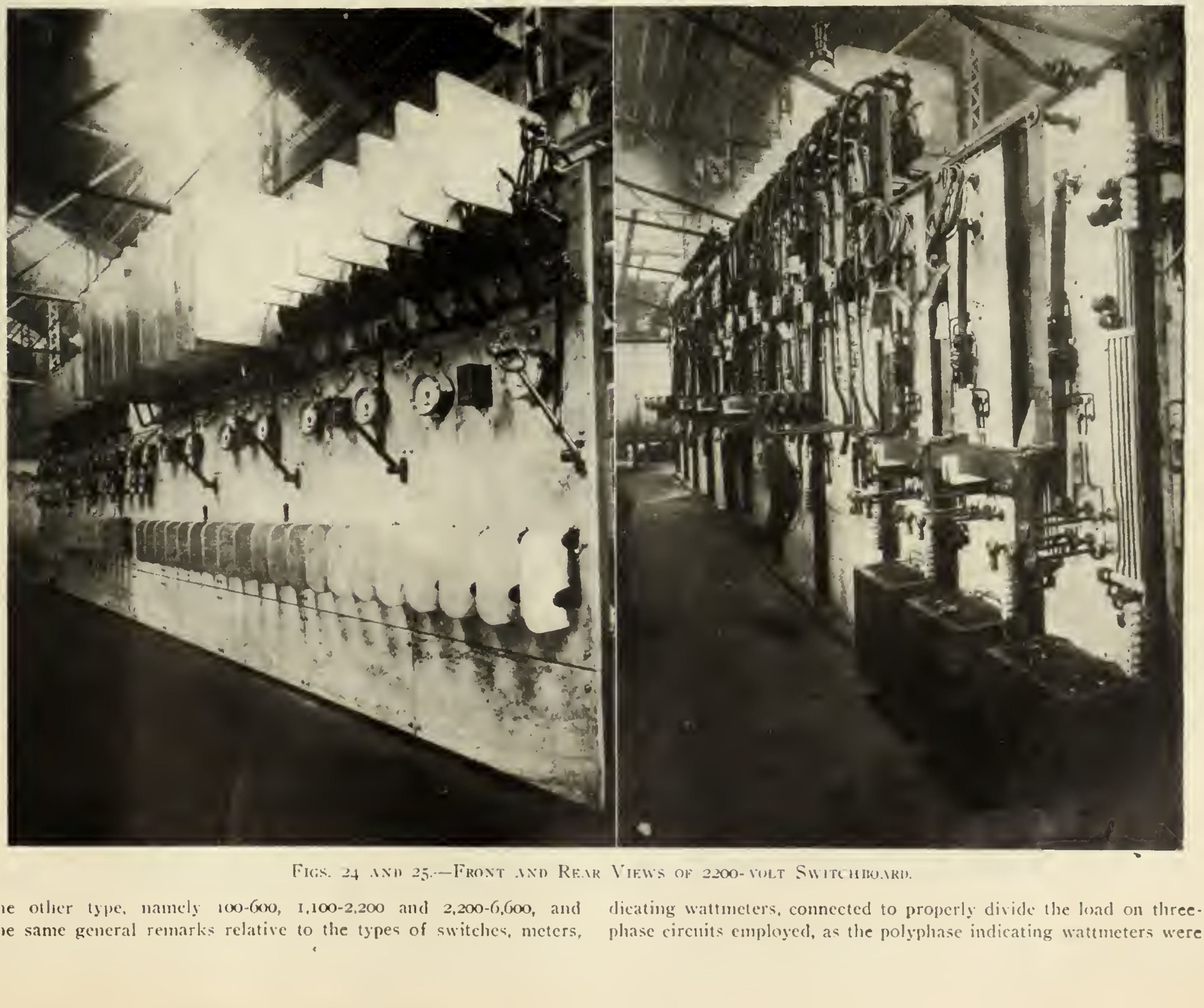
The afternoon session was devoted to the reading of and discussion on John F. Ohmer's paper entitled "Fares and Fare Protection." In the evening the delegates enjoyed a smoker at the Park Hotel. The following day over seventy delegates took a pleasant trip, in three special coaches, to Eagles Mere, via the Reading, Williamsport & North Branch Railroad. The election of officers resulted as follows: President, F. B. Musser, general manager, superintendent and purchasing agent of the Harrisburg Traction Company; secretary, C. H. Smith (re-elected), superintendent and purchasing agent of the Lebanon Valley Street Railway Company; treasurer, William H. Lanius (re-elected), president of the York County Traction Company.

Alternating Current Switchboards—IV.

By Stephen Q. Hayes.

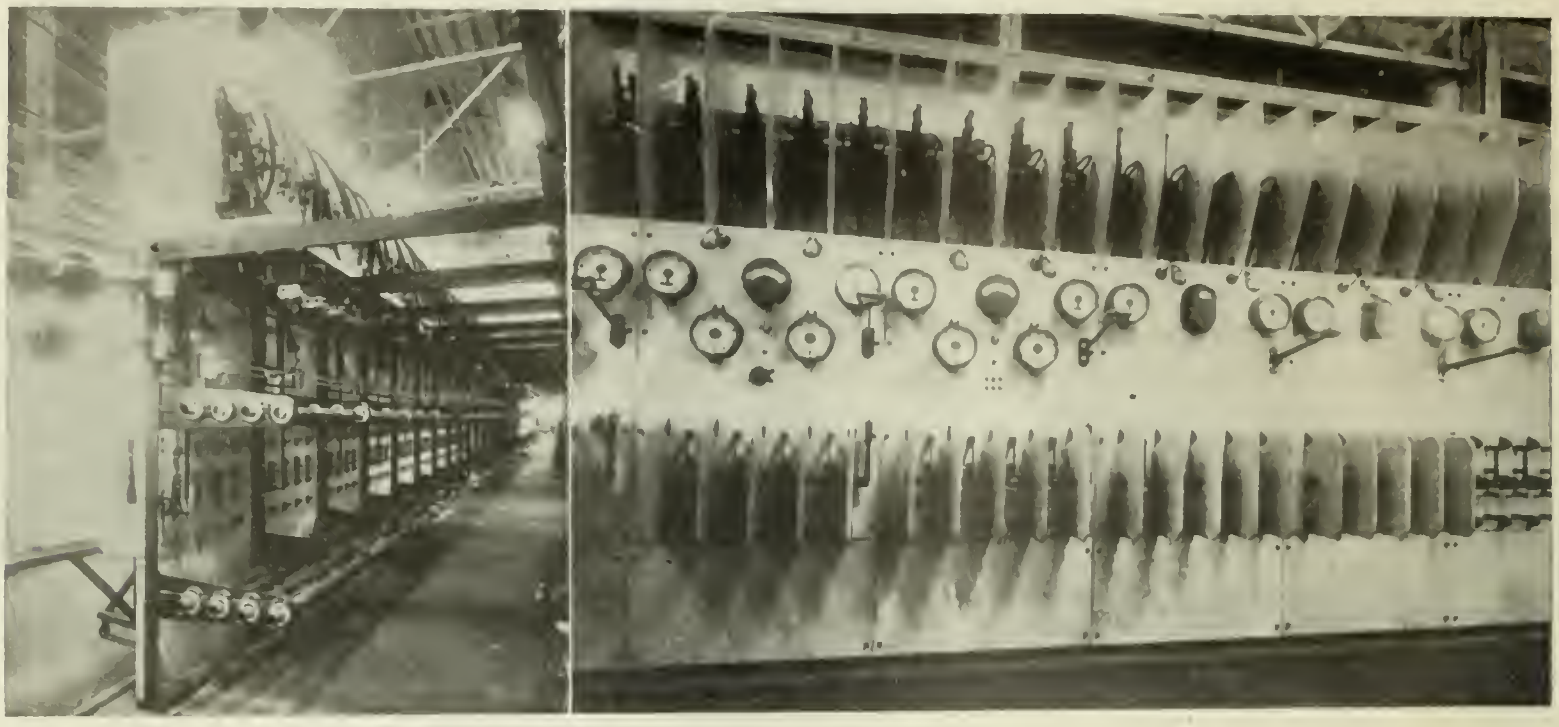
ANOTHER type of panel similar to that described in the preceding article is shown in Fig. 22, the main difference being that the circuit-breaker slab is made 25 in. higher to accommodate the necessary closing mechanism; the main slab is increased to 65 in. to hold the additional meters, and a few other changes are made. These boards are built for the same voltages as the other type, namely 100-600, 1,100-2,200 and 2,200-6,600, and the same general remarks relative to the types of switches, meters, circuit-breakers, etc., will hold good for both types. The illustration shows one of the boards built of this type—made, in fact, previous to the standardization of this line of panels—but it illustrates very well the general construction. The board shown differs from the present standard in the following particulars: The circuit-breaker panels are 18 in. high, instead of 25 in., making it necessary to locate the closing mechanism of the circuit-breaker off the instrument slab instead of on the upper slab; different types of ammeters and voltmeters were used, and two single-phase Niagara type indicating wattmeters, connected to properly divide the load on three-phase circuits employed, as the polyphase indicating wattmeters were


Figs. 22 and 23.—Front and Rear Views of 600-volt Switchboard.

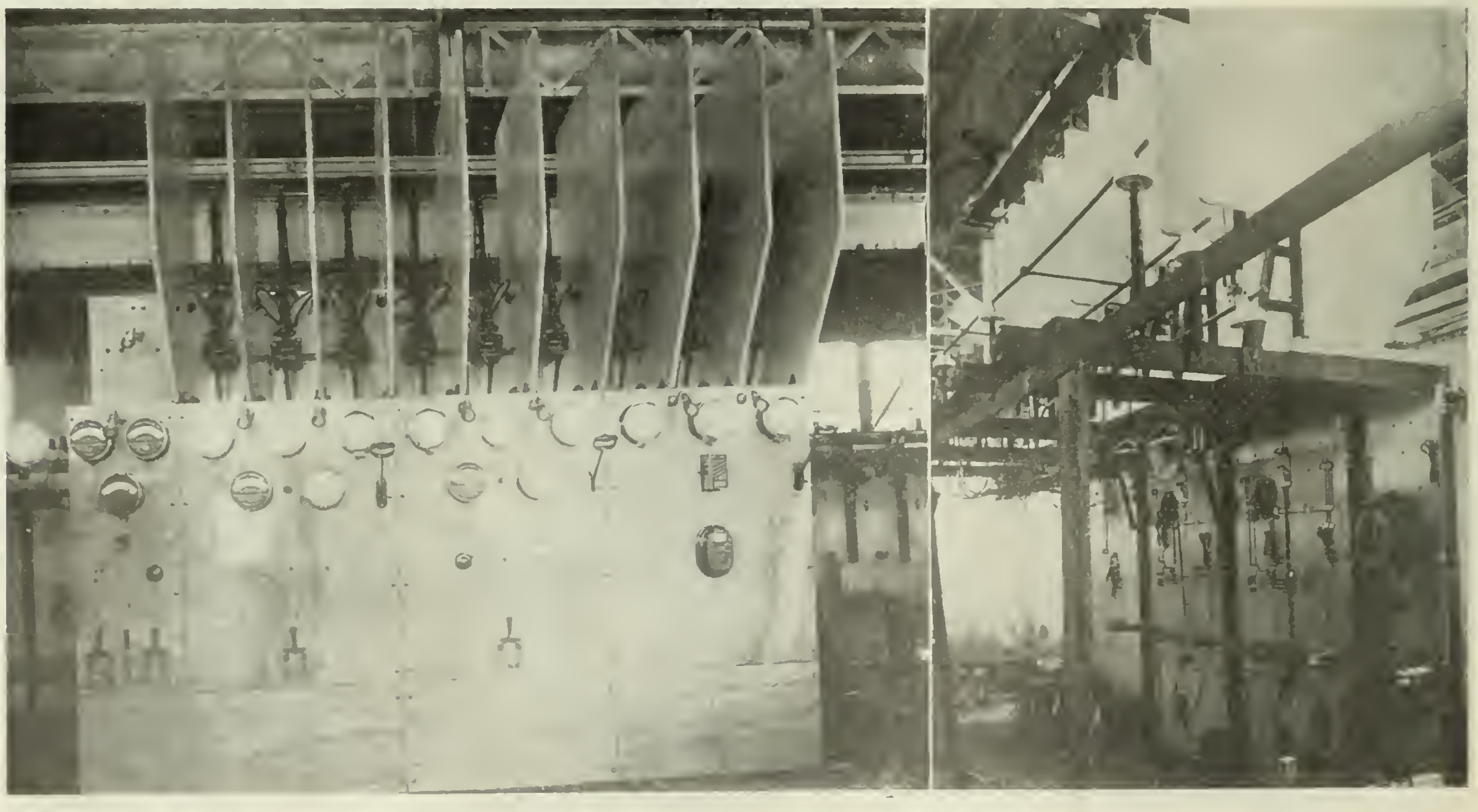

Figs. 24 and 25.—Front and Rear Views of 2200-volt Switchboard.

not designed when the board was built; field plugs were used instead of field switches, and the feeder panels were built 24 in. wide instead of 32 in., the present standard for this size.

Fig. 23 shows rear view of this same board and illustrates the bus-bar construction, the strap connections, series transformers, etc. These strap connections are made with copper straps 3 in. x ⅜ in. in section, spaced ⅛ in. apart, a sufficient number being provided to carry the current without undue rise in temperature. With very heavy currents, such as are handled on these boards, the outer bars will carry more current than the inner ones, due to the so-called "skin effect." As this effect is more noticeable at higher frequencies, more straps are used for the same current at 60 cycles than at 25 cycles or for direct current.



FIGS. 26 AND 27.—SIDE AND FRONT VIEWS OF 2200-VOLT SWITCHBOARD.



FIGS. 28 AND 29.—FRONT AND REAR VIEWS OF 11,000-VOLT SWITCHBOARD.

The 600-volt panels of this type are built for practically the same work as the type previously described, using the same type of meters, switches, breakers, etc., so that it is not necessary to repeat the remarks on these items. There are a few points of difference, however, that may be briefly noted.

The circuit-breakers, instead of closing singly, are thrown in all at the same time by the action of cross shaft and lever. The feeder panels, which as a rule control banks of raising transformers feeding power transmission lines, are usually supplied with overload time limit breakers. The function of the time limit relay is to delay the opening of the circuit-breaker for some predetermined length of time, ranging from one to ten seconds after the overload or short circuits come on the transmission line. This device prevents a temporary overload or short-circuit in one of the sub-stations fed from the transmission line cutting off the power from the entire line, as it gives time for the sub-station breakers to come out, simply cutting off the one station. The panels are also built for 1,100-2,200 and 2,200-6,600 volts similar to the corresponding panels of the type previously described, with the addition of a single-throw or double-throw square shaft switch connected in series with and interlocked with the main circuit-breaker.

Fig. 24 shows a front view of a 2,200-volt, two-phase switchboard illustrating the type of switches and circuit-breakers used. Fig. 25 is a rear view of the same board and shows the bus-bars, series and shunt transformers, ground detector condensers, etc.

Another type of panel is illustrated in section in Fig. 26. In this board, which is for 2,200 volts, channel iron braces are run from the top of the meter and switch panels to the wall and the circuit-breakers are supported on slabs resting on these horizontal channels and the various poles of the breaker are separated by marble barriers. The bus-bars on this particular board were 2-in. round copper rods insulated with fullerboard and mica tubes and later covered with asbestos steam pipe covering for the purpose of fire proofing.

Fig. 27 is a front view of this board and shows how the breakers are set back of the board and illustrates the type of switch used. These switches consist of knife blades mounted on an insulated shaft, and separated by marble barriers. These switches are not used to open the circuit under load and in fact are so interlocked that when the breaker is closed it is impossible to open the switch, but if already open can be closed. When the breaker is open, the switch can be opened or closed and thrown over from one bus to the other. The breakers used generally are the stick form, described in connection with a previously described type. The synchroscopes are here also mounted on swinging brackets. There is an ammeter for the field circuit on each generator panel and an ammeter is furnished for each phase. On two-phase generator panels there are two single-phase indicating wattmeters, and on three-phase generator panels a polyphase indicating wattmeter is used.

Panels of this type for 2,200-6,600 volts are similar to those just described except that they are only built for three-phase work, and the breakers and switches are designed for the higher voltage. The panels for 6,600-11,000 volts are also similar to those just described, except that there are no switches, the circuit being opened and closed on the breakers, which are of suitable size to successfully handle currents at this voltage.

Fig. 28 illustrates a board of this type used for the control of two 500-kw, 11,000-volt, three-phase generators, two 37½-kw, 125-volt exciters, and one main outgoing feeder. On the upper slab of the double exciter panel should be a pair of static ground detectors connected to condensers on the main high-tension bus-bars, but these instruments and the generator rheostats were not mounted when the switchboard was photographed. A polyphase integrating wattmeter is mounted on the feeder panel to measure the entire output of the station. Fig. 29 is a rear view of this same board and illustrates the bus-bar construction, location of series transformers, etc., and shows how the high-tension wiring is kept away from the instruments, etc., with which a person is liable to come in contact.

Sources of Rubber Supply.

The Department of Agriculture has issued an interesting bulletin on rubber culture and production in the Central American States and the dependencies. The publication is the work of O. F. Cook, botanist in charge of tropical agriculture, who has made an exhaustive study of rubber culture in every field of production. Its importance appears from the fact that rubber is the third of the large imports from the tropics, sugar and coffee being the first and second respectively. The average value of the yearly importance of rubber is $28,000,000. These studies are directed primarily to the question whether rubber culture is promising for Porto Rico and the Philippines, and the principal fact established in this report, namely, that a continuously humid climate is neither essential nor even desirable for rubber culture, promises well for the extension of this industry to the tropical islands of the United States.

It is now accepted that rubber can be cultivated and that the supply from wild growths cannot be relied on for a sufficient amount from year to year. At the same time it has hardly been shown that cultivation is safe and profitable, and the whole industry may be said to be still in the experimental stage. It has been demonstrated that the Pará tree may be cultivated interchangeably with the Castilla in Central America and Porto Rico, and is producing handsome results in the Malay Peninsula, Ceylon and Borneo. The variety of soils, exposures, altitudes and climates where Castilla will be successful have been found to embrace widely separated sources of supply. Mr. Cook commends rubber culture in the Philippines in view of what has been learned about Castilla.

Studies of Castilla in Mexico have resulted in a favorable opinion regarding the prospects of Castilla in Porto Rico, since it is believed that the requirement of continuous heat and humidity has been overstated. Mr. Cook says there are toward the southwest corner of the island many places where the climatic conditions are not unsuited for Castilla and where experimental plantings should be made.

An Object Lesson in Telephone Receivers.—V.

By Arthur V. Abbott, C. E.

THE HOLTZER-CABOT RECEIVER.

THIS model is illustrated in Figs. 77 to 80, inclusive. Fig. 77 shows it assembled in readiness for use. In Fig. 78 it is dissected. The case consists of two parts, a body and a receiver cap. The magnetic system is built of U-shaped bars of steel which is slightly semi-circular in section. The bar is .624 in. wide and .26 in. thick and 3.5 in. long. The pole pieces are nearly semi-

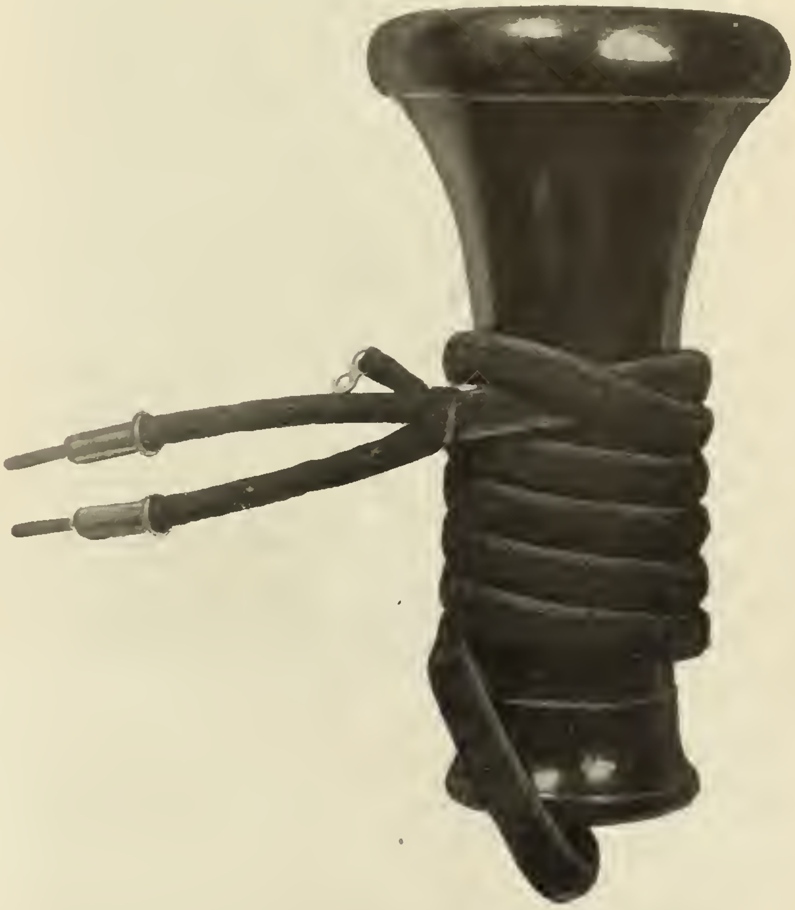


FIG. 77.—RECEIVER ASSEMBLED.

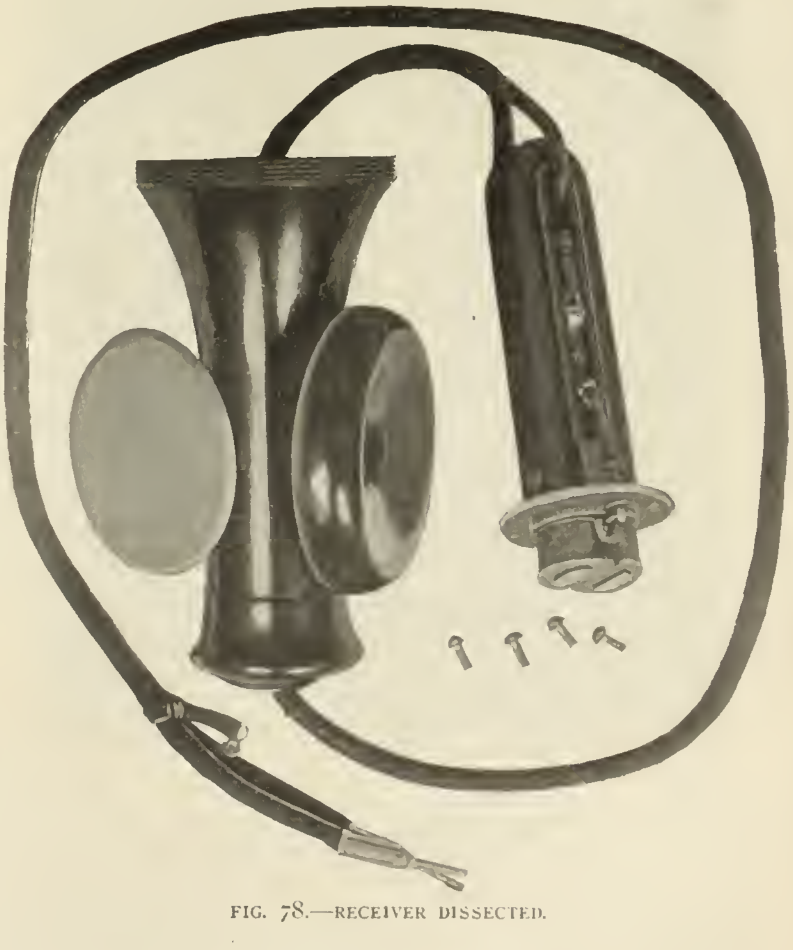


FIG. 78.—RECEIVER DISSECTED.

circular in section .17 in wide .15 in thick, .47 in wide and 1.25 in long, and are secured to the magnet by a pin, which is driven through the magnet bars, the pole pieces and a filling piece. The coil spools fit the pole pieces and are .13 in wide, .81 in long and .36 in deep. The winding is No. 36 wire and the resistance 70 to 80 ohms, the coils are connected in series. On the inside of the shell a bearing is faced. Between the magnet bars and the line spools a non-metallic disc is set which is brought to a bearing upon the ledge on the inside of the shell, and the magnetic system held in place by four screws, which pass through this disc into the receiver case. The diaphragm is of sheet iron, tinned flat; .013 in. thick, 2.1 in in diameter and 1.87 in. free diameter. The face of the case is machined and the diaphragm clamped between the cap and the body of the case. The receiver cord passes through a hole in the rear of the case, the braid of the cord is then looped around the U of the magnet, and there tied so that the entire receiver hangs to the braid thus attached to the magnetic system. Between the faces of the magnet a fibre block is placed to which the cord terminals are carried and attached by means of two screws. Upon this fibre block two clips are placed. The cord terminals are attached to one end of the clip line, the leading in, wires to the other, and then they extend to the coil spools. Figs. 79 and 80 are the phantoms from this receiver, Fig. 79 showing the phantom with the diaphragm removed, and it is curious to note that this field is almost circular in cross-section, which would apparently correspond in distribution very closely to the shape of the diaphragm. Fig. 80 is the phantom with the diaphragm in place, and indicates an exceedingly uniform distribution with a diaphragm that is not oversaturated.

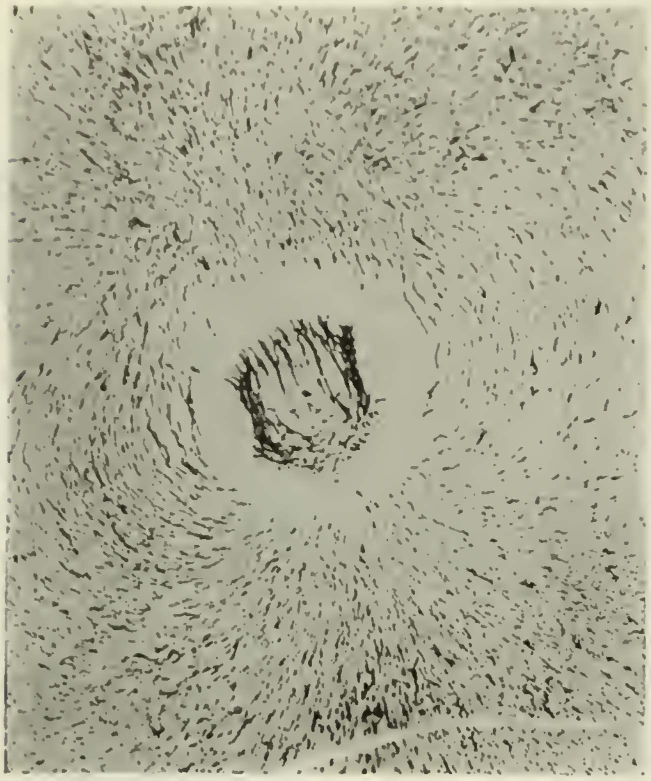


FIG. 79.—PHANTOM OF RECEIVER WITH DIAPHRAGM REMOVED.

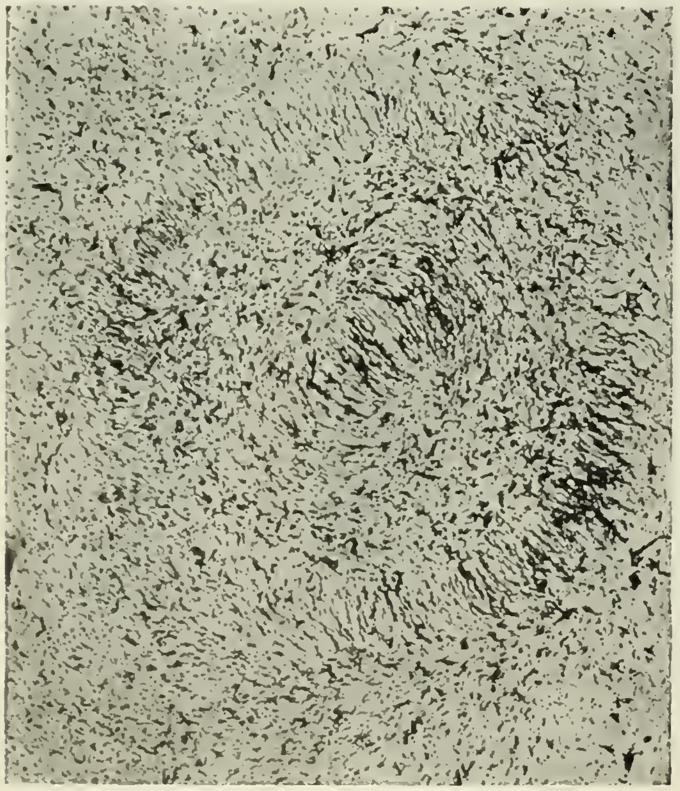


FIG. 80.—PHANTOM OF RECEIVER WITH DIAPHRAGM IN PLACE.

Fig. 81 is rather a unique model of receiver and is only known as being an attempt to produce a design which could be subjected to any amount of abuse without injury. The magnetic system consists of a U bar upon the end of which the customary pole pieces are placed. Besides this U bar two leading-in wires are placed that are attached to two binding posts set near the end of the magnet. Thus the whole arrangement is placed in a mold and composition pressed around it so that the leading-in wires, magnetic system and pole pieces are cast into a solid block of composition. The case is then faced off, the coil spools pressed upon the pole pieces and the terminal wires soldered to the leading-in wires. The diaphragm is then placed on the case and the diaphragm cap secured home. Obviously there is no possibility of adjustment to this receiver after it is once manufactured, and in case of any injury to any part the easiest method of repair is to throw the receiver away and buy a new one.

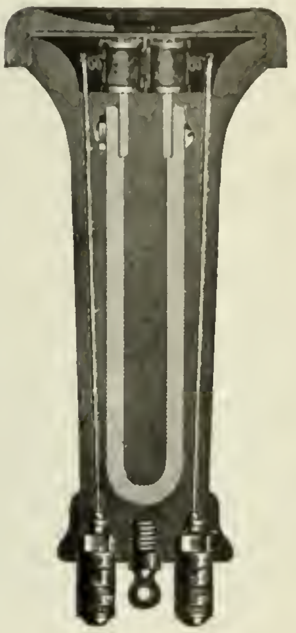


FIG. 81.—THE SOLID RECEIVER.

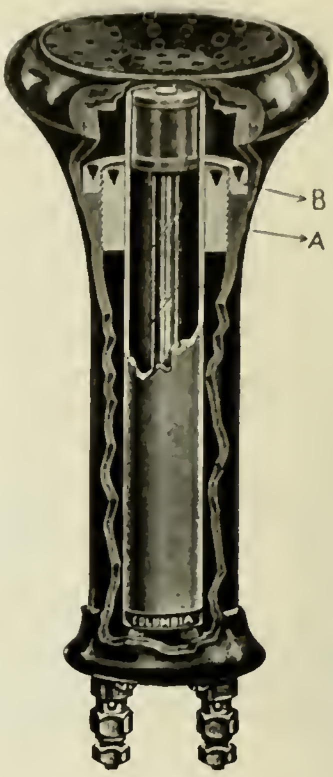


FIG. 82.—COLUMBIA RECEIVER.

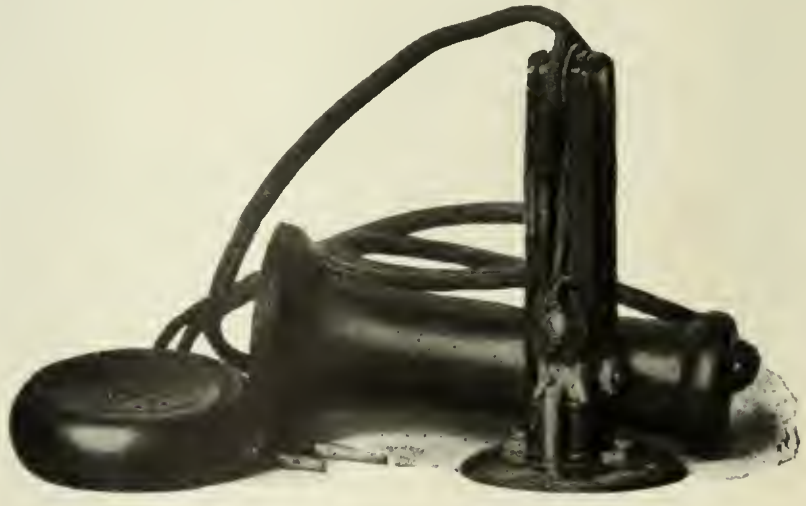


FIG. 83.—THE SUN RECEIVER.

The Columbia receiver, shown in Fig. 82, is a design using a shell magnet instead of a bar magnet, as is shown in the illustration. The magnetic system consists of a central pole piece, upon the end of which the line wire coil is placed. This bar is enclosed in an iron tube, which forms the other half of the magnet system. Around this tube a composition bushing is placed which is threaded to fit a corresponding screw thread in the interior of the case. The magnetic system is then screwed home and adjusted at the proper distance from the diaphragm. Then a lock nut is screwed on the outside of the bushing, which locks it against a ledge machined in the receiver case. The diaphragm is secured in the usual manner by clamping it to the face of the case by means of a diaphragm cap. The Columbia receiver adopts a method similar to that used in the receiver of the Western Telephone Construction Company, of perforating the diaphragm cap with a number of small holes instead of a large central aperture. This by some is considered an advantage, as it prevents the curious or malicious from poking the diaphragm with a pencil or other object, and thus bending it out of shape. Doubtless this is an advantage from a maintenance standpoint, and while it is asserted that this method of making the diaphragm cap does not perceptibly impede the delivery of sound waves to the air, it seems almost certain that the larger number of small holes must exercise some perceptible retarding action upon the air impulses.

TABLE VI.—RECEIVER DATA.—THE MAGNETIC SYSTEM.

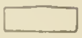
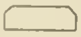
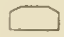
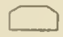
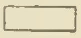
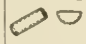
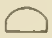
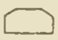
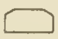
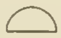
		Width ins.	Thickness ins.	Shape.	Dist. between base. ins.	Area sq. ins.	Length in.	Traction effort gram.	Remanence Gausses	No. of base.
1	A. B. T. Co. Hand Receiver	.'30	.25		.50	.157	3.25	588	4250	2
2	" " " " Head " ..	425	.127		...	.053	. ..	477	3500	2
3	Stromberg Carlson Hand " ..	625	.24		.32	.150	4.60	1332	5800	1
4	American Electric Telephone Co. - " ..	655	.25		.32	.164	4.25	964	4750	1
5	Kellogg Switchboard & Supply Co. - " ..	630	.24		.38	.151	3.50	1170	5400	2
6	Manhattan Hand - " ..	628	.120		.31	.075	3.75	364	4300	2
7	" Watch Case " ..	Steel	Cast'g		...	. .	....	156	....	..
8	Erickson Telephone Co. - " ..	.622	.20		.50	.125	4.00	1177	6000	1
9	Western Telephone Construction Co. " ..	.627	.24		.38	.151	3.50	553	5000	1
10	Swedish American - " ..	623	.23		.25	.142	3.75	761	4500	1
11	Holtzer-Cabot	624	.26		.38	.158	3.50	1262	5500	1

TABLE VII. RECEIVER DATA. THE POLE PIECES.

No.	Name.	Width, in.	Thickness, in.	Length, in.	Area, sq. cm.	Dial lt. center, in.	Magnetization of wire.
1	A. B. T. Company hand receiver	.540	.085	1.36	.30	.312	9600
2	A. B. T. Company head receiver	.375	.086	.50	2.05	.500	9700
3	Stromberg-Carlson hand receiver	.590	.100	1.18	.38	.436	13100
4	American Electric Telephone Company receiver	.610	.100	1.50	.39	.420	10900
5	Kellogg Switchboard & Supply Company receiver	.540	.102	1.25	.36	.420	12300
6	Manhattan hand receiver	630	.120	Prolongation of in.	.52	.480	6000
7	Manhattan watch case receiver	Steel pin	.280" diam.	.145" hole	.26	...	5300
8	Erickson Telephone Company receiver	.573	.115	.970	.43	.415	11600
9	Western Telephone Construction Company receiver	.495	.090	.970	.29	.412	9680
10	Swedish American receiver	.625	.120	1.31	.45	.500	8800
11	Holtzer Cabot receiver	.470	.150	1.120	.46	.475	10500

TABLE VIII.—RECEIVER DATA. THE LINE COILS.

No.	Name.	Width, in.	Length, in.	Depth, in.	Material.	Wire, No. B. & S.	Resistance, ohms.
1	A. B. T. Company hand receiver	.40	.90	.43	Brass	36	20 to 26
2	A. B. T. Company head receiver	.37	.68	.31	Brass	38	60
3	Stromberg-Carlson hand receiver	.44	.86	.50	Fibre	38	94
4	American Electric Telephone Company receiver	.40	.90	.62	Brass	36	125
5	Kellogg Switchboard & Supply Company receiver	.41	.90	.42	Brass	30	69
6	Manhattan hand receiver	.44	1.00	.43	Brass	36	68
7	Manhattan watch case receiver	1 spool	Circular 1" diam	.312	Wood	38	73
8	Erickson Telephone Company receiver	.41	.88	.31	Brass	36	121
9	Western Telephone Construction Company receiver	.42	.83	.37	Brass	36	98
10	Swedish American receiver	.43	.92	.43	Brass	34	75
11	Holtzer Cabot receiver	.43	.81	.36	Brass	36	78

TABLE IX.—RECEIVER DATA. THE DIAPHRAGM.

No.	Name.	Thickness, in.	Diameter over all, in.	Full diameter, in.	Material.	Coating.	Shape.
1	A. B. T. Company hand receiver	.01	2.25	1.93	Ferrotype	Varnish	Flat
2	A. B. T. Company head receiver	.01	2.00	2.00	Ferrotype	Varnish	Flat
3	Stromberg-Carlson hand receiver	.01	2.19	2.12	Sheet iron	Tin	Flat
4	American Electric Telephone Company receiver	.01	2.12	1.87	Sheet iron	Tin	Dished
5	Kellogg Switchboard & Supply Company receiver	.011	2.18	1.93	Ferrotype	Varnish	Flat
6	Manhattan hand receiver	.01	2.25	1.75	Ferrotype	Varnish	Flat
7	Manhattan watch case receiver	.005	2.00	1.75	Ferrotype	Varnish	Flat
8	Erickson Telephone Company receiver	.01	2.31	2.00	Sheet iron	Tin	Flat
9	Western Telephone Construction Company receiver	.011	2.13	1.93	Sheet iron	Tin	Flat
10	Swedish American receiver	.014	2.19	2.00	Sheet iron	Tin	Flat
11	Holtzer Cabot receiver	.013	2.13	1.87	Sheet iron	Tin	Flat

The model which is known as the Sun receiver, exhibits a peculiarity in the adjustment of the pole pieces to the diaphragm. As is shown in Fig. 83, the model consists of a case, body and a diaphragm cap. The magnetic system is composed of two parallel bars that are united by two bolts and filling pieces, those at the rear being of magnetic and those in the front of non-magnetic material. The pole pieces are secured to the front bolt and carry the coil spools to which is bolted a heavy brass plate, on top of which the diaphragm is placed. The pole pieces extend through the brass plate, which is faced off and forms a bearing for the diaphragm. This brass plate bears against the body of the case, and the diaphragm cap clamps the diaphragm case and magnetic system together at a single operation. While this model is similar to those of the Swedish-American and the American; it is a departure in placing the supporting plate outside of the line coils, and thus reduces to a minimum all of the resonant cavities of the receiver. For the sake of easy comparison the data of the models illustrated is collected into the following four tables: No. 6, the magnetic system; No. 7, the pole pieces; No. 7, the line coils; No. 9, the diaphragm.

◆

Electric Power for New England Mills.

In a paper read at the recent meeting of the New England Cotton Manufacturers' Association, Dr. F. A. C. Perrine discussed the economics of water power development and suggested a change from the present practice of each mill generating its own power to a system whereby power for all the mills in a given district would be generated and distributed from a central station plant.

New England mills are equipped with both steam and water power, and there is probably no body of men in the country more familiar with variable water power than their superintendents. Water powers not continuous require an equivalent steam power equipment of engines, boilers and men, with interest charges, and in consequence such powers only effect a saving equivalent to the fuel consumption of the steam engine. This, with continuous power and coal at the average New England price, amounts to approximately $36 per hp-year, and in consequence it is not reasonable to contemplate the development of excess power beyond the continuous flow of the stream where the generation of the excess power involves capital and operation charges exceeding $36 per year. Furthermore, it is safe to estimate that this means that one should not expend as much as $600 per horse-power for the development of excess power, since a cotton mill organization which can only net 6 per cent. on the investment which it has made for machinery and equipment had better use its money in a banking business and go out of manufacturing. In fact, it is unwise to develop the variable power of a river where the expenditure for this portion of the developing exceeds on the basis of twelve months' supply of power, $200 per horse-power, or, in other words, $100 per horse-power for six months' power, or about $150 per horse-power for nine months' power. But it is economical to develop the variable power where the continuous power does not exceed in cost $300 per horse-power, and the variable power does not exceed $200 per horse-power, based upon a continuous rate.

It has been stated that the development for continuous power at a cost not exceeding $300 per horse-power produces energy at a rate with which steam plants cannot compete successfully, no matter what the cost of fuel. Dr. Perrine said he is further of the opinion that where the excess power for a development does not cost more than $200 per horse-power it more than pays for the saving in fuel alone, and that this condition warrants the development of this excess power and the installation of a steam plant to be operated only during the time of the deficiency of water. As these opinions may not be easily justified in the installation of the plants having less than 1,000 hp minimum capacity, and as the majority of mills and water powers to which the argument might apply are of less capacity than this, it may at first sight seem that the arguments which have been presented have no particular or general interest; but before hastily arriving at this conclusion, attention should be given to the fact that the development, generation and distribution of power is no more the business of a cotton mill than making investments of a banking character would be.

Cotton mills have been built up along the water powers of New England, and as a consequence we find everywhere wasteful and expensive development of power, a lack of proper railroad facilities and a general disregard for manufacturing convenience in consequence of a choice of site rendered necessary by the domination of the needs of past methods of water power development. Dr. Perrine advocated a centralized plant, developing power for the use of many cotton mills. In many cases this means the purchase of power from a concern altogether independent of the mill itself, though in the future central power plants may be owned by the cotton mills, precisely as they own their insurance companies to-day, with a separate and efficient management and with a common interest and aim. The development of the water powers in large units and not in small units, with auxiliary central steam plants, will permit at all times the distribution of constant power to the mills and the consequent location of the mill with reference to their product and operatives and not with reference to the power. In order to do this it is necessary to abandon the developments of small individual falls and to substitute therefor the unification of many falls into one high head power wherever this can be accomplished by the means of flumes or dams. Whether this shall be done by the individual mills or a separate water power company owned by the mills is a question for each individual case. Generally, in sections thickly covered by mills and intersected by power streams there is no doubt what the central plant can easily utilize and concentrate all powers within a radius of 35 miles, tying the auxiliary steam plants and water power plants together by transmission lines so that the mills will be free, not only from the variation in the water supply but also from interruption of service due to breakdowns of machinery.

It may be objected that the opportunities for accomplishing this have most of them altogether disappeared. This, indeed, is regretfully true, but it is not altogether true, and there are to-day many streams throughout New England undeveloped on account of their fancied inaccessibility, which can readily become available if the question of the possibility of the site of the mill near the water power be considered as unimportant, and if transmission distances of from twenty-five to thirty-five miles be contemplated.

The development of water powers at high heads has not only advantages on account of the fact that the inefficiency of many small wheels is eliminated, but also from the standpoint of the storage reservoir, since with the high heads that are sometimes reasonably available the quantity of water necessary to develop a large power is so much reduced that reservoirs become important, which under low heads are of inconsiderable capacity. Along the Boston & Albany Railroad, between Becket and Chester, is to be seen an opportunity of carrying out such a plan as is here in mind. Whether the water in the Westfield River is sufficient for any development may be a question, but it is assumed that the water is in reasonable quantity, as it is used to operate several mills a little below. It will be observed as in traveling along the railroad that a canal of about five miles in length along the hillside would give at its lower end a head of approximately 400 ft., and although there are no mill sites in the immediate neighborhood of such a possible power plant, there are good mill locations within ten miles down the valley.

In the vicinity of the mills at Dalton is one of the best reservoir sites in the New England States, probably rendered forever unavailable by reason of the presence of Crane's Pioneer and Berkshire mills at the bottom of what might have been a reservoir backing up the water beyond Weston's mill and turning this little branch of the Housatonic from a power stream of comparative insignificance into a stream giving a large continuous water power.

Down the Housatonic River at Glendale are two powers which have practically been abandoned—that at Glendale and the one at Challenders. The configuration of the ground is such that not only these two powers might be united, but if it were not for the present development of the river, many feet additional head could be obtained in consolidating the heads by fluming the river for a distance of ten or fifteen miles.

The disadvantage of the location of mills along the rivers is most beautifully shown in the neighboring cities of North Adams and Adams, where there are mill after mill with foundations sunk in the river beds at a very considerable expense, and where once every five or ten years great repair bills on account of floods are encountered, though the configuration of the ground is such as would have permitted the consolidation of the water powers into one large efficient central station plant.

The most notable example of the wastefulness of low-head development is to be found at Holyoke, where the canals consume space which should be available for good factory sites, and where they are losing from 20 per cent. to 25 per cent. of the entire power developed by reason of the inefficiency of many low-head wheels in series. It would not be correct to object that in such a case as that of Holyoke the inefficiency of electrical machinery and transmission would more than counterbalance the increased efficiency of the waterwheels, since we all know that the introduction of the electrical drive will of itself overcome the loss from belting amounting to more than the loss incident to the electrical machinery, and whatever increased efficiency there could be gained by the high head would be clear gain and increased power.

The present day marks an era of consolidation and specialization, and all that has been said is in direct line with this tendency, and is hardly more than calling attention to the fact of the improvements in hydraulics and hydraulic machinery, electrical generation, transmission and application, and the great change now made possible in the methods of power application over anything that has been seen heretofore in New England.

The advantage of these principles has been widely appreciated in the regions of the Rocky Mountains and beyond, and by their application the manufacturers of these regions have succeeded in overcoming their very great disadvantage of inaccessibility and expensive fuel, even where they have had to run flumes and ditches from five to fifty miles in length, and have had to transmit power to such great distances that the limit set of thirty-five miles seems to the Western engineers so short that they do not hesitate at rendering available powers that are at least 100 miles from a possible market.

The reception of the ideas outlined will eliminate many of the present difficulties met in New England from the gradual increase in price of coal, and will tend to solve also some of the questions that are so serious which present themselves with reference to the labor problem, and will aid New England in retaining its cotton manufacturing business, which during the past generation has been so important in its development and prosperity.

Electro-Hydraulics and Street Railway Operation.

As noted briefly in these pages last week, one of the papers read before the New York State Street Railway Association was by Mr. C. E. Parsons, of Glens Falls, on hydraulics in connection with street railway operation. He gave some interesting details with regard to work in his own vicinity, and said:

"The new hydro-electric development at Spier Falls on the Hudson River is to play a most important part in the operation of the street railways in the eastern part of the State. Some of the features of this plant, and of the one at Mechanicsville, together with their various transmission systems, give an idea of what may be done in reducing the cost of energy as used for electric traction.

"Within the last year a complete system of connecting railways has been put in operation in the Hudson and Mohawk Valleys, and lines now run from Gloversville in the west to Albany and Hudson in the east and south, and Lake George on the north, while all of the intervening cities have the benefit of the most modern electric railway engineering and construction. Six different railway systems are located within a radius of 45 miles of the Spier Falls plant. The Hudson Valley Railway connects Albany and Warrensburg and the adjoining villages. The Ballston Terminal Railway connects the various manufacturing villages in the vicinity of Ballston. The United Traction Company's lines are located in Albany, Troy and vicinity. The Albany & Hudson Railway's third-rail system covers the territory from Albany south to Hudson. The Schenectady Railway Company operates lines between Schenectady, Albany and Troy, and has nearly completed a line to Ballston and Saratoga. The Fonda, Johnstown & Gloversville Railroad covers 34 miles of territory between Gloversville and Schenectady.

"Three of these systems are now using power from Spier Falls and Mechanicsville. The Hudson Valley Railway is connected with the Glens Falls transmission line at Glens Falls. The voltage on this line is 20,000, and part of the current is used in rotaries at this point. The remainder is transmitted over the company's high-tension lines located on the right of way to the Wilton sub-station. The 18-mile line from Saratoga to Glens Falls is supplied from the rotaries at this station. The railway company has a complete system of high-tension lines, and connections may be made with very little additional copper, so that the whole 125 miles of line may be operated from Spier Falls. The United Traction Company of Albany is under contract to take 6,000 hp at its sub-stations in Watervliet and Albany, and a large part of this power is now being supplied. The Schenectady Railway Company is receiving power over three separate transmission lines. Two are from the Mechanicsville plant at 10,000 volts, and one from Spier Falls at 30,000 volts. These lines reach sub-stations at Latham's Corners on the Troy branch, Colonie on the Albany branch, and the Dock Street Station in Schenectady. The railway company also has a 10,000-volt transmission system connected to its steam plant.

"With the prospect of so much of the energy being used from Spier Falls for railway purposes, it became of the utmost importance that a reliable and constant supply should be assured. The one object which of all others has been kept in view since the very inception of this water power development was to so build that the supply of power would never fail.

"One of the first questions to be decided in a water power plant is the size of the units, both of wheels and of generators. The Spier Falls plant is laid out with four more generators than can be run in extreme low water. This gives a spare set of generators during the low water months, and provides for the sale of 30 per cent. more power during the eight months of the year when the supply is abundant. Another feature which also applies to most plants is that of the construction of storage reservoirs to regulate the flow during the summer months. It is easier to provide for additional units to be supplied from this storage, while the first part of the plant is under construction, than at some future time, when foundations would have to be put in with the aid of cofferdams. The additional cost of the masonry and rock work for spare units is small, as compared with the expense of a shut-down, if future extensions are found to be desirable.

"In regard to the question of the comparative size of water wheels and generators there seems to be a difference of opinion among designing engineers, and at first consideration it might seem as if there were no necessity for a wheel much larger than the generator. The Spier Falls wheels are built to develop 40 per cent. more power than the rated capacity of the generators, and the wisdom of such construction has already been demonstrated in the following manner: It became necessary, in order to fill power contracts, to start the generators before the dam was carried to its full height, and the wheels are now operated under a 64-ft. instead of an 80-ft. head. Because of their large capacity they are able to maintain the speed and develop the full rated power of the generators, although the head is 20 per cent. less than that for which the wheels were designed.

"The protection of the canal and forebay is a most important feature, and a thorough study of existing plants was made before the present layout was adopted. The canal and intake rack run parallel with the river, and the racks are made continuous, with ample space behind them. This gives a larger rack surface, and the velocity being correspondingly less, there is not so great a tendency for driftwood to choke the water supply. This arrangement allows the larger pieces of wood to be floated down the face of the racks, and over the wasteway at the end, instead of lifting them out bodily. A practice which should be avoided where feasible is that of placing the intake square across the current. If this is done heavy projecting piers must be built to take the ice thrust in times of high water.

"The plant at Mechanicsville, unfortunately, has this arrangement, and there was serious trouble with the ice almost every year, until a series of ice breakers was built diagonally across the river. In order to facilitate the making of repairs on the hydraulic equipment, and to enable any part of the system to be laid up without interrupting service, a series of grooves for stop logs was arranged, both for the canal head gates and for the gates in front of the penstocks, and any of the gates may now be repaired or replaced without affecting the others.

"The question of the governing of a plant is one to which altogether too little attention is usually given. It is impossible to attain accurate speed regulation with the best governor that can be built, unless due consideration has been given to the principles upon which depends the speed of a water wheel. The function of a governor is to vary the energy delivered to the wheel as the generator load changes, and this can be satisfactorily done only when the gates and gate rigging are so designed that they will respond quickly to the governing mechanism. The limitation of speed control is that imposed by the inertia of the water, and to obtain good governing the one most essential thing is for the water column to respond promptly to the varying aperture of the gates. It is to the water column, therefore, that attention should be given from the moment the plant is begun, if the accurate speed control which is now demanded is to be obtained. The shorter the penstock, the sharper the downward pitch, and the less the velocity, the better on the whole will be the regulation.

"It must be remembered also that the water column does not end at the gate, and long and contracted draft tubes and shallow tail-races may have a serious effect on the governing, even if the work above the wheel is correctly planned. Frequent cause of disaster is the sudden and dangerous rise of pressure in the penstock, due to sudden closing of the gates, and there seem to be but two practical methods of eliminating this danger. Standpipes are effective if properly built, but are expensive and a source of trouble in cold climates. The problem seems to be solved at Spier Falls by the use of Lombard relief valves. They are easily adjusted, open and close quickly and have a discharge area large enough to afford ample protection. As a result of a study of the foregoing principles and of the adoption of the most modern governors, the regulation of the Spier Falls plant is very satisfactory.

"The switchboard is another part of the system which needs to be carefully studied if shut-downs are to be reduced to a minimum, and the one at Spier Falls is to be modern in every respect. It will be possible to put any one of the ten machines on any one of the eight outgoing circuits, by means of the small controlling switches on the operating board in the center of the station. Consequently, in case of trouble with the generators, there will be no delay in changing. The transmission lines are all to be built in duplicate, and two separate pole lines, running through different sections of the country, will reach the larger centers of power distribution.

"There is a great deal of scepticism among railway managers in the East, as to the reliability of water power as applied to electric traction. This is largely due to the fact that designing engineers have not given the proper study to their hydro-electric developments, and numerous shut-downs and poor regulation have caused the more conservative to withhold their approval. From the results which will be attained in the Spier Falls plant, and in other modern plants of this character, under construction, it seems safe to predict that water power will be as reliable as steam, with the additional advantage of a saving of 50 per cent. in the cost of energy."

New Telephone Patents.

CALL REGISTERING SYSTEM.

The proportioning of telephone charges to the amount of service given has always been a rather knotty problem. The flat or unlimited system of charging of course makes no attempt at such equalization, while the more modern message rate system is far from perfect in this direction. Slot machine service, as given in many cities, does equalize the charges fairly well, but it cannot be perfect in this direction so long as one does not pay something for "busy" calls. For instance, suppose A to make five attempts to call per day, but owing to the class of subscribers called but one of these is successful. On the other hand, suppose B to call but twice a day and both calls are successful. Now every attempt to make a call by A has taken part of the time of his operator, and as this must be paid for in some manner by the subscribers, it is evident that were A and B the only subscribers on the system a large proportion of B's payment for his two good calls would go toward paying for A's failures to complete his one call. A system of registering calls recently patented by Albert J. Springborn contemplates a differentiation between successful and unsuccessful calls. These are scored separately upon two counters. These counters are located at the subscriber's premises—one, that for good calls, being operated automatically; and the second, for lost calls, being under the control of the central office operator. Unfortunately, the present development of the system is rather of the laboratory than of the practical type, as there is at each subscriber's station such an abundance of coils, contacts and levers as to render the maintenance system a disadvantage far beyond any saving which it could possibly introduce.

SELF-RELEASING INTERCOMMUNICATING SWITCH.

George F. Archer, of New York, is the patentee of an automatically releasing intercommunicating system switch. With this switch each line terminates in a spring member, the end of which plays across a latch member. When a line is desired the corresponding spring member is depressed beyond the latch to a stop member, to which the signal battery is connected. When it is released it returns to the latch, thereby completing the talking circuit to the desired line. If the receiver be returned to the hook, or if a second line spring be depressed, then the latch will tilt and release any spring previously latched.

BELL YOKE ADJUSTMENT.

One of the primary adjustments of a polarized bell is that controlling the distances between the armature and pole faces of the core and between the armature and the free pole of the polarizing permanent magnet. As in almost all bells of this type, the armature is carried by a yoke spanning the longitudinal frame members, this adjustment is well termed the yoke adjustment. A common practice in providing for this yoke movement is the threading of the longitudinal members which pass through the yoke ends, one nut being placed on each side of the yoke. This certainly provides a secure, if rather awkward, adjustment. Frank B. Cook, of Chicago, has recently obtained a patent for another means of yoke adjustment, by which the movement of the yoke is facilitated. In this bell the longitudinal members are cut off at about the level of the pole faces. These ends are then drilled and tapped to receive screws which pass through the yoke. These screws are quite long and after passing through the yoke they are threaded through spiral springs. These latter hold the yoke against the screw heads, while at the same time permitting of a considerable range of motion of the yoke.

CURRENT NEWS AND NOTES.

CHICAGO BRANCH A. I. E. E.—Mr. P. Junkersfeld, local secretary, announces the appointment of the following members to the Executive Committee of the Chicago branch of the American Institute of Electrical Engineers: Messrs. George A. Damon, James Lyman, H. H. Wait, Kempster B. Miller, Prof. P. B. Woodworth, J. R. Cravath and T. P. Gaylord. Arrangements for the fall programme are to be made at an early date.

MAIL BY TELEPHONE.—It is stated that Senator Fairbanks, of Indiana, as soon as the regular session of Congress convenes, will take up a matter in which he is much interested. Just before the adjournment last spring he offered a resolution calling upon the Postal Department to investigate the feasibility of using the telephone in the delivery of special delivery letters. The Senate would not make an appropriation at that time, as the proposition was new. Senator Fairbanks talks enthusiastically of the matter. He believes that the adoption of the rural telephone will make it possible for the farmer to receive his mail as quickly as the man in town. He would have it arranged so that the postmaster could open the special delivery letter, and read it over the telephone to the man in the country. The rapid extension of telephone lines through the rural districts makes the scheme more easy than it would have been at the time he prepared it. He has talked with merchants and farmers and members of the Post Office Department, and they are all in favor of the plan. He says he intends to push the matter as rapidly as possible.

ELECTRIC VAPOR LAMPS.—Two patents were recently granted to Mr. Peter Cooper Hewitt for improvements in his electric vapor lamp. While the old familiar type of this lamp is held in a vertical position, Mr. Cooper Hewitt has found that operation in a horizontal position has certain advantages, and has now patented details of construction for this purpose. It is stated that a horizontally-disposed lamp having a luminous element of considerable length placed in the upper part of a room furnishes a kind of illumination which is agreeable to the eye and is well adapted to display the special features of architecture, decoration or furniture, and at the same time the light is said to be agreeable for reading purposes. The other patent relates to details of construction which improve the method of starting the mercury vapor lamp. By adding certain other materials, such, for instance, as red sulphide of mercury, during the manufacture of the lamp, a condition is produced within the lamp which facilitates the starting, a much lower potential being sufficient than if such material is not present. It is also of advantage to provide a band of foil in proximity of the negative electrode and in electrical connection with the positive electrode. To start the lamp, it is connected to a special circuit having a higher potential than that upon which the lamp is intended to run after it has been started, this higher potential being produced by a spark coil.

MASSACHUSETTS STREET RAILWAYS.—At the annual meeting of the Massachusetts Street Railway Association, held at Young's Hotel, Boston, the following officers were elected: President, Edward P. Shaw, of Newburyport; first vice-president, Francis H. Dewey, of Worcester; second vice-president, Robert S. Goff, of Fall River; treasurer, Fred H. Smith, of Quincy; secretary, Charles S. Clark, of Boston. Executive Committee, the president, vice-presidents and H. H. Crapo, of New Bedford; P. F. Sullivan, of Lowell; W. S. Loomis, of Holyoke; W. W. Sargent, of Fitchburg, and R. T. Laffin, of Worcester The following were elected Auditing Committee: Charles F. Grosvenor, of Palmer; George W. Cook, of Springfield, and H. C. Page, of Pittsfield.

N. E. L. A.—President Edgar accomplished a good deal of work for the association during a visit to New York last week. He has completed the organization of the committee for the investigation of the steam turbine, and a meeting will be held at an early date to formulate a plan for immediate and thorough work. The association made a large appropriation for this work at the Chicago meeting, believing it to be one of great importance to the members; and in the hands of the men composing the committee the investigation is sure to result in a valuable report for the Boston meeting. The following gentlemen have consented to take up this work: Mr. Wm. C. L. Eglin, Philadelphia, chairman; Mr. Frederic Sargent, Chicago, and Mr. A. C. Dunham, Hartford.

A GREAT STORM.—The Atlantic seaboard—particularly the States of New York and New Jersey—was visited by a tremendous rainstorm last week, lasting virtually from Thursday to Saturday, and doing immense damage. Work was interrupted at the General Electric factories, Schenectady, by the rising of the Mohawk River. The electric power dam at Port Jervis, N. J., broke away and damage was inflicted on the plant of the Neversink Light & Power Company. At various points along the Hudson River electric light and power plants were submerged and silenced, and the same is true of the system of the Public Service Corporation, in New Jersey, whose plants border the Passaic. Serious trouble of the same kind was experienced at Scranton, Pa. In several places, including New York City, the street railway systems were tied up or badly restricted.

MARCONI AT WORK.—When the steamship *Campania* arrived in New York Harbor on Saturday last it was learned that Mr. Marconi had been successful in his latest wireless telegraph experiments. The steamship *Lucania*, with the inventor on board, and with special apparatus, sailed from New York on October 3, when Mr. Marconi said that he would attempt to communicate with one of the land stations all the way over, receiving everything they sent. His success was announced in a wireless telegraph "extra," which was printed on the *Campania* in midocean on Wednesday morning, shortly after the two ships passed. The *Lucania* at that time was in communication with the land station, and had been since leaving Sandy Hook. She conveyed all of the latest news of the world to the *Campania*. As soon as the *Campania* had received the news from the *Lucania*, Purser Graham assumed the rôle of editor, and with the aid of several of the other members of the crew, published an early morning extra. The paper was given to the passengers at breakfast, with the information that it was the first thing of the kind ever done at sea. Such "relaying" is a very effective demonstration of the immense possibilities of wireless telegraphy.

STREET RAILWAY PENSIONS.—At the recent annual meeting of the Metropolitan Street Railway Association—the benefit organization of the New York street railway interests—President Vreeland said: "Referring to the pension system in combination with the association, from the time a man enters the service of the company, until the time of his death, he is properly cared for, the pension system stepping in where the association leaves off when a man becomes incapacitated for active labor. It has also been made a rule that all of the lighter grades of work, such as transfer agents, janitors, watchmen, etc., are reserved for men in the service of the company who, either on account of age or injury, have become incapacitated for the more active service. This is in direct contrast with the system in vogue years ago, when influence had much to do with the placing of men in these positions, employees of many years of service being forced out with no means of support. As an illustration of the workings of the pension system, an employee with an annual salary of $900, who receives 40 per cent. of that average salary through pensions, would receive $360 per year. This is the interest, at 4 per cent., on $9,000, a sum which a man living in a thrifty manner, would be unlikely to save during his active service."

AMERICANS AS ENGLISHMEN.—Our London contemporary, *Electrical Times*, comments amusingly on the industrial invasion of England by Americans. Anywhere, it says, between Maine and Manila, it is allowed to be the manifest destiny of America to dominate the world. "The preliminary step is the invasion and industrial conquest of this country. After that the rest is easy. Resistance is futile, owing to the difficulty of distinguishing the invader from a true-born Englishman after he has been six months on this side. Sometimes one has not to wait so long. Until last week if there were wanted for polemical purposes a well-established landmark of the progress of the American invasion, it could have been found in the acquisition by the American storage battery interest of the Chloride Company at Manchester. It was all in the New York papers, and, besides, directors of the Electric Storage Battery Company, of Philadelphia, were made directors of the English company, so there could be no doubt of it. The English company held its annual meeting at Clifton Junction last week, and there was Mr. Herbert Lloyd, the president of the Philadelphia company. In accordance with dramatic propriety he should have forthwith ordered the stars and stripes to be hoisted over the company's new offices. Nothing of the kind: he simply intimated to the assembled shareholders that he had been raised in the old country, and was, as a matter of fact, a real Britisher. Moreover, the other director, who resided in America, was also an Englishman, and the American company was not run by Americans, but by Englishmen. It was he who had invaded America twenty years ago, and now came back with the experience of those twenty years to give the mother country the benefit of it. Now, what is to be done with an invasion which is not an invasion, but simply the return of the native? One of my colleagues has started off on a research designed to establish the proportion of eminent American electricians that were born under the British flag, and he tells me the results are surprising, but I don't trust him. It does not seem safe in this matter to trust anybody."

LETTERS TO THE EDITORS.

Theories in Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

SIRS:—I notice that in your issue of September 19 last, page 474, reference is made by Mr. A. F. Collins to Prof. Fessenden's "Sliding half-wave" theory.

I have on other occasions refrained from making any comments when various names have been put forward as the originators of this theory, but feel impelled in this instance to point out that the theory in question did not originate with Prof. Fessenden, as he himself will no doubt be the first to admit.

So far as I am aware, the theory was first propounded by myself in articles published in the *London Electrical Review*, of May 12 and 19, 1899.

The first mention of the theory by Prof. Fessenden appears to have been made at a meeting of the American Institute of Electrical Engineers in November of the same year, as will be found on reference to the *Transactions* of the Institute.

LONDON, ENGLAND. J. E. TAYLOR.

Boyleiana.

To the Editors of Electrical World and Engineer:

SIRS:—Having had occasion to consult the 1774 edition of Boyle's works recently presented to the Library of the American Institute of Electrical Engineers by Dr. S. S. Wheeler, it occurred to me that the following notes might be of interest to the general scientific reader:

(1). In the life of Boyle by Dr. Birch, which forms the first 94 pages of this fine quarto edition, will be found on page 70 a letter from Sir Isaac Newton to the philosopher of Lismore on the properties of the ether, which hypothetical substance is there held to be "capable of contraction and dilatation, strongly elastic, and in a word much like air in all respects, but far more subtile."

(2). The tract on the "Mechanical Origin of Electricity," Vol. III, p. 647, is of historic interest, being the first work (1675) written in English on the subject of electricity. Gilbert's famous work (1600) contains a very important chapter on electricity, but written, like the rest of "De Magnete," in Latin.

(3). In his "Experimenta et Observationes Physicæ," Vol. V, p. 81, Boyle makes the curious remark that a brick rendered red hot and then allowed to cool while lying in the magnetic meridian acquires "magnetical verticity."

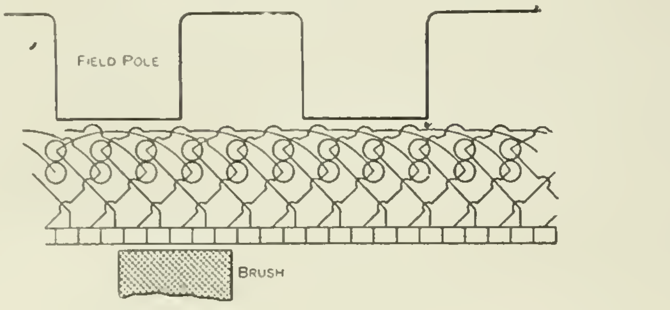
(4). Vol. V contains a paper entitled "A short account of the statical baroscope imparted by Mr. Boyle, March 24, 1665." This letter, written by Boyle to Mr. Oldenburgh, is especially interesting from the fact that in it we meet for the first time the term *barometer* (see page 133).

Manhattan College, New York. B. Potamian

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Single-Phase Repulsion Motor.—Cramp.—The author describes in a general way his construction of a single-phase repulsion motor. He believes that repulsion motors may be built up to at least 20 hp, which will compare favorably with any type of motor at present in use. In the first form of repulsion motor which he tried he found that the spark was almost as great on closing the coil as on opening it. He found that on the whole, to avoid sparking on the make, a good, firm, clean, low-resistance contact is adequate; this could be obtained by copper brushes. He was enabled to obtain sparkless opening by means of the same principles that are employed in what is known as "resistance commutation"; that is, by providing a sufficient interpolar space to enable each rotor coil to pass entirely outside the magnetic field, so that the current can die down before the opening of the circuit. Of the two forms of commutation to be adopted in the design of a repulsion motor, namely, resistance or e.m.f. commutation, the author states that he tried both forms, and finds that while both may be rendered sparkless between certain limits, the former gives good commutation over a wider range, while the latter gives better starting torque and a better power factor. As far as the design of the rotor winding is concerned, the author illustrates two arrangements, in the first of which all short-circuited coils are in series, while they are in parallel in the second. All motors at present under construction are of the first type, while with the second class of windings it has been found that if the rotor is of the closed-coil type, besides those coils actually short-circuited, there are other closed circuits carrying useless or even harmful currents. Most of his experiments were made with a type illustrated in the adjoining figure, in which the rotor is practically converted into an open-coil armature, with two coils in parallel. He then discusses theoretically the e.m.f., current, torque, etc., with the help of diagrams. As far as efficiency is concerned, the author does not give definite figures, but states that the repulsion motor for a given power will be heavier than the corresponding polyphase motor, and lighter than the single-phase motor with its starting apparatus. Considering the enormous waste of energy in starting the latter, the repulsion motor will be far more economical of energy for non-continuous running. The great advantage of the repulsion type of motor is that it may be started under full load, with a current only slightly exceeding the full load current, without any expensive and cumbersome starting arrangement. If maximum torque of the motor is required at starting, and the brushes are to be kept fixed, the power factor can never exceed 70 per cent. At any speed the torque will always be a maximum with about this power factor, but in order to keep this maximum the brushes would have to be moved gradually in the direction of rotation as the speed rose. The author sees no reason why this should not be done either automatically or by hand, in the case of small motors.—Lond. *Elec.*, September 25.



SINGLE-PHASE REPULSION MOTOR.

Power.

Three-Phase Motors for Electrical Driving.—Eborall.—The continuation of his paper, previously mentioned in the Digest, on the application of three-phase motors to the electrical driving of workshops and factories. The use of a rotor resistance, according to the author, presents the advantages that the current consumption for a given torque is greatly reduced and the power factor of the starting current attains a high value, approximating to the value it has when the motor is running well loaded. The starting is gradual, in accordance with the requirements of the load, and it is perfectly under the control of the operator. Test curves are given of the running and starting performance of three-phase, 15 and 30-hp motors, with wound rotors. Such motors start with a torque equal to that at full load, with a starting current a little in excess of the full load current; they can, if desired, start with more than twice the full load torque, and then the current consumption is two and a quarter to two and a half times the full load running current. The starting performance of three-phase slip ring motors, as compared with direct-current motors, is also illustrated by curves. The author then discusses the question of speed regulation, the slip ring type of motor being the only one which can be employed in this connection. He concludes that for all practical purposes rheostatic (rotor) control is the only method of general application, which is available at the present time for varying the speed of three-phase motors. He gives the diagram of connections for a three-motor crane, each of the three-phase motors having its own controller and resistance. The controllers are represented in the form of developed diagrams.—Lond. *Elec.*, September 18.

Distribution of Electric Power and Lighting.—A description of the system adopted for the distribution of power and lighting in the new locomotive shops of the Philadelphia & Reading Railway, at Reading, Pa. The reasons are given in detail, which led the management to choose the two-phase alternating-current system of power distribution, with two-phase generators, as best suited to the local conditions. For lighting purposes the series, enclosed, 6.6-amp., alternating-current lamp was adopted for both inside and outside use. Both alternating and direct current are furnished, the former for driving induction motors on all machinery requiring constant-speed driving, the latter for cranes and variable-speed motors on individually-driven tools. A frequency of 60 cycles at 480 volts was adopted. The construction of the wiring tunnel leading from the power house to the shops is described and illustrated.—*Am. Eng. & Rail. Jour.*, October.

Motor-Driven Chasing Lathe.—A short illustrated description of a recent English construction. The fast head-stock casting is so arranged as to form a bedplate for the motor, which drives the spindle by means of rawhide spur gearing. The machine is specially designed for the rapid production of fire box stays in brass, copper or bronze, and a small pump, driven from the motor shaft, is used for flooding the tools while making a cut.—*Eng'ing*, September 25.

Electrically-Driven Quartering Machine.—An illustrated description of an interesting new design for mounting electric motors for driving a machine for quartering and boring crankpin holes in locomotive driving wheels. The machine is driven individually at each head by 3½ hp constant-speed motors. The most important feature of the design is the simplicity of the construction for changing around for quartering with left instead of right-hand lead, without altering the relative locations and the principal dimensions of the drive.—*Am. Eng. & Rail. Jour.*, October.

REFERENCES.

Application of Induction Motors.—A note on the electrical equipment of a cement factory. The plant includes ten variable-speed induction motors, each of them direct-geared to a rotary kiln and provided with a controller permitting the motor to be run at any one of four speeds; the note does not describe how it is done. The operation of the kilns by variable-speed induction motors is said to be a new departure from the usual method of applying power to this class of machines.—*Engineer*, October 1.

Coal-Handling Machinery Driven by Electric Motors.—Willey.—An illustrated description of the installation of the Maryland Steel Company, at Sparrow's Point, Md.—*Elec. Rev.*, September 19.

Alternating Versus Direct Current for Mines and Smelters.—Brown.—An article on the relative advantage of 2,300 volts alternating current versus 550 volts direct current for mine and smelter work, in which the author enumerates the various advantages and disadvantages of each system. He concludes that no hard and fast rules can be laid down to determine the question, as it depends upon local conditions.—*Eng. & Mining Journal*, September 26.

Motor-Driven Machine Tools.—An illustrated description of recent practice in the application of electric driving to drilling machinery.—*Am. Eng. & Rail. Jour.*, October.

European Electrically-Operated Cranes.—Perkins.—An illustrated description of several constructions.—*Elec. Rev.*, October 3.

Traction.

New Power Station at Brussels.—An illustrated description of the power station which has just been put in operation and is intended to distribute polyphase current to three sub-stations to operate the entire tramway system in Brussels. The sub-stations are located in the old direct-current stations, which are to be given up, but the old direct-current feeders will be used. The station contains at present four 1,500-kw alternators generating current at 6,600 volts and 25 cycles. Each alternator is operated by a twin, tandem-compound condensing engine, with cylinder dimensions 630 mm. and 1,090 mm. by 1,200 mm. stroke. These engines operate at 94 r.p.m., with a pressure of nine atmospheres and an admission temperature of the steam of from 275 to 300° C. The principal feature of the station is the switchboard, which consists of three sections. The apparatus for the low-tension, direct-current apparatus, such as the exciters, battery, lighting circuits and motors used around the station constitute one section. The second part of the switchboard is that for the operation of the high-tension switches. All of these switches are operated by low-tension circuits, and the low-tension apparatus for doing this work is mounted on a table in the center of the switchboard gallery. This table is also provided with rheostat connections for the alternators and with the controller for an especial electrical governing device on the engine governors. The third part of the switchboard includes the recording instruments, together with the automatic relays for operating the oil switches. The switchboard operator thus has all this apparatus in front of him and also has a clear view of the engine room. The bus-bars are divided into sections so that any feeder or leads from any machine can be switched to any section of the bus-bar.—*St. R'y Jour.*, October 3.

REFERENCES.

Colorado Springs & Interurban Railway System.—A description of the line which connects the cities of Colorado Springs, Colorado City and Manitou. The roadbed is built with a view of obtaining high speed. A new power house, new shops and new car houses have been erected recently, plans and views of all of which are presented. Three direct-connected generating units of 750 hp each furnish current for the railway plant, and an alternator has been installed to furnish current for lighting the buildings and the parks of the company.—*St. R'y Jour.*, October 3.

Notes on the Operating Practice of the Indiana Union Traction Company.—An article calling attention to a number of operating details which have been worked out on this important system, and which are of general interest for those who are engaged in the operation of interurban properties. The limited service established by this company is described, together with the train dispatching system and a number of features of construction and equipment.—*St. R'y Jour.*, October 3.

Electric Railways of Budapest.—Koester.—An illustrated description of the electric underground and surface roads. The power plant is briefly described.—*St. R'y Rev.*, September 20.

Columbus, London & Springfield Electric Railway.—Reagan.—A long illustrated description of the system of the Columbus, London & Springfield, and the Dayton, Springfield & Urbana Railways. The mechanical and electrical equipment of the power house is described in detail.—*St. R'y Rev.*, September 20.

Electric Railways in the United States.—Serrell.—A statistical article, reviewing the railroad situation from the investor's standpoint.—*Cassier's Mag.*, October.

Installations, Systems and Appliances.

Gas-Driven Electric Light Plant.—A short illustrated description of the plant of the Tunis (Algiers) Electric Light Plant, which is stated to offer special interest, because it affords the first instance in which a gas company has adopted producer gas and gas engines as the motive power for its electric station. There are three gas producers, a brief description of which is given, with coke scrubber and chemical purifier. The engine room contains four high-speed gas engines of 106 brake hp each, running four dynamos of 70 kw each at 240 volts. The engines can be run with producer gas or coal gas, and can be changed to either while running.—*Eng'ing*, September 25.

Wires, Wiring and Conduits.

Conductivity of Certain Aluminum Alloys.—Wilson.—A paper read before the recent meeting of the British Association on the electrical conductivity of certain aluminum alloys as affected by exposure to the London atmosphere. Specimens of various alloys in the form of wire of 0.126 in. diameter were placed on the roof of Kings College on June 11, 1901, taken down and tested after a year's exposure in 1902 and again in 1903. A table gives the results obtained. During the first year the series of copper aluminum alloys diminished in conductivity to a greater extent the greater the percentage of copper they contained. This process has progressed still further in the second year, though in a smaller percentage ratio. The manganese and the nickel series have changed very little. For exposed light aluminum alloys the results, therefore, confirm the conclusion previously arrived at, namely, that copper alone should not be used in comparatively large quantity.—Lond. *Elec.*, September 18.

REFERENCES.

Sag and Tension of Suspended Wires.—Sengel.—A mathematical article containing a method of approximately calculating the new tensions and sagging which are produced through variations of temperature, load or distance between the poles. The calculations are made in the metric system.—*Elek. Zeit.*, September 24.

Bringing High-Tension Conductors into Buildings.—Skinner.—A short illustrated discussion of the methods employed.—*St. R'y Rev.*, September 20.

Electro-Physics and Magnetism.

Radioactivity of Metals in General.—Voller.—A discussion of the results obtained by McLennan and Burton, previously noted in the Digest. These experimenters found that metals like lead, aluminum, zinc, tin and copper send out spontaneously positive ions and retain, therefore, negative charges. They found negative potentials of 0.216 to 0.073 volts. The author calls attention to the fact that in electrometer measurements of such potentials, which are of the order of the Volta contact potentials, it is necessary to consider all electromotive forces which appear between the single metallic parts of the electrometer or the whole electrometer system, when they touch each other. In such cases the metals to be investigated and the metals of which the electrometer is composed have to be of the same nature. If, however, the electrometer quadrants were of brass there was always the voltaic electromotive force of brass against lead, aluminum, etc., acting in the system. These forces generate potentials, the value of which is equal to or greater than those measured by the first-named experimenters. If the above influence of the voltaic potentials has not been excluded, there is no necessity to assume a general and spontaneous electronic emanation of all metallic surfaces.—*Phys. Zeit.*, October 1.

Action of the Earth in the Propagotion of Electric Waves.—Voller.—The author gives the result of experiments with a small Braun and Siemens-Halske apparatus, which was operated in four ways:

1, in the ordinary manner, with both air wires, without any earth connection, 2, without both air wires and with connecting wires to earth plates, 3, with replacement of sender or receiver wire respectively by earth connection, 4, without air wires or earth connections. He concludes that a variable electrification, communicated to the surface of the earth, is propagated by conduction in the latter in the same way as in a dielectric by progressive polarization, and that, therefore, a sort of wave telegraphy through the surface of the earth is possible.—*Phys. Zeit.*, October 1.

Action of X-Rays on Vapors.—Campanile and Commo.—The authors investigated the property of condensing vapors possessed by air ionized by the X-rays. They established that the air which is traversed by X-rays has the property of condensing a sensitive ray of vapors, even of other liquids than water. The air traversed by X-rays also condenses such vapors, which are generated in the air, if a liquid is contained in an electrified metallic capsule. They confirmed that negative ions are more effective in producing condensation than positive ions.—*Phys. Zeit.*, September 15.

REFERENCES.

Losses by Hysteresis and Eddy Currents.—Richter.—A mathematical article, accompanied by diagrams, in which the author investigates the influence of the distribution of the lines of force in an iron ring on the losses by hysteresis and eddy currents. He finds that with an irregular distribution of the lines of force smaller iron losses are obtained than with regular distribution.—*Elek. Zeit.*, September 3.

Terrestrial Magnetism.—Creak.—An abstract of an address before the British Association, on terrestrial magnetism in its relation to geography, reviewing the work done by magnetic surveys, the search for the magnetic poles of the earth, etc.—Lond. *Elec.*, September 18.

Alternating Currents.—Tell.—A didactic article on the elementary principles of alternating currents.—*Engineer,* September 15.

Electro-Chemistry and Batteries.

Electrolysis and the Solvent.—Lobry de Bruyn.—An abstract of an article in which the author publishes the results of his endeavors to obtain quantitative data bearing upon the question as to whether the ions carry the solvent with them in electrolysis. This cannot be decided by using purely aqueous solutions, and, therefore, the author used a mixed solvent of water and alcohol. Then, if one of the ions carried with it one of the solvents, this would be found by the difference in the proportion of the two solvents at the cathode and at the anode. The electrolyte was silver nitrate dissolved in 25, 35 and 64 per cent. solutions of methyl alcohol, and silver electrodes were employed. The apparatus was such as is used for the determination of transference numbers of the ions. The result was distinctly negative. If the silver or the nitrogen oxide ion had carried with it one molecule of the solvent, then for every 4 grams of silver an increase or decrease of 0.6 to 0.7 grams of water or of about 1.2 grams of alcohol at the anode or cathode would have taken place. This would have been easily detected by analysis, even though the amount had been largely diminished by diffusion.—Lond. *Elec.*, September 18; from *Proc. Roy. Acad. Sc.*, Amsterdam, August 27.

REFERENCES.

Extraction of Mercury in the Electric Furnace.—Becker.—A short, popular description of the ordinary chemical process of treating cinnabar and the advantages of the electric furnace, when used in this connection. It is proposed to heat the cinnabar together with lime.—*L'Ind. Electro-Chimique*, September.

Quantitative Electrolytic Precipitation of Metals.—Nissenson and Danneel.—A paper read before the Congress of Applied Chemistry at Berlin on the quantitative precipitation and separation of metals by electrolysis, for analytical purposes. The authors give methods of determination for lead, copper, antimony, tin, cobalt, nickel, zinc, and cadmium.—*Zeit. f. Electrochem.*, September 10.

Manufacture of Metallic Powders.—A short review of several electrothermic processes for the manufacture of metallic powders.—*L'Ind. Electro-Chimique,* September.

Units, Measurements and Instruments.

Resistance of Highly Insulating Substances to Perforation.—Walter.—A very long article in which the author describes in detail a method which he has worked out for testing strongly insulating substances in order to ascertain the resistance which they offer to perforation. He calls attention to the fact that different insulating substances show considerable differences as far as their specific resistances are concerned, but that their resistances to perforation are not nearly as different. The method is founded on the discovery that a rather thick plate of an insulating substance can be easily perforated by the following method: A drop of wax, stearin or similar substance is brought on one side of it and after it has become cold is perforated with a fine needle, until the surface of the plate is reached, and the whole brought between two electrodes, which are connected with the poles of a high pressure machine, or an induction apparatus. The arrangement must be such that the perforation in the drop is in line with the two electrodes, and the latter are about 1 mm. distant from the plate, on each side. It is then possible to perforate the plate in a direction representing the continuation of the perforation in the drop of wax, even with a comparatively low potential measured by a spark-gap connected in parallel. The author found that for a certain plate of insulating material there was always a certain minimum length of spark, with which the perforation is just possible, and that this minimum spark length increases proportionately with the thickness of the plate. An induction apparatus of 20 to 30 cm. length of spark is sufficient for several millimeters' thickness of insulation. The arrangement of the apparatus and the method of carrying out the determination is discussed by the author at considerable length, as the exactness of the experiments depends largely on conforming to the proper conditions. For glass plates of various thicknesses and composition, the author found that the composition of the glass is not to be neglected, as the resistance to perforation of plates which contained a larger amount of lead was considerably less. He mentions in this connection the interesting fact that the dielectric constant of a glass containing 45 per cent. of lead is almost the same as that of a glass which contains no lead. He also gives experimental results on a number of hard rubber plates and hard porcelain plates. He also conducted an extended series of experiments with mica and micanite plates, the behavior of which was found to be different from that of the other plates, in so far as this material consists of several superposed pieces of mica, separated partly from each other by air cavities. The drop method in such a case will not lead to a perforation of the whole plate, but only of the upper pieces of mica, up to the next air cavity, in which the electricity then spreads to all sides. The practical value of the results consists in the comparison of the qualities of the different materials and the possibility of calculating the minimum thickness of a layer of insulating material.—*Elek. Zeit.*, September 24.

Measurement of Electromagnetic Radiation.—Huth.—The author describes an oscillation galvanometer, devised by himself, for the measurement of electromagnetic radiation. The instrument is shown in the adjoining figure. It consists of a bundle, *a*, of steel wires of 0.1 mm. diameter, and 16 mm. length, which is carried by an ivory rod suspended at *f* by a phosphor-bronze wire, *c*. The lower cord of the rod is fastened by a phosphor-bronze spiral, *d*, on the base plate of the instrument at *g; p, p* are damping wings of paper, *e* is a storage battery, which furnishes magnetizing current for the bundle. The current goes from *e* over *f* and *c* through the magnetizing spiral, *b*, through the torsion spiral, *d*, and returns over *g* to *e*. Parallel to this circuit are arranged the antennæ, which are indicated at *f* as air wire, and at *g* as earth connection. The measurement takes place as follows: The bundle, *a*, is first magnetized and endeavors to arrange itself in the magnetic meridian, thereby subjecting the spiral, *d*, to torsion. If now, after the magnetizing current has been opened, electric waves strike the antennæ, and demagnetize the bundle, the disturbance of the magnetic equilibrium is followed by a turning of the movable system, which is measured in the usual way by means of the mirror, *S*, and a scale.—*Phys. Zeit.*, September 15.

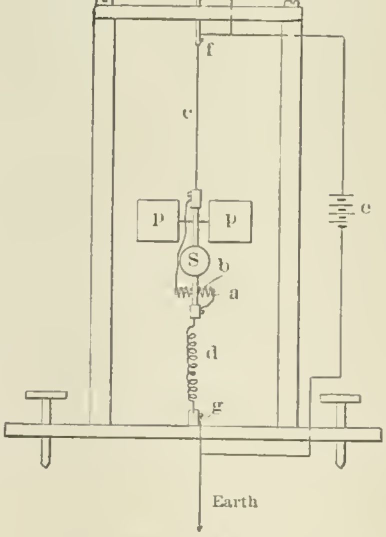


DIAGRAM OF INSTRUMENT.

Method for Finding the Efficiency of Series Motors.—Wilson.—A paper read before the British Association at its recent meeting. The method is stated by the author to be of great accuracy and to have been found to work well in practice. The diagram of connections is given in the adjoining figure. M and G are two like machines mechanically coupled together with or without gearing, according as the efficiency of either machine with or without gearing is to be obtained. In the test M runs as a motor and delivers current to G running as generator. The field coils, F_1 and F_2, are in series with one another and the motor armature, in order that each machine may be conveniently magnetized to the same degree. The input of the motor is measured on the voltmeter, V_1, and ammeter, A_1. The generator is loaded on a resistance, R, and its output measured on the voltmeter, V_2, and the ammeter, A_2. If R_1 and R_2 are the ohmic resistances of the motor and generator armatures respectively, then $V_1 A_1 - V_2A_2 = X$ are the total watts dissipated in the system, exclusive of the generator field coil, F_2. Of these $A_1^2 (F_1 + R_1) + A_2^2R_2 = Y$ are the ohmic resistance losses in watts and $X - Y$ are the watts due to brush, bearing and wind friction, eddy currents and magnetic hysteresis. The machines are equal and rotate at the same speed. $(X - Y) /2$ are the watts which can be debited to each machine, when calculating the efficiency, it being assumed that the brush contact resistance has the same value as when measured with the machines at rest, and that armature reaction does not produce inequality in the watts dissipated by eddy currents and magnetic hysteresis in the two machines. The expressions for the efficiency are, for the motor $(X - Y) /2 + V_2A_2 + A_2^2R_2/V_1A_1$, and for the generator, $V_2A_2/ (X - Y/2) + A_2^2R_2 + A_1^2F_2 + V_2A_2$. The author has made an extension to this method by adding two low-resistance shunts, r_1r_2, a millivoltmeter, a, and a voltmeter, v. By these instruments the differences, $A_1 - A_2$, and $V_1 - V_2$, have been measured as direct quantities. Greater accuracy can be obtained by measuring A_1 and a and using the value $A_1 - a$ instead of A_2, and measuring V_1 and v and using the value $V_1 - v$ instead of V_2. For instance, if $V_1 = 500$, $A_1 = 50$, $V_2 = 450$, $A_2 = 42$, $R_1 = R_2 = F_1 = F_2 = 0.5$ ohm, and the liability for error in reading the instruments is 1 per cent., then the possible error in the value of $X - Y$, when V_1, A_1, V_2, A_2 are the measured quantities, is 31.9 per cent.; whereas, it is 1.9 per cent., when V_1 v A_1 a are the measured quantities.—Lond. *Elec.*, September 18.

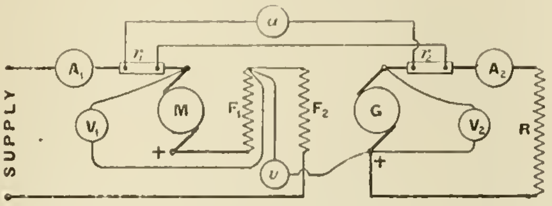


DIAGRAM OF CONNECTIONS.

String Galvanometer.—Einthoren.—An abstract of a paper describing the instrument constructed by the author, of which it is stated that it appears likely to displace the capillary electrometer as an instrument for physiological research. The instrument consists essentially of a silvered quartz thread, which is stretched like a string in a strong magnetic field. When an electric current is passed through the thread, the latter is deflected perpendicularly to the direction of the magnetic lines of force, and the amount of the deflection can be measured by means of a microscope with an eye piece micrometer. The thread now used has a resistance of 10,000 ohms. If the tension is very feeble and the deflection requires ten or fifteen seconds to establish itself, the instrument can be made extremely sensitive, sufficient to measure a current of 10 to the 12th power amperes. But, as a rule, the tension used is such that the final position is reached in about one second or less. The motion is absolutely dead beat, and there is no perceptible disturbance from tremors nor any creeping of the zero as in the capillary electrometer. The author has applied the instrument to obtaining photographic "electro-cardiograms," showing the currents traversing the human body with every heart beat.—*Lond. Elec.*, September 18, from *Proc. Royal Acad. Sc.*, Amsterdam, August 27.

Demand Indicator for Three-Wire Installations.—Dick.—A short description of the method devised by him, with illustration of the instrument. There is a difficulty in measuring the maximum demand in three-wire installations, when two separate instruments are used, as the maximum values of the currents on the positive and the negative sides will probably not occur simultaneously. The new method consists in dividing the neutral wire, and inserting two equal resistances in the branches, across the ends of which the indicator strip is connected. The resistances are very low and the total drop is less than with two separate instruments. It can be shown that the reading on the demand indicator is always directly proportional to the sum of the positive and negative currents. This, of course, holds good for maximum values of these currents, which is what it is desired to measure. In addition to the gain in accuracy, considerable economy is effected by the employment of the three-wire instrument in place of two single indicators.—Lond. *Elec.*, September 11.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Cables with Iron Wire Winding.—Walsoe.—The author believes that the Krarup method of winding several layers of thin iron wire closely around the telephone cables, for the purpose of compensation of the capacity, is more rational than Pupin's method. In the first place, the ohmic resistance is not increased and the self-induction is distributed evenly over the whole length of the conductor. Furthermore, the Pupin induction coils can only replace an evenly distributed induction for a predetermined number of oscillations. These oscillations vary, however, in the transmission of speech, between 100 and 1,000. The author states that he has made experiments with the Krarup method which disprove the objection raised against this system, namely, that it caused an increase of capacity. He found that the capacity is increased for direct currents, but that for alternating currents its value is considerably decreased and the more so, the higher the number of alternations. The author states that several cables laid recently between the Danish islands are provided with such iron wire winding. One of these cables contains four strands of seven copper wires each, of 1.35 mm. diameter. These wires are wound as closely as possible with an 0.3 mm. iron wire. Whether each individual wire or each bundle of wires is thus wound is not stated in the article. The author investigates mathematically the connection between the cross-section of the iron wires and the value of the self-induction and deduces a formula for the calculation of the latter. For the coefficient of self-induction of the above cable he calculates 0.002 henrys, while actual measurements gave 0.0025. He finds that the increase of the self-induction soon reaches its practical limit, and states that the powerful action of the capacity could hardly be compensated entirely by a mere increase of the self-induction. It remains, therefore, that a new means for the complete compensation of the capacity is still to be found.—*Elek. Zeit.*, September 10.

Block Signal System.—An illustrated article describing a block signal system for trolley railways. When the car enters a block, the trolley wheel passes a contact strip which actuates the signal system. In each signal box are two diamond-shaped targets. When the signals are employed on a single-track road between turnouts, the top target shows red when a car is approaching in the block ahead and the bottom target is not displayed. If there is a car in the block ahead traveling away from the signal the top target is not displayed and the bottom target shows white. Opposite each of these targets are lamps showing colors similar to those displayed by the targets. The targets are so wired, however, that they will operate whether the lamps light or not. When no car is in the block both targets are in a horizontal position and the lamps are all out. The same system can also be employed on double-track roads.—*St. R'y Jour.*, October 3.

REFERENCES.

Measured Telephone Service.—Stroud.—The first part of an illustrated serial. The author gives a description of the "nickel service" in Chicago and its rapid growth.—*Telephony*, September.

Regulations for Testing Electrical Machines.—A reprint of the Regulations for the rating and testing of electrical machines, proposed by the Association française des propriétaires d'appareils à vapeur and the Association des Industriels du Nord de la France.—*L'Eclairage Elec.*, August 29.

Forged Street Railway Paper.

According to a dispatch from Worcester, Mass., indorsements on paper of the Worcester & Southbridge Street Railway Company, representing nearly $1,000,000, are said to have been pronounced forgeries by handwriting experts. The road went into the hands of a receiver two months ago.

New Books.

The Metallurgy of Zinc and Cadmium. By Walter Renton Ingalls. New York: *The Engineering and Mining Journal*. 701 pages, 401 illustrations. Price, $6.00.

This book, while not appealing to the special field of electrical engineers, is so exhaustive and thorough a treatise on the subject that the reviewer believes that it deserves more than passing notice.

Zinc, of course, has had a tremendous influence on the development of electrical science. The discovery of the zinc primary cell gave the investigator a source of current which was fairly steady and efficient. Most of those who studied electricity before 1880 made more use of the Bunsen battery than the storage battery and generator. Now, of course, zinc is used even more largely in the form of sheet zinc for dry batteries, for enclosed fuses, and in cast zinc and rolled rods for negatives of several types of cells (e. g., the Leclanche and gravity). Sheet zinc is also used to seal up electrical instruments and other articles for shipment. Considering its low price, it is probable that sheet zinc will displace sheet brass and sheet copper for many purposes. Accordingly, Ingalls' "Metallurgy of Zinc" and his briefer book, "Production and Properties of Zinc," should be read by every electrical engineer who prides himself on being up-to-date in his professional knowledge.

For the metallurgist this book is of more than special interest. Not less than forty-five special forms of roasting furnaces are described. Chapter IV is in itself a treatise on mechanical roasters and Chapters VIII and IX on combustion of fuels and furnace designs. We take pleasure in stating that in our opinion this book is worthy of a place on the shelf of the metallurgist's library, besides "Howe's Steel," "Campbell's Iron," "Hofman's Lead," "Percy's Copper" and "Peter's Modern Copper Smelting."

Students' Guide to Submarine Cable Testing. By H. K. C. Fisher and J. C. H. Darby. Third Edition. New York: D. Van Nostrand Company. 230 pages, illustrated. Price, $2.50.

This book, in its latest edition, has been considerably enlarged and improved. It is divided into three parts. Part I deals with definitions of terms and the elements of regular cable testing. The descriptions are simple and clear. There is a good explanation of the universal shunt, although there are unfortunate misprints both in the illustration and in the text.

Part II is devoted to the localization of faults in cables, or to the tests of faulty cables. The treatment of the subject is excellent and is aided by a number of illustrative examples. Part III deals with the measurement of electrostatic capacity in cables and is a good compendium of the various methods in vogue.

The appendices contain useful tables, questions and answers or problems in the various sections of the book, as well as standard diagrams of signalling connections. The book terminates with a good index.

The work is specially recommended to all students of submarine cable testing and will be useful to all who are interested in that subject.

BOOKS RECEIVED.

Onde Hertziane e Telegrafo Senza Fili. By Oreste Murani Milan: Ulrico Hoepli. 341 pages, 170 illustrations. Price, 3.50 lire.

Whittaker's Electrical Engineers' Pocket Book. By Kenelm Edgcumbe. London: Whittaker & Company. 44 pages, 149 illustrations. Price, 3 shillings sixpence.

The Engineering and Electric Traction Pocket Book. By Philip Dawson. New York: John Wiley & Sons. 1,411 pages. Price, $5.00.

Die Montage Elektrischer Light und Kraftanlagen. By H. Pohl. Hannover: Gebruder Janecke. 272 pages, 328 illustrations. Price, 4.40 marks.

Die Krankheiten Elektrischer Maschinen. By Ernst Schulz. Hannover: Gebruder Janecke. 50 pages, 42 illustrations. Price, 1.75 marks.

Construktion und Prufung der Elektricitatszahler. By A. Konigswerther. Hannover: Gebruder Janecke. 328 pages, 362 illustrations. Price, 9 marks.

Elektrische Apparate für Starkstrom. By George J. Erlacher. Hannover: Gebruder Janecke. 228 pages, 131 illustrations. Price, 8 marks.

The Practical Physics of the Modern Steam Boiler. By Frederick J. Rowan. New York: D. Van Nostrand Company. 638 pages, 314 illustrations. Price, $7.50.

The Co-Operative Telephone Company's System at Detroit, Mich.

Another chapter in the chequered telephone history of Detroit, Mich., and in independent development there, is begun by the opening of the exchange of the Co-operative Telephone Company's system in that city. Previous chapters have often been retold and are familiar to our readers, so it is not necessary to go over the story again. The starting up of this exchange would indicate that the "independent" spirit is still strong in the community, and that a large patronage is counted upon from the public, especially as there are 40,000 independent telephones and 600 independent exchanges and toll stations scattered through the State.

The company's franchise, embodying provisions which absolutely prevented any possible chance of its ever being absorbed by competitors, allows a charge for rentals of $48 for business and $24 for residence service, at which rate party line service may be given. The franchise also allows the use of the city's conduit system, pole lines and public buildings upon a purely maintenance basis, which provision is of considerable advantage, the city owning its municipal lighting system covering the entire city with its conduit system and pole line.

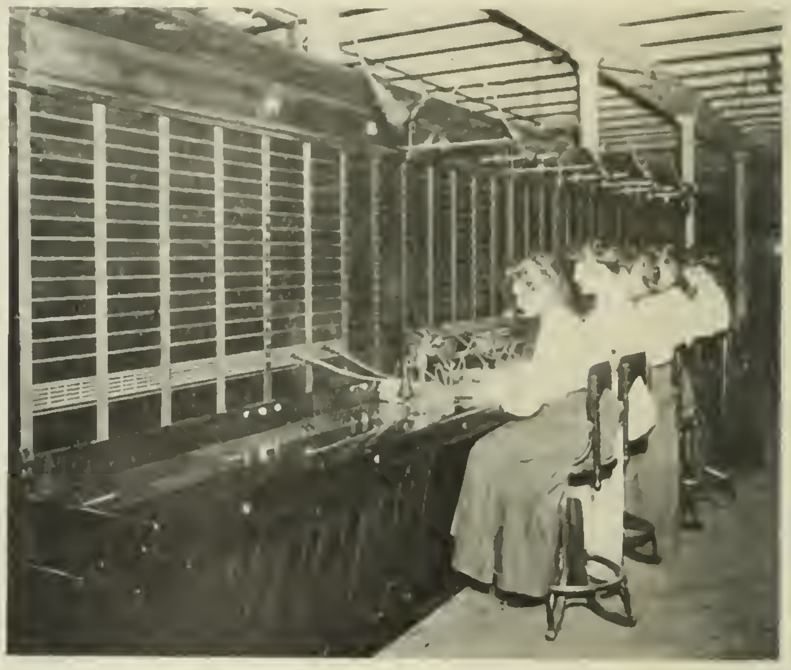


FIG. 1.—12,000-LINE-CAPACITY SWITCHBOARD.

Under the organization of the Co-operative Telephone Company each business subscriber also subscribes for at least one share of the stock of the company, par value $50. The conditions of these stock subscriptions and small stock holdings are such as to absolutely prevent their sale to the competitors.

In view, it is said, of the strong efforts being made to discourage investors in independent systems, it could not be hoped to establish a system covering the entire city upon this basis, and under these conditions, at once, so it was decided by the management of the co-operative company to start with a business men's exchange in the down-town district, to establish services with the more than 40,000 independent subscribers throughout the State, with the wholesale houses, hotels and other large business places, and to thoroughly demonstrate to the people the value of independent connections.

The company, under the leadership of Mr. C. M. Burton, president, one of Detroit's most prominent citizens, president of the Michigan Historical Society, and under the management of A. A. Cowles, also one of the local prominent business men, together with the support of J. C. Danziger, secretary; Max J. L. Towler, vice-president, and J. Ward Howland, treasurer, all local merchants of wide connections and with high reputation, soon had a sufficient number of business subscribers to warrant beginning work. The company had in view the establishing of an exchange with the most modern and practical system in use and one where the initial business men's exchange could be increased at any time without discarding the original installation. They contracted with the International Telephone Manufacturing Company, of Chicago, for four sections with an ultimate capacity for 12,000 line lamp signal central energy multiple switchboard equipment, with long-distance central energy telephones embodying the many new features and improvements that have been evolved by the International Company.

The exchange is located in the Golden Block, 32 Michigan Avenue, which allows for extending space to make the necessary increase. Fig. 1 shows four sections of the original installation of switchboard. The board is constructed in sections with a capacity for installing the necessary multiple jacks for the ultimate equipment of 12,000 subscribers' lines. The sections are built of heavy architectural iron and are firmly braced to make them strong and rigid. The cabinet work is of heavily polished dark mahogany. The plug board and the pilot lamp panel back of the plug board are covered with mahogany-stained heavy belt leather ⅛ of an inch in thickness. The first position is provided with the necessary multiple jacks as an annex to the second position. The second and third positions are arranged for installing the necessary incoming trunk line equipments. The fourth position is equipped for twenty long-distance toll lines and arranged as extensions for a main toll board. The remainder of the board is equipped for regular city exchange lines.

The toll line signals are high-wound tubular drops, with drop shutters of the regular size. The local subscriber's line signals are a ⅓-cp lamp mounted in an opaque tube provided with a small opalescent jewel, set in a shouldered brass cap to allow it to be readily inserted into its socket or removed from the front of the board. The lamp signal jacks are arranged in banks of ten and are mounted in hard rubber strips provided with a well braced brass rail support. The banks of lamp jacks are so constructed that they can be readily installed or removed from the front of the board.

Alternating with the strips of lamp jacks and corresponding in number, are mounted the necessary answering jacks arranged in banks of ten, constructed with their springs firmly clamped in strips of hard rubber, and securely supported by a front piece of a heavy brass rail, provided on its front and back with strips of hard rubber perfectly insulating the ferules of the spring jacks from the frame. The multiple jacks are arranged in banks of twenty, mounted on ⅜-in. centers, with the construction of the banks the same as the answering jacks, making the banks very strong, rigid and durable.

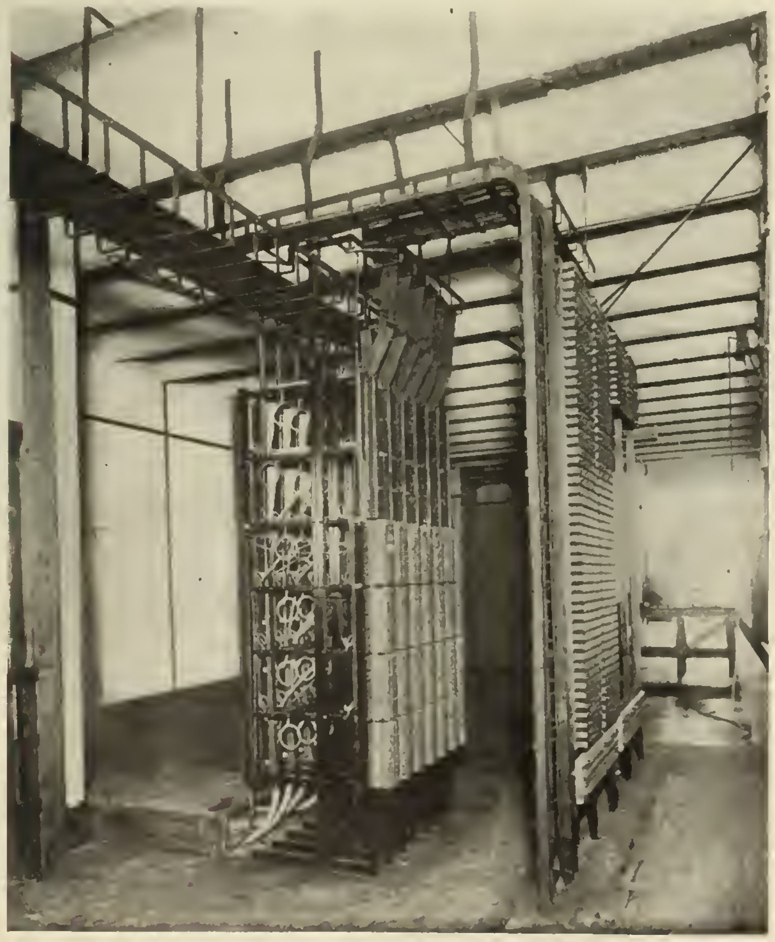


FIG. 2.—LIGHTNING ARRESTER AND DISTRIBUTING RACK AND RELAY.

The banks of multiple jacks are so constructed that they can be readily fastened or loosened from the front of the board. Their front heavy brass rail making them perfectly straight and rigid, allows the taking out a strip at any part of the position without disturbing those above the strip removed. The strong and solid construction of the banks and absence of contacts in the spring jacks, makes them practically indestructible and immune from incidental trouble.

Each operator's position is equipped with a long-distance International transmitter, mounted in a strong oxidized brass case. The switchboard transmitters are adjusted to avoid taking up side tone as much as possible, to prevent subscribers hearing operators in adjoining positions, but transmitting clearly and distinctly conversation spoken directly into the mouthpiece in a low tone of voice. The transmitters are suspended on a pair of cords, supported by an adjustable extension arm. These arms are constructed of heavily nickel-plated brass on which are mounted oxidized hangings with pulleys. The cords are supplied with proper weights so that the transmitters may be lowered or heightened as required, and the arm is arranged to be extended or shortened, if necessary.

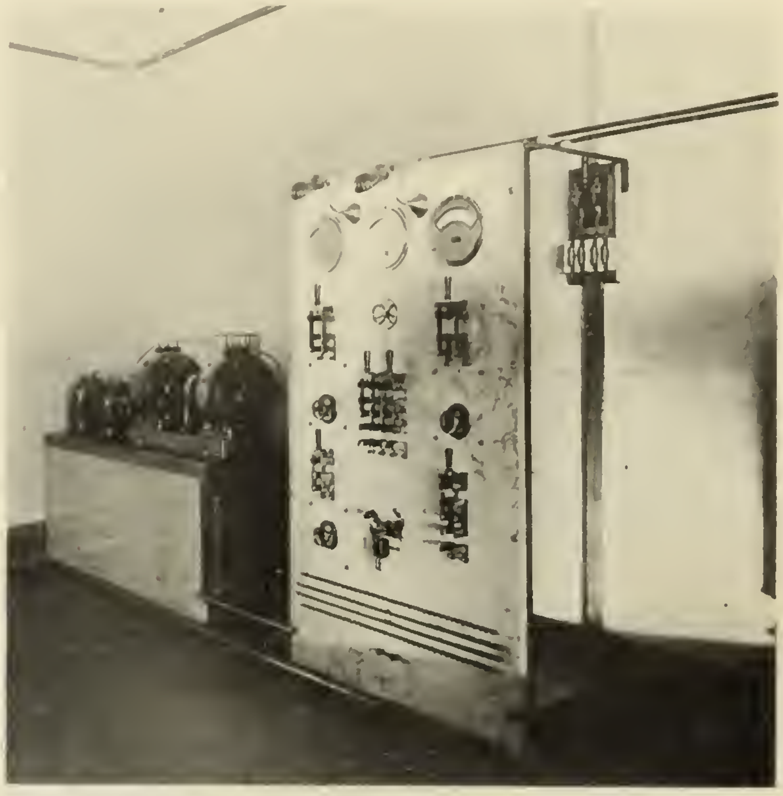


FIG. 3.—POWER PLANT FOR INITIAL INSTALLATION.

The operators' receivers are provided with a cord and plug and can be attached and detached at a cut-in jack in each position, mounted underneath the key shelf. The key shelves are constructed of five layers of the wood of which the board is constructed, glued together, the grain of the two outside and central layers running lengthwise and the grain of the other two layers running crosswise.

The ringing and listening keys are mounted on the bottom of the shelves with the lever passing through the shelf, supplied at the top with a nickel-plated brass sliding escutcheon to prevent dust entering. The sets of ringing springs and listening springs are mounted one above the other; firmly clamped in a hard rubber block. This arrangement allows the use of heavy and long springs to prevent breaking and the small and compact key enables mounting the required number in one line in each operator's position. The key springs are of German silver and provided with platinum contacts. The keys are constructed with the terminals of both the ringing and listening set at one end, enabling all connections to be made from one side with one key cable, and leaving the springs and contact points open for convenient inspection.

The supervisory clearing-out lamps, one for each cord, are mounted on the plug board between the plugs and the keys. The clearing-out signals consist of ⅓-cp lamps mounted in an opaque tube similar to the line signal and provided with an opalescent jewel set in a shouldered brass cap. This is supplied with an arched wire guard to prevent the breaking of the opal from impact of the plugs and also to provide the means for removing the lamps from the top of the board without the use of special tools. The supervisory lamp sockets or jacks are mounted individually on the bottom of the plug board. The clearing-out lamp opal with guard is so constructed as to prevent the accumulation of dust.

The plugs are made small and compact to allow two or more being placed in adjoining multiple jacks, mounted on [illegible] in. centers. The sleeve of the plug is of black polished hard rubber and is mounted to allow its turning on the shank to avoid twisting the plug when inserting and kinking the cord, thus minimizing the cord trouble. The plug sleeve is fastened with a set collet screwed onto the shank from the front or tip end, to avoid using a set screw through the sleeve, and the possibility of breaking the shell.

Each operator's position equipped is provided with three pilot signals, one for indicating in connection with the subscriber's line signal, one to show in connection with the supervisory clearing out signal, and one for use in the ringing circuit. The pilot signals are a ½ cp lamp mounted in an opaque tube, provided with a large brass cup receptacle into which is mounted the colored prism bull's eye. The pilot lamp sockets can be readily removed from the front of the board, the same as the line or clearing-out signals.

Fig. 2 shows the distributing board with lightning arrester board, and relay rack for the original installation of 600 lines. The line side of the distributing board is arranged with immediate capacity for 800 pairs of cable. On the switchboard side of the distributing board are mounted 700 pairs of carbon lightning arresters with self-soldering heat coil protectors. The relay rack is divided in sections for 500 lines to the section. The rack is constructed of heavy architectural iron, well braced to make it strong and rigid. The relays are mounted in strips of ten. They are constructed with an iron-clad shell completely enclosing the winding-in iron when the armature is drawn up. The springs are constructed of the best grade of spring German silver and are of ample length to insure accuracy. All contacts are provided with platinum. The relays are so constructed and mounted as to be readily removed or inspected. In addition to the iron shell, the complete relay is individually enclosed with a heavy brass tube or cap, screwed onto a threaded base, avoiding rust or dust entering the working parts. At the bottom of the relay rack is mounted a heavy marble slab containing fuses for the leads to the relays in order to properly protect the coils.

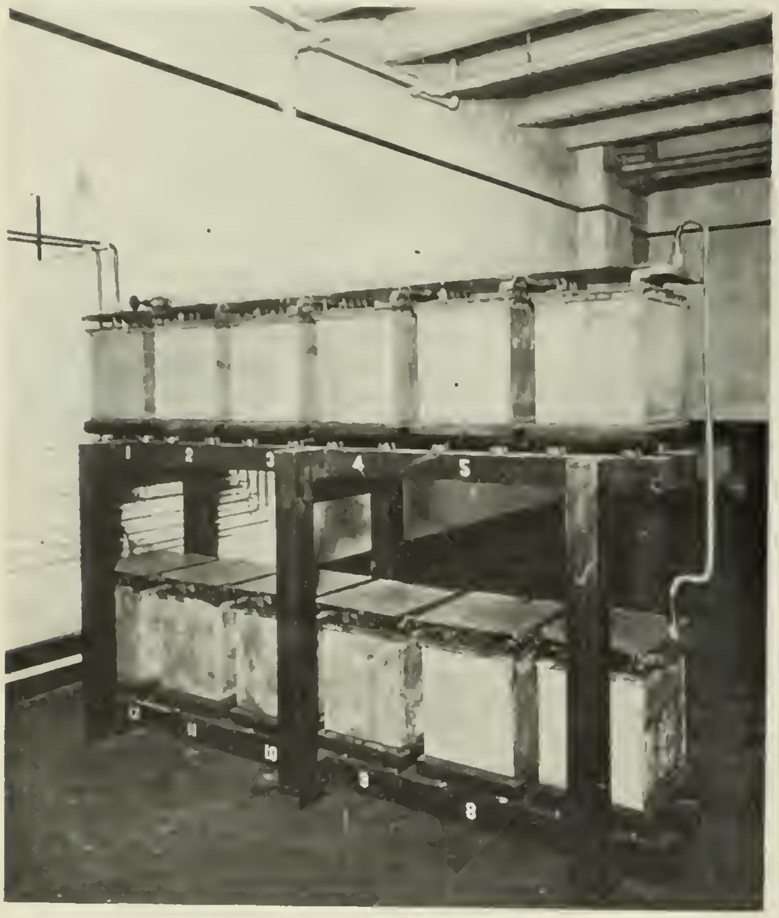


FIG. 4.—INITIAL INSTALLATION OF BATTERY PLANT.

The cables from the relay rack and the distributing board are run to the switchboard on a strong iron cable chute or rack. The distributing board and relay rack can be extended at any time up to the full ultimate capacity of the exchange.

Fig. 3 shows the power switchboard, charging machine, main and auxiliary ringing machines. The power board is built of a heavy marble slab, supported by an architectural iron rack of strong and rigid construction. It is provided with the necessary ammeters, voltmeter, voltmeter switch, circuit breaker, starting boxes, field rheostat and the necessary double-pole copper blade knife switches for properly controlling the system. Fig. 4 shows one set of the battery plant, consisting of 12 cells of lead-lined tank Chloride storage batteries.

The telephones used in the system are of the well known International long-distance type neatly and substantially constructed, efficient and durable. All distinct parts of the telephones as well as the switchboard equipment are made by machinery, directly from the crude material from modern designed compound dies and special tools, making all like parts absolutely uniform and renewable on the spot.

This exchange has recently been connected, through the toll lines of the Peninsular Telephone Company, of Detroit, with the other independent lines of the State, once more opening telephone communication with Detroit to the independent telephone subscribers in Michigan, as well as the independent systems throughout the other States.

Stanley Alternating Current Recording Wattmeter.

A new type of recording wattmeter for alternating-current circuits has been added to the list of the manufactures of the Stanley Instrument Company, of Great Barrington, Mass. This instrument, which is illustrated in the accompanying cuts, is known as the balance-thrust recording wattmeter, for which a number of important claims are made, as follows: There is no jewel wear from hammer or side thrust, and no "kicking" auxiliary friction device is used; the instrument has the highest effective torque, an improved spring support, the braking is not affected by temperature, magnetic short-circuits are impossible, and the instrument compensates for inductive lag; the method of sealing protects against any manner of tampering and the instrument is air, moisture, dust and insect tight.

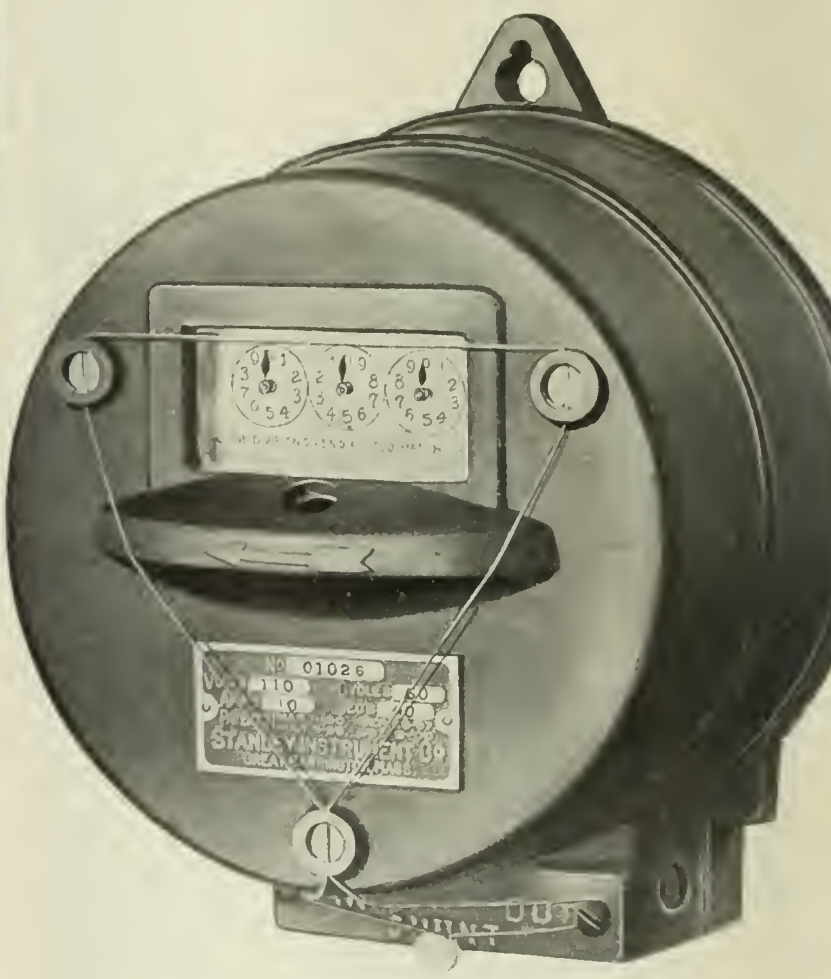


FIG. 1.—PERSPECTIVE VIEW OF WATTMETER.

It is well known that when a current is caused to flow through the field of a magnet a thrust is produced at right angles to the field and to the current flow. This tends to move the disc of a meter bodily away from its normal position and forces the spindle against its bearings. In some meters this side thrust is fully as great, and in some cases greater, than the torque thrust, and of course increases the friction. In the Stanley meter this thrust is counterbalanced by closed-circuit copper rings placed over the side of the field or shunt pole nearest to the edge of the disc. By this means an opposing thrust is set up which can be proportioned to exactly counterbalance the side thrust. A second source of friction which is counterbalanced in the Stanley meter is that due to an unsymmetrical relation of the shunt or shunt and series system with reference to the disc. In this instrument the magnetizing forces are applied to the shunt system symmetrically, and being thus evenly distributed on each side of the disc, the pushing tendency of the magnetism is neutralized. A third source of friction in contact bearing meters is that due to the trembling or vibration of the disc or armature caused by the magnetic attraction and repulsion existing between the magnets and the moving parts. In the Stanley meter the disc is placed at the zero magnetic potential position and as a consequence all trembling or vibration of the disc is obviated. In this instrument also the magnetic balance existing prevents the lifting and filling of the disc, thus obviating a pounding action affecting the life of the mechanism and the accuracy of the instrument.

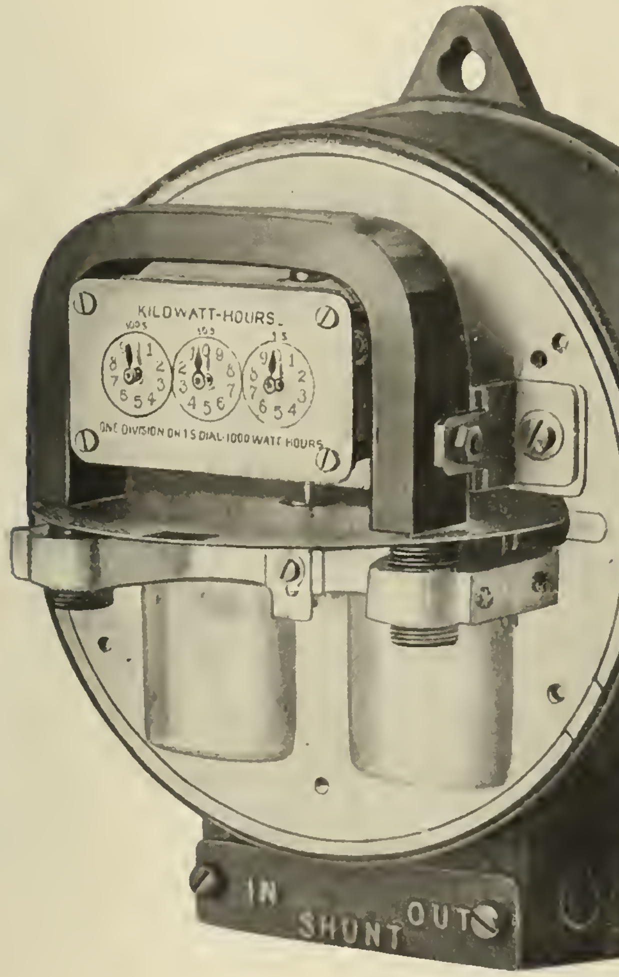


FIG. 2.—VIEW OF WATTMETER MECHANISM.

Owing to the balancing of the thrust in this meter its disc will not creep, moving only when energy is being used, and it will rotate and measure at extremely small loads. As a consequence there is no need of any auxiliary or kicking device. The air-gap or distance between the disc and brake magnets cannot be changed by variations of temperature, as the magnets are held rigidly in a permanent position, so that they cannot expand or contract. A feeder plate between the back and front of the meter constitutes a magnetic shield, upon the front of which plate is mounted the disc shaft and its bearings, the brake magnets, train gearing and other mechanisms. This shield acts as a complete protection to the brake system against the effects of short-circuits. The disc shaft when in place rests upon a finely polished, carefully-selected jewel mounted in a carrier supported on an accurately graduated spring. The entire arrangement of jewel, carrier and spring are immediately in sight and readily accessible for adjustment or replacement.

Seattle Municipal Power Plant.

A contract for supplying water wheels to the city of Seattle Municipal Lighting & Power Plant has been awarded the Pelton Water Wheel Company, of San Francisco. The main wheel units will be two in number, each direct-connected to a 1,200-kw, 400-r.p.m., 2,300-volt, 60-cycle, three-phase revolving field generator. The wheel units will operate under an effective head of about 550 ft. and will have a capacity sufficient to develop 50 per cent. overload in each generator. Combination needle and deflecting nozzles will be employed for regulating wheels, the needle portion to be hand-controlled, while Lombard governors will take care of the deflecting portion. The governors will be equipped with 125-volt motors to permit of central control of the main machines from the switchboard. Two 75-kw, 125-volt, compound-wound multipolar direct-current generators will furnish exciting current. Each of these machines will be direct-connected to a Pelton wheel running at 550 r.p.m.

A riveted steel pipe line of uniform diameter of 48 in. will lead the water a distance of about 1,080 ft. from the main penstock, the pipe varying in thickness from 3/8 in. to 11/16 in., terminating in a steel receiver, from which branch pipes will distribute the water to the various wheels. The transmission line into Seattle will be approximately 40 miles long, over two separate lines of three No. 1 copper wires, or equivalent aluminum wires. The current at Seattle will be stepped down to two-phase at 2,200 volts for city distribution for power purposes, incandescent lighting and arc and series incandescent street lighting by means of constant-current transformers.

Owing to the season being so far advanced, it is the intention to complete and get into operation one of the transmission lines, the other to be erected as soon thereafter as possible.

Street Railway Exhibits at Syracuse.

Quite a large number of concerns in the supply field were represented last week at the Syracuse convention of the New York State Street Railway Association. Some of them had exhibits.

The Crouse-Hinds Electric Company, of Syracuse, N. Y., had a very neat exhibit, in the writing room of the Yates, of the various specialties manufactured by this company. It was along the lines of their recent fine exhibit at Saratoga. The booth was decorated by Norbitt specialties. The new arc headlight recently placed on the market was exhibited in operation. The Syracuse changeable headlight, junction boxes and heavy switches were also on exhibition. President H. B. Crouse was in charge, assisted by a staff of active employees.

The General Electric Company was represented by J. J. Mahony, H. Greer and A. B. Babson, of the New York office; W. Gibson Carey and J. G. Barry, of Schenectady; H. H. Crowell, of Syracuse, and J. C. Calisch, of Buffalo.

The Standard Underground Cable Company made a fine exhibit, including bare, weather-proof and rubber-covered wire, and aerial, underground and submarine cables. One of the company's large new plants has been devoted almost exclusively to the manufacture of trolley and weather-proof feed wire for railway use, and it is now engaged in turning out some of the largest orders for these materials given out of late. The company was represented by H. P. Kimball, of the New York sales office.

Westinghouse.—The interests of the Westinghouse Electric & Manufacturing Company were looked after by Paul T. Brady, S. B. Storer and J. D. Mickle, of the Syracuse office of the Westinghouse Company. The Westinghouse Traction Brake Company was represented at the convention by J. R. Ellicott, C. R. Ellicott and George E. Baker.

National Electric Company was represented by H. W. Ransom, J. T. Cunningham and R. Long. John A. Roebling's Sons Company was represented by M. R. Cockey and G. W. Swan. Pittsburg Reduction Company by S. R. Colby and W. R. Darby. American Steel & Wire Company by A. G. Greenberg and F. A. Keyes. The H. W. Johns-Manville Company by J. W. Perry. Ohio Brass Company by N. M. Garland. New Process Raw Hide Company by T. G. Meachem. Van Dorn-Elliott Electric Company by W. A. Dutton. Electrical World and Engineer by J. M. Wakeman.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The market continued depressed, the professional interests being bearish in sentiment while public buying of stocks was exceedingly restricted. An unfavorable impression was produced by the reduction of the Steel common dividend, and also by the developments in connection with the United States Shipbuilding scheme. The Steel shares, Amalgamated Copper and the traction stocks showed special weakness. Western Union rallied sharply at the close of the market on Wednesday on the news that the company had won an old suit against the American Bell Telephone Company. The stock closed on that day with an advance of 1¼ points. Brooklyn Rapid Transit fluctuated between 34¾, the highest, and 31⅝, the lowest, closing at 32¼, thus losing 1⅛ points net. Metropolitan Street Railway was also weak, ranging between 107½ and 102½, the closing price being 103, a net loss of 3½ points. General Electric is off 6 points, closing at 144 after having touched 140. The highest figure of the week was 149¾ and the sales aggregated 4,000 shares. Westinghouse common closed at the lowest figure of the year—134—this representing a net loss of 12 points for the week. The highest figure for this stock this year was 221. Preferred made a net gain of 6 points, closing at 172. Western Union closed at 82. American Telephone & Telegraph lost 3½ points, closing at 122¼. During the week it touched the lowest point of the year, viz.: 117¼. Following are the closing quotations of October 13:

NEW YORK.

	Oct. 6	Oct. 13		Oct. 6	Oct. 13
American Tel. & Cable	78¼	78¾	General Electric	147	140⅛
American Tel. & Tel.	127	..	Hudson River Tel.	..	..
American Dist. Tel	25	24	Metropolitan St. Ry.	105	103
Brooklyn Rapid Transit	38⅛	31⅞	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	.	145	N. Y. & N. J. Tel.	..	..
Electric Boat	15	18	Marconi Tel.	.	..
Electric Boat pfd.	40	42	Western Union Tel.	81½	81¾
Electric Lead Reduction.	1¼	1¼	Westinghouse com.	142	131
Electric Vehicle	4	4	Westinghouse pfd.	165	161½
Electric Vehicle pfd.	6	5			

BOSTON.

	Oct. 6	Oct. 14		Oct. 6	Oct. 14
American Tel. & Tel	127½	120¼	Western Tel. & Tel. pfd.	*80	80
Cumberland Telephone	....	....	Mexican Telephone	1⅜	1⅛
Edison Elec. Illum.	231	230	New England Telephone	121¼	*123
General Electric	145	142	Mass. Elec. Ry.	20	18
Western Tel. & Tel	10	10	Mass. Elec. Ry. pfd.	77½	77¼

PHILADELPHIA.

	Oct. 6	Oct. 14		Oct. 6	Oct. 14
American Railways	42	41	Phila. Traction	94	93½
Elec. Storage Battery	50	48	Phila. Electric	6¼	5⅞
Elec. Storage Battery pfd.	48	48	Phila. Rapid Trans.	12½	11¾
Elec. Co. of America	7¾	7¼			

CHICAGO.

	Oct. 6	Oct. 14		Oct. 6	Oct. 14
Central Union Tel.	..	..	National Carbon pfd.	88	*89⅛
Chicago Edison	140	143	Metropolitan Elev. com.	18	17
Chicago City Ry.	170	170	Union Traction	4	4
Chicago Tel. Co	115	115	Union Traction pfd.	30	30
National Carbon	*20	19			

* Asked

BOSTON EDISON.—The annual meeting of the Edison Electric Illuminating Company, of Boston, is to be held October 13. The company closed its fiscal year June 30. Its report of operations as filed with the gas commissioners compares as follows:

	1903.	1902.
Income from sales of light and power	$2,663,733	$1,840,291
Expense of station	533,732	339,340
Expense of distribution	250,705	201,929
Expense of management	243,583	188,272
Expense of taxes and incidentals	702,435	516,058
Total expense	$1,730,456	$1,245,599
Net income	933,277	594,692
Other income	36,578	47,021
Total net	$969,855	$641,713
Accrued profits from purch. Cos.	....	306,129
Total	$969,855	$947,842
Interest and miscel. charges	185,508	174,654
Balance	$784,347	$773,188
Dividends	804,667	727,345
Surplus	Def. $20,320	$45,843
Previous surplus	60,951	15,109
Total surplus	$40,631	$60,951

The 1902 figures include the operations of the Boston Electric Light Company but for five months, and the Suburban Electric Light Company for seven months.

CLAY CREDITORS.—A committee of seven bankers, of which Frederick B. Schenck, president of the Mercantile National Bank, New York, is chairman, representing the interests which are creditors in the bankruptcy proceedings of the various Penfield clay products companies, has sent out a circular looking to the consolidation of the creditor interests. When the receivership was sought, on account of notes to a number of Eastern and Western banks then becoming due, and for which Mr Penfield, in his scheme of financiering, had apparently made no arrangement in the matter of payment, the creditor institutions agreed not to press their paper until such plan could be worked out as would enable all the demands to be met.

TELEPHONY IN CINCINNATI.—The Queen City Telephone Company has been incorporated in Cincinnati with a capital of $1,000,000, but this capital will eventually be increased to either $4,000,000 or $6,000,000. The company, which is closely identified with the independents, claiming to have connections as far east as Philadelphia, west to Kansas City, north to St. Paul and south to Galveston, will apply for a franchise, and if necessary will go before the Legislature this fall in order to secure authority to establish its exchanges. The new company when once established will cut the rates far below those which are now being charged by the City & Suburban Telegraph Association (the Bell Company).

Commercial Intelligence.

THE WEEK IN TRADE.—Trade conditions are still irregular, as reflected by reports to the mercantile agencies. There are, however, many underlying favorable conditions, first of which is the better tone of advices from the corn and wheat crops. Others are improving collections, coincident with the expansion of the corn and cotton movement, and the excellent business done by the railroads. Business is of a fair volume, but not so active as a year ago, partly because of the backward season, heavy rains interfering with crop movement and collections; vexatious labor troubles, the spread of a conservative feeling among buyers based upon stock market liquidation, and the feeling that high prices of many products will tend, if they have not already done so, to check consumption automatically. The growing weakness in pig iron will have the effect of shutting off production to the extent of 1,000,000 tons for the last quarter of the year and of ending foreign imports. Finished products of iron are taken in a fair way, and some railroads are entering the markets for rails and cars. Copper showed no improvement, and the market is still practically lifeless. In the absence of demand the official quotations remained unchanged and are nominally as follows: Lake, 13⅜; electrolytic, 13⅛, and casting stock, 12⅞. Railway earnings for September promise to show a gain of fully 10 per cent. over the same month a year ago. Business failures for the week ending October 8, according to *Bradstreet's*, numbered 197, against 153 the week previous, and 170 the corresponding week of last year.

MINING EQUIPMENT FOR GUANAJUATO.—Electricity will be largely employed in extensive operations on the Guanajuato River, Mexico. The working of the tailings will necessitate the purchase of large shovels to be electrically operated as well as various other mining equipment. E. Gybbon Spilsbury, of the Spilsbury Engineering Company, 45 Broadway, New York, has gone to Mexico regarding the undertaking and on his return, early next month, contracts will be awarded. The plant will have an initial capacity of 1,000 tons a day.

MOTORS FOR CAPE MAY SEWAGE WORK.—The Mackay Engineering Company, 149 Broadway, New York, has secured a contract for a 100-hp and a 50-hp motor for direct-connection to pumps built by R. D. Wood & Co., of Philadelphia. The equipment is to be used in connection with the city of Cape May, N. J., sewage work. The motors will be built by the Akron (Ohio) Electric Manufacturing Company.

ELECTRIC COAL CUTTING MACHINERY FOR N. S. W.—The Jeffrey Manufacturing Company, of Columbus, Ohio, has secured a contract for electric coal cutting machinery for installation in one of the principal collieries in New South Wales.

CANADIAN WESTINGHOUSE COMPANY, LIMITED, ORGANIZED.—At a meeting held at Hamilton, Ont., October 8, the Canadian Westinghouse Company, Limited, was organized with a capital of $2,500,000. Mr. Westinghouse was present, accompanied by Mr. H. H. Westinghouse, vice-president of the Westinghouse Air Brake Company, of Pittsburg, Pa.; Mr. John Caldwell, treasurer of the same company; Mr. Frank H. Taylor, vice-president of the Westinghouse Electric & Manufacturing Company, and Mr. George C. Smith, president of the Security Investment Company, all of the same city. They were met by Mr. Paul J. Myler, of Hamilton, who has been manager and secretary of the Westinghouse Manufacturing Company, Limited, which the new organization succeeds. The new company is a consolidation of all the Westinghouse interests in Canada, which heretofore have been conducted individually. It will take over all the property patents and other interests of the succeeded companies, including the sales organization and business of Ahearn & Soper, of Ottawa. The organization committee elected the following board of directors: Mr. George Westinghouse, of Pittsburg; C. F. Size, of Montreal; H. H. Westinghouse, George C. Smith, Frank H. Taylor, L. A. Osborne, all of Pittsburg; Thomas Ahearn, of Ottawa; Hon. J. M. Gibson, of Hamilton; W. Y. Soper, of Ottawa, and Paul J. Myler, of Hamilton. The executive committee as formed will consist of H. H. Westinghouse, F. H. Taylor, L. A. Osborne, George C. Smith and W. Y. Soper. The officers as elected are: George Westinghouse, President; H. H. Westinghouse, vice-president; F. H. Taylor, vice-president; Paul J. Myler, general manager and treasurer; John H. Kerr, secretary. The board when complete will consist of fifteen members, the remaining five to be named from the Canadians interested. Ground is to be broken for the new works in Hamilton within the next two weeks, and the erection of the buildings will follow as fast as possible. It is expected that at least a thousand employees will be serving the company within a year, as soon as the plant is completed. When it is considered that the Westinghouse Manufacturing Company alone have had sales in the Dominion amounting to about $2,000,000 annually, the importance of this addition to the Canadian industry cannot be overestimated.

MEXICAN TRACTION COMPANY.—The American capitalists interested in the Compania Mexicana de Traccion (the Mexican Traction Company) recently organized for constructing and operating an extensive system in Mexico City, met in New York last week for the purpose of increasing the financial resources of the enterprise, and determining as to what rails, cars and power equipment would be required. About 1,000 tons of 85-pound girder rails will be ordered right away. The company will also be in the market for twenty 40-ft. cars, which will be equipped with four motors of 56 hp each. The power house will have an initial capacity of 2,000 hp. Westinghouse equipment will be installed. The company has acquired what are known as the Moylan, Garcia & Requima concessions, which permit of the building and working of about 100 miles of road, about 50 in the city and 50 in the suburbs. The company has also assumed control over the Empresa del Circuito de Banos, a horse road two miles long, operating between Belvanera and Alberca, in the heart of the Mexican capital. It will be electrically converted. Construction will begin immediately. M. R. McAdoo, 15 Wall Street, New York, is president of the company. The other officers are Mexicans. The company is incorporated under the Mexican laws. There is an American advisory board of directors composed of Pittsburg capitalists. The directors are James B. Oliver, Julius Bieler, Reuben Miller, Sr., James H. Park and Frank B. Smith. Mr. Oliver is president and Mr. Bieler is treasurer. The chief engineer of the company is A. T. Montgomery, C. E., Mexico City. George C. Pierce, formerly of another road, has been appointed superintendent and electrical engineer of the new company. Construction work will be begun right away, and the system is expected to be in active operation inside of eighteen months.

ST. LOUIS FAIR FIRE PUMPS.—The authorities of the Louisiana Purchase Exposition are taking every precaution to prevent the recurrence at St. Louis of any such disastrous fire as that which destroyed the great cold storage building at the Chicago Exposition in 1893, and are making adequate provision for water supply by putting in the largest installation of fire pumps in the world. These pumps, which have been purchased from Henry R. Worthington, of New York City, comprise twelve 1,000-gallon standard underwriter fire pumps, each capable of supplying four fire streams, making it possible to have 48 fire streams in use at one time. The pumps are of the duplex, double-acting type, and are supplied with air and vacuum chambers of large capacity. The fittings are of composition metal throughout, and the piston and valve rods are of bronze. Every measure has been taken in designing these pumps to insure that they will start at a moment's notice at any time after having been idle for a long period. They are the pumps recommended by the Associated Factory Mutual Insurance Companies, and, in fact, formed the basis of the specifications for fire pumps adopted by the Associated Companies.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, of Chicago, reports that it has just shipped several carloads of central energy switchboard equipment to the Fort Worth Telephone Company, Fort Worth, Tex. The capacity of the exchange is 6,000 lines. It is thought that this is the first large switchboard intended for independent service where each cord circuit is equipped for four-party selective signaling service; the American Company's high and low-frequency selective apparatus having been adopted. In addition to the Fort Worth equipment, a 3,000-line capacity switchboard has been shipped to the Kewanee Telephone Company, Kewanee, Ill., this switchboard also being equipped complete with four-party selective keys.

TURBINE STEAMSHIPS.—Mr. William Denton, head of the firm of Swan, Hunter, Wigham & Richardson, one of the largest shipbuilding concerns in the world, states that in all probability the new Cunard liner which his firm is about to build will have turbine engines. The Cunard Company has appointed a committee of experts to study the question. The new liner, said Mr. Denton, will be larger than the *Deutschland*. She will be 785 ft. long, and will have a displacement of 37,500 tons. Mr. Denton is convinced that the turbine engines, in which he has the greatest faith, will prove an immense success in vessels of that type. The new liner will be built at Newcastle-on-Tyne.

THE EUREKA ELECTRIC COMPANY, of Chicago and Genoa, has just furnished one of its late outfits, comprising the new Bell style ring-down magneto switchboard, to the exchange at Fullerton, Neb. It now has a complete 200-line outfit and this will make one of the finest in the State of Nebraska. The Eureka Electric Company also has its apparatus installed at Wahoo, Neb., in one of the most successful independent exchanges. This company is also manufacturing a self-restoring drop switchboard as well as a central energy visual drop board, in regard to which it has issued a new catalogue and bulletins Nos. 26 and 27.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, reports a decided increase in number of orders for the past month. It has recently placed on the market a new type mechanical self-restoring drop switchboard, which has met with such favor that a large number of orders were booked before the tools were completed for its manufacture. The first delivery of the board was made to D. S. Thomas, Paris, Mo., who purchased a complete exchange equipment, including telephones.

ENLARGEMENT OF N. Y. EDISON SUB-STATION.—The New York Edison Company has filed plans with the building bureau for a new four-story basement and mezzanine story electric power house to be built by it in West Twenty-seventh Street, between Broadway and Sixth Avenue, immediately in the rear of the present power house in West Twenty-sixth Street. The new building will be 44 ft. front and 96 ft. deep, and will cost $85,000.

THE JENNEY ELECTRIC MANUFACTURING COMPANY, of Indianapolis, has opened an office at Chicago, with Mr. A. J. Cline, formerly with the Milwaukee Electric Company, in charge. The company, which manufactures a complete line of direct-current motors and generators, will give special attention to machine tool and printing press equipments.

LIGHTING OUTFITS FOR MANHATTAN BATHS.—The Borough of Manhattan Public Baths are to be equipped with lighting outfits. The Buffalo Forge Company, 39-41 Cortlandt Street, has secured a contract calling for six 40-hp engines, which are to be direct connected to Crocker-Wheeler generators of 25 kw capacity each.

MOTORS FOR PRINTING TICKERS.—The Page Machine Company, 812-814 Greenwich Street, New York, has placed a contract with the Holtzer-Cabot Electric Company for 50 motors of special design, and of 1-20 hp capacity for operating the company's printing tickers in Philadelphia.

LIGHTING PLANT FOR CUBA.—The Mackay Engineering Company, 149 Broadway, has secured a contract through the American Trading Company for a small lighting equipment for Cuba. The outfit will be built by the Akron (Ohio) Electric Manufacturing Company.

LIGHTING EQUIPMENT FOR AUSTRALIA.—Mackenzie, Quarrier & Ferguson, 114 Liberty Street, has secured an order for a 90-hp. belted Harrisburg engine, to drive a 55-hp generator, for shipment to Sydney, Australia, for lighting purposes.

EQUIPMENT FOR MEXICO.—The Reeves Engine Company, Trenton, N. J., have secured a contract for a 400-hp engine for direct connection to a 200-kw generator of General Electric build, for a Mexican plant.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, Mass., has sold a 2,000-kw revolving field generator to the Memphis Consolidated Gas & Electric Company, Memphis, Tenn.

General News.

THE TELEPHONE.

DEMOPOLIS, ALA.—The Demopolis Telephone Company's lines are being extended very rapidly, about 10 new telephones per month have been added. The switchboard is of Stromberg-Carlson make, and there are 160 subscribers.

OSCEOLA, ARK.—The Tristate Telephone Company, of Osceola, has been incorporated with a capital stock of $25,000. The incorporators are W. J. Driver, president, C. H. Gaylord, vice-president, William Pyles, secretary and treasurer, R. C. Rose, Charles S. Driver, Samuel Bowen, S. S. Semmer, J. H. Lovewell, J. L. Ward, J. W. Edrington, A. O. Burton and L. A. Morris.

SAN FRANCISCO, CAL.—The Yosemite Valley Commissioners, it is stated, will inaugurate a telephone system in the Yosemite Valley.

LOS ANGELES, CAL.—The Home Telephone Company is planning to extend its line from El Monte to Pomona, a distance of about twenty miles.

LOS ANGELES, CAL.—The Sunset Telephone & Telegraph Company has begun extensive repairs and remodeling in its systems at Santa Monica and Ocean Park.

DENVER, COLO.—The Pitkin Telephone Company has been incorporated with a capital stock of $10,000. The directors are Scott Dickenson, John Pinson, W. S. Henderson, D. C. Masson, W. Heckert, John Custed and Thomas Huxtable.

CAIRO, ILL.—The Central Union Telephone Company has sub-licensed the Thebes Home Telephone Company of Thebes. The latter place will be connected with Cairo.

BLOOMVILLE, ILL.—Mr. J. T. Carbin operates an exchange at this place and also one at Republic. The former has 125 subscribers and the latter 75, which will soon be increased to 100.

INDIANAPOLIS, IND.—The New Long Distance Telephone Company declared a dividend of one per cent., payable Oct. 15.

CONNERSVILLE, IND.—The Connersville Independent Telephone Company is putting in a new "central energy" system at a cost of $10,000.

INDIANAPOLIS, IND.—The Libertyville Mutual Telephone Company, of Libertyville, Vigo County, has filed articles of incorporation. The capital stock is $5,000. J. B. Baatman is president and Ira D. Andrews, secretary.

BURROWS, IND.—The Burrows Telephone Company filed articles of incorporation with the Secretary of State. The capital stock is $15,000. The company will build and operate a telephone system in Carroll and Cass counties with principal office and exchange in Burrows.

RICHMOND, IND.—The directors of the Richmond Home Telephone Company has declared a quarterly dividend of one per cent, payable Oct. 15. This dividend does not include the bond interest. P. J. Freeman resigned the office of president and A. C. Lindermoth was elected.

SULLIVAN, IND.—The Sullivan Telephone Company has been organized and incorporated with a capital stock of $50,000. The headquarters and exchange will be in Sullivan. The incorporators are W. W. Harbaugh, W. T. Melott, J. S. Bays, C. J. Sherman and G. R. Dutton.

WABASH, IND.—The Central Union Telephone Company has submitted the draft of an ordinance asking for the right to use the streets of this city for a period of twenty-five years. The company has been operating without a franchise and was ordered to remove the poles and wires. It is doubtful if the franchise will be granted.

CLAYTON, IND.—The Clayton Free Telephone Association has transferred its property to a company of five local men, of which E. J. Smith is president, and D. M. Reynolds, secretary. The new company will furnish switching service and keep up lines to the town limits. The association has been operating on the co-operative plan, and its business became so large that it was thought best to make the change. Party lines will continue as private property up to the town limits. There are 150 subscribers and the company expects to add several hundred more.

EVANSVILLE, IND.—The United States Court convened in this city Oct. 5, Judge Anderson presiding. The most important case on the docket is the injunction proceedings of the Cumberland Telephone Company against the city of Evansville. The decision of this case will practically decide the status of the Cumberland Telephone Company in this city—whether it has a right to remain in the city and to use the franchise under which it has done business in past years. The company has installed a new switchboard in a new exchange building and built new lines in the city, while the city has encouraged the organization of the Municipal Telephone Company to occupy the field exclusively.

SLOAN, IA.—The North Telephone Company has been formed with a capital stock of $5,000 to build rural lines.

DES MOINES, IA.—The Jasper County Telephone Company has increased its capital stock from $100,000 to $150,000.

BOONE, IA.—The Central Union Telephone Company, it is stated, proposes to erect a handsome exchange building in this city, if it cannot buy an existing building that is suitable for its purposes.

BOONE, IA.—The Jackson Telephone Company has been incorporated with a capital stock of $10,000. This business has been established for some time. The officers are W. A. Will, president; W. S. Crisswell, secretary, and Emmanuel Nelson, treasurer.

SHELBY, IA.—The Shelby Independent Telephone Company operates exchanges at Shelby with 190 subscribers and Minden with 150 subscribers. The company is installing an exchange at Neola with a capacity of 600 drops, and is operating about 80 miles of toll line. Its local rates are $2 per month for business, and $1 for residence. The rate for rural service is $18 per year. The company is continually building lines, and expects to cover all the section of the country to the Missouri River west of Avoca. The officers of the company are: President, C. R. Benedict; vice-president, D. C. Cooper, secretary, N. Jasper Jones, treasurer, G. A. Cassidy.

DURANT, I. T.—The Chickasaw Choctaw Telephone Company of this city has purchased the line of the Western Telephone Company between Durant and Mead, and will extend this line to Kinlock, Fort Washita and Madill. The company is erecting two new wires between Durant and Denison.

WELLINGTON, KAN.—The Western Union Telegraph Company has run a special wire from Ponca City to Blackwell, O. T., to connect with Kansas City, Chicago and New York, to be used exclusively for the markets from the East; also a special wire from Topeka to Wellington, Kan. and another to Arkansas City, to be used for railway service.

DANFORTH, ME.—The Danforth Telephone Company has been organized with a capital stock of $10,000, of which $2,000 has been paid in. The officers are: President, Veazie A. Price, of Weston; treasurer, Martin L. Porter, of Danforth.

SOUTH FRAMINGHAM, MASS.—The New England Telephone & Telegraph Company is putting in an underground service in this town.

SALTILLO, MEX.—It is stated that another telephone line is being constructed at Saltillo.

ST. PETER, MINN.—The Nicolett County Telephone Company will make extensive additions to its system.

BUCKLIN, MO.—The Bucklin Telephone Exchange has been sold by its former owner and manager to Mr. George Linberry.

PARNELL, MO.—The Parnell Mutual Telephone Company and the North Mutual Telephone Company have been consolidated and will be operated under one management.

HALE, MO.—The Hale Telephone Company has been incorporated with a capital stock of $25,000. The incorporators are George R. Vaughan, J. R. Heryford, W. W. Deardoff and others.

NAPOLEON, MO.—The Napoleon Telephone Company has been incorporated with a capital stock of $5000. The incorporators are J. M. Hutchins, H. F. Ellers, P. D. Williams, Adolph Bettien and J. A. Woestemeyer.

HANNIBAL, MO.—The directors of the Bluff City Telephone Company have elected officers as follows: President, J. F. Davidson; vice-president, C. E. Brown; secretary and manager, H. C. Conger; treasurer, James P. Hinton.

MISSOULA, MONT.—The Rocky Mountain Bell Company contemplates extending its lines to Spokane by way of Sand Point, Ida.

FREMONT, NEB.—A trust mortgage to Mr. S. S. Sidner to secure an issue of $20,000 of bonds has been filed by the Fremont Telephone Company. A portion of these will be sold to meet outstanding indebtedness.

SPRINGFIELD, N. J.—The Central New Jersey Telephone Company has petitioned the Springfield township committee for a telephone franchise. The home office of the company is at Trenton, N. J.

MANLIUS, N. Y.—The Manlius Telephone Company, with 30 subscribers, has just started a co-operative local system.

NAPLES, N. Y.—Some rural party lines are projected by the Naples Telephone Exchange which has at present about 100 subscribers.

WAYNE, N. Y.—The Barrington-Wayne Telephone Company, with a capital stock of $2500 has been incorporated by Olney Welker, Elmer E. Miles, Dundee, N. Y., and Quincy A. Earnest, Wayne, N. Y.

ONTARIO, N. Y.—The Wayne-Monroe Telephone Company, of Ontario, has been incorporated; capital, $30,000. Directors: J. A. Driscoll, Rochester; L. T. Yeomans, Walworth, and J. Selden Brandt, Ontario.

MORGANVILLE, N. Y.—There are 28 subscribers to the Stafford Telephone Company which expects to double the number within a year. Through the Inter Ocean Telephone Company long distance connection is secured.

MIDDLETOWN, N. Y.—A Stromberg-Carlson central energy visual signal multiple board with 600 drops, ultimate capacity 1,000 drops, is being installed by the Orange County Telephone Company. There have been 86 telephones added since January, the company having now 641 subscribers. It expects a large addition to the number when the new board is in working order.

JAMESTOWN, N. Y.—The Ashville & Panama Telephone & Telegraph Company, which was organized recently, has 185 subscribers, its switchboard capacity being 50 drops. The company has 41 miles of toll line and intends to build 10 to 15 miles of local lines this fall. The system throughout is equipped with Stromberg-Carlson apparatus. The rates for service are $9 and $12 per annum, payable in advance. Mr. Alton H. Appleby is secretary and treasurer.

COINJOCK, N. C.—A charter has been granted to the Currituck Telephone Company, of Coinjock, with a capital of $2,500. E. R. Johnson is interested. The company will operate in four counties.

WILLIAMSTON, N. C.—The Williamston Telephone Company claims to have more subscribers for the size of town than any other place in its part of the country. There are 88 miles of toll line and 90 subscribers.

HOPE, N. D.—A line from Page to Casselton, N. D., is under consideration by the Union Telephone Company, which serves at present 165 subscribers, and has 50 farm stations. An "American" 130-drop switchboard is in operation.

HILLSBORO, N. D.—The Hillsboro, Duane, Caledonia & Shelby Telephone Company has 225 subscribers (all using farmers' lines), with Standard Telephone Manufacturing Company's apparatus. The charge is $15 per annum in advance.

ROCK HILL, S. C.—The Southern Bell Telephone Company will build a long distance line between Yorkville and Rock Hill.

COLUMBUS, OHIO.—The Citizens' Telephone Company, of this city, is preparing to install a new automatic switchboard.

ALBANY, OHIO.—The Albany & Vales Mills Telephone Company has 100 subscribers and 100 miles of toll line. North apparatus is used.

LEXINGTON, OHIO.—A North 80-drop switchboard is used by the Mansfield Telephone Company for its 100 subscribers, who pay $1.25 a month.

BURTON, OHIO.—The Burton Telephone Company employs Kellogg apparatus. It has 225 subscribers and 75 miles of toll line. The rate is $12 per annum.

BELLEFONTAINE, OHIO. The United Telephone Company contemplates increasing its plant. It numbers at present 750 subscribers, and has 450 miles of toll line.

ASHLAND, OHIO.—Kellogg apparatus is in operation at the exchange of the Star Telephone Company, which has a subscription list of 1,010. The company owns 350 miles of toll line.

GREENFIELD, OHIO.—The Greenfield Home Telephone Company has been organized, with $30,000 capital, by D. O. Miller, Stanley Pike, Fay Baldwin and others. It will install a local exchange.

BROOKVILLE, OHIO.—Two years ago the Brookville Telephone Company was started; it has now 160 subscribers, 15 miles of toll line and reports a good outlook. Swedish-American telephones are used.

ADA, OHIO.—The Ada Telephone Exchange Company operates an "American" 420-drop switchboard and has 510 subscribers. The charges for service are $2 for business and $1 for residence, per month.

FAIRVIEW, OHIO.—The Union Telephone Company has doubled the number of its subscribers in the last year and expects to add about 30 or 40 more next year. Kellogg apparatus is used. The rate is $12 a year.

TOLEDO, OHIO.—The Toledo Home Telephone Company has announced a slight advance in rates to take effect Oct. 15. The original rates were based on an exchange of 3000 lines, but now the company has over 7000 subscribers.

COVINGTON, OHIO.—Farmers' lines will be erected in all directions by the Covington Home Telephone Company. The exchange at Covington, having 350 subscribers, was rebuilt in 1902 and has gained 40 per cent. in the past year.

HURON, OHIO.—New telephones are being added every day by the Huron Telephone Company and several new country lines are under consideration. The 125 subscribers pay from $1 to $2.50 per month. Kellogg apparatus is installed.

COSHOCTON, OHIO.—The Citizens', Farmers' & Merchants' Telephone Company has had a very rapid growth, numbering now 1,500 subscribers. Five miles of cable are soon to be added. Kellogg, Viaduct and North instruments are employed.

CONNEAUT, OHIO.—Mr. Henry H. Hart, vice-president, reports a normal increase in the business of the Conneaut Telephone Company numbering at present 670 subscribers, who pay a rental of $1, $1.50 and $2. American Electric apparatus is installed.

ARLINGTON, OHIO.—Mr. Oscar Wise, general manager, People's Telephone Company, informs us that his company has added 75 subscribers in the past year, numbering at present 175. It expects to have 300 within a year. "American" apparatus is used.

HICKSVILLE, OHIO.—The Hicksville Telephone Company has secured 100 new subscribers in five months, the total number at present being 355. It operates 38 miles of toll line. American Electric apparatus is used. Mr. William Purdy is the secretary.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company announces that its new Kellogg central energy board will be in service about January 1. The new board will take care of 8000 lines. The change will not affect the several branch exchanges of the company.

KENT, OHIO.—The Portage County Telephone Company has 558 subscribers in Kent and about 1,700 in the county. The company plans to build 50 more miles of toll line. The rates charges are $18 and $24 on the selective system. North instruments are used.

CIRCLEVILLE, OHIO.—An exchange at Laurelville, Ohio, has lately been opened by the Citizens' Telephone Company, which has also built a line to Stoutsville, a point never reached before by the independents. The system has 925 patrons and 43 miles of toll line.

BELLEVUE, OHIO.—The addition of some farmers' lines is planned by the Bellevue Telephone Company, which has 475 subscribers, 50 of which have been added during the past year. The charges are $1.25 and $2 per month. A 600-drop "American" switchboard is in operation.

LIMA, OHIO.—The Lima Telephone & Telegraph Company has just completed a 600-pair-cable extension and connected up 400 additional subscribers, making the present number 1,500. The rates are $30 for business, $18 residence for a single line and $15 on a four-party line.

BRYAN, OHIO.—The Edon exchange of the Williams County Toll Line Company has been sold to the Edon Home Telephone Company, recently organized, with E. L. Palmer, of Edon, president, and E. E. Newman, Edon, secretary. The new company will improve the exchange.

GREENFIELD, OHIO.—New incorporation papers are now being taken out by the Greenfield Mutual Telephone Company for an increase of capital stock to $30,000. It intends to install cables and a new switchboard shortly. There are 435 patrons who pay a rental of $12 and $18 per annum.

ELMORE, OHIO.—Seven exchanges and 23 toll stations are in operation by the new Ottawa County Telephone Company, the entire system numbering 1,200 subscribers. There are 200 miles of toll line. An exchange of fifty telephones is projected for Curtice. Mr. J. G. Steinkamp is general manager.

BETHANY, OHIO.—The Bethany & Hughes Telephone Company was bought by the Hamilton Home Telephone Company, which will change the system, with 130 subscribers, from grounded to full metallic and will use all new instruments. It is purposed to build several rural lines this fall.

CAREY, OHIO.—The Carey Electric Company operates an American "Express" switchboard of 300-drops capacity and uses Kellogg and Hipwell telephones for the 275 subscribers. Ninety telephones have been added since January and the company is figuring on increasing the number of subscribers to 350 by January, 1904.

BRYAN, OHIO.—Manager U. G. Townsend, of the Bryan Telephone Company, informs us that the company has one telephone to every seven and one-half persons. The system has at present 435 subscribers, and the addition of 300 farmers' telephones of branch exchanges is under consideration. The Bryan exchange uses "American" apparatus.

FOSTORIA, OHIO.—The Citizens' Telephone & Message Company now has 887 subscribers and there are still 140 unfilled contracts on hand. The exchange is taxed to its utmost capacity and it is the plan of the company to increase the plant 50 per cent. American Electric apparatus is used. The rates charged are $24 and $12 for business and $18 for residence.

AKRON, OHIO.—Since 1901 the growth of the Akron People's Telephone Company, which operates in Summit County, has been almost beyond its ability to take care of. There are 3,548 subscribers at Akron, 1,200 at Barberton, 500 at Cuyahoga Falls, 400 at Hudson and 100 at Talmudy. Stromberg-Carlson telephones are used. The rates are from $12 to $36 per annum, according to the location of the telephone.

CRESTLINE, OHIO.—The Crestline Local Telephone Company has recently installed a new switchboard and cable, increasing the capacity of the exchange to 500. Heretofore it has been unable to care for new subscribers. Country lines projected will reach thickly settled regions, and the outlook is splendid, we are informed by President Jacob Babst. A 400-drop Stromberg-Carlson switchboard is used and North telephones.

COLUMBUS, OHIO.—Judge Dillon, of the Franklin County Court, holds that a telephone number is an asset. A Columbus grocer recently sold his store and ordered his telephone with the old number removed to his home. The purchaser of the store claimed that the telephone as well as the number by which it was known was part of the assets of the store and went with the purchase. The court sustained this view.

BATAVIA, OHIO.—Eleven exchanges in Clermont County are operated by the Citizens' Telephone Company, which is extending its lines to Cincinnati and will be able to give service as soon as it can arrange to get through the towns of Madisonville and Norwood. The Batavia exchange has 115 patrons, who pay $2 for business and $1 per month for residence service. The Citizens' Company has recently built 20 miles of toll and farmers' party lines.

KENTON, OHIO.—A gain of 215 subscribers for the year 1902 and 60 so far this year is the record of the Kenton Telephone Company, which has at present 780 subscribers. Mr. C. E. Nicholas, manager, writes: "Our farm telephones are increasing in number so rapidly that we will have to put them on a board by themselves and then add a selective system to them, but we want a selector that will let us use our present telephones and be full metallic and not use a ground or third wire."

CLEVELAND, OHIO.—President Dickson, of the Federal Telephone Company, denies that the Columbiana County Telephone Company is experiencing any great difficulty in increasing its rates in Columbiana County. The company gave a very low rate and allowed free toll service throughout the country. Recently it increased its rates and established a charge for toll service, with the result that some of the subscribers complained. President Dickson claims that the company will not lose more than 100 subscribers and that double this number can be acquired.

DAYTON, OHIO.—The Automatic Electric Company's system is in operation by the Home Telephone Company. Subscribers to the number of 1,400 are securing service and from 15 to 40 additions are being made daily. The charges are $40 for business and $28 for residences. We are informed that the automatic switches and telephones are giving excellent satisfaction and meeting with public approval and endorsement. It is the expectation to have the entire city covered by lines within two months. The Dayton exchange is stated to be the largest all-cable plant in the country. The officers of the Home Telephone Company are Mr. John T. Barlow, president; Mr. H. C. Kiefarber, vice-president; Mr. J. C. Reber, secretary and treasurer; Mr. W. C. Prickett, general manager; Mr. R. D. Funkhouser, cashier.

CADIZ, OHIO.—The Harrison County Telephone Company began business two years ago with 100 subscribers and since then has built 50 miles ot toll line, put in an exchange at Jewett, and finished one in Scio last spring with 125 subscribers. It recently finished a copper metallic circuit from Scio to Canotton and Bowerstown, and is now making arrangements to build from Bowerstown to Plum Run, where it can connect with the Tuscarawas County Telephone Company. It now has under construction an exchange at Bowerstown. The United States Telephone Company has ordered material to build from Cadiz to Ulrichsville, which will connect the Harrison Company with all important towns and cities. Stromberg-Carlson apparatus is used. Cadiz has 210, Scio 140 and Jewett 50 subscribers. The charges are $24 for business, $12 for residence service.

FREDERICK, OKLA.—The Southwestern Telephone Company has been incorporated with a capital stock of $15,000. J. T. McClannahan is one of the directors.

PRAGUE, OKLA.—The Prague Telephone Company has been incorporated with a capital stock of $2,500. The incorporators are J. B. Charles, of Stroud; H. Josey, of Prague; E. L. Conklin, of Sac and Fox Agency; Roy Hoffman, of Chandler.

PITTSBURG, PA.—The Northern Lackawanna Telephone Company has been incorporated with a capital stock of $5,000. M. D. Potter and W. C. Smith are among the directors.

BIRDSBORO, PA.—The Conestoga Telephone Company proposes to extend its line from Joanna to Birdsboro, a distance of ten miles, to connect with one of the long distance telephone companies.

DELMONT, S. D.—T. A. Pieplow has been granted a franchise for a telephone exchange in this place.

WATERTOWN, S. D.—The Dakota Central Telephone Company contemplates building a new exchange here, and some conduit work is projected.

DEADWOOD, S. D.—The City Council has granted the Nebraska Telephone Company a franchise giving the right to erect its poles and wires and to lay subways throughout the principal streets. A similar ordinance was passed by the City of Lead several months ago. It is stated that the company will make improvements in Deadwood to the extent of about $30,000.

NASHVILLE, TENN.—The Lauderdale Telephone Company, of Lauderdale County, has been granted a franchise. It is proposed to build and operate a line from Ripley to Durhamville and Arpa. The capital stock of the company is $1,500, and the incorporators are T. A. Anthony, W. G. L. Rue, J. C. Moorer, F. L. Spright, J. A. Holmes, J. R. Anthony and A. S. Anthony.

CORSICANA, TEX.—The Corsicana Telephone Company has just completed the construction of a telephone toll line from this city to Ennis, Tex.

SULPHUR SPRINGS, TEX.—The Northeast Texas Telephone Company, of Sulphur Springs, has been incorporated with a capital stock of $50,000. The incorporators are R. C. Hawley, James F. Quinn, Luther A. McLemore and John D. Williams, of Sulphur Springs, and J. J. Ellis, of Pittsburg, Tex.

OGDEN, UTAH.—The Independent Home Telephone Company, which recently received a franchise to operate in this city, has commenced work on the erection of a building.

MARTINSVILLE, VA.—The Henry County Telephone Company, of Martinsville has been incorporated with a capital stock of $800 to $5000. W. O. Minter is president.

RICHMOND, VA.—The Mendota-Benhams Independent Telephone Company has been incorporated with a capital stock of $2500 to $5000 by J. C. Pruner, W. W. Sproles, J. S. Fleenor and others.

RICHMOND, VA.—The Albemarle Mutual Telephone Company has been granted permission to change its corporate name to Farmers' Mutual Telephone Company. Mr. T. E. Powell is president, and Mr. C. A. Miller, secretary.

RICHMOND, VA.—The Central Telephone Company, of Charlotte Courthouse, has amended its charter so as to permit it to increase its capital stock to a maximum of $20,000. W. H. Smith is president and W. G. Williams, secretary.

SPOKANE, WASH.—The Pacific States Telephone & Telegraph Company plans the extension of its underground cables so that there will be direct communication between this city and Seattle. Heretofore connection had to be made by way of Portland, Ore. That line is one of the longest in the Northwest. The Rocky Mountain Bell Telephone Company already has material ready for the extension of its system from Sandpoint, Idaho, to Newport, Wash., where it will connect with the lines from this city. The strike of the telephone girls here has not yet been settled, but the girls are still confident of going back to their old employment.

RIO, WIS.—The People's Telephone Company, of this place, is actively developing rural service. It now has 700 subscribers, 100 of which are of recent acquisition. Its switchboard capacity is 300 drops Kellogg and Peerless Mfg. Company apparatus being used. Mr. J. L. Farrington is president of the company.

ELECTRIC LIGHT AND POWER.

SANTA ANA, CAL.—The citizens have voted to issue $60,000 bonds for an electric light plant.

MILLEDGEVILLE, ILL.—The question of constructing an electric light plant is under consideration here.

TERRE HAUTE, IND.—It is reported that the Terre Haute Electric Company will expend about $200,000 in new machinery and other improvements.

EVANSVILLE, IND.—W. B. McDonald has succeeded George Whysall as general manager of the Evansville Electric Light Company and has assumed his duties.

NEW CASTLE, IND.—The New Castle Light, Heat & Power Company has authorized the issue of $15,000 bonds for improvements. L. F. Wayman is secretary.

HAMMOND, IND.—The Hammond Illuminating Company has filed with the Secretary of State a certificate increasing its capital stock from $350,000 to $2,000,000. The company is organized to operate a lighting plant and heating system for Hammond, East Chicago and Whiting.

GREEN CASTLE, IND.—The two electric companies of this city have been merged by the sale of the plant of the Green Castle Electric Light Company to the Putnam Electric Company. The former company until the last few months had the contract for the city lighting. The Putnam Company organized and secured the contract for the city lighting which is the cause of the sale.

ELKHART, IND.—The Elkhart Power Company has been organized with Walter Brown, of Elkhart, president, and Vernon W. Van Fleet, of Elkhart, secretary. Work will begin immediately upon the erection of a power house; 12,000-hp will be installed this fall and more power will be added as soon as new dam can be completed, which will probably be early next year. It is the intention of the company to construct a 16-foot dam in St. Joseph River below the present dam.

EMPORIA, KAN.—Mayor John Martin is planning to expend $10,000 in extending the electric light system.

COFFEYVILLE, KAN.—A petition is being circulated asking the Mayor and City Council to call an election to vote on issuing $15,000 bonds for enlarging the electric plant.

OTTAWA, KAN.—Plans are being made for the construction of a new dam across the Marais des Cygnes River at this point and the installation of a plant to develop electricity from water power. The city will be asked to aid in the construction of the dam.

MORGANTOWN, KY.—J. O. Carson writes that it is proposed to construct water works and an electric light plant and bids will soon be asked.

NEW ORLEANS, LA.—The New Orleans Lighting Company will construct a new substation on Broad and Esplanade Streets.

HOLYOKE, MASS.—For the purpose of extending the electric light system the Board of Aldermen has authorized the city treasurer to negotiate a bond issue for $16,000.

GLENWOOD, MINN.—The village council has granted the recently incorporated Glenwood Mill & Electric Light Company a 15-year lighting franchise. The ordinance contains a provision that the village may purchase the plant at any time after five years.

DULUTH, MINN.—It is stated final surveys and engineering work of the Great Northern Power Company to determine most feasible plans for development of St. Louis River and for installation and transmission of electric power to Duluth and Superior and to the Missabe and Vermilion iron ranges have been completed. Manufacturers of hydraulic and electric equipment will now be asked for final designs and bids for water wheels and generators required for first installation of 30,000-hp.

ABERDEEN, MISS.—The Aberdeen electric light plant and franchise have been sold and transferred by J. F. Enderlin to E. M. and J. K. Jones. The entire system will probably be overhauled and repaired.

COLUMBIA, MO.—F. P. Spaulding has prepared estimates for water works and an electric light plant, to cost about $150,000.

OMAHA, NEB.—Some of the local ward improvement clubs are agitating the question of a municipal electric lighting plant though it is not probable that such a plant will be established in the near future.

ST. PAUL, NEB.—The City Council has granted a 25-year franchise to the Loup Valley Electric Company for the installation of an electric light system. The company includes J. E. and H. E. Crawford, of New Castle, Pa.

WASHINGTON, N. J.—W. M. Ostrander, Philadelphia, Pa., reports the sale by him of the Washington electric light plant to Mr. Harry Reed, of New York City. The Washington Company has a capital of $50,000. Mr. Reed expects to make Washington his home and give the property his personal attention. Mr. Ostrander also sold recently the plants at Hollidaysburg, Pa., and Hempstead, N. Y.

COOPERSTOWN, N. D.—J. S. Webster, of Minneapolis, Minn., contemplates installing an electric light plant here.

COLUMBUS, OHIO.—The Infirmary Directors are considering the advisability of establishing an electric light plant.

GREENFIELD, OHIO.—W. L. Day, of Bettsville, is considering the establishment of an electric light plant at Greenfield.

SCRANTON, PA.—Bids are wanted Oct. 16 for installing electrical equipment in the Almshouse at Hillside Home near Clarks Summit. Edw. H. Davis, Connell Building, is the architect.

SEVEN VALLEY, PA.—The Council of the borough of Seven Valley, a town of 500 inhabitants in this county, is considering the project of lighting the town by electricity. Spurgeon Heathecote, proprietor of the woolen mills at Glen Rock, Pa., is endeavoring to secure the franchise for supplying the town with light. Mr. Heathecote has purchased an old mill property at Seven Valley in which he will establish a woolen mill and also an electric light plant, if he secures the franchise. He is endeavoring to interest the proprietors of factories in the town with the view to supplying the plants with motive power.

GREENVILLE, S. C.—The Southern Water Power Company, of Greenville, is to develop about 40,000-hp in various places in upper South Carolina.

CLINTON, S. C.—There is considerable talk in the town of installing an electric light plant and water works, and a company has been interested.

SPOKANE, WASH.—It is reported that the Spokane Light & Power Company will develop water-power on Spokane River.

NEWPORT, WASH.—Alex. M. Winston and J. C. Odell, both of Spokane, have applied for a franchise for an electric light plant for Newport.

SPRING VALLEY, WIS.—H. C. Hullinter, of Berlin, has secured a franchise for an electric light plant.

JESUS MARIA, MEX.—A large electric generating plant is to be established near here by Manuel Hernandez Acevedo. The water power for operating the plant will be obtained by constructing a dam across the Santa Maria River at a point nine miles east of this place. The electric power will be supplied to the town of Santa Maria del Rio.

CHILPANCINGO, MEX.—It is announced that the Mitchell Mining Company, which is operating extensive copper mines in this state, has under consideration the establishment of large electric power plants. The company has acquired two waterfalls, one capable of providing 20,000-hp and the other 1,500-hp. The plans of the company contemplate the construction of an electric railway between the mines and the port of Acapulco, a distance of 31 miles. This road will be used to transport the ore and other freight of the company. John F. Dowling can give further information in regard to the projects.

FREDERICTON, N. B.—Bids will be received Oct. 15 by Chas. W. Beckwith, City Clerk, for $15,000 electric light bonds.

STRATFORD, ONT.—H. M. Sloan, of Chicago, and Dr. McKay, of Ingersol, have petitioned Council for a 50-year franchise to supply electricity for lighting and power.

BERLIN, ONT.—The Town Council has voted $70,000 to the Light Commissioners to be used for improvements to the electric light and power plant recently purchased by the city. In place of steam, coal gas engines will be installed.

The Electric Railway.

DOVER, DEL.—A contract has been awarded to the Tennis Construction Company for building the electric railway from Chesapeake City to Elkton, Md. The ultimate aim of the parties who control the line is to build a connection at the State line, with an extension via Newport, Del., Stanton and Newark, Del., and from Chesapeake City to Fredericktown, across the Sassafras River, to Chestertown, Md., with a branch probably from Chesapeake City to Middletown, Del., thus completing a circuit via Delaware City and New Castle to Wilmington, Del. If this last arrangement is carried out, the line will undoubtedly be continued down the State to Smyrna, and thence on through to Rehoboth, giving the entire peninsula a complete electric railway for freight and passenger business.

EAST ST. LOUIS, ILL.—The East St. Louis & Columbia Electric Railway Company has been incorporated with a capital of $45,000. The incorporators are Thomas N. Chase, J. P. Meyers and John Pickbaw.

MARSEILLES, ILL.—The Streator Manufacturers' Railway has been incorporated to build a railroad from Ottawa, Ill., to Marseilles and to Streator. The capital stock is $25,000, and the incorporators are Frank R. Davidson, John F. Clark, Charles H. Adams and others.

CHARLESTON, ILL.—Articles of incorporation have been filed at Springfield by the Charleston, Champaign & Northern Interurban Railway Company. The principal offices will be at Charleston, and the capital is $10,000. The incorporators and first board of directors are W. R. Patten, W. F. Jenkins, J. B. Mitchell, C. L. Lee and J. L. Shisand, of Charleston.

DECATUR, IND.—The Springfield & Fort Wayne Electric Railway Company is preparing plans for a new power house.

CAMBRIDGE CITY, IND.—The Richmond Street & Interurban Railway Company will in the spring convert the Red Whitewater Division of the Big Four from Hagerstown to Connersville into a traction line.

FT. BRANCH, IND.—The Evansville & Princeton Electric Railway Company, whose power house is situated in this place, has made a proposition to install a system of electric lights for this city and it is thought the council will ratify the proposition.

TERRE HAUTE, IND.—The County Commissioners have granted a franchise to the Western Traction Company to build an electric railway from the south line of the county to Terre Haute. Samuel Williams, of Vincennes, is president of the company.

SIOUX CITY, IA.—Negotiations have been pending for the purchase by the Sioux City, Homer & Southern Railway Company of a right of way across the Winnebago and Omaha Indian reservations. This seems to point to the certainty of the extension of the line from Homer to Omaha. The Omaha Northern Railway Company owns a right of way over these reservations, but has never done anything as yet to construct the line from Omaha to Sioux City.

LOUISVILLE, KY.—The promoters of the Louisville, New Albany & French Lick Valley Traction Company have practically abandoned the plan to construct the line, and there is now an opening for some other company to build it. It is presumed that the Louisville & Southern Indiana Traction Company will take over the franchises and build the line.

BALTIMORE, MD.—William P. Lyons, of Baltimore, has been appointed co-receiver of the Washington, Baltimore & Annapolis Railway Company.

BURLINGTON, MASS.—The town of Burlington has instructed the Board of Selectmen to grant a location to the Middlesex Street Railway Company, which proposes to construct a line between Arlington and Lowell, with rails in Arlington, Bedford, Burlington and Billerica. The route, so far as possible, will be over private land and a double track will be laid.

CADILLAC, MICH.—The Cadillac Traction Company, recently organized, will build a line to skirt Lake Cadillac. The company has purchased the electric light, power and water plants of the city, and will operate the street railway in connection with them. The company has been granted a franchise which will aggregate about 10 miles of track in Cadillac proper and around Lake Cadillac, passing Lake Mitchell. The officers of the company are Willis J. Cornwell, president; John F. Vasberg, vice-president; George S. Hanley, secretary; Francis O. Gaffney, treasurer; James H. Orr, manager and purchasing agent.

JOPLIN, MO.—An Eastern syndicate, headed by Major William Vincent, of the United States Guarantee Loan & Trust Company, of New York, proposes to build an electric railway between Joplin and Kansas City. The road will be 170 miles long. It is the intention of the company to do a general freight as well as passenger business.

LINCOLN, NEB.—In response to appeals of its employees the Lincoln Traction Company has raised the wages of first-class conductors and motormen one cent per hour, taking effect October 1.

DOVER, N. J.—The Morris County Traction Company is making plans to extend its lines from Dover to Morristown.

JERSEY CITY, N. J.—The Keeler Transportation Company has been incorporated here, capital $500,000. Incorporators: Frank R. Baldwin, Elmer A. Keeler and Martin A. Ryan.

UTICA, N. Y.—The directors of the Utica & Mohawk Valley Street Railway Company have re-elected the present officers.

BINGHAMTON, N. Y.—The Montrose Railway Company has voted to issue bonds to the amount of $100,000, and it is reported that the line will be extended through to Binghamton. It has been decided to widen the road to standard gage, to buy a right of way into Montrose, and to build the necessary trackage and station.

MIDDLETOWN, N. Y.—It is understood that negotiations are on for the extension of the power lines of the Honk Falls Power Company from Ellenville to Middletown, a distance of more than 20 miles, so as to supply power to both the Middletown-Goshen Electric Railway Company and the Consumers' Light & Power Company.

NEWARK, OHIO.—The Newark, Martinsburg & Mount Vernon Traction Company has amended its articles of incorporation to authorize the construction of branch lines through Martinsburg, Gambier and Wooster.

CINCINNATI, OHIO.—The Cincinnati, Dayton & Toledo Traction Company will install a new generating unit at its Spring Grove Avenue power house, and it is probable that a new power house will be erected at Hamilton to improve the condition of the city service.

MANSFIELD, OHIO.—Hon. S. M. Douglass, of Mansfield, is at the head of a project to build an electric railway from Mansfield to Akron by way of Wooster and Orrville. The company has not yet been incorporated, but it is stated that practically all the required right of way has been obtained.

GENEVA, OHIO.—C. W. Goodrich has filed a petition with the County Commissioners for a franchise for an electric railway through Ashtabula County, from Geneva to Jefferson, and thence to Meadville. The right of way for this line has all been secured and engineers have made a survey of the same.

YOUNGSTOWN, OHIO.—The Youngstown & Southern Railway Company and the Youngstown & Salem Railway Company have been consolidated into one corporation to be known as the Youngstown & Southern Railway Company; capital, $1,800,000. A. W. Jones, John Ruhmann, W. H. Ruhmann, J. R. Long, W. S. Andrews and R. L. Andrews are the directors.

EAST LIVERPOOL, OHIO.—L. W. Healey, manager of the United Power Company, of East Liverpool, has applied to the Jefferson County Commissioners for a franchise to extend the company's line from Wellsville to Empire. The object of the extension is to connect with the line of the Steubenville Traction & Light Company, now completed to Empire. This would give a continuous line from East Liverpool to Wheeling.

GUTHRIE, OKLA.—The Blue Island, Riverdale & Hammond Street Railway Company, of Oklahoma City, has been incorporated with a capital stock of $1,500,000. The incorporators are William F. Owen, August W. Miller, John F. Noel, Ira J. Owen, W. S. McCaull and Frank E. White, of Chicago; W. F. Harn, T. F. McMechan and John Threadgill, of Oklahoma City.

HARRISBURG, PA.—Control of the West Fairview & Marysville Electric Railway has passed into the hands of the Harrisburg & Mechanicsburg Street Railway Company.

OXFORD, PA.—The Town Council has granted the right to lay tracks to the West Chester, Kennett & Wilmington Electric Street Railway Company. The projectors promise to have the road in operation by the new year.

BEAVER, PA.—The Beaver Valley Traction Company will extend the Morado line to Homewood, and may extend the Monaca line to Aliquippa Park. Surveys for both extensions have been made. It is reported that the company will build an extension to Ellwood City.

CHAMBERSBURG, PA.—The Chambersburg, St. Thomas & Fort Loudon Electric Railway Company has been organized to build an electric railway from Chambersburg to St. Thomas and Fort Loudon. The officers of the company are John R. Eberly, president; Frisby Miller, secretary; Dr. F. G. Strock, treasurer.

CONNELLSVILLE, PA.—A charter has been granted the Monongahela & Clairton Street Railway Company. The incorporators are Paul W. McCully, W. P. Whitledge, John G. Parke, Jr., Culin Armstrong, William H. Lewis, B. W. Castner, John W. Ailes, William H. Binns, J. N. Mullin and Oliver S. Scott. The capital stock is $75,000.

LANCASTER, PA.—Mr. W. F. Given, president of the Lancaster County Railway & Light Company, has resigned his position, owing to the discovery of a shortage in his accounts of over $100,000. Mr. Given was also president and director of the Columbia Trust Co., both of which offices he has resigned. It is stated that in large part he has made restitution and that the stockholders of the Lancaster County Company will not suffer a severe loss. According to reports, Mr. Given did not owe the Columbia Trust Company anything. It is stated that he was a plunger in the stock market. He was regarded as a man of great wealth.

GEORGETOWN, S. C.—The proposed electric railway at Georgetown has resulted in the application for a commission from the Secretary of State by R. M. Barnes, Jos. B. Johnson and others. The capital stock will be $10,000. The company also asks for the right to furnish light and power.

MEMPHIS, TENN.—The Memphis Street Railway Company will extend its line from Buntyn, a suburb of Memphis, to Colliersville, Tenn., a distance of 18 miles.

AUSTIN, TEX.—The law passed by the Texas legislature at its last regular session requiring all street railway companies operating lines in this state to place vestibules on their cars is being generally observed. All cars will be equipped with vestibules by the time the winter season opens.

NEW BRAUMFELS, TEX.—The project of building an interurban electric railway between this place and San Antonio is being considered by capitalists. The distance is about thirty miles. This is one of the greatest pleasure resorts in Texas and thousands of people are attracted here. The most abundant water power in the state is afforded in the Guadalupe river at this place and if the project is carried out the power station will be located here. Colonel Harry Landa, of New Braumfels, can give information.

MADISON, WIS.—The Chicago & Northwestern Lake Electric Railway Company has filed an amendment to its charter, with the Secretary of State, providing for the construction of a branch line from the state line, in Kenosha County, into the city of Milwaukee, 45 miles.

OSHKOSH, WIS.—The Eastern Wisconsin Railway & Light Company, which has in contemplation the construction of an electric railway between Oshkosh and Fond du Lac and through contiguous territory, has just filed articles of incorporation with the Secretary of State of Wisconsin. The capital of the company is $500,000, and the directors are Frank B. Hoskins, Benjamin Wild, Sr., and Leander Choate.

LEGAL.

WESTERN UNION VS. BELL TELEPHONE.—The United States Circuit Court of Appeals, sitting at Boston, has sent down a decree in the case of the Western Union Telegraph Company et al. vs. the American Bell Telephone Company, reversing the decision of the circuit court, which confirms the master's report. The master's report held that the plaintiff could not recover in the suit seeking an accounting for certain shares of stock in the companies licensed by the Bell Company, under a contract made in November, 1879. Now the court of appeals holds that the plaintiff can recover. The amount involved is very large. This decision marks the end of a legal contest which has been in and out of the courts for almost twenty years. The suit was brought originally by the Western Union Telegraph Company in 1884 to recover 20 per cent. of certain telephone profits of companies licensed by the Bell Telephone Company which had taken over certain telephone patents and companies of the Western Union under a contract made in November, 1879, whereby in exchange for those patents the Western Union was to receive the royalty above stated. The contract gave the Bell Company the exclusive license for the Western Union patents or any extensions. The Western Union also agreed to acquire certain other patents, application for which were pending and to license the Bell Company under them. It also stipulated that if it should thereafter acquire any telephone patents, the Bell Company should have the right to use them. It agreed to withdraw from the manufacture, rental and use of telephones and gave the field to the Bell Company. It also agreed to transfer telephone exchanges it had established. The Bell Company was to give the Western Union 20 per cent. of the rentals for royalties. Shortly after making the contract the Bell Company changed its methods of business and began to give licenses to use telephones for rentals and for stock. The Western Union contended that the stock received was as much rental as the money rental. Rush Taggart says: "We do not know the amount in question until an accounting is rendered. We believe the sum to be a large one. It may be between $2,000,000 and $4,000,000." There seems a likelihood that the case may be appealed.

SUIT AGAINST U. G. I.—Charges against the United Gas Improvement Company to the effect that it has made a secret and illegal profit of $20,000,000 in the stock of the United Electric Company of New Jersey are made in a bill in equity filed in Common Pleas Court No. 1, Philadelphia, in behalf of Col. Allan B. Wallace, of Summit, N. J. It is alleged that the Philadelphia corporation promoted the New Jersey concern for the purpose of subsidizing a number of electric light and power companies in and around Newark and Jersey City. It is said that the U. G. I., in the spring of 1899, through Frank M. Stillman, William J. David and others, formed the New Jersey corporation with an authorized capital of $20,000,000, divided into 200,000 shares of the par value of $100 each. David became president, Stillman, secretary, and the other representatives of the U. G. I. formed with them the directorship of the concern. It is explained that at this time there were about twenty smaller companies around Newark and Jersey City engaged in the electric lighting and power business. In order to get control of these the U. G. I. offered, through the Fidelity Trust Company of Newark, to buy stockholders' holdings with the United Electric bonds. It also offered to sell the balance of the bonds of the United Electric Company to them for $30 a share. The scheme proved successful and the directors of the United Electric Company made a bond issue of $20,000,000 and turned the securities, together with the stock, over to the U. G. I. At this time Col. Wallace was a shareholder in the People's Light & Power Company, a subsidiary concern. It is complained that the U. G. I. did not disclose to the purchasers of the bonds and stock of the United Electric Company that it was getting the entire issue of the stock as a profit, or bonus, for promoting the organization, and that the receipt of its stock by its agents in the capacity of directors without full disclosure was illegal. It is also contended that the whole transaction was in fraud of the rights of the electric company and of those who purchased the stock from the U. G. I. A full discovery of all profits is asked for and when these have been ascertained the court is asked to order the U. G. I. to turn them over to the electric company and to declare the assignment of the $20,000,000 stock to the U. G. I. invalid. The U. G. I. people state that they know little or nothing of this matter.

OBITUARY.

MR. F. D. OLMSTED, assistant chief engineer of the Telluride Power Company and the Power Company of Montana, died in Denver, Colo., October 4, of tuberculosis and heart trouble, after a short, acute illness. Mr. Olmsted has been associated with these companies for the last five years. He was an Ann Arbor man, and previous to his connection with the Telluride Power Company was with the Edison Electric Company, of New York City. He had done a great deal of very creditable original work in hydraulics with these companies. He was also associated with Mr. P. H. Thomas, of the Westinghouse Electric & Manufacturing Company, in original research on static strains produced by interruptions of high tension long distance circuits. Mr. Olmsted was highly thought of, both for his technical ability and his personal character, by all of his associates, and the Telluride Power Company feel they have lost one of their best men. He died on his twenty-eighth birthday. He was a junior member of the American Society of Mechanical Engineers.

COL. R. H. SAVAGE.—We regret to note that Col. Richard Henry Savage, the soldier, author, traveler and scientist, died on Sunday, October 11, in New York City, from injuries which he received on the night of Oct. 3, when he was knocked down and run over by a wagon. He was well known by his literary works, of which he had published about thirty volumes of prose and poetry, many of which have been translated and sold on the Continent of Europe. His first novel, "My Official Wife," has been translated into seventeen languages, besides being dramatized and burlesqued. He was born in Utica, N. Y., on June [illegible] 1846. He went to San Francisco at an early age, where he was one of the first public school children in that city. While in the West he became acquainted with frontier life, and saw the workings of the Vigilance Committee formed by the early settlers in those parts. At the age of twenty-two he was graduated from the West Point Military Academy with the highest honors. From the Academy he went into service on the Western frontier. Col. Savage then went to Egypt, where in 1871 he entered the Egyptian Army as Major, serving for one year, at the end of which he received an honorable discharge. At various times he was Vice-Consul at Marseilles and at Rome. He was Commissioner in Texas in 1872-4 to settle the Mexican-Texas border dispute. For fourteen years Col. Savage carried on geographical studies which carried him over most of the globe. When war was declared against Spain Col. Savage was one of the first to volunteer his services to the Government. He was assigned to the command of the First Battalion United States Volunteer Engineers.

PERSONAL.

MR. C. J. H. WOODBURY, M. E., has changed his Lynn, Mass., address to 51 Baltimore Street.

MR. C. A. BENTON, of the Marine Engine & Machine Company, has sailed for Europe this week, and will be over there some little time.

MR. E. E. STARK, of the Bay Counties Electric Power Company, California, has been appointed electrical engineer for the Waipori Falls Electric Power Company, New Zealand.

MR. JAMES C. HOBART, manager of the Triumph Electric & Ice Machine Company, of Cincinnati, was in Chicago the past week, looking after some important interests of his company.

MR. A. W. HENSHAW, formerly with the General Electric Company, at Schenectady, will henceforth have charge of the motor department of the Stanley Electric Mfg. Company, Pittsfield, Mass.

MR. JOHN MUSTARD, who was formerly with the Wagner Electric Mfg. Company, has opened an office at 1617 Real Estate Trust Building, Philadelphia, where he will handle several lines of electrical specialties.

MISS CECILE WOODWORTH has painted an admirable portrait of the late John W. Mackay, head of the Commercial Cable & Postal Telegraph interests. It has been on exhibition the past week at the Schaus galleries in New York City.

MR. H. H. VREELAND, president of the Interurban Street Railway Company, of New York City, has started with $1000 a fund for the Department of Railway Engineering at Sibley College, Cornell University, to be used in starting a laboratory for that department. The building will cost between $10,000 and $15,000.

MR. J. F. MAC WILLIAMS, the superintendent of the Meridian, Miss., Light & Railway Company, has resigned and has accepted a similar position with a company with headquarters in Chicago. His place has been taken by Mr. H. M. Blackington, formerly superintendent of construction for Ford, Bacon & Davis, at Birmingham, Ala.

MR. J. C. MURRAY, formerly with the Kellogg Company and later with the Stromberg-Carlson Tel. Mfg. Company, has resigned his position with the latter company to engage with the International Telephone Mfg. Company, of Chicago, as traveling representative. Mr. Murray will cover Indiana and Michigan.

PROF. W. E. AYRTON, F. R. S., member of the Mosely Educational Commission from England, arrived here last week and has since been very actively engaged in connection with that work. He has found, however, a host of old electrical friends in this country who have gladly seized the opportunity to meet him once again. He will spend about three weeks in America. Prof. Ayrton will deliver a lecture before the New York Electrical Society in the lecture room of the American Institute, 19 West 44th Street, New York, Monday, Oct. 19, at 8 p. m. His subject will be "An Informal Talk on Some Electrical Measuring Instruments and Recent Use of Them."

MR. WARD BARNUM, who for several years has been superintendent of the Cincinnati, Newport and Covington Light & Traction Company has been appointed electrical engineer for the Louisville & Nashville Railroad system with headquarters at Louisville. He will have supervision over all the electrical work of the entire system, including the large shops now under construction at Louisville. He assumed his duties October 1.

SIR CHARLES METCALFE, chief engineer, etc., of the South African Chartered Company, which proposes to develop electro-hydraulically the power of the great Victoria Falls on the Zambesi River, arrived in this country last week from England to study power development here, including that at Niagara. He was met by Mr. George Westinghouse at the pier. The Victoria Falls are reputed to be three times as high and twice as wide as Niagara.

MR. JOHN A. DREW.—The Brooklyn Engineers' Club held the first meeting of the season on the evening of October 8. Besides the usual formal business, a very interesting paper entitled "A History of Pumps, Ancient and Modern," was read by Mr. John A. Drew, of the Worthington Company. Mr. Drew sketched the development of pumping machines from the early Egyptian "noria," resembling the familiar well sweep, to the latest triple-expansion, condensing, water-works pumping engines, requiring little more than a pound of coal per horse-power-hour. The paper was illustrated by a large number of lantern slides.

MR. STEVEN F. FR. DE CSESZNAK, called at the office of ELECTRICAL WORLD AND ENGINEER this week on his return from a four months' trip in Europe. He reports the prospects for business on the other side of the Atlantic as particularly good, and says that American apparatus is growing in favor in all of the European countries he visited, especially in Russia, where the industrial outlook and financial conditions are both excellent, and where

American machinery is regarded with the greatest favor, not only because of its superiority, but also on account of the dislike which the Russian has to dealing with some of the other nations. An electric light plant is being installed in Moscow, and a large corporation for the construction of electric railroads through the Russian Empire has been formed in St. Petersburg. The larger portion of machinery and supplies to be used will be purchased in the United States.

MR. CHARLES CHURCHILL, managing director of Charles Churchill & Company, Limited, of England, which concern is the largest handler of American labor-saving devices in Great Britain, is now on a visit here. Mr. Churchill is an American by birth and was the pioneer importer of Yankee machine tools on the other side. His company handled $1,000,000 worth of machinery within the last twelve months. He looks for a steady demand right along. The company recently secured substantial contracts from the British Westinghouse Electric & Manufacturing Company, the British Thomson-Houston Company and other electrical concerns operating large British plants; also for various equipment for the Woolwich arsenal. The Churchill Company represents the British interests of nearly 100 American manufacturers, including the W. F. & John Barnes Company, of Rockford, Ill., the Cincinnati (O.) Milling Machine Company, etc. Mr. Churchill is making his headquarters at the American Gas Furnace Company's offices, 23 John Street. He will be in this country until the end of November.

EDUCATIONAL.

DELAWARE COLLEGE, DEL.—The college opens with the largest and best prepared class in its history. Over 70 per cent. of the new students will take the engineering course. Of the new men, 11 have registered for the electrical course under Prof. Wood. The enlargement of the shops is nearly completed, giving an addition of over 5,000 sq. ft. of floor space. A part of this will be used for the new electrical laboratory and dynamo room, and the new schedule for the course requires laboratory work, to a greater or less extent, from all of the seventy-five engineering students. Mr. L. A. Fruedenberger, a graduate of Lehigh University, who has taught in the electrical department there for over a year, was recently appointed instructor in electrical and mechanical engineering. Mr. Freudenberger's work on the investigation of train acceleration is known to the readers of Electrical World and Engineer. The entire electrical work is being brought up to a standard of proficiency which should insure thoroughness in the most advanced branches of the science.

Trade Notes.

MR. E. O. WAYMIRE, of the Dayton Fan & Motor Company, has been in New York for the past ten days.

OIL FILTERS FOR GERMANY.—Eighteen Cross oil filters have just been shipped to Witten, Germany, by the Burt Mfg. Co., Akron, Ohio.

THE TRANSIT FINANCE COMPANY, of Philadelphia, announces the removal of its offices to the Land Title Building, Broad and Chestnut Streets.

L. B. ALLEN CO., INCOR., of Chicago, has issued a neat pamphlet on its soldering paste. The book is envelope size and is accompanied by a loose sheet price list, which any of our readers may have by writing for it.

ARC LAMPS FOR STEEL WORKS.—The Carnegie Steel Company has purchased through the Doubleday-Hill Electric Company, of Pittsburg, 250 Adams-Bagnall arc lamps for its new Donora works.

EXHAUST HEADS.—The Baldwin Locomotive Works, Philadelphia, Pa., has just sent their thirteenth order for Burt exhaust heads to the Burt Mfg. Co., Akron, Ohio. The Baldwin Company now has 39 Burt exhaust heads in use in its plant.

JOHNSTON, LIVINGSTON, JR. & COMPANY, successors to the electrical construction department of the United Engineering & Contracting Company, announce removal to their new building at 113 East Twenty-Second Street, New York City.

HARVEY HUBBELL, Bridgeport, Conn., has brought out catalogue and price list No. 7, devoted to his high grade electrical specialties, in such lines as pull sockets, pull clusters, attachment plugs, shade holders, chandelier and other switches, insulating joints, etc. To all of these great ingenuity, excellent workmanship and good material have been applied.

THE ELECTRIC APPLIANCE COMPANY, Chicago, writes that it will be pleased to send its new catalogue to those in the trade, by prepaid express. Applications coming from its territory, which takes in the United States except the Eastern States, will have prompt attention, if accompanied by business card. Its catalogues are claimed to be the latest and most comprehensive electrical supply catalogues issued by any house.

HALLER MACHINE COMPANY, 127-129 Fulton Street, Chicago, has issued a neat 8-page quarto size circular as to its sign department. The concern makes letters for electric signs, "raised" or "box," as well as "sunken" or "grooved" letters. These letters make admirable signs. They take a durable glossy surface finish, reflecting excellently the light from the lamps. The concern build up also complete electric signs.

THE EUREKA ELECTRIC COMPANY, of Genoa and Chicago, has lately furnished new switchboard and telephone equipment to no less than 19 exchanges situated in Indiana, Wisconsin, Illinois, Minnesota, Iowa, Pennsylvania, Georgia, Tennessee, Missouri and Nebraska. The Eureka Company is now well settled in its new plant at Genoa, Ill., with increased capacity and better able to take care of customers than ever in the past.

THE SHELBY ELECTRIC COMPANY, manufacturers of Shelby "useful light" incandescent lamps, has made an important change in its New York office. While the office is still in the Parker Building, No. 225 Fourth Ave., Mr. Wormley, who has been in the employ of the company as manager of the branch, has been relieved, and Mr. W. G. McKennan, who has been with the company for a number of years, will hereafter have charge of the sales department. The telephone number of the New York office is No. 18—18th St.

LA HARPE METAL.—The success of sheet zinc under this brand has led the Lanyon Zinc Company, sole manufacturers of "La Harpe Metal" to specialize certain of its products for the various requirements of the electrical trade. For spinning, stamping or drawing, and forming to special shapes, the sheet zinc of this brand has won an enviable position amongst the materials available to manufacturers. The long experience of the Lanyon Zinc Company as the largest producer of zinc in this country insures a quality which users are not slow to recognize.

ASBESTOS PRODUCTS.—A unique postal card is being sent out by the H. W. Johns-Manville Company, 100 William Street, New York, setting forth the advantages of asbestos filtering cloths and of asbestos "Vitrex" retort cement. It consists of a sheet folded in three sections to a size equal to that of the ordinary postal card. On one of the sections is the address, and another section is perforated that it may be used to mail with an inquiry asking quotations. Between two of the sections and glued on the face of one of them are two specimens about two inches square of asbestos filtering cloths. Truly this is an instance of *multum in parvo*.

BANNER LAMPS.—Conclusive proof of the steadily increasing popularity of Banner lamps is furnished by the fact that several times during the past two years the company has found it necessary to make important additions to its plant at Youngstown, Ohio. In order to furnish sufficient power for the enlarged factory a new power house is being constructed. This building, which will be isolated from the rest of the plant, will contain a direct connected 60-hp Walrath gas engine now under construction. Next to quality, the Banner Company prides itself on prompt deliveries, and with its increased facilities, orders will be filled even more punctually than in the past.

STORAGE BATTERY FANS.—It has been asserted pretty often that if an efficient storage battery could be devised which would operate without liquid electrolyte, the problem of the operation of fans and other small machines would be solved. The National Battery Fan Company, of 14 South Broad Street, Philadelphia, Pa., has, it is claimed, combined the principles of the primary and secondary battery, and so utilized these principles as to retain all the advantages of the primary battery while providing for its being recharged at a nominal cost, and producing a dry battery capable of being shipped like ordinary merchanidise by express or freight to any part of the country.

THE NERNST LAMP.—This is the title of a special publication just issued by the Nernst Lamp Company, of Pittsburgh. It is a 24-page brochure, octavo, handsomely printed and illustrated. Its really valuable feature is a treatise by Mr. A. J. Wurts, electrical engineer of the company, which constitutes in popular form a digest of all the data and all the arguments bearing upon the beauty, utility and superiority of the lamp which Mr. Wurts has done such admirable work upon in this country. The cuts include a number of excellent curves dealing with current consumption voltage, candle power, efficiency, etc. Diagrams are also given showing the construction, circuit connections, etc. We can imagine a big demand for this well-conceived and well-executed pamphlet.

SAUTTER, HARLE & COMPANY, of 26 Avenue de Suffren, Paris, have just issued, in English, an excellent and interesting pamphlet on high pressure centrifugal pumps, of the Rateau system, for mining purposes. These pumps are shown and described in the pamphlet connected to electric motors of various types and in different positions, and a list is given of plants that have been equipped. Data are also furnished with regard to turbo-pumps, in which an even higher speed than that of motors is attained. An instance is given of the turbo-pumps in the Bruay mines, Pas de Calais, which raise a single jet of 250 cubic meters per hour to a height of 350 meters, the unit developing 500-hp. Both centrifugal and multicellular electric pump installations are brought to notice. The steam turbines referred to are, of course, those lately brought forward by Prof. Rateau.

TRANSFORMERS.—The General Electric Company has added to its list of pamphlets on transformers two new publications, one entitled "Core Type Transformers," and the other "Permanency of Transformer Insulation." Both of the pamphlets are gotten up with the excellent taste that characterizes the productions of the General Electric Press. The former, which is a reprint of an article appearing in these columns, with additional illustrations, describes in detail the core type of transformer, curves being included of core losses and regulation, comparative curves of copper losses, and curves showing the reduction in core losses that has been brought about in recent years by improvements in transformers. The other pamphlet discusses the requirements of transformer insulation, and shows how these are improved by the vacuum drying and compound filling process employed by the General Electric Company.

SKINNER AUTOMATIC ENGINES.—At this season of the year, the central station manager, after thinking it over all summer, is making active preparations for the winter's business. His entire equipment is being overhauled and very often he finds that further engine capacity is required. In a majority of such plants, the automatic engine enjoys great vogue, and in an investigation of this subject, the manager cannot fail to be impressed with the good qualities of the Skinner automatic engine. It embodies features which combine to make it durable, economical, close regulating and easily cared for, and up-to-date. Some original features embodied in its design may be mentioned as follows: a frictionless governor, requiring no oil, a frictionless outside connection, no eccentric and strap being required, a valve which is guaranteed steam tight for five years and, furthermore, automatically takes up wear, relieving the cylinder from water; an automatic oil and water separator, the oiling being automatic and in plain sight of the operator, entirely replaceable shaft boxes not requiring the removal of the shaft; a permanent alignment device; a self aligning out board pedestal bearing; entirely removable top and bottom guides, a shifting eccentric for low pressure cylinder on compounds, a combination piston stuffing box on tandem compounds, wedge and screw adjustment on all important bearings, and entirely removable polished oil shield rendering the engine accessible, while absolutely preventing the escape of oil. In fact the popularity of the Skinner automatic engine has compelled the company to increase its facilities. A new building 75x180 feet with main bay and two lean tos, is now being erected, and will be completed the first of the year. This will embody the most improved features of construction, galleries being provided in the lean tos for the light work, whereas the heavier and erecting work will be done in the main bay, by the aid of an electric traveling crane. An entirely new equipment of modern labor saving tools, electrically driven, will be installed. This addition will practically double their capacity and permit them to turn out larger engines than formerly as well. The last month's business is the largest in the history of the company, the sales in three of the largest cities in the country aggregating over thirty engines.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 6, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

739,978. MINE GATE; Newton K. Bowman, North Lawrence, Ohio. App. filed Jan. 13, 1903. A gate arranged across the track of a mine railway and which is made of collapsible material, carries a bridge on its lower edge which comes in contact with a trolley wire mounted just above the gate, when the lower part of the gate is lifted to allow a car to pass. The bridge carries the trolley wheel uninterruptedly past the gate.

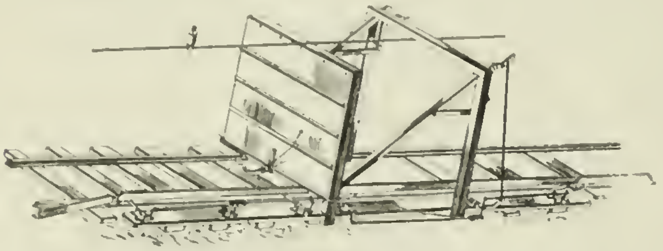
740,273. MOTOR CAR; Robert H. Hassler, Indianapolis, Ind. App. filed Nov. 20, 1902. A gas engine, a dynamo driven thereby, an electric motor geared to the vehicle and a controller for electrically connecting the dynamo with the motor and simultaneously shifting the sparking time of the engine.

740,370. ELECTRIC FURNACE FOR THE MANUFACTURE OF FILAMENTS; W. L. Voelker, Erie, Pa. App. filed March 15, 1902. A small electric arc furnace in form of a crucible through which the filament is passed at a short distance from the axis of the electrodes, and means for deflecting the arc into the path of the filament. The crucible may be charged with hydrocarbon reducing gases.

740,385. ELECTROTHERAPEUTIC APPLIANCE; William B. Bassell, Columbus, Ohio. App. filed Dec. 8, 1902. A cap for the head, having opposed electrodes arranged therein so that current can be directed through the head when the cap is worn.

740,428. SPARK GAP; John O. Heinze, Jr., Lowell, Mass. App. filed May 20, 1903. To prevent an arc from rising between the surfaces of a spark gap, the surfaces are arranged on an incline, thus controlling the current of heated air which influences the arc.

740,447. MEANS FOR REGULATING ALTERNATING CURRENT CIRCUITS; Waldo A. Laymann and Ferdinand Schwedtmann, St. Louis, Mo. App. filed Nov. 23, 1901. The number of sections of a transformer in circuit is controlled by an electro-magnetic switch, the current for operating which is itself controlled by the current in the transformer circuit.



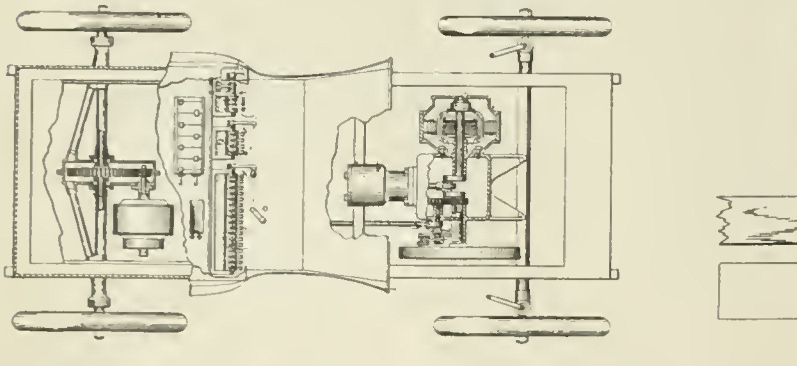
739,978. Mine Gate.

740,450. AUTOMATIC FIRE ALARM AND SPRINKLER SYSTEM; Frank K. Ludlow, Cincinnati, Ohio. App. filed March 3, 1902. The starting of a sprinkler actuates an alarm circuit.

740,461. ELECTRIC LIGHTING APPARATUS FOR RAILWAY CARS; Roger M. Newbold, Birmingham, Ala. App. filed Nov. 15, 1902. Resistance in the field magnet circuit of the dynamo is controlled by the action of a solenoid in the main circuit opposed by a predetermined weight.

740,505. AUTOMATIC BLOCK SIGNAL SYSTEM; Asbury G. Wilson, Wilkinsburg, Pa. App. filed Feb. 1, 1902. The devices comprise relays having neutral and polarized armatures, pole changers in the track circuit each connected to the home signal of the next section in advance and slow release relays having a release so slow as to prevent the momentary reversal of current in the neutral polar relay from changing the signal through the momentary release of the neutral armature thereof.

740,512. APPLIANCE FOR SOUND-TRANSMITTERS; Samuel Judson Ballard, Los Angeles, Cal. App. filed May 14, 1900.



740,273.—Motor Car.

740,548. ELECTRIC SHOE; John W. Gibbs, New York, N. Y. App. filed July 16, 1903. The insole has a number of pairs of electrically opposed disks across which the circuit is closed by the foot.

740,577. TROLLEY POLE; Joseph F. Mackin, Columbus, Ohio. App. filed April 25, 1903. The trolley pole is made up of a system of levers in the style of a parallel ruler, permitting it to shift laterally without tipping the wheel.

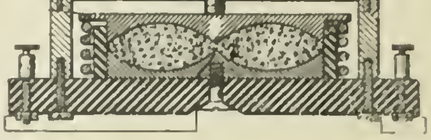
740,585. SYSTEM OF ELECTRICAL CHARACTERS AND MEANS FOR FORMING SAME; Dennis J. O'Brien, San Francisco, Cal. App. filed Nov. 3, 1902. A lamp used for signs consisting of a tube having end-caps from one to the other of which a filament is stretched, one end of the filament being spring supported to permit it to expand and contract.

740,635. BRUSH HOLDER; Charles A. Eck, Belleville, N. J. App. filed Feb. 12, 1903. Adjacent to the brush guide is a cylinder containing a spring operated plunger from which a finger projects to engage with the back of the brush, the finger carrying a pivoted plate for holding the brush in position and for removing the brush from its seat.

740,663. ELECTRICAL OUTLET BOX; Hubert Krantz, New York, N. Y. App. filed May 25, 1903. The neck or outlet sleeve from the box can be lengthened or shortened by means of interlocking extension sections and screw bolts for determining their position.

740,671. PORTABLE ELECTRIC LIGHT; Harold S. MacKaye, Yonkers, N. Y. App. filed May 19, 1903. Details.

740,707. TROLLEY; Bruno Stenvall, New York, N. Y. App. filed March 21, 1903. The pole carries two horizontally arranged wheels and is made up of two rods pivoted to the base and to the wheel frame in such a manner as to always maintain the axis of the wheel in the same horizontal plane.



740,787.—Rheostat.

740,744. POLARIZED ELECTRIC BELL; Frank B. Cook, Chicago, Ill. App. filed Dec. 18, 1902. (See page 646.)

740,745. ELECTRIC CUT OUT; John Erikson, Providence, R. I. App. filed Mar. 5, 1902. A glass plug around the inner walls of which the fuse runs so as to be seen from the outside; the fuse is covered with a material which becomes discolored by the heat when the fuse is melted.

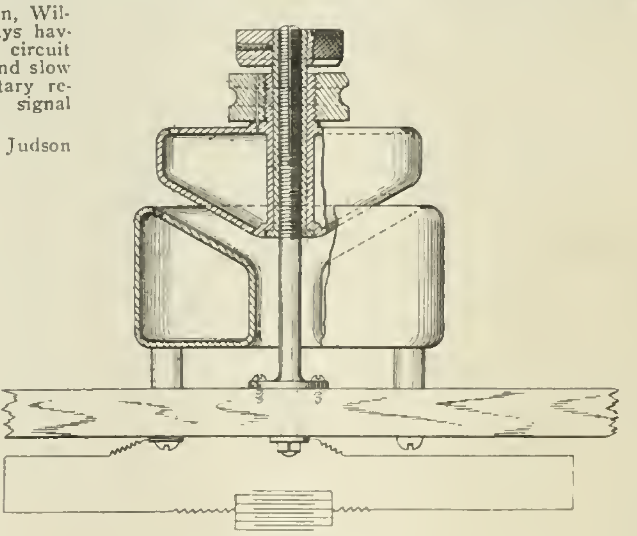
740,787. RHEOSTAT; Joseph C. Vetter, Astoria, N. Y. App. filed Nov. 19, 1902. Two cup-shaped plates adjustable in distance from each other confine between them a mixture of granular elastic non-conducting material, and granular, inelastic conducting material; the conductivity is changed by bringing pressure to bear upon the mass.

740,823. FIRE SIGNAL; John H. Dixon, Pittsburg, Pa. App. filed Sept. 26, 1901. Wires held under tension and strung throughout the protected area, include fusible joints, the separation of which causes a signal to be given.

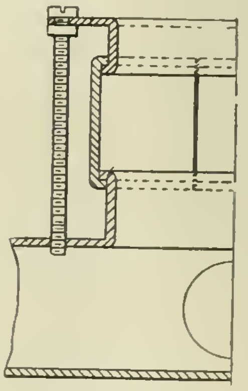
740,831. RHEOSTAT; August Eimer, New York, N. Y. App. filed Dec. 3, 1902. The resistance bodies are located on a removable support and are surrounded by cooling devices.

740,873. APPARATUS FOR TREATING SKIN DISEASES; Jakob Kjeldsen, Copenhagen, Denmark. App. filed Oct. 23, 1900. An arc lamp having metallic electrodes the light from the arc being directed through rock crystal windows to form a linear spectrum with a surplus of violet rays.

740,912. RAIL BOND; Louis Pfingst, Dorchester, Mass. App. filed July 16, 1902. A double bond having the respective ends connected together through two openings in the web of the rail.



740,428.—Spark Gap.



740,663.—Outlet Box.

740,952. SWIVEL ATTACHMENT PLUG FOR ELECTRICAL CONNECTIONS; Tycho Van Aller, Schenectady, N. Y. App. filed Aug. 2, 1902. Details of an attachment plug which may be turned freely in the lamp socket without twisting the wires.

740,973. SYSTEM OF ELECTRICAL DISTRIBUTION; Albert E. Doman, Elbridge, N. Y. App. filed May 31, 1902. An electro-magnetic device for automatically directing current through a storage battery or around it, depending upon the voltage of the circuit.

Electrical World and Engineer

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OHIO ELECTRIC LIGHT ASSOCIATION.

The meeting at Columbus last week of the Ohio Electric Light Association demonstrated again the great value which, under proper management, such territorial associations may have, not only for their members but for the electric lighting industry at large. At Columbus the majority of the papers and all of the discussions related to the electric lighting situation as it exists in the territory covered by the association, and thus the proceedings have a most direct value to all members, which can rarely be true in the case of the programme of bodies covering the entire country. The programme of papers was of excellent quality, as will be seen from the abstracts which we print elsewhere, and the discussions were kept well to the point, if exception be made of an exhibition of commercial rivalry which consumed a good part of the time of one of the sessions. The practical character of the proceedings is indicated by the fact that half of the papers and topical discussions dealt with the steam end of the central station plant. Perhaps the most notable feature of the meeting was the evident uncertainty manifested as to the relative value of direct and alternating currents for central station service. It is true that none of the old-time animadversions were made against the alternating current; but it was evident that the direct current was yet dear to the hearts of many of the central station men. A reading of the papers and discussions, however, brings out very clearly that the favor in which the latter continues to be held is owing entirely to two factors—the storage battery and the lack of an all-around alternating-current elevator motor. If it can be demonstrated that a rotary converter link between the alternating-current generator and the storage battery does not involve any uncertainty of operation, and if a satisfactory alternating-current elevator motor system is devised, the direct vs. alternating-current question in its present form would no longer harry the minds of central station men and load down the programmes of electric light meetings.

Though the gas engine is used more largely in Ohio than in most States of the Union, it was received with little favor by the speakers who touched upon its use for central station purposes. Here again it would appear that the objections were not to the gas engine *per se*, but to specific machines in the knowledge of the critics, which had not operated satisfactorily. Practical men are prone to make sweeping criticisms based only on their individual experience, which experience may be far from sufficient to justify a general indictment; and presiding officers at meetings such as that at Columbus would perform a particular service if in such cases they were to draw out the specific experience on which a criticism was based or a statement of the conditions thought to sufficiently justify it. The importance of the gas engine situation in view of recent developments is such that it merits the most careful attention of central men, who should not be misled by sweeping condemnations based perhaps upon limited experience or with what in a few years may be obsolete types. As was natural, considerable interest was shown in the subject of the steam turbine, and in the discussion it was brought out that at present direct-current turbo-generators are limited to a capacity of 500 kw owing to the commutator, which even in the size mentioned assumes ungainly dimensions as compared with the other parts of the unit. At this meeting also the first public announcement was made of a new type of arc lamp being developed at Schenectady, concerning which there have been rumors afloat during the past year or more. It appears that in this lamp one electrode is of copper, and the other is composed of a metallic substance described as magnetite. It was stated that this lamp will give at 300 watts the same quantity of light as the ordinary carbon arc at 450 watts, and the same statement was made with respect to the Bremer arc lamp employing composite electrodes. With two such promising inventions in process of development, the future of the arc light is considerably brightened.

Harnessing the Hudson.

The great Spier Falls power development described elsewhere in our columns is a fine example of the modern idea in power transmission The stimulus of dear fuel has produced a remarkable revolution in the industry, and the public has come to realize that a great hydraulic power is a very stable and valuable asset when it is within electrical reach of a market. With this very consciousness has come willingness to consider such a plant a conservative and permanent investment, and to establish it on a sound and economical basis. The power at Spier Falls has been known of course for many years, and as in many other cases, has waited in vain for industries commensurate with its importance to gather around it. But other influences than cheap power alone act in determining the location of industrial centers, and it is only since the success of electric power transmission that cheap power and other manufacturing advantages can be made coincident. It is particularly interesting to note that the demand for power from the Spier Falls plant has been so keen that it has become necessary to put into action at once 6,500 kw in generators working in a temporary wooden power house and at partial head on the wheels to save the time which will be required for the completion of the permanent works. There could be no better augury of financial success. The distribution from the finished plant, as will be seen from the general location, will be not a single line to a single market, but a radiating system of lines delivering large "blocks" of power in half-a-dozen different places.

The transmission lines have some interest to the engineer as an expression of sound conservative opinion on line construction. They are all of hard-drawn copper varying in size from No. 000 to No. 0, carried on porcelain insulators. These insulators are of rather moderate size and have to withstand a puncturing test of 80,000 volts for five minutes, and that after the insulator has been soaked 24 hours in water. There is, therefore, a nominal factor of safety of 2.66 in insulation strength. The pole line itself is mainly of 35-ft. poles, 24 in. in circumference at the tops and set 5½ ft. deep. The cross arms are extra heavy, bolted and braced on the poles, and the wires in the three-phase transmission circuit are spaced three feet apart. The poles are spaced down to 100 ft. and even closer on curves, and the whole construction is of the most substantial character. Just at the present time when all sorts of innovations in pole line practice are being tried, it is instructive to see this large installation, supplying vital power for a group of large enterprises, constructed along methods so conservative. There is no doubt that in dealing with insulation for very high voltages such as will be largely used in the future, some new ideas will find place, but is still far too early to speak with confidence of the innovations which have so far been tried. Long spans and insulators the size of wash tubs may be standard practice ten years from now, but it is a good thing to remember that they are now on trial, and that it takes more than one season to try out anything connected with transmission work, assuming it to have any elements of success.

One of the most significant things about the Hudson River system is the nature of the load which is to be carried. The day has gone by in which a water power is developed, distribution rights obtained in the market, and the product peddled out to small consumers. The towns and cities which generally must serve as the market are usually well supplied with electric distribution systems, and the modern transmission project must do a wholesale as well as a retail business, dealing directly with a few large customers, some of them retailers of power and light. In the case before us the energy all goes to a relatively small number of patrons, some of them direct users like the General Electric Company and the Schenectady Street Railway, others distributors like the lighting companies in Troy and Albany. As electrical transmission lines get longer and cover more and more territory, it becomes progressively more difficult for one company to look after the full details of the transmission and to attend to the numberless small distributing systems requisite to supply the territory. These can best be handled by local interests buying their energy at wholesale rates of the great producers. Working in this way it is sometimes possible to sell the whole product of a large hydraulic development as yet uncompleted for future delivery to a single customer on a long-time contract. This is often very advantageous to both parties, since the generating company can reckon at once upon a good and safe return upon its investment, and the distributing company can obtain its stock cheaper than it can manufacture it. It is a natural change in business methods brought about by the growth in the electrical distribution business, and we think that more and more in the future long and important transmissions will be undertaken upon this basis. The East, save in a few localities, has been backward in the utilization of the larger water powers, and we trust that the example set in the great plant before us will be followed elsewhere.

Wireless Telegraphy.

The wireless telegraph has for a year or more entered into strong competition with the storage battery as a source of inventive inspiration, as indicated by the record of the United States Patent Office. Almost every week one or more patents on this subject are issued, usually on details, but sufficiently often on systems to make already a formidable list of the latter. During the past year one of the most prolific of inventors in this line as gauged by the number of patents granted in his name, has been Mr. John Stone Stone, of Boston, and elsewhere we print an account from the pen of Dr. Louis Duncan of the fundemental principles of the Stone wireless telegraph system. As will be seen, the main feature of Mr. Stone's system is a sifting device between the Hertzian wave generator and the transmitting antennæ on the one hand, and between the receiving antennæ and the receiving circuit on the other hand, whereby all waves generated except those of a desired frequency are suppressed at the sending station, and at the receiving station only waves of a desired frequency are permitted to pass to the receiver. In this latter respect there is a strong likeness in principle to the Pupin multiplex telegraph system, in which tuned circuits are employed in a similar manner to the end that a multifrequency current charged with a number of messages may be enabled to deliver each message at the station tuned to the frequency at which it was transmitted, and at this station only. The article of Dr. Duncan does not mention an interesting feature of the Stone system which has been the subject of a number of patents. This consists in the use of two transmitting antennæ, each sending out waves of a definite but different frequency, and two receiving antennæ connected with the same number of sifting circuits. Signals are simultaneously transmitted in two frequencies. The receiver is controlled by a relay in connection with the two sifting circuits in such a manner that it only acts when both circuits are simultaneously receiving the two frequencies sent from the receiving station. It may be added that a similar "Yale lock" system of selective wireless telegraphy is also the subject of patents issued to Mr. Nikola Tesla.

THE MECHANISM OF ELECTRICAL ENERGY TRANSFER.

Elsewhere we print an elegant generalization by Dr. Kennelly on the mechanism of electric power transmission, that term including Hertzian as well as alternating and direct-current transmission. In the minds of most people there is a wide distinction between simple direct-current phenomena and those of alternating currents, owing to the complexity of the latter due to inductive and capacity effects; while Hertzian wave phenomena as ordinarily explained introduce a distinct and abstract order of ideas having few or no points of contact with those employed in the usual treatment of direct and alternating currents. Though less familiar, the fundamental principles of Hertzian wave propagation are by far the simplest as compared with those of alternating and direct currents, and Dr. Kennelly first takes up the former for consideration, following with alternating currents, of which direct currents are treated as a special case. An admirable feature of the article consists in the employment of numerical examples to illustrate the direct application of the principles deduced. Aside from the test this affords of the correctness of deductions, the method is of immense value when a new order of ideas is treated, for it offers the mind a means of passage from the abstract with its pitfalls for all but the elect to the firm ground of the concrete.

THE PERMANENCE OF RESISTANCE STANDARDS.

This year's report of the Committee of the British Association for the Advancement of Science, on Standards for Electrical Measurements, has recently been published, and contains a number of interesting statements. A number of standard resistance coils have been under the observation of the committee during many years. Some of the measurements extend as far back as 1864. It seems that since 1888 some of the standard platinum-silver resistance coils have changed slightly in value. Others do not appear to have changed appreciably. Out of ten standard coils reported upon, the maximum change in fifteen years has been an increase of one-tenth of one per cent., and the average change has been an increase of about one-sixtieth of one per cent., half of the coils only having shown any change. Individual measurements show both small increases and small decreases, the decreases being only about half as frequent as the increases. The general average tendency is to a slight increase. It seems safe to say, therefore, that while, for most practical purposes, a platinum-silver standard resistance coil has constant resistance, yet where the greatest attainable accuracy is required, a platinum-silver standard coil may not have an entirely constant resistance. According to the results reported for the temperature coefficients of the same coils, their temperature-coefficients of resistance differ appreciably in some cases from those observed in 1888. The greatest change is about ten per cent. Nevertheless, the mean temperature coefficient of all coils is practically the same in 1903 as in 1888, and is 0.028 per cent., or approximately one-fortieth of one per cent. per degree Centigrade.

The Board of Trade standard international ohm is stated to be smaller than the accepted British National Physical Laboratory standard international ohm by about the seventieth part of one per cent. The mercury tubes of the British National Physical Laboratory constructed to represent the international ohm agree with those constructed at the German Reichsanstalt to about one-seven-hundredth part of one per cent. Comparisons between measurements of various coils made at the Reichsanstalt and at the British National Laboratory agree to about one-hundredth of one per cent. Such comparisons are as much tests of thermometers as of resistance, since a small difference of temperature between the coil and the thermometer may give rise to errors of the magnitude here considered. It thus appears that the standard of the international ohm kept at the London Board of Trade Laboratory, at the British National Physical Laboratory and at the Reichsanstalt are all within one-sixtieth of one per cent. This is about the degree of certainty which seems to prevail in the scientific world at the present time concerning standards of electrical resistance. If a resistance coil be sent to these various laboratories to be measured, the three reports may seemingly be depended upon to agree within one-sixtieth of one per cent., and often within one-hundredth of one per cent. This degree of accuracy is far greater than existed only a few years ago.

The definition of the concrete standard international ohm as agreed upon by the International Electrical Congress of Chicago in 1893, was the resistance of 106.3 cm. of mercury weighing 14.4521 grammes at 0° C. This means a column of mercury one square mm. in cross-section. According to the report, this column is slightly too long to represent the ohm, and should be reduced to 106.291 cm., so that the existing concrete international ohm is about one-hundredth of one per cent. bigger than the true ohm of physical theory. If this is the case the Chicago congress overshot the mark. The original B.A. ohm represented 104.8 cm. of sq. mm. mercury column. Then the Paris 1884 congress advanced the length to 106 cm. as a round number, and the Chicago congress went as far as 106.3 cm., although many experimentalists reported results lower, and some as low as 106.2 cm. According to the present report, the correct length should be 106.291 cm. Except for measurements of great accuracy, it is evident that we may all feel well contented with the international ohm of the Chicago congress. The report also considers the resistance of a metre-gramme of copper at 60° F., or 15.55° C. In 1860 Matthiessen published a value for the resistivity of the purest copper he could get, which corresponds to 0.150 international ohm. Modern electrolytic copper is stated to range between 0.1475 ohm and 0.1492 ohm. Taking a mean of 0.1485 ohm, it transpires that modern good commercial copper has one per cent. higher conductivity than Matthiessen was able to secure in 1860, or has a conductivity of 101 per cent. of Matthiessen's standard. There is, in fact, no difficulty in securing 99 per cent. of Matthiessen standard conductivity in ordinary good samples of commercial copper wire. The report incidentally accepts the density of copper as 8.91.

If the standard international volt were in as satisfactory a condition of accuracy as the international ohm, we should be very much better off than we are. We have recently pointed out in these columns that the concrete standard of e.m.f. as defined by the International Electrical Congress of Chicago, in terms of the Clark cell, is uncertain to the extent of about the one-fourteenth of one per cent. Consequently, attention to this standard in the near future is more necessary than to the standard ohm. With the international ohm comfortably settled to about one-hundredth of one per cent., research should next be directed to correcting and establishing the concrete value of the volt. An error of one-fourteenth of one per cent. is almost an error of practical importance in electric lighting and its technical work. The international ampere was defined by the International Electrical Congress of Chicago by its electrolytic effect in a standard bath of silver nitrate solution, i. e., in a silver coulombmeter. This value is likewise subject to a small range of uncertainty, and it is probable that if the volt could be reproduced at will from a concrete standard to an accuracy of one-sixtieth of one per cent., it would be better to reproduce the concrete standard ampere indirectly by reference to the volt and the ohm, instead of directly by electrolytic effect.

Annual Report of the Western Union System.

The annual report of the Western Union Telegraph Company, published last week, is an encouraging document and bears out the showing made by the previous quarterly report. The net earnings for the year were $922,143 greater than those of the previous year. The surplus of the company on June 30, including the surplus earnings of the year just passed, was $13,019,725.

The increase of $1,094,592 in the revenue of the company represented an increase of $321,760 from the transmission of regular messages and an increase of $282,774 from leased wires, the balance coming from sundry other sources. The earnings and disbursements as compared with the previous year were as follows:

	1903.	1902.
Revenues	$29,167,686.80	$28,073,095.10
Expenses	20,953,215.07	20,780,766.21
Net revenue	$8,214,471.73	$7,292,328.89
Interest on bonds	1,077,700.00	992,580.35
Profits	$5,136,771.73	$6,299,748.54
Appropriated for dividends	4,868,050.00	4,868,031.25
Surplus	$2,268,721.73	$1,431,717.29

The expenses in detail were: Operating and general expenses, including taxes, $15,553,337.31; rentals of leased lines, $1,567,705.98; maintenance and reconstruction of lines, $3,431,822.21; equipment of offices and wires, $400,349.57; total expenses, $20,953,215.07.

During the year the company transmitted 69,790,866 messages, an increase of 415,983 over the previous year, these figures not including the equivalent of about 10,000,000 messages sent over leased wires. There were added to the company's system 402 miles of poles and 59,228 miles of wires, of which 47,000 miles were of copper. In the number of offices there was a decrease of 447 from 23,567 in 1902 to 23,120 in 1903. This may reflect the closing of certain offices along the lines of the Pennsylvania Railroad. On June 30 the company was operating 196,517 miles of poles and cables.

The company's new railroad business secured during the year consisted of contracts covering 3,840 miles of railroad, including the St. Louis Southwestern Railway Company, East Carolina Railway Company, Manitou & Pike's Peak Railway Company, Boston & Maine Railroad Company, Nevada Central Railroad Company, Manhattan Railway Company and a number of divisions of the Brooklyn Rapid Transit system.

President Clowry says, in his report: "Since my last report the reorganization of the service has been completed. The system of thorough inspection, including our Atlantic and Cuba cable terminals, has been continued, and a further reduction of expenses has been effected, bringing the total up to $612,000 per annum."

The general balance sheet as of June 30 last is as follows:

ASSETS.

Telegraph lines, stocks owned of leased telegraph companies that are merged in Western Union Company's system, franchises, patents, etc.	$112,073,906.15
Stocks and bonds of leased telegraph companies received in exchange for collateral trust bonds	8,504,000.00
Stocks of not leased telegraph companies, and other securities	11,459,415.96
Real estate	4,765,130.54
Supplies and material in supply departments	498,010.76
Sundry accounts receivable, etc.	2,156,265.12
Cash in treasury and in hands of agents (since remitted to treasury)	2,678,015.73
	$142,134,744.26

LIABILITIES.

Capital stock	$97,370,000.00
Funded debt	24,504,000.00
Gold and Stock Telegraph Company for stocks of other companies held through lease of that company until 1981	1,946,592.00
Sundry accounts payable, etc. (including dividend July 15, 1903)	3,696,243.68
Surplus of income prior to Oct. 1, 1881, appropriated for construction and acquisition of telegraph lines and property (in excess of the $15,526,590 capital stock distributed in 1881 on account of such appropriations of income during the 15 years preceding)	1,598,184.03
Surplus of income subsequent to Oct. 1, 1881, ($12,389,964.64) plus the proportion of surplus of income prior to Oct. 1, 1881, ($629,759.91) that was not appropriated as above	13,019,724.55
	$142,134,744.26

The following table gives some interesting statistics:

	1903.	1890.	1880.	1867.
Miles of pole and cable	196,517	183,917	85,645	96,270
Miles of wire	1,089,212	678,997	231,534	85,291
Offices	23,120	19,382	9,077	2,565
Messages	*69,790,866	55,878,762	29,215,509	5,879,282
Receipts	$29,167,687	$22,387,029	$12,782,894	$6,568,925
Expenses	20,953,215	15,074,304	6,948,957	3,944,006
Net revenue	$8,214,472	$7,312,725	$5,833,937	$2,624,919
Av. toll per message	31.4	32.4	38.5	. . .
Av. cost to Co. per message	25.6	22.7	25.4	. . .

* Not including messages sent over leased wires or under railroad contracts.

Of the new circuits 47,000 miles of wire were of copper and $3,351,645 was spent during the year on construction.

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Enormous Expenditures for Chicago Traction.

The extension ordinance for the Chicago City Railway Company has been completed and is in the hands of the local transportation committee. It is accompanied by two reports, one from the engineers of the street railway company and one from the city's experts, showing that from $15,000,000 to $17,000,000 should be expended in the rehabilitation of the traction system. In estimating the amount needed for the improvement of the Chicago city lines the city experts have placed the figure 6 per cent. lower than the company's estimate, it being the purpose of the company, it is claimed, to beg out of high compensation with the plea of great outlay for improvements.

The measure provides for the following: Joint use of tracks with the Union Traction Company wherever possible and exchange of transfers with that company's substitution of the underground trolley for the present cable system; immediate renovation of roadbed, plant and equipment, and maintenance of the lines in a first-class modern condition; removal of all dead tracks not used by the company and not required by public interest; use of the grooved rail in streets paved with granite, asphalt, brick or wooden blocks; use of cars with center aisles and without footboards entire length of sides; sprinkling streets for their entire width and the sweeping of them if possible by car sweepers and sprinklers, and the removal of garbage and refuse by street cars if possible; use of poles by the city for stringing wires; making of detailed annual reports by the company; whatever value may be conceded to the ninety-nine-year claims shall be determined in the adjustment of compensation and a waiver considered as part of this.

The extension ordinance has been accepted by the Chicago City Railway Company, it is said, in every feature except compensation. No amount is specified by the clause dealing with this. This will be the obstacle in the measure. The company insists that 3 per cent. is high enough, while the aldermen declare such an amount to be ridiculous, and hold out for 20. The grant is for twenty years. At the expiration of that time the city may acquire the property by purchase, may let another company take it, or may renew the grant.

It is expected that the Union Traction interests will oppose a separate settlement with the Chicago City Railway Company because an extension ordinance once having been granted the latter, that hereinafter granted to the Union Traction Company will have to be similar and the former company is in position to give much better terms to the city. If the compensation can be adjusted to the satisfaction of both city and company, it is probable that the south side extensions will be granted as one of the first acts in franchise legislation this fall.

Six applications for six different permits have been made by General Manager Roach, of the Union Traction Company, on behalf of the receivers, to the Commissioner of Public Works. Speedy litigation to define the scope of the ninety-nine-year act may be the result of the applications depending entirely on the answer the city makes to the request. If it gives consent absolutely or with such limitations as the authorities deem safe, that will be the end of the matter. If the application is refused then an application to Judge Grosscup for instructions based on rights claimed under the ninety-nine-year act will follow, and out of the orders he may issue will come the test of the act.

Judge Grosscup has made permanent his injunction of August 15 prohibiting the attorneys for the minority stockholders objecting to the plan of reorganization of the Union Traction and its underlying companies from attempting to interfere with that reorganization. This will permit the minority to perfect an appeal for the October term of the United States Court of Appeals.

Transmission of Hudson River Power.—I.

ENERGY from the Hudson River is to displace more than 40,000 hp of steam apparatus in the triangular territory between Albany, Schenectady and Glens Falls, N. Y. The extent of this territory in a direct line between Albany and Glens Falls is about 45 miles, and the cities of Albany and Schenectady are 15 miles apart. Within the area named are Troy, Albany, Schenectady, Cohoes, Lansingburg, Ballston Spa, Saratoga, Fort Edward, Sandy Hill and Glens Falls, with an aggregate population of 300,000.

This water power is to be transmitted from two generating stations owned by the Hudson River Water Power Company, one located at Spier Falls and the other at Mechanicsville. From these generating plants a network a transmission lines extends to all the cities and towns above named, and also to a number of electric railway sub-stations scattered over the territory. A part of the energy developed at these two water power plants goes to sub-stations owned by the company at Glens Falls, Saratoga and Ballston Spa, where the local systems of electrical supply are also in the hands of the company. Besides the energy required for these systems the Hudson River Water Power Company has contracts with the following companies for the delivery of the amounts of power named, as soon as the water power plants can deliver it, or by fixed dates: General Electric Company, 10,000 hp; United Traction Company, of Albany, 6,000 hp; Hudson Valley Railway Company, 2,000 hp; Municipal Gas Company, Albany, 8,000 hp; Troy Lighting Company, 8,000 hp; Glens Falls Portland Cement Company, 1,000 hp.

These contracts, it will be noted, aggregate 35,000 hp, without taking any account of the regular lighting and motor loads in Glens Falls, Saratoga and Ballston Spa, where the company is now operating the electrical supply systems. Besides all the above, applications are on file for more than 6,000 hp for use in Saratoga, Glens Falls, Ballston Spa, Sandy Hill and Fort Edward.

In order to carry the total of the loads just named, the new power plant at Spier Falls and the remodeled plant at Mechanicsville are being pushed to completion as fast as possible. The ELECTRICAL WORLD AND ENGINEER of June 27, 1903, gave some account of the water power development at Spier Falls, and of the great dam and power house going up there. As then noted, the capacity of the ten main generators at Spier Falls will be 24,000 kw, or 32,000 hp at normal rating. In the Mechanicsville plant the normal generator capacity for the seven units is 7,000 hp, giving thus a normal rating of 39,000 hp for the two water-driven stations. Both plants when completed will have water wheels with materially larger capacities than the generators to which they are connected, so that the generators can be overloaded to some extent when desirable.

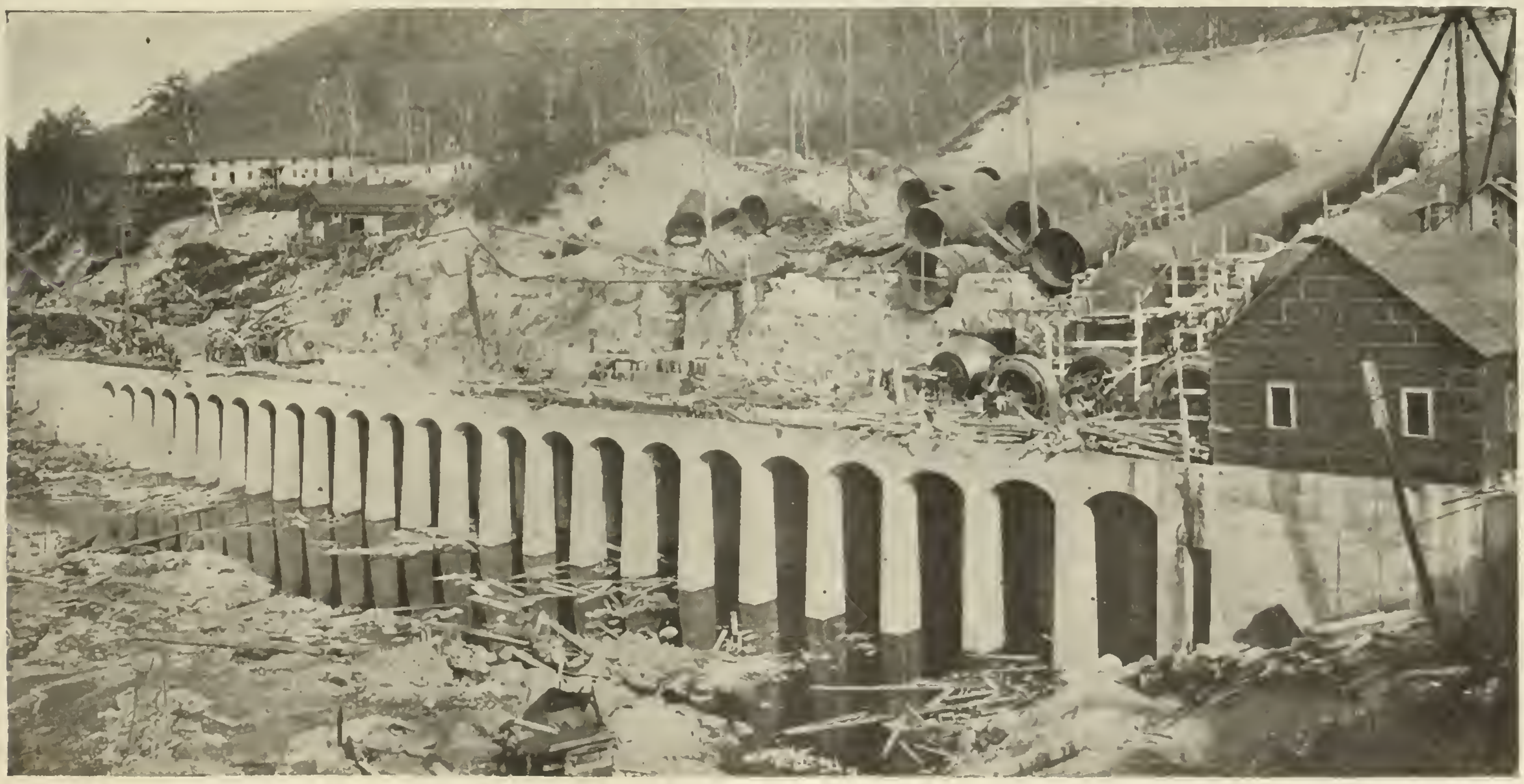


FIG. 1.—FOUNDATIONS OF POWER HOUSE AT SPIER FALLS.

Since the former matter was written on the plant at Spier Falls work on the dam and the foundations of the power house has gone rapidly forward, so that the two 2,000-kw and one of the 2,500-kw generators are in operation, though the full head of 80 ft. of water is not yet available for their wheels. At the present time a portion of the overflow section of the dam has been left a few feet below its final level, pending the completion of the river section, and the head of water at the wheels is about 60 instead of 80 ft., the final figure. In spite of this reduced head the generators are carrying their loads in a satisfactory way, because of the large capacities of their wheels. The foundation of the power house as well as its floor is entirely concrete masonry above the natural rock of the river bed and bank. This foundation and the floor of the power house have been completed, so that it is possible to erect and operate the generators, though the remainder of the power house is lacking, and so urgent is the demand for power that this has already been done as above noted. To protect the generators, transformers and other apparatus

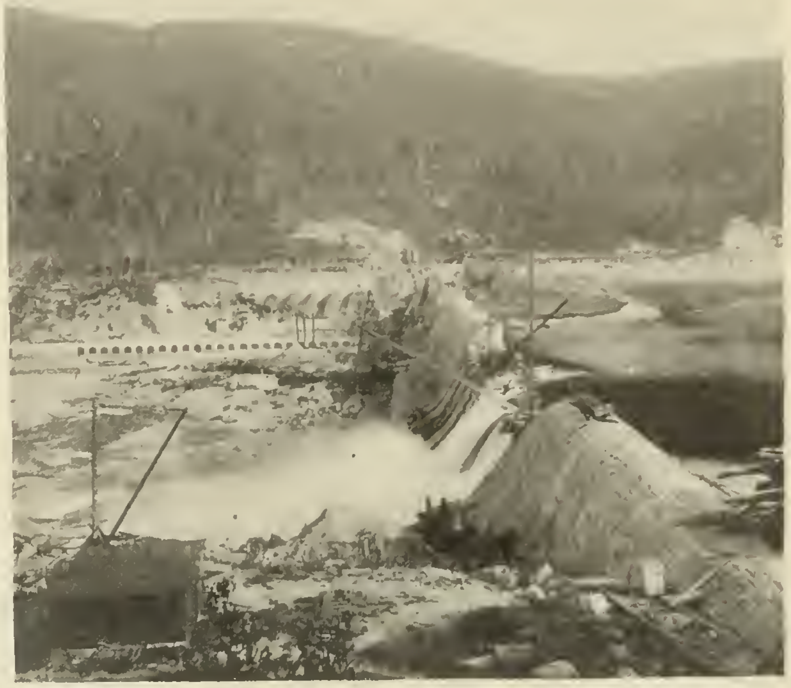


FIG. 2.—DAM AT SPIER FALLS.

a temporary wooden building has been erected pending the completion of the brick power house.

This power house when finished will be 70 ft. 10 in. x 392 ft. inside, save that a space 28 ft. x 34 ft. is omitted at one corner. A space extending across the entire width of the building and 40 ft. in the direction of its length is devoted to the transformers and the high and low tension switchboards. The remainder of the power house is divided into two parts in the direction of its length by a water-tight brick partition that gives the wheel room a width of 34 and the generator room a width of 35 ft. Along the outside wall of the wheel room ten steel penstocks each 12 ft. in diameter enter from the canal. Each of eight of these penstocks supplies water to one pair of horizontal turbine wheels that discharge through a single draft tube, and are direct connected to a 2,500-kw generator. Each of the other two penstocks supplies one pair of wheels that is direct-connected to a 2,000-kw generator and also a wheel connected to a 200-kw exciter. Each of the pairs of wheels is regulated by a Lombard governor. The 2,500-kw generators operate at 240 r.p.m., 40 cycles, three phase and 2,000 volts. The 2,000-kw generators have a speed of 300 r.p.m. and also develop 40-cycle, three-phase, 2,000-volt current.

That section of the power station containing the transformers and switchboards adjoins the dam and has a basement underneath the main floor. This basement with the dam for one of its side walls and its floor, roof and other sides formed of concrete masonry, contains a central air chamber where a pressure of 5/8 ounce per sq. in. is maintained by blowers in order to force air through the transformers that sit on the main floor above it. On that side of this air chamber which is nearest to the main generator room is the low-tension switchboard, where the 2,000-volt current from the generators is received. On the opposite side of the air chamber and basement is the lower portion of the 30,000-volt switchboard, the upper part of which runs above the main floor. With this latter switchboard are included the motor-operated oil switches, through which the 30,000-volt windings of the transformers are connected to the transmission lines. Each phase of these switches is contained in a separate brick compartment. The 30,000-volt connections are mounted on the stone and concrete masonry by means of Locke porcelain insulators. Each insulator for this purpose is secured to an iron pin and has a cast-iron cap. The joint between the pin and insulator, and also the joint between the insulator and the iron cap is made with a thin mortar of neat Portland cement. Insulators with pins and caps of this sort are used to support not only the connections but also the knife switches for the 30,000-volt lines. One of these knife switches is located in each wire on each side of every oil switch, so that the oil switch may be entirely disconnected from the line wires and transformers when any work on the switch is to be done.

FIG. 3.—GENERAL VIEW OF MECHANICVILLE POWER HOUSE.

In the complete equipment of the Spier Falls station are included thirty transformers of the air-blast type, designed to operate at 2,000 volts primary and either 15,000 or 30,000 volts secondary. Each of 24 of these transformers is rated at 833 kw, and each of the other 6 transformers is rated at 670 kw. The 833-kw transformers are connected in groups of three with the 2,500-kw generators, and each group of three 670-kw transformers is connected to a 2,000-kw generator. Six three-phase transmission circuits are to leave the Spier Falls station, and each of the eighteen wires that make up these circuits will be connected to a ground plate through a knife switch and a series of twelve lightning arresters mounted in a stone and brick cell. Each of these lightning arresters is of General Electric make and includes two carbon resistance rods and five brass cylinders with four air-gaps between them, all mounted on a porcelain base. The length of the air-gaps between cylinders varies somewhat and appears to range between 1/32 and 1/16 in.

Each of the two exciters at the Spier Falls station has a capacity of 200 kw and is driven by water from one of the penstocks that supply the wheels of the 2,000 kw generators. The operating switchboard is located in front of the row of main generators and about midway of the length of the station. On this operating board are the switches that start the motors on oil switches of the high-tension lines. Besides the equipment of indicating meters there are also recording wattmeters for the entire output. About 25 miles in a direct line from the Spier Falls station, though at a somewhat greater distance by the course of the river, is the second water power plant of the Hudson River Water Power Company, namely, that at Mechanicsville. This plant, as at first built, was completed in 1898, and described by the Electrical World and Engineer in September of that year. The Hudson River at the point where the dam and

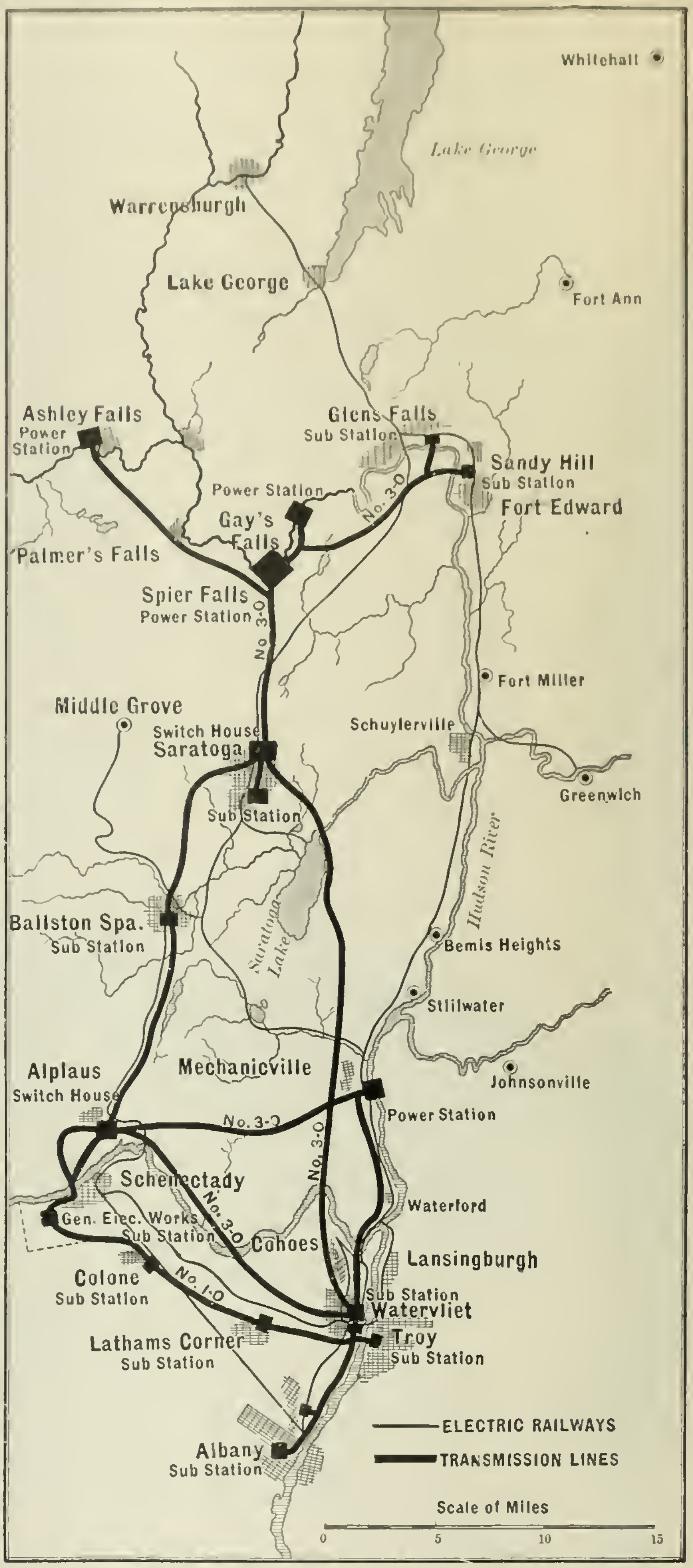


FIG. 4.—MAP SHOWING LOCATION OF GENERATING AND SUB-STATIONS AND THE TRANSMISSION LINES.

power house were built has a total width of about 1,200 ft. At a distance of about 800 ft. from the eastern bank of the river a rocky island divides the channel into two parts, and across the greater of these parts the main or overfall section of the dam was built. The length of the overfall section of the dam between abutments is 707 ft., but the spillway has recently been increased 143 ft. by the removal of the soil from the ledge at the eastern end of the dam, and the construction of a crest there that is one foot higher than the crest of the original overfall section. This section stands 15 ft. above the bed rock of the river, is 16 ft. thick through its base, 8 ft. just below the crest, and 30 ft. thick through the base and apron.

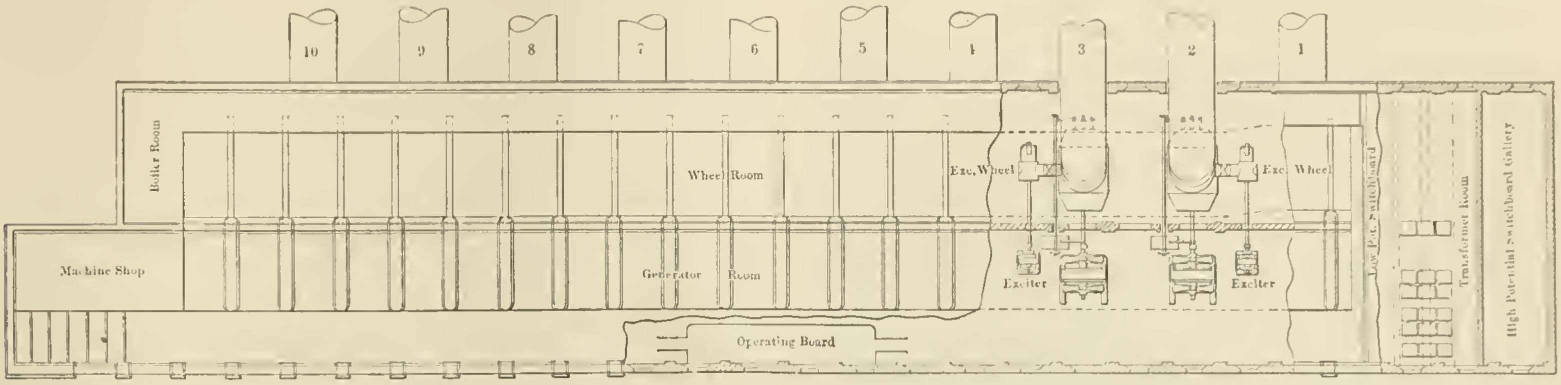


FIG. 5.—PLAN OF FOUNDATIONS OF SPIER FALLS POWER HOUSE.

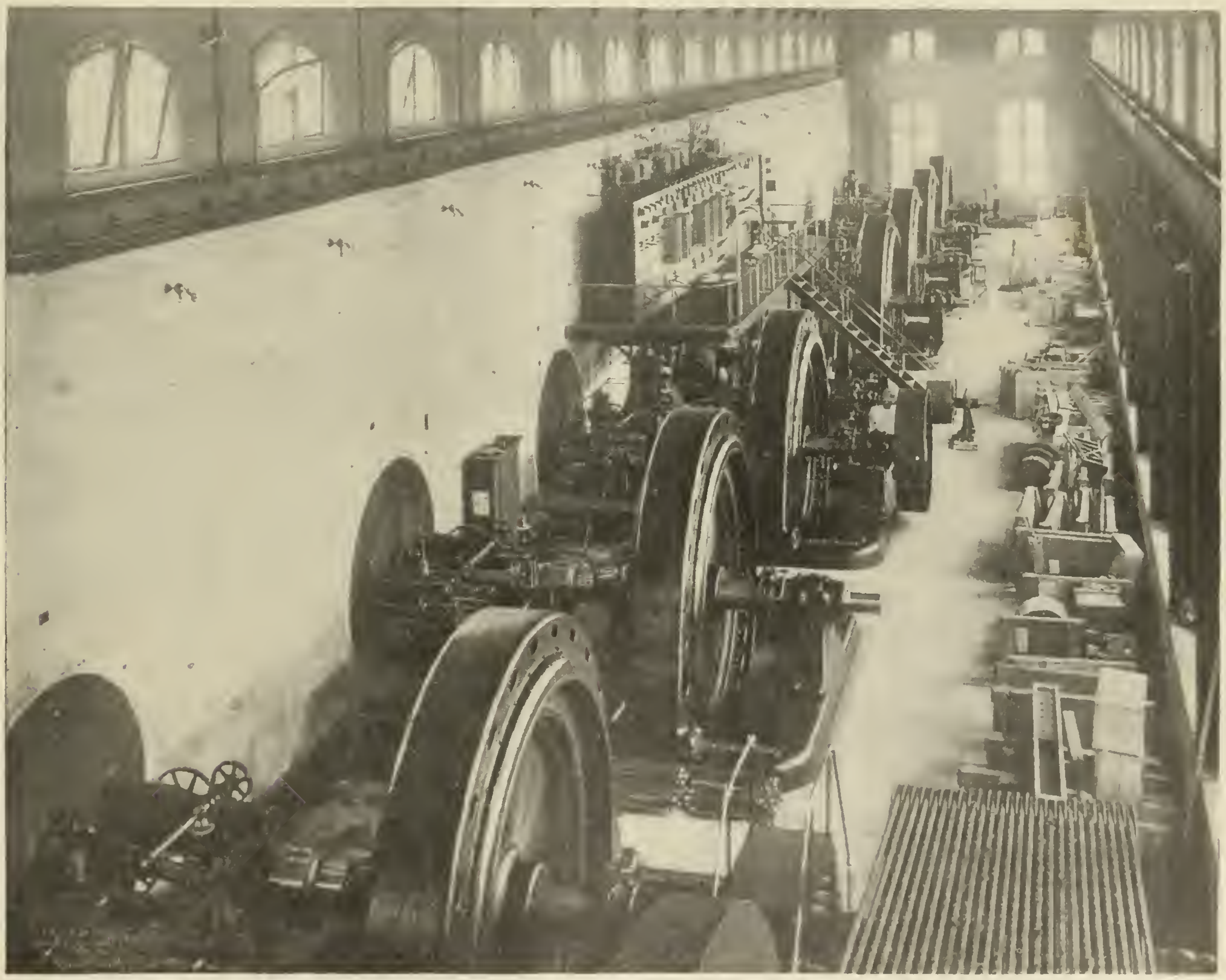


FIG. 6.—VIEW OF INTERIOR OF MECHANICVILLE POWER STATION.

From the western bank of the river the power station extends a distance of 215 ft. toward the island, and the remaining width of the channel is closed by a dam 26 ft. high, 10 ft. wide on top and 18 ft. wide at the base. In the section of dam last mentioned are four arched waste gates each 4 ft. wide and 6 ft. 9 in. high.

In the western abutment of the main dam there are 12 waste gates each 4 ft. wide and 6 ft. high. From the foregoing it may be seen that the power house forms one section of the dam across the western channel of the river. In total length the power house measures 257 ft. 6 in., and its width up and down stream in the river section is 66 ft. 6 in. Of this total width the wheel chambers on the upstream side take up 32 ft. 6 in., and the generator room on the downstream side has 34 ft. Up to the level of the floor of the generator room the power house, like the dam, is constructed of concrete masonry, but imbedded in the concrete arches and piers beneath the power house are steel I beams and columns. Above the main floor on the downstream side, and above the wheel chambers on the upstream side, the power house walls are of brick with steel columns at intervals that carry the steel roof trusses and the traveling crane of 20-tons capacity. The upstream half of the power house is divided into nine wheel chambers which have arched concrete roofs as well as concrete floors and sides. The head wall that separates each wheel chamber from the generator room is 6 ft. thick and is fitted with a large bulkhead of cast iron that carries a water tight bearing for the wheel shaft. Each wheel chamber connects with the west channel of the river through an arched opening at its upstream end, and this opening is protected by an iron rack to intercept floating objects. Seven of the wheel chambers are designed for wheels that operate the main generators, and each of these chambers is 32.5 ft. long, about 18 ft. high, and 23 ft. wide approximately. The head water level in each wheel chamber is 49, and the elevation of the tail water underneath is 31, under normal conditions, so that the effective head on the wheels is about 18 ft. at best. Each set of main wheels is set with its shaft 7 ft. below the normal head water, and 11 ft. above the normal tail water level, and the draft tubes extend some distance below the tail water. As at first constructed by another company, the highest points of the arched openings at the upstream ends of the main wheel chambers were about 2 ft. below the level of the river at that point, but since the plant has come into the hands of the Hudson River Water Power Company a large amount of concrete has been cut from the tops of these arched openings, so that the head water can the more readily flow to the wheels.

In each main wheel chamber four 42-in. diameter turbine wheels were originally mounted on the horizontal shaft, and each pair of these turbines was provided with its own draft tube. Each main wheel shaft, after passing through the cast-iron bulkhead, is coupled to the shaft of a 750-kw or 1,000-hp generator. The four 42-in. wheels were rated to deliver 1,000 hp, but these wheels proved to be too small to drive the 750-kw generator at full load and overload under the variations of head due to changes in the flow of the river. To remedy this defect the 42-in. turbines have recently been replaced by others of 51 in. diameter each. These 51-in. wheels are mounted four on each shaft, like the former ones. The horizontal shafts carrying the turbine wheels just named have a speed of 114 r.p.m. and drive the connected generators at that rate. S. Morgan Smith Company is the builder of the new 51-in. turbines. Each of the two exciters is driven by three 18-in. Victor wheels mounted on the same shaft and operating at 250 r.p.m. All water wheel governors, of which there is one for each set of wheels, are the product of the Lombard Governor Company.

Each of the seven shafts driven by the larger water wheels is direct-connected to a 750-kw, 12,000-volt, three-phase, 40-cycle generator of General Electric make, and these generators are of the internal revolving magnet type. Current for the magnets of these generators is supplied by two 100-kw, 125-volt exciters, each direct-driven by three of the 18-in. wheels. To provide for the contingency of low water, two Heine water tube boilers rated at 505 hp each, and one Hamilton Corliss tandem-compound engine with cylinders 24 x 48 x 48 in., and rated at 1,000 hp, has been installed. This engine is connected by a rope drive to a short shaft that can be readily coupled to the shaft of the 750-kw generator nearest the river bank when desired.

A switchboard gallery is located on the upstream side of the generator room, and oil switches for all of the 12,000-volt generators and transmission lines are operated from this gallery. A part of these oil switches are operated by hand and a part by motors, but both these types of switches are located in separate fire-proof compartments, the manual switches being beneath the gallery, and the motor operated at one end of the station. These oil switches were all made by the General Electric Company. Air-break switches were at first installed in this station, but they did not prove satisfactory on the 12,000-volt generators and circuits.

In addition to the existing stations at Spier Falls and Mechanicville the Hudson River Water Power Company owns a large water power at Ashley Falls, about ten miles northwest of Spier Falls, on the Sacandaga River, and another large power at Gay's Falls, about three miles downstream from Spier Falls on the Hudson River. It is the intention of the company to develop the powers at Ashley and Gay's Falls in the near future.

From the plants at Spier Falls and Mechanicville current is to be transmitted to sub-stations of the Hudson River Water Power Company at Glens Falls, Fort Edward, Saratoga, Ballston Spa and Watervliet. The Glens Falls, Saratoga and Watervliet sub-stations are already in operation, and construction of the Fort Edward and Ballston Spa sub-stations is underway.

Besides its own sub-stations just named, the water power company is delivering energy to a number of sub-stations along the line of the Hudson Valley Railway, which extends from Troy to Mechanicville, Saratoga and Glens Falls, to sub-stations of the Schenectady Street Railway at Ballston Spa, Schenectady, Colonie and Latham's Corner, to a sub-station in the General Electric Works at Schenectady, to sub-stations of the United Traction Company, of Troy and Albany, located at North Albany and Watervliet, respectively, to a sub-station of the Albany Electric Illuminating Company, to the Lighting Company, of Troy, and to a sub-station of the local lighting company in Lansingburg.

To transmit energy from the plants at Spier Falls and Mechanicville to the various sub-stations named the following three-phase circuits will be employed, all circuits being made up of copper wires hard drawn and solid. Between Spier Falls and the sub-stations at Glens Falls and Fort Edward, a distance of about 10 miles, there is a single circuit of 3/0 wire. From Spier Falls to Saratoga switch house three circuits of 3/0, and two circuits of 1/0 wire will be employed. One circuit of the 1/0 wire goes from Saratoga switch house to Saratoga sub-station, a distance of about two miles, and terminates there. Two of the 3/0 circuits pass from the Saratoga switch house to the sub-station of the Hudson River Water Power Company at Watervliet, which is about 35 miles from the power plant at Spier Falls.

The remaining, one 1/0 and one 3/0 circuits, go from Saratoga switch house to Alplaus switch house, which is about five miles from the sub-station in the General Electric works at Schenectady. From Alplaus switch house two 3/0 circuits pass to the General Electric sub-station, distant about 32 miles in a direct line from Spier Falls. Both the circuits between Saratoga switch house and Alplaus switch house pass through the sub-station at Ballston Spa, which is 17 miles south of the generating plant. Alplaus switch house is connected with the water power company's sub-station at Watervliet by one circuit of 3/0 wire. Between this Watervliet sub-station and that of the Albany Electric Illuminating Company there are two circuits of 3/0 wire. This Albany sub-station is about 41 miles in a direct line from Spier Falls, but the distance by line is somewhat greater. The sub-station of the local lighting company in Troy is connected with the Watervliet sub-station by two 3/0 circuits, and the last-named sub-station feeds that of the United Traction Company at North Albany over one circuit of 1/0 and one of 3/0 wire. A circuit of 1/0 wire connects the Watervliet sub-station of the power company with the Latham's Corner sub-station of the Schenectady Street Railway, and this circuit has been continued by the railway company to the sub-station in the General Electric Works. Three circuits each of 3/0 wires leave the water power plant at Mechanicville. Two of these circuits pass to the Watervliet sub-station and one goes to the switch house at Alplaus.

Of the above-named circuits, three of 3/0 wire between Spier Falls and Saratoga switch house, and two of 3/0 wire between Saratoga switch house and Watervliet sub-station have not been erected, but it is the intention to complete them at an early date. When the power plants at Gay's Falls and Ashley Falls are in operation their transmission lines will join those already named at Spier Falls.

A Plea for Punctuality.

The *New York Tribune* says: "With the opening of the season of medical, electrical and other scientific conferences, a familiar characteristic of such meetings in this city is brought into fresh prominence. The members are rarely called to order until ten or fifteen minutes after the appointed time. Not infrequently the delay is greater. Similar tardiness may be observed in formally opening the proceedings of charitable and social organizations, and such laxity is not without its drawbacks. Comment is confined here, however, to the group of gatherings first named, because a lack of punctuality among scientific people is, after a fashion, inconsistent with that exactness of thought and statement which the world expects from them and on which they occasionally pride themselves. Men who are trained to precision of observation and utterance might reasonably be expected to be exceptionally scrupulous in keeping engagements. Any shortcomings in this respect become even more conspicuous when a comparison is made with the promptness with which bank directors' meetings and church services begin, to say nothing of theatres and symphony concerts." The American Institute of Electrical Engineers and the New York Electrical Society will please take note.

On the Mechanism of Electric Power Transmission.

By Dr. A. E. Kennelly.

THE mechanism of electric power transmission in an electric circuit over wires is essentially of the same nature as the mechanism of wireless telegraph communication. In the latter case electromagnetic waves, comprising electric and magnetic fluxes, with their energies, carry away the electric energy of the sending antenna, and run freely over the conducting surface of the earth, spreading and attenuating as they run. In the former case, the waves are guided over the surfaces of the wires and do not spread or attenuate, except by leakage or by absorption due to imperfect conductivity in the metal. In both cases electromagnetic fluxes escape from the source, and at the speed of light, and carry with them the energies pertaining to such fluxes. The key to the narrow channeled mechanism of wire telegraphy is found in the open field of wireless telegraphy.

In wireless telegraphy, owing to our present imperfect knowledge of the height and contour of the advancing waves above ground, we must be content with certain simple assumptions. Let us assume that all of the electric energy resident in a vertical sending antenna is utilized in radiation; or, that its radiation efficiency is 100 per cent.; also that this energy is all radiated in one double-oscillation or complete wave. That is to say, the radiation is to be monochromatic, and to be confined to one pair of alternations, as distinguished from a series of decaying oscillations. Let the single emitted wave be supposed to expand hemispherically in three dimensions, like a half bubble, and to run without any loss by conductive absorption over the surface of the earth, regarded as a smooth, perfectly conducting plane. None of these assumptions can justifiably be applied to a practical case; yet the results worked out on this basis are probably reliable so far as the nature of the mechanism is concerned, and may possibly be reliable, for practical purposes, as a crude working hypothesis, to a first approximation.

Suppose a vertical antenna, say 30 metres in height, charged to a potential of 30 kilovolts, and suddenly discharged to ground, with perfect radiation conversion efficiency. The capacity of the antenna may be about 0.01 microfarads, or 10^{-17} abfarad. The potential being 3×10^4 volts, or 3×10^{12} abvolts, the quantity of electricity in the antenna, just before discharge, will be 3×10^{-5} abcoulomb, and the energy of this charge $\frac{3 \times 10^{12} \times 3 \times 10^{-5}}{2} = 4.5 \times 10^7$ ergs, or 4.5 joules, or 3.32 foot-pounds. This is the stock of energy for the outgoing wave.

On discharge, the 45,000,000 ergs are thrown off into space, at the speed of light, in the hypothetically assumed form of a hemispherical wave. Since the height of the antenna is a quarter wave-length, the thickness of the wave will be everywhere 120 metres, in two alternations of 60 metres each, the front half-thickness being say positive, and the rear half-thickness negative. At a distance of say 10 kilometres from the emitting antenna, the wave surface area will be $2\pi\ (1{,}000{,}000)^2 = 6.283 \times 10^{12}$ sq. cm., and the volume of the wave shell will be $12{,}000 \times 6.283 \times 10^{12} = 7.54 \times 10^{16}$ c. c. The mean voluminal energy of the wave will then be $\frac{4.5 \times 10^7}{7.54 \times 10^{16}} = 6 \times 10^{-10}$ ergs per c. c. If the wave were of the rectangular type graphically, i. e., of uniform amplitude in each oscillation, there would be 6,000 cm. of wave-shell in the positive half, and 6,000 cm. of wave-shell in the negative half; while in each of these half-shells the energy would be uniformly distributed at 0.0006 microergs per c. c. Half of this, or 0.0003 microergs, would be in energy of electric flux, and half in energy of magnetic flux. The magnetic energy would be of the type $\frac{\mathfrak{B}^2}{8\pi}$ ergs per c. c., where $\mathfrak{B}$ is the magnetic induction density in gausses. Consequently, $\frac{\mathfrak{B}^2}{8\pi} = 3 \times 10^{-10}$ ergs, whence

$$\mathfrak{B} = \sqrt{24\pi \times 10^{-10}} = 8.68 \times 10^{-5} \quad \text{gauss.}$$

The magnetic intensity of force $\mathfrak{H}$ would be 8.68×10^{-5} gilberts per cm.

The electric energy would be of the type $\frac{E^2}{8\pi}$, where E is the electrostatic induction. Consequently, by similar reasoning, $E = 8.68 = 10^{-5}$ C. G. S. electrostatic units of induction. The electric intensity in the wave would be 8.68×10^{-5} abstatvolts per cm (0.02604 volt per cm.). It is interesting to observe that if the electric quantities are expressed in electrostatic units, and the magnetic quantities in magnetic units, the numerical values of the electric intensity, induction-density and energy, are respectively the same as those of the magnetic intensity, induction-density and energy at the same part of any single electromagnetic wave whatsoever, whether in wire or wireless systems. This convenient property renders it necessary to compute one only of the magnetic and electric sets of values.

Since the electric flux paths are all vertical in the wave front at the ground, while the magnetic flux paths are all horizontal, a receiving vertical antenna, say 30 metres in height, 10 kilometres from the source, and cut by the advancing wave, will be in the condition of a single-wire dynamo-armature, whose armature wire, 3,000 cm. long, cuts a field of $+ 8.68 \times 10^{-5}$ gauss, at the speed of light, for a period of 0.02 microsecond, and then cuts a field of -8.68×10^{-5} gauss, at the same speed (3×10^{10} cm. per second) for another period of 0.02 microsecond. The e.m.f. generated in the dynamo will, therefore, be $3{,}000 \times 8.68 \times 10^{-5} \times 3 \times 10^{10} = 78.12 \times 10^8$ abvolts $=$ 78.12 volts. This would be the momentary e.m.f. induced in the receiving antenna for 0.02 microsecond in the positive direction, and then for the next 0.02 microsecond, in the negative direction. That is, the e.m.f. induced at each instant in the antenna is parallel to the electric flux and e.m.f. brushing by in the wave shell. Moreover, with 0.02604 volts per cm. of wave-front elevation, and a receiving antenna of 3,000 cm., the total e.m.f. in the wave-front, bridged by the antenna, will be $3{,}000 \times 0.02604 = 78.12$ volts.

Consequently, we may regard the e.m.f. induced in the receiving antenna either as magnetically-induced by cutting horizontal magnetic flux, or as embraced and picked up, by the height of the antenna, from the vertical electric flux.

The waves emitted from the sending antenna would not, however, be of the graphical rectangular type, as above considered, but would naturally be of the sinusoidal type, in which case all the quantities considered, instead of being of constant magnitude throughout each alternation, would gradually wax to a maximum and wane to zero. The maximum would be $\sqrt{2}$ times greater than the uniform values above deduced. The maximum e.m.f.'s in the receiving antenna would thus be ± 110.5 volts.

On the same crude theory of no absorption at the ground, and hemispherical expansion, the voluminal energy of the wave would diminish inversely as the square of the distance from the source; but the intensities, inductions and induced e.m.f.'s would vary only inversely as the distance, so that at 100 km. the received e.m.f. impulse would reach maxima of ± 11.05 volts, and at 1,000 km. ± 1.105 volts.

There would also be a wave, or double oscillation, of alternating electric current on the surface of the earth, which would be relatively intense close to the sending antenna, and would fall off in strength inversely as the distance. In practice, with imperfect conduction of the earth, this alternating current would penetrate the ground to some depth, with loss of wave energy by absorption. The current wave on or in the earth would always be located at the foot of the advancing wave. It would consist of an electric charge or charges, moving out radially from the source at the light speed.

Turning now to the case of wire transmission, consider a pair of parallel insulated aerial copper wires, such as might be used for a single-phase circuit. Let a constant e.m.f. of e abvolts be applied to the sending end of these wires and assume, for the sake of simplicity, that the conductor-resistance and leakance are both negligibly small. Then the surge resistance, or resistance which the line will offer to advancing electromagnetic waves, is known to be $r = \sqrt{\frac{l}{c}}$ absohms, where l is the inductance per cm. in abhenrys, and c is the capacity per cm. in abfarads. But $l = \frac{1}{cv^2}$, where v is the velocity of light.

$$r = \frac{1}{cv} \text{ absohm}$$

The initial current strength at the sending end, when the e.m.f. is applied, will be $i = \frac{e}{r} = ecv$ absamperes, and the initial power will be $ei = e^2cv$ ergs per second. All of these are known electrical conditions of the circuit under the assumptions made.

If we take a pair of infinite parallel planes, 1 cm. apart and perpendicular to the two conducting wires, there will be an initial electric charge of ec abcoulombs communicated to the centimetre length of the circuit, comprised between the two planes. This represents an electric energy of $\frac{e^2c}{2}$ ergs stowed away in the centimetre slab of ether between the planes. There will be an initial magnetic energy of $\frac{li^2}{2}$ ergs in the same slab. But $\frac{li^2}{2} = \frac{e^2c}{2}$ from the preceding equations; so that the initial energy contained in the slab will be e^2c ergs, half electric and half magnetic. It will reside in the electric and magnetic fluxes permeating the slab. But the fluxes in the slab move bodily along the wires at the speed of light, which is the same as though v slabs were emitted from the sending end per second, each containing e^2c ergs. Consequently, the initial rate of power transmission will be e^2cv ergs per second, and this is just the power rate from circuital considerations as stated above. Consequently, the phenomenon of the transmission of electric power over a circuit is the rush of v centimetre slabs of electric and magnetic flux per second over the wires, each slab carrying a definite amount of flux energy. The energy is carried wholly through the ether, but is guided by the wires.

There is an electric current on or in the wires and energy transfer in the ether outside them. If the wires conducted perfectly there would be no penetration of current below their surfaces. In practice, the electromagnetic fluxes on reaching the end of the circuit are partly absorbed and partly reflected, the reflected remnants coming back at light speed, to be again partly reflected at the sending end. A wave thus makes an indefinitely great number of journeys to and fro before being completely absorbed. After a brief period, in which the current is building up over the circuit, there is a long series of superposed waves whose resultant or sum is the steady current of Ohm's law. The law as to flux transmission of power applies to the steady state as well as to the initial state; but requires to have all the fluxes properly summed in regard to strength and direction, in order to arrive at the total power.

As an example of the preceding reasoning consider a pole line consisting of a pair of No. 00 A. W. G. copper wires suspended on insulators at a uniform interaxial distance of 18 inches (45.72 cm.). The capacity of these wires is (ignoring insulators) 0.009736 microfarad per mile of loop, or 6.049×10^{-23} abfarad per cm. of loop. The inductance of the wires, assuming perfect conduction, is 0.002955 henrys per mile of loop, or 18.36 abhenrys per cm. of loop. If we express the electrostatic capacity in electrostatic units, we multiply by v^2, or 9×10^{20}, and we have $C = 5.444 \times 10^{-2} = 0.05444$ abstatfarad per cm. The inductance per centimetre of the circuit in abhenrys is the reciprocal of the capacity per centimetre of the circuit in abstatfarads, and this is a remarkable general law applicable to all circuits, when the inductance within the substance of the wires is ignored.

If an e.m.f. of say 30 kilovolts, or 3×10^{12} abvolts, or 100 abstatvolts, be suddenly connected between the two wires at the sending end, the charge per linear centimetre will be $100 \times 0.05444 = 5.444$ abstatcoulombs. The electric energy of the charge will be $\frac{100 \times 5.444}{2} = 272.2$ ergs. This will be the energy of electrostatic flux in any centimetre slab of the ether perpendicular to the two wires. The magnetic energy of the advancing flux will be equal to the electric energy. The total flux energy in any centimetre slab will thus be 544.4 ergs. But the fluxes advance along the wires at the speed of light, 3×10^{10} cm. per second. There are thus virtually 3×10^{10} slabs sent out from the source per second, each carrying 544.4 ergs. The total initial power transmitted will, therefore, be $3 \times 10^{10} \times 544.4 = 1.633 \times 10^{13}$ ergs per second, or 1.633 megawatts, reckoned on the basis of electromagnetic wave power. The surge resistance of the circuit at the sending end, neglecting conductor resistance, is

$$r = \sqrt{\frac{l}{c}} = \sqrt{\frac{18.36}{6.049 \times 10^{-23}}} = 5.51 \times 10^{11} \text{ absohms} = 551 \text{ ohms.}$$

The initial outgoing current will be $i = \frac{30,000}{551} = 54.44$ amperes, and the power of the initial current will be $ei = 30,000 \times 54.44 = 1,633,000$ watts, or 1.633 megawatts, reckoned on the basis of electric circuit laws, and agreeing with the computed transfer by electromagnetic fluxes.

As soon as the outgoing wave has had time, at light speed, to reach the distant end of the circuit, to be partially reflected therefrom, and to return to the sending end, the current and power will begin to be modified by superposition of successive waves, so that the final current and power may be very different from the initial values. The same theory, however, applies in the final state through a process of summation.

The electric transfer of energy in a circuit corresponds to the mechanism of rope transmission, in so far as it depends upon a constant definite velocity and a variable tension. In the circuit the velocity is the velocity of light and the pull is varied either by altering the applied e.m.f., or by varying the number of waves that can add up to make the final summation current.

If the applied pressure in the preceding case had been 3,000 volts, instead of 30,000 volts, the electric and magnetic energies in each slab would both have been one hundred times smaller. For the same final proportional resultant wave system in a circuit, the power transmitted must increase as the square of the applied pressure, because the number of slabs sent off per second does not vary, but the energy per cubic centimetre, or per slab, varies as the square of the impressed voltage. A high-pressure circuit is, therefore, one which compresses a relatively large amount of energy into the fluxes linked with the circuit; so that when these fluxes run to and fro over the circuit at light speed a relatively large amount of energy is carried with them.

Grouping of Cells to Obtain Maximum Current.

By W. J. Humphreys.

Elementary matters are never so trifling as to justify being passed by without proof; but while to some students one demonstration is clear, others may more easily follow a different one. This is the excuse I offer for submitting the following equations, which lead to the same conclusion that was so nicely found by Mr. Pierce in the issue of October 3.

As in his article:

Let I = current.
e = e.m.f. of one cell.
r = internal resistance of one cell.
R = external resistance of circuit.
p = number of cells in each "parallel" set.
s = number of such sets in series.
$n = ps$ = total number of cells.

Then

$$I = \frac{se}{R + r\frac{s}{p}} = \frac{ne}{pR + rs} = \frac{ne}{\sqrt{(pR - rs)^2 + 4nRr}}$$

Since the value of ne cannot change, its terms being constant, I is a maximum when $(pR - rs)^2 + 4nRr$ is a maximum. But $4nRr$ is also a constant, because its several terms have fixed values, and, therefore, the current is greatest when $(pR - rs)^2$ is least; that is, in the ideal case, when $pR - rs = 0$, or $R = r\frac{s}{p}$. In words, when the external resistance is equal to the battery resistance.

This is not, of course, an economical method of grouping cells since only half the total energy is available for external or useful work.

The Stone Wireless Telegraph System.

By Dr. Louis Duncan.

THE commercial future of wireless telegraphy depends largely upon the possibility of selective signaling. To attempt the extended application of wireless telegraphy without such a system would cause confusion and failure. It is not possible that any international agreement should help matters at the present time, for wireless telegraphy is such a new art that we cannot tell at present what its final development will be, and any restrictions that might be imposed would only confine and delay its improvement and application. The futility of any such agreement is evident to any one who has followed the past development of the art and has in view its future possibilities.

What has already been done is most encouraging. I think there is no doubt that signals have been sent across the Atlantic and under favorable conditions messages have been sent and received. And the methods and results have been steadily improved. In fact, it has been shown that as far as overcoming distance goes wireless telegraphy is a success. The efforts to make this signaling selective—that is, to make it possible for a station to communicate with a station selected out of a number of others without interfering with the others—has so far proved a failure.

Mr. Stone's system aims to do away with this difficulty. His work deals almost entirely with selective signaling. Broadly, he accomplishes his purpose by the use of a sending apparatus that emits simple harmonic waves of a determined period, not a number of waves of different periods, as in other systems; and a receiving apparatus that responds to a single period only. To do this he utilizes the properties of resonant circuits.

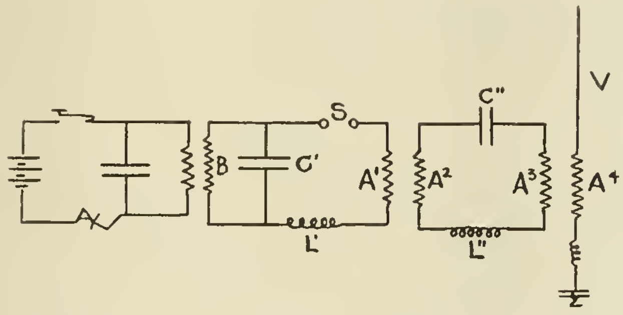


FIG. 1.

It is well known that a single circuit, including a capacity and inductance, has a definite period of electrical vibration, the expression for the frequency of this vibration being $n = \frac{1}{2\pi\sqrt{CL}}$, or if $p = 2\pi, n p = \frac{1}{\sqrt{CL}}$. If e.m.f.'s of different periods, including the period of the circuit, be impressed on this circuit, the current due to the e.m.f. of period $p = \frac{1}{\sqrt{CL}}$, will be exaggerated, while those due to the other periods will be to a large extent suppressed. If, however, this circuit be placed in inductive relation with a second circuit, the natural periods of both circuits will be modified; but this modification will be unimportant provided $L' L''$ is great compared with M^2, L' and L'' being the respective self-inductions of the two circuits, and M their mutual induction. So by filtering an electric vibration of mixed period through a number of such circuits having the same period and placed in inductive relation, we can finally arrive at a vibration of a single period—that is, at a simple harmonic wave.

So far we have considered the natural vibrations of the system, but if an e.m.f. of a period different from the natural period of the system be impressed on it, it will execute "forced" electrical vibrations of a period equal to that of the impressed e.m.f. The mechanical analogy is exact and evident. If there are no frictional losses in the system—magnetic and dielectric hysteresis—and a simple harmonic e.m.f. of a given period be impressed on it, the result will be a simple harmonic current of the same period. This is the principle of Stone's transmission device, which I have shown in Fig. 1. An induction coil has a secondary, B, and a spark-gap, S. On a discharge taking place across the spark-gap, an oscillating discharge from the condenser passes through the circuit, $S\,A'\,L'\,C'$, this circuit being so tuned that it responds to the period desired. In inductive relation to it is a second circuit, $A^2\,C''\,A^3\,L''$, tuned to the same period and in turn placed in inductive relation with the vertical wire, v, through the coils, A^3, A^4. The coils, A^1, A^2, A^3 and A^4, consist of a few turns of wire (twenty is the greatest number in the apparatus used) wound on a wooden frame about 8 in. square and placed about ⅓ in. apart. The inductances, $L'\,L''$, are placed in the circuit to make the condition hold that $L'\,L''$ must be much greater than M^2; actually they are immeasurably small, but their values may be calculated from the dimensions. Any number of intermediate circuits similar to $A^2\,L''\,A^3\,C''$ might be used to still further purify the wave, but it is not necessary to multiply them.

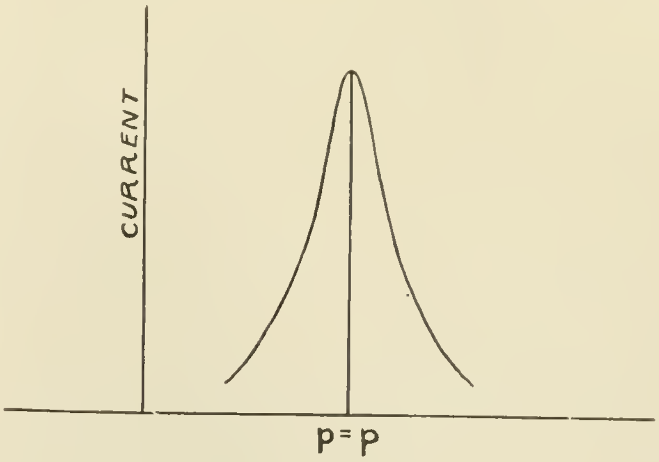


FIG. 2.

The use of this apparatus gives this result: We have impressed on a continuous vertical conductor simple harmonic alternating waves of a definite and determined period. By changing the values of $L'\,C'\,L''$ and C^2 we may alter this period as we wish.

Now to turn to the receiving end of the system. If we have a resonant circuit such as we have been considering—that is, a circuit with concentrated capacity and inductance, as distinguished from distributed capacity and inductance—and place it in inductive relation with a circuit on which is impressed an alternating e.m.f., then as the period of this e.m.f. approaches the natural period of the circuit the current in the latter increases rapidly, reaching a sharp maximum when the two periods are equal. Fig. 2 shows such a state of affairs. If the impressed wave is not simply harmonic, but contains a number of waves of higher periods, then the maximum is not so sharp, and some part of the higher impulses appear in the resonant circuit. It is true, too, that even simple waves of different periods would cause the circuit to execute forced vibrations. To obviate this, and prevent impulses of a different period affecting the receiving devices, the same means may be employed as at the transmitting end, i. e., a second circuit tuned to the same period may be placed in inductive relation to the first and the receiving device placed in it. In this way a receiving station may be constructed that will respond, within narrow limits, to one period and to only one period.

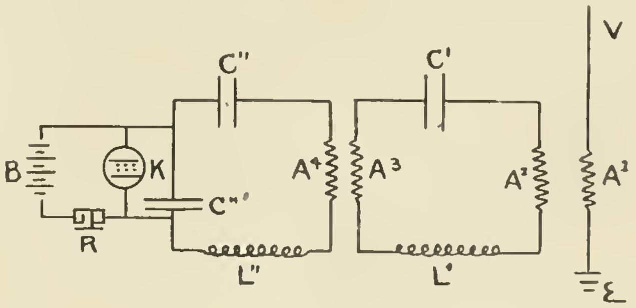


FIG. 3.

This is the plan Mr. Stone has used. It is shown in Fig. 3. Here V is the vertical wire containing the coil, A', in inductive relation with the coil, A^2, of the resonant circuit, $A^2\,C'\,L^1\,A^3$, which is in turn through the coils, A^3 and A^4, in inductive relation with the circuit of equal period, $A^4\,C''\,C'''\,L''$. Across the condenser, C''', in the latter circuit, is the circuit of the receiving device.

In such an apparatus for receiving signals there is one matter that should be carefully considered. The magnitude of the effect on the receiving apparatus due to a slight change of period of the impressed e. m. f. depends on the sharpness of rise of the resonant curve. In 1892, with Messrs. Carichoff and R. H. and G. E. Hutton, I made a number of experiments on resonant circuits and published a brief description of the work, giving a few quantitative results. We found that hysteresis losses in the circuits greatly decreased the effect of resonance, the introduction of a solid iron core into the inductance core used reducing the results to a small fraction of what was obtained by calculation from the resistance, inductance and capacity of the circuit. We found that dielectric hysteresis had the same effect. With the high frequencies used in wireless telegraphy these results are greatly exaggerated, and the presence of even slight amounts of hysteresis will mask all of the effects and render the method inoperative. In the apparatus being used by Mr. Stone hysteresis is practically eliminated. The coils that I have described have no hysteresis loss, and dielectric hysteresis is eliminated by using air condensers.

Such, very briefly and without detail, is Mr. Stone's system for selective wireless telegraphy. There are, however, three or four points in connection with it I wish to discuss a little further.

It may be objected that the train of waves due to a spark of the induction coil does not persist long enough to take advantage of the resonance effects. That this is not true may be proved by measuring the spark across C'' in Fig. 1 when the circuit A^2 L'' A^3 C'' is tuned, and when its period is changed by say 20 per cent.; in this case the spark length around the condenser varied from 1¾ in. to something less than 1/32 in. We should consider, too, that while the waves in the condenser circuit, starting when the discharge takes place, commence at a maximum, gradually die out, the induced waves starting at a low value increase for a while, probably persist for a time and then die out slowly. It is impossible to say exactly how long the trains of waves do last, but the experiment cited above shows that they last long enough to have their full or almost their full resonant value.

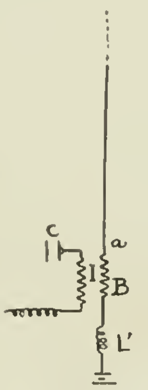


FIG. 4.

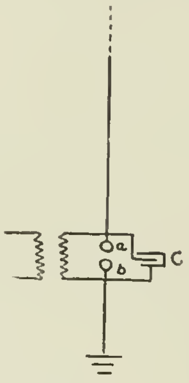


FIG. 5.

I have already stated that in the Stone system the vertical sending wire is continuous, the condition of affairs being shown in Fig. 4. The typical sending wire of other systems is shown in Fig. 5, where there is a spark-gap in the circuit. This spark-gap to a certain extent limits the voltages used on account of the high ohmic resistance of a long gap—or perhaps I should say it would limit it but for the employment of large shunting condensers, which throw so much energy into the discharge that the resistance is diminished. In the Stone apparatus any desired potential difference between *a* and *b* may be obtained by changing the ratio of transformation at *I*, without changing the length of the spark-gap in the induction coil secondary. Again, to change the period of the waves in systems represented by Fig. 5, the geometrical constants of the system must be changed—the length of the vertical wires, for instance. In the Stone system the period may be changed without regard to the length of wire by changing the electrical constants, *L* and *L'*, Fig. 4, for instance. But the most important thing is that the system with the spark-gap in the vertical wire cannot send out simple harmonic waves of one definite selected period, while the Stone system can.

I have had the opportunity of witnessing tests on the selectivity of the Stone system. There are two stations about 1,600 ft. apart in Cambridge and one in Lynn, about 12 miles from the others. The selectivity shown was about 10 per cent.; that is, a variation of 10 per cent. in the period changed the results from a maximum receptive strength to absolute zero. Trolley lines run very close—at Lynn to within 100 ft. to the stations, but they have no effect on the receiving apparatus.

In the work that has been done on the system, coherers are used as the receptive device. A coherer is peculiarly unfitted for selective work, because of its great variations in sensibility. In changing the resonant period of the receiving device from a maximum effect a stage is soon reached where the results are uncertain—sometimes the coherer works and sometimes it does not—and this is the condition of affairs over a considerable part of the interval between maximum effect and silence. With such a system the limits of sensibility are as important as the actual sensibility.

As I have said, Mr. Stone's apparatus enables him to do two things, one of which at least must belong to any successful selective system of wireless telegraphy. First, to send out simple harmonic waves of a definite period; second, to receive these waves by an apparatus that does not respond to any other electrical disturbances.

Glasgow's Varied Activities.

It is stated that Glasgow corporation supplies the people of the second city in Great Britain with water, gas, electric light, cable and electric cars and telephones; they control 11 public parks and galleries, 13 baths and wash houses, a fruit and vegetable market, a dead meat market, a home cattle market, two foreign cattle markets, a cheese market, a bird and dog market and an old clothes market, four slaughter houses and offices, four hospitals and one burying ground; they are the owners of 2,488 municipal houses, 78 lodging houses, of which they manage 7; a family home, which they also direct; 372 shops, 49 stores, 43 warehouses, 43 workshops, 12 halls, two churches, two hotels, one theatre, one studio, one pawn office, one nursing home, one powder mill, one laundry, one bakehouse, one golf course and one gospel tent; they farm over 1,000 acres of land, where large crops are grown, including hay, oats, wheat, turnips, etc.; they convert the city sewage into solid matter and sell it to farmers for manure; they carry on business as market gardeners; they possess stone quarries and 900 railway wagons; they build street cars, reclaim bogs, conduct a civic granary, raise $5,000 a year on the clinker, from the refuse cremating furnaces, collect and sell waste paper, and are not above melting and disposing of the solder from the old tin cans they find in the dust heaps. This is interesting variety and versatility, to say the least.

Free Scientific Lectures.

Dr. Leipziger is pursuing his good work as head of the bureau of free public lectures of the New York Board of Education. Last year 1,200,000 people heard 4,221 lectures in 128 centers. He is pushing scientific lectures this year and says: "The attendance at the scientific lectures is such as to show that the purpose of the lecture course should be to lay especial stress upon the popularization of science. For this reason it is hoped that at no distant day two or three well-equipped science halls, where experiments can well be made, will form a feature of the educational plant of the city, and to those halls shall come the very ablest scientists to expound to the thinking people of our city the great principles of science, and elaborate on the great discoveries that are constantly being made."

Scientific Training.

In a very interesting lecture delivered in London recently on Lord Bacon, Mr. Sidney Lee expressed doubt whether a Temple of Science such as Bacon imagined in "The New Atlantis" would ever come into existence. At present the portents were, Mr. Lee feared, not favorable for its emergence in England. It seemed more likely to come first to birth in Germany or in America, where things of the mind received from the general public a consideration which was denied them in England. The experience of a recent visit to America had shown Mr. Lee that there was nothing in his own land to compare with the widespread eagerness among the youth of the United States to enjoy academic scientific training. It was difficult for them at home, too, to realize even dimly the munificent readiness with which American Legislatures responded to demands made on their resources to supply the American people with fit endowment and equipment of research.

Alternating Current Switchboards—V.

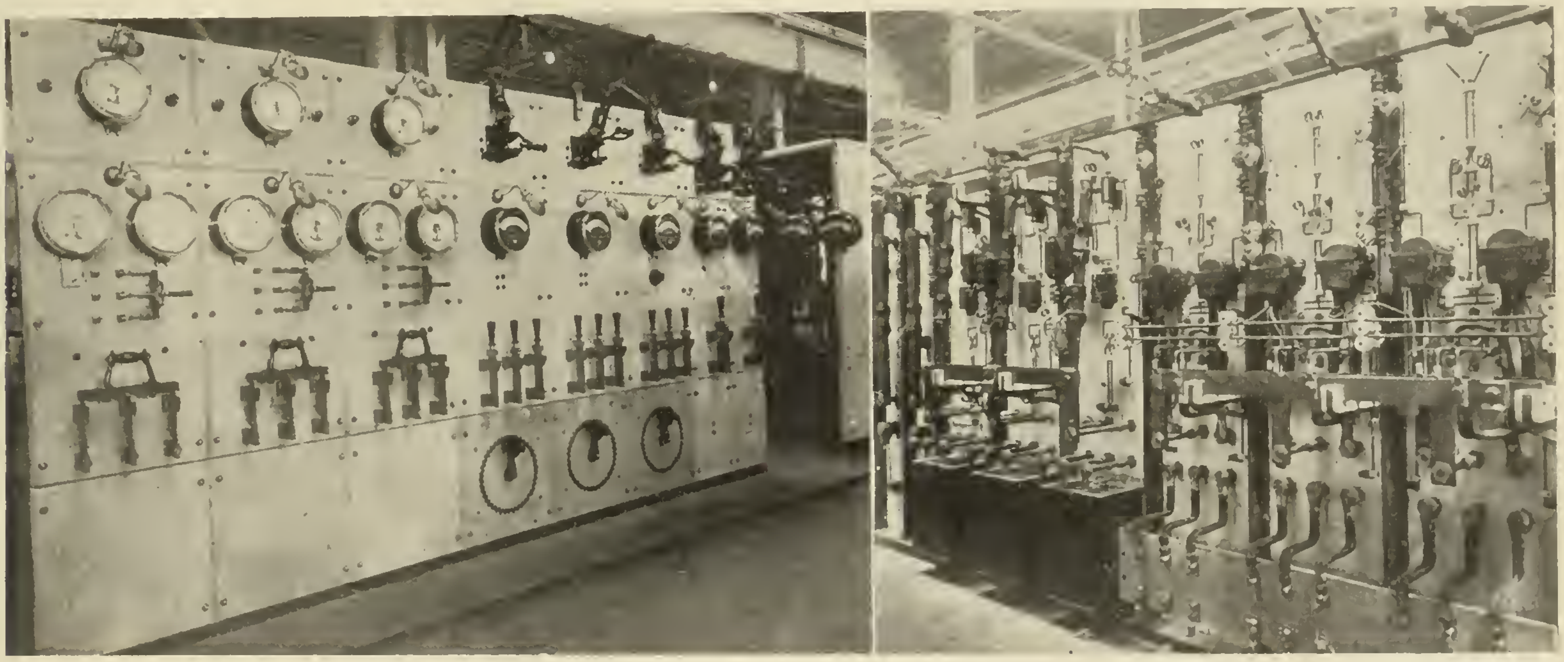
By Stephen Q. Hayes.

(*Concluded.*)

Exciter panels, although strictly coming under the head of direct-current panels, are so closely connected with alternating-current panels that it might be well to say a few words about them here. As several of the previous views have illustrated typical exciter panels, no lengthy description of them will be given. These panels are built chiefly in two styles, single-exciter panels and double-exciter panels. The former control one machine and are usually provided with a three-pole switch, an ammeter, voltmeter and rheostat. The latter control two exciters and are provided with an ammeter and rheostat for each machine, a voltmeter to be connected to either by means of receptacle and plug, two two-pole switches, one for each machine, and one single-pole switch used for the equalizer circuit.

Rotary converter panels are the connecting links between the alternating-current and direct-current panels, just as the rotaries themselves form the connecting links between the two systems. The panels for the control of the direct-current side of the rotaries and the direct-current feeders are usually standard railway panels with but slight modifications. The alternating-current panels are arranged for either two-phase or three-phase circuits and ordinarily the rotaries are arranged to be started from the alternating-current end by means of a starting motor on the end of the shaft.

Fig. 30 shows front of a rotary switchboard supplied for the control of three 250-kw, three-phase rotary converters. The three panels at the left-hand end control the alternating-current end of the three rotaries, the next three panels take care of the direct-current end, and the last two are the direct-current feeder panels.



Figs. 30 and 31.—Front and Rear Views of Rotary Converter Switchboard.

On the alternating-current panels the equipment consists of three ammeters, one in each phase; a three-pole, double-throw switch for the starting motor; a three-pole, single-throw main switch, and synchronizing lamps and plugs. The function of the latter switch for the starting motor is to allow either of two voltages to be impressed on the motor terminals. These motors are wound with a fewer number of poles than the rotary, so that their synchronous speed is higher than that of the rotary to which they are connected. The armature resistance of the motor is comparatively high; in fact, crane motors are used, so their speed varies with the voltage impressed on their terminals. The two voltages selected for the double-throw switches are such that one will cause the motor to run slightly above the synchronous speed of the rotary, and the other slightly below, so that by switching from one side to the other the rotary can be brought to exact synchronous speed before being thrown in.

On the board shown the lamps and plugs connected across the jaws of the main switch are used for synchronizing. Very often, however, a synchroscope is used instead, as this will indicate whether the rotary is running too fast or too slow and will show at each instant just how much out of step the rotary is at any time. As the power factor of a rotary can be varied like that of any synchronous motor, by adjusting the field circuit, some or all of the alternating-current ammeters are occasionally omitted and a power factor meter supplied instead.

A voltmeter is not considered necessary for alternating-current rotary panels, as the alternating-current voltage, as a rule, cannot be varied, and moreover bears a definite ratio to the direct-current voltage for which a voltmeter is supplied. The direct-current rotary panels are supplied with a single-pole circuit-breaker, an ammeter, a rheostat, voltmeter receptacle and three single-pole switches. The reason for furnishing three single-pole switches instead of one three-pole is that if one rotary is running and a second one is to be started up, the closing of the positive and equalizer switch on the second panel will connect the series field of the second machine in multiple with that of the first one, so that its voltage is bound to build up in the right direction. Swung on the end of the board are two direct-current voltmeters, one connected to the direct-current bus-bars and the second connecting through a voltmeter bus and the voltmeter receptacles with any of the three rotaries. The last two panels are direct-current feeder panels, each provided with a circuit-breaker, ammeter and switch, with a lightning arrester mounted on the rear.

Fig. 31 shows the rear of this same board and illustrates one method of mounting fuses in gangs on the rear of a switchboard. In the stations of the plant where this board was installed the alternating-current sides of the rotaries were connected to a common set of bus-bars fed from a bank of lowering transformers, and for this reason it was necessary to insert the fuses. Where each rotary is fed from its own bank of transformers, the low-tension fuses are omitted, the automatic protection being furnished by fused circuit-breakers or similar apparatus in the high-tension side of the lowering transformers.

In connection with rotary converter boards, it might be well to call attention to the necessity of field switches when the rotary is started from the direct-current side by means of a starting rheostat. When starting, the field of the rotary must be connected to the direct-current bus and when the rotary is up to speed the field should be connected to the brushes of the rotary. For this work a double-throw rocker type switch has been designed to transfer the field from the bus to the rotary without the field being opened.

When a rotary is operated from direct to alternating-current, it will not work satisfactorily with its field connected to its own armature or to any source of constant direct-current e.m.f. The reason for this is that if a heavy current is taken off from the alternating-current end, particularly if the power factor is low, the armature reaction will weaken the field and the rotary, behaving like a shunt motor with its armature voltage kept constant and field weakened, will speed up, changing its frequency, etc. To obviate this very objectionable change in speed, inverted rotaries may be excited from specially designed shunt-wound exciters attached to the end of the shaft, or driven in synchronism with the rotary; as the exciter is operated with an unsaturated field a slight change is its speed will mean a big change in its voltage. This change in the exciter voltage will so strengthen the field of the rotary as to hold its speed practically constant.

The additional apparatus needed for an inverted rotary consists simply of the exciter rheostat, a field switch and occasionally a direct current differential voltmeter with one side connected to the terminals of the field and the other connected to the exciter. As the rotary has to be started up with its field connected to the direct current bus-bars, this differential voltmeter indicates the correct instant for transferring the field from the bus to the exciter. A special switch does this without opening the field circuit.

Rotary converters are often used to feed three-wire, direct-current circuits, the neutral connection being brought out from the lowering transformers feeding the rotary. The alternating-current panels for three wire rotaries are the same as for the two-wire, but the direct-current panels differ from standard railway panels in that they have two single pole circuit breakers, two ammeters and three single pole switches, instead of one ammeter, one single-pole circuit-breaker and three switches. The reason for this difference is that on three-wire machines it is necessary to have an ammeter and circuit-breaker in both the positive and negative circuits, as the current in the neutral may be due to an unbalancing on either side, so a meter in one wire would not properly indicate the load on the machine, nor would a breaker in one leg give sufficient protection.

The Westinghouse Company is at present building a great many switchboards using oil switches mounted either on the panels or apart from the board and operated mechanically or electrically, but as these are usually designed to meet special conditions, they hardly come under the same class as the "standard" panels described in these articles, so no mention has been made.

Measurements of Radioactivity.

In newspaper references to the gift of radium recently made to the New York Museum of Natural History by Mr. E. D. Adams, the activity of the material was expressed in numbers with no explanation of the manner in which the numbers were determined. In the paper read by Mr. Hammer in April before the American Institute of Electrical Engineers and the American Electrochemical Society, which in part treated of radium, this explanation appears.

To measure radioactivity, Prof. and Mme. Curie measure the electric conductivity which a radioactive substance imparts to air, and take as unit the radioactivity of uranium. The radioactive substance is placed on one of two condenser plates, which are charged to a high potential. The air between the condenser plates is rendered a conductor of electricity by the presence of the radioactive substance, and in a certain time a certain quantity of electricity will pass from this condenser plate to the other plate. This quantity of electricity passing over in a certain time is determined and serves as a measurement of radioactivity. If the quantity of electricity passing from one plate to the other in a certain time is x times the quantity which would pass in the same time if uranium was substituted for the tested radioactive substance, it is said that the latter has the radioactivity x. The problem is, therefore, to measure the quantity of electricity passing from the one condenser plate to the other in a certain time. This may be done in two essentially different ways. Either by an electrometer method the quantity of electricity may be measured which during a given time passes over to the previously uncharged condenser plate. Or the time may be measured in which this plate when connected to an original charged gold leaf electroscope discharges it. For these latter measurements the gold leaf electroscope may be observed by means of a telescope provided with a micrometer scale and the time taken for the discharge of the electroscope is taken by the means of a chronometer. By such methods, the Curies say, according to Mr. Hammer, that they can detect the presence of a radioactive substance by the means of such a minute quantity that it would require 5,000 times this amount to show at all in the spectroscope. And it is stated that this method of electrical analysis is thousands of times more sensitive than spectrum analysis and millions of times more sensitive than chemical analysis.

Photometric Tests of the Nernst Lamp.

The fourth progress report of the N. E. L. A. Committee for Investigating the Photometric Values of Arc Lamps is devoted to the Nernst lamp, and to tests of the mantle and naked gas flame. The work has been carried on, as heretofore, at Purdue University, by Prof. C. P. Mathews, assisted by Messrs. Paul G. Winter and Terry T King. Prof. W. E. Goldsborough is the chairman of this committee.

A careful series of tests was conducted upon the Nernst lamp of the one, three and six glower types, equipped with the various globes, shades and heater cases furnished by the manufacturers. In making candle power measurements on the Nernst lamp, constancy of voltage is of the utmost importance. A special test given in the report shows that a change of 1 per cent. in the voltage makes in this particular case a change of more than 14 per cent. in candle-power. It was found that operation of the Nernst lamp under conditions of a constant current of .4 amp. per glower, gives the most satisfactory result from a photometric standpoint.

Fig. 1 shows the distribution of candle-power from a six glower lamp in a horizontal plane containing the glowers. It will be seen that the candle-power in this plane varies between wide limits. Normal to the glowers the value is 260 per cent. of that parallel to the glowers. This horizontal distribution of candle power is characteristic of the parallel arrangement of glowers in a horizontal plane. It is interesting to contrast this curve with similar curves obtained from the naked gas flame, the mantel burner, and the arc lamp. These last-named sources give candle-power distributions in the horizontal plane that are circular, or nearly so. When the Nernst lamp is equipped with a diffusing globe, its horizontal distribution of candle-power is, of course, considerably rounded out. Because of this peculiar distribution of candle-power, the computation of the mean spherical intensity presents some difficulties not found in the case of the other sources referred to. The difficulties are, in fact, precisely those encountered in spherical measurements on an incandescent lamp. In Table I the relative errors in the three different methods of computing the mean spherical intensity from candle-power distribution are shown. The methods are: (1) From the mean of six distribution curves in vertical planes 15° apart. (2) From the mean of two distribution curves, namely, parallel and normal to the glowers. (3) From a single distribution curve in a vertical plane 35° to the glowers.

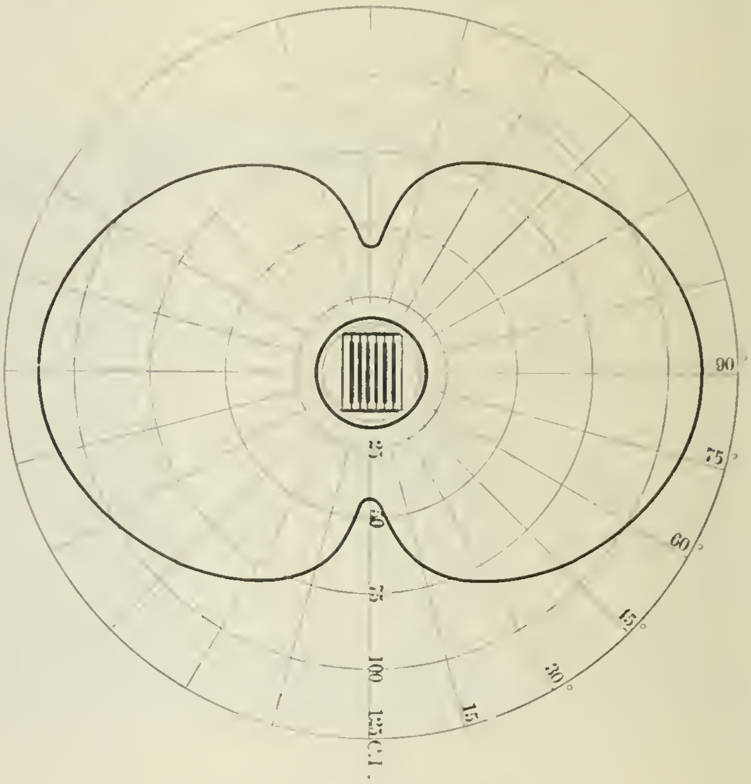


FIG. 1.—HORIZONTAL DISTRIBUTION OF CANDLE-POWER ABOUT SIX-GLOWER LAMP, EQUIPPED WITH CLEAR GLOBE.

Considering the first method as correct, the errors in the other two methods are as tabulated. The second method seems to yield a result correct to about 1 per cent., when diffusing globes are used, and about 4 per cent. when clear globes are used. It was found that there is no single plane, in which a candle-power distribution can be taken and integrated for the mean spherical intensity, with correct results for all types of globes and shades. With an integrating photometer, however, the matter becomes simply that of the taking five or six photometer settings, the mean of which yields the value sought.

TABLE I.

ERRORS IN COMPUTATION OF MEAN SPHERICAL AND MEAN HEMISPHERICAL CANDLE-POWER.

Lamp.	Mean of six curves every 15° around glowers.	Mean of parallel and normal.	35° to glowers.
		Per cent. error.	
Six-glower, clear globe, M. H. S.	0	—4.3	
Six-glower, clear globe, M. S.	0	—4	
Six-glower, pearl opal globe, M. H. S.	0	+ .8	—2
Six-glower, pearl opal globe, M. S.	0	+1.8	—1
Three-glower, pearl opal globe, M. H. S. ..	0	+ .5	
Three-glower, pearl opal globe, M. S.	0	+ .9	

From the records of the many Nernst lamp tests, contained in the report, those on a six-glower lamp equipped with various globes and shades, are reproduced here as being fairly typical. Figs. 2 and 3 show the distribution of candle-power from this lamp in vertical planes respectively parallel and normal to the glowers.

Figs. 4 and 5 show candle-power distribution in the same planes from the same lamp when equipped with opal and metal shades. The results show that the Nernst lamp equipped as indicated gives maximum candle-power directly beneath the lamp. It may be said that for many purposes this distribution of light is very satisfactory, there being sufficient upward light for the purpose of general illumination, while the light thrown downward within an angle of 45° from the vertical is very strong, making a desirable source for the illumination of reading tables, counters, machines, etc. A comparison of Figs. 2 and 3 brings out the great difference in the distribution of candle-power in the two vertical planes respectively parallel and normal to the glowers, to which reference has already been made. The use of opal and sand-blasted globes alters the distribution of candle-power in such a way as to diminish the downward intensities and increase the outward and upward intensities.

The marked effect of various shades and globes on the downward flux of light is well illustrated in the case of the tests upon the three-glower Nernst lamp. As tested with a constant current of .4 amp. per glower, this lamp consumes approximately 260 watts. It yields mean hemispherical candle-power ranging from 64.3 for the pearl opal ball, to 118.4 for the clear heater case. The corresponding values of watts per mean hemispherical candle-power, is 4.18 and 2.22.

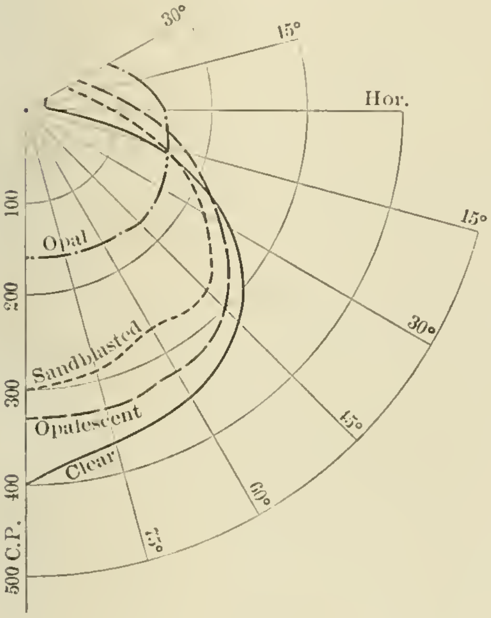


FIG. 2.—DISTRIBUTION OF CANDLE-POWER IN A PLANE PARALLEL TO GLOWERS FOR SIX-GLOWER LAMP, EQUIPPED WITH GLOBES AS INDICATED.

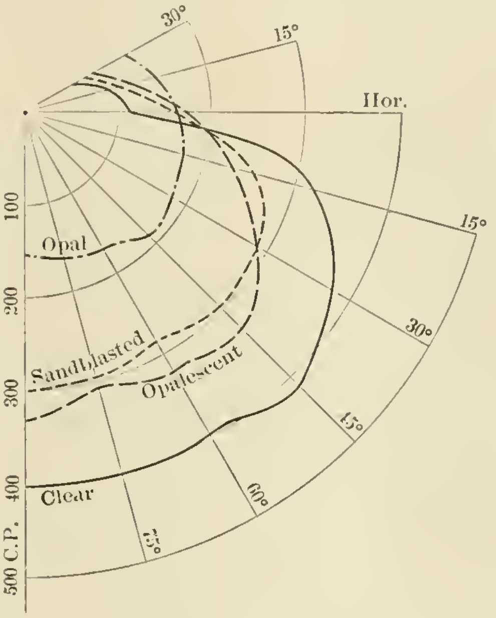


FIG. 3.—DISTRIBUTION OF CANDLE-POWER IN A PLANE NORMAL TO GLOWERS FOR SIX-GLOWER LAMP, EQUIPPED WITH GLOBES AS INDICATED.

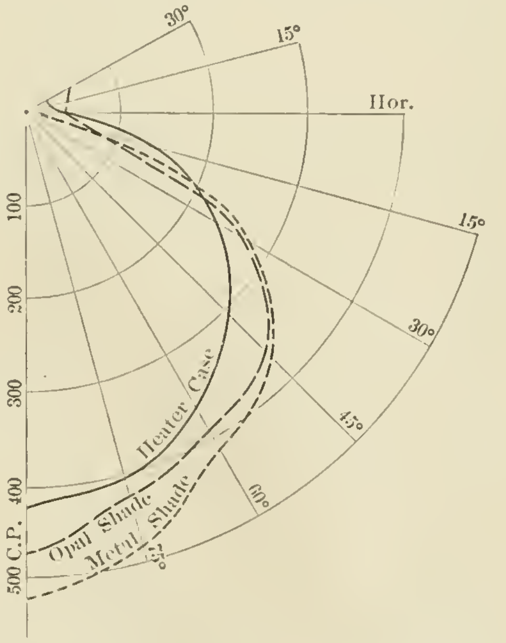


FIG. 4.—DISTRIBUTION OF CANDLE-POWER IN A PLANE PARALLEL TO GLOWERS FOR SIX-GLOWER LAMP, EQUIPPED WITH CLEAR HEATER CASE AND OPAL AND METAL SHADE AS INDICATED.

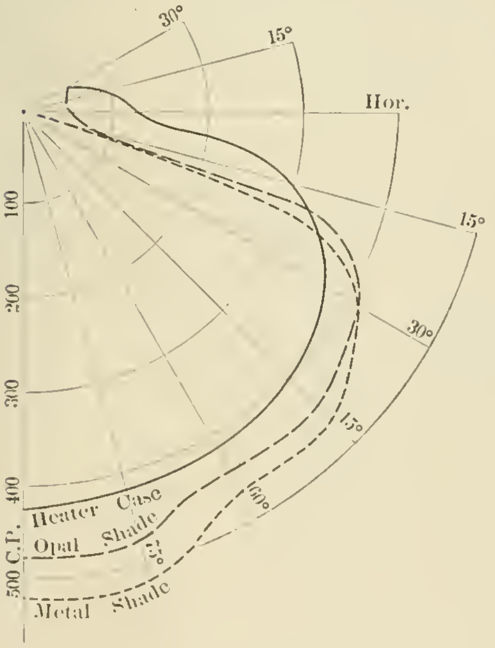


FIG. 5.—DISTRIBUTION OF CANDLE-POWER IN A PLANE NORMAL TO GLOWERS FOR SIX-GLOWER LAMP, EQUIPPED WITH CLEAR HEATER CASE AND OPAL AND METAL SHADES AS INDICATED.

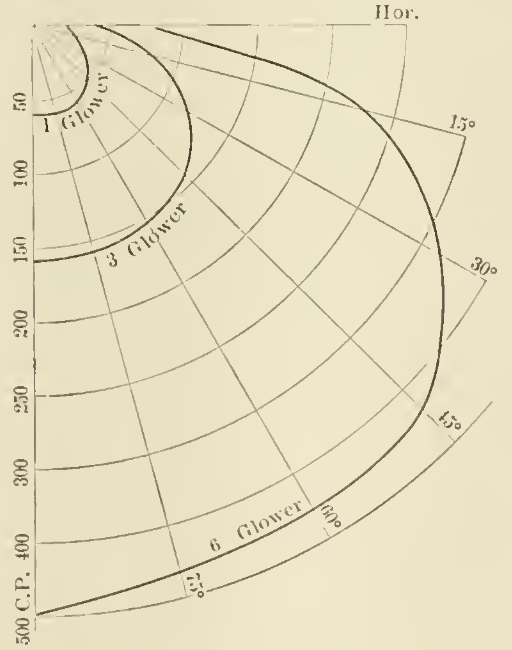


FIG. 6.—MEAN DISTRIBUTION CURVES EQUIPPED WITH CLEAR GLOBES.

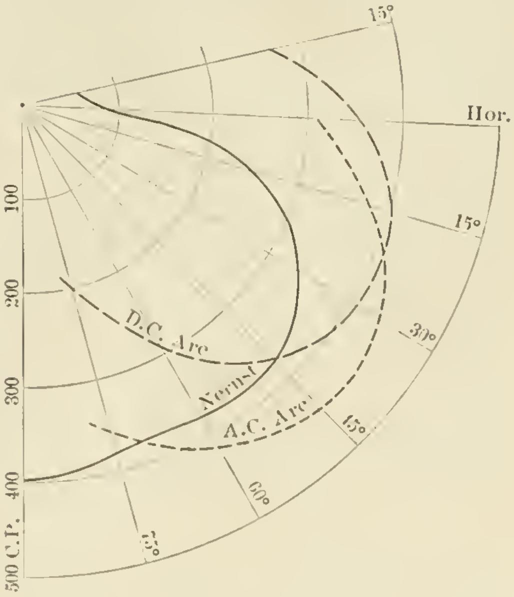


FIG. 7.—COMPARATIVE DISTRIBUTION CURVES OF NERNST AND ARC LAMPS.

The wide variation in these values indicates clearly how it is possible to alter the flux of light below the horizontal plane by the use of different globes and shades, and is a strong argument against the rating of lamps on the basis of mean hemispherical candle-power, or, for that matter, on any basis that does not take into account the total volume of light emitted by the source. Coming now to a comparison of the light output, based on the mean spherical candle-power, we find a minimum of 51.9 and a maximum of 68.7, the power consumption being the same as in the previous case. The corresponding variation in specific power consumption or watts per mean spherical candle-power, is from 5.09 to 3.84. It is evident that the variation in mean spherical candle-power can be due only to differences in the absorbing power of the globes and shades used. To put the matter in another way, this three-glower lamp, consuming approximately a constant power, is made to yield through the agency of its nine different equipments, a maximum variation of 8.4 per cent. in mean hemispherical candle-power, and a maximum variation of 32 per cent. in mean spherical candle-power.

It is interesting to note the relative candle-power of the one, three and six-glower lamps. In Fig. 6 will be found distribution curves plotted to the same scale for the three lamps, equipped with clear globes. These curves are the mean of parallel and normal distributions.

The relative power consumption per unit of candle-power is shown in Table II, which gives the watts per mean hemispherical and per mean spherical candle-power for each of the three types of lamp.

TABLE II.
RELATIVE POWER CONSUMPTION PER CANDLE-POWER OF ONE, THREE AND SIX-GLOWER LAMPS WITH VARIOUS GLOBES AND HEATER CASES.

Watts per Mean Hemispherical Candle-power.

No. glowers.	Opal heater case.	Clear heater case.	Clear globe.	Opal globe.	Sand-blasted globes.
1			2.31	4.19	2.78
3	3.09	2.22	2.33	4.18	2.72
6	2.31	1.90	1.88	3.25	2.29

Watts per Mean Spherical Candle-power.

No. glowers.	Opal heater case	Clear heater case.	Clear globe.	Opal globe.	Sand-blasted globes.
1			4.11	4.95	4.30
3	4.55		4.04	4.51	4.28
6			3.30	4.01	3.64

The table shows clearly that the three-glower lamp is slightly more efficient than the single-glower lamp, and the six-glower lamp considerably more efficient than the three-glower. This increase in efficiency can be accounted for, if we remember that a number of glowers in close proximity must, through mutual radiation, operate at higher temperature than would an isolated glower. The result is an increase in light output in spite of the fact that multiple glowers must screen the light from one another in certain directions, dependent upon their arrangement in the holder. Thus, if the number of glowers be increased, in the type of lamp with which we are dealing in these tests, the horizontal intensity will not increase in the same ratio as the downward intensity, because of the screening action of one glower upon another.

The report contains interesting results on the effect of varying the number and arrangement of glowers in the holder. The whole matter may be summed up by saying that, increasing the number of glowers, augments the efficiency of the lamp in candle-power per watt, notwithstanding the screening action of the glowers one upon another.

TABLE III.

Angle.	Candle-power. Nernst 6 glower.	Series arc A. C.	Series arc D. C.
Hor.	87	310	352
15° B.	248	375	404
30° B.	335	440	410
45° B.	373	445	375
60° B.	372	420	295
75° B	380	355	200

Globes.	Clear.	Opalescent inner, street shade.	Opalescent inner, clear outer.
E. M. F.	226	73.8	71.
Current	2.4	7.5	6.6
Watts	542	469	459
Mean hemispherical candle-power	289	394	360
Watts per mean H. S. C. P.	1.87	1.19	1.27

Although the six glower Nernst lamp takes about 20 per cent. more power than either the direct or alternate-current, series-arc lamps commonly used in street service, yet it is, as regards maximum candle power, a light source of the same order of brightness, and hence a comparison of the three sources is justifiable. Fig 7 shows the mean distribution curve of the six-glower Nernst lamp, equipped with metal shade, plotted on the same sheet with the curves for the 6.6-amp., direct-current, series arc and the 7.5-amp., alternating-current, series arc. (See Table III.) These arc curves have been taken from a previous report of the committee. The lamps on which these measurements were made were equipped for street service. The direct-current lamp having an opalescent inner globe and a clear outer globe, the alternating-current lamp having an opalescent inner globe and a metal shade. It will be noted that the candle-power distribution of the Nernst lamp is altogether different from that of either arc lamp. The Nernst lamp is strong where the arc lamps are weak, and vice versa. The points of intersection of the curves form segments which show the superiority in certain zones of each lamp over the other two.

New York Meeting of the American Institute of Mining Engineers.

THE eighty-fifth meeting of the American Institute of Mining Engineers was held in New York City from October 13 to 17. At the opening meeting on October 13, biographical notices of lately-deceased members were presented as follows: J. P. Leslie, by Mr. Benjamin Smith Lyman; William E. Dodge, by Dr. James Douglas; Theodore D. Rand, by Dr. T. M. Drown, and George S. Morison, by Dr. Leonard Waldo. The sessions devoted to the reading and discussion of papers were held on October 14 in Columbia University and on October 15 in the Hall of the American Society of Mechanical Engineers. The papers read on the first day referred to mining and to the science and art of metals other than iron and steel, while the session of the second day was devoted to the metallurgy of iron and steel.

On the afternoon of October 15 optional trips to metallurgical plants in the vicinity of New York had been arranged, invitations having been extended to the Institute by the following concerns: The American Smelting & Refining Company, the Nichols Chemical Company, the Balbach Smelting & Refining Company, and the Bayonne Refinery of the Standard Oil Company. On the evening of October 15 a reception and dance were given at Sherrys. On October 16 an inspection of the Rapid Transit Subway had been arranged for the forenoon and for the afternoon a trip by water around Manhattan Island. On the evening of the same day Dr. G. F. Kunz and Dr. Charles Baskerville presented a paper on "the action of radium, Röntgen rays and ultra-violet light upon minerals" at the hall of the American Museum of Natural History. On October 17 a visit was made to West Point and to the football game between Harvard and West Point.

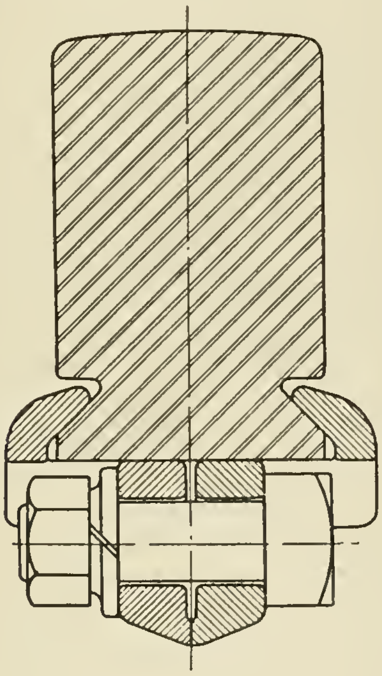
During the session of Thursday the secretary, Dr. R. W. Raymond announced the result of balloting concerning the proposed gift of Mr. Carnegie, "a fellow member of the American Institute of Mining Engineers," for the Union Engineering Building. It will be remembered that the council had declared heartily in favor of this scheme and that the question of the advisability of the Institute of Mining Engineers joining the other societies in this scheme was submitted to all the members for a letter ballot. Out of about 3,500 members, 1,600 voted, and Dr. Raymond stated "about 1,600 votes were in the affirmative and 5 or 6 voted against it." The argument presented by the latter was that the society had been run so smoothly for so many years that it seemed not advisable to change anything. Dr. Raymond pointed out that this smooth running of the affairs of the society was mainly due to two principles which were always followed. First that the council of the Institute is omnipotent; second, that this omnipotence refers only to a very limited circle of duties. Neither the council nor even the society itself is allowed to adopt resolutions for or against, say, the metric system or to adopt rules of standardization. This does not prevent the Institute from having a committee appointed for a discussion of such questions or to discuss it in a general session; but what the Institute is after is the information gathered by such committees or brought out in such discussions, and not the adoption of resolutions. "We do not endorse anybody's theory, we do not endorse our own." The carrying out of the Union Engineering Building scheme will necessitate some changes in the constitution of the Institute of Mining Engineers. They will be submitted to the members at the next general meeting in February, 1904. One of these changes refers to the introduction of an initiation fee for members, the other one to the formation of a separate corporation, a board of trustees, which will have in charge the ownership of the Union Engineering Building, as far as the Institute of Mining Engineers is concerned.

In the whole 50 papers were on the programme of which, however, only a small number were read. Below we give an abstract of those which are of interest to electrical engineers.

TESTS OF STEEL FOR ELECTRIC CONDUCTIVITY, WITH SPECIAL REFERENCE TO CONDUCTOR RAILS.

A paper on this subject was presented by Mr. J. A. Capp, of the General Electric Company, of Schenectady, N. Y. He started with a brief comparison of the trolley system and the third-rail system. While no third-rail installation has yet been in operation long enough to give exact figures of cost, it would appear that the cost of maintenance of the third-rail construction should be less than that of the overhead trolley. This consideration, together with that of sightliness and adaptability (especially in the case of terminals, yards and very heavy or high-speed service) would frequently offset a higher cost of the third-rail construction.

For the first third-rail installations old rails were used when obtainable, and these old rails were supplemented with new rails of standard T-section and composition. With the coming of the very heavy high-speed service during the past few years, the resistance of these old and new standard T-rails was found to be so high that they would not carry the high currents necessary, without too great a drop in the line potential.



CROSS-SECTION OF NEW CONDUCTOR RAIL.

"Because of the lack of specific data on the relation between conductivity and composition of mild steel, specifications for conductor rails have usually been based on the fact that the conductivity of a metal is generally more or less directly in proportion to its purity. In most cases the purity of the iron specified for such rails has been so high that not only was it difficult to obtain, but the iron was also correspondingly of high price. One of the factors governing the choice between a third rail and a trolley wire is the relative price of steel and copper, allowance being made for the difference in conductivity. Hence, a balance must be struck between high conductivity (which is equivalent to saying a high degree of purity or freedom from the usual metalloids associated with iron) and the cost of producing the steel of the composition necessary for the conductivity required."

The author then gave the results of tests made in the testing laboratories of the General Electric Company with the object of drafting an original specification for such third-rail steels. Steels of as wide a range of composition were tested as could be obtained from the steel makers and the results are given in various tables and diagrams.

The T-section rail was the outcome of designs intended to present the greatest life and strength of the section, with the least weight of the metal, conditions necessarily to be met in a running rail. But the conditions of the third rail are different. What is required here is sufficient surface for the collection of the powerful current, and an ample cross-section to carry the current without an undue drop in potential. On the other hand, the strength of the section is of little moment, and any section which is easily installed in an insulator is satisfactory. This permits the use of sections rectangular or nearly so which may be rolled easily in many mills. With these facts in mind a section of a conductor rail has been designed by Mr. W. B. Potter which, when 2.5 in. wide by 4 in. high, will weigh about 98 pounds to the yard. This shape, which is shown in the attached diagram, may be easily rolled in any merchant bar mill heavy enough to attempt sections of this weight. A dove-tail at the bottom provides an easy means of securing the rails by fishplates of special forms, and any of the common forms of bond may easily be applied. Ordered in lots of a thousand tons or more, such a rail should cost no more than a plain rectangle of equal weight.

From the elaborate tests of the author on the influence of special additions to steel upon its electric conductivity it appears that manganese preponderates in influencing the resistance of the steel, and that for lowest resistance manganese must be present in very small quantity, much smaller than is usual in merchant steel or structural steel. While all the elements must be present only in very small percentages, so great is the preponderance in the influence of manganese that other elements may be tolerated in quantities which the steel makers would consider reasonable, without unduly increasing the resistance.

For a satisfactory third rail, the lowest possible resistance (say, from 6 to 6.5 times that of copper) is not necessary; and the great cost of making such extremely pure steel is not warranted. In fact, such extremely pure steels would probably be so soft that the frictional wear of the collecting shoe would be excessive and the life of the rail in service unduly short. Assuming, then, that a rail made from steel having a resistance not greater than eight times that of copper (13.8 microhms at 20° C.) would be desirable for conductor rails, the figures tabulated would seem to indicate that the following extreme composition would be permissible:

	Per cent.
Carbon up to	0.2
Manganese up to	0.4
Phosphorus up to	0.06
Sulphur up to	0.06
Silicon up to	0.05

This composition, however, would be extreme, and any overstepping of bounds might result in too great resistance; therefore, for resistance up to eight times that of copper, the specified analysis should be:

	Per cent.
Carbon not to exceed	0.15
Manganese not to exceed	0.30
Phosphorus not to exceed	0.06
Sulphur not to exceed	0.06
Silicon not to exceed	0.05

This latter composition is one which could be made easily in any open-hearth furnace, and it should present no difficulty in rolling to a shape suitable for conductor rails. In fact, steel of this composition has been successfully rolled into sheets as thin as 0.014 in., a size which was for a long time a standard product of a large sheet mill.

The author added some remarks concerning wear and tear of such conductor rails, and from what he said it appears that this is a very serious question. While he did not give the exact figures, he said that the wear and tear of the third rail of the Manhattan Railroad has been about 1/10 of an inch since the time of its installation. This seems to be too much.

In the discussion which followed, Dr. Raymond asked why wheels are not used instead of the ordinary shoe for collecting the current from the third rail. Mr. Capp replied that the shoe gives a much better line of contact. The shoe, as made at present, does not wear, while the rail does. In the further discussion, in which Mr. John Fritz and Mr. Herbert E. Field and others participated, the fact was brought out that any larger addition of nickel to steel would increase the electric resistance enormously. On the other hand, it is possible that a small addition of nickel might diminish the wear and tear to an extent which might more than counterbalance the increase of resistance. However, from the general drift of the discussion, it was evident that the problem is still to be considered as unsolved.

ELECTRIC STEEL FURNACE AT GYSINGE, SWEDEN.

A paper on this subject was presented to the Institute by Mr. F. A. Kjellin, of Gysinge, Sweden. In the absence of the author, the paper was read by Dr. Leonard Waldo, who, in his introductory remarks, called attention to the very high temperature of the electric arc, which is much higher than the temperature required in the metallurgy of iron and steel. He, therefore, thinks that the arc furnace is not specially suitable for iron and steel. "Boiling iron is very interesting, but not of much use." The resistance furnace is a good substitute, but the trouble with the ordinary resistance furnace, if used for iron and steel, is that the electrodes are eaten up and that the charge is thus contaminated from the electrodes.

This difficulty is completely overcome in the "induction furnace," in which the charge represents the single secondary turn of an alternating-current transformer. There are, therefore, no electrodes whatever. The operator is in absolute control of the situation, and especially of the temperature. There is absolute freedom of the charge from contact with any form of fuel.

Dr. Waldo then read Mr. Kjellin's paper in which he describes his interesting induction plant, which was also described in Electrical World and Engineer of April 4, 1903. Mr. Kjellin, who had first made experiments with a small furnace of this kind, had the misfortune that a pulp mill which he owned burned down. He then concluded to use the available water power for a larger steel furnace. Mr. Kjellin's paper does not seem to contain much more information concerning his plant and his process than has already been published in these columns. He emphasizes that the steel which he makes is of the very best kind. It contains no gaseous matter. It is very easy to make the composition of the steel just what it is wanted to be. There was no discussion of the paper.

COMPRESSED AIR AND ELECTRICITY IN MINING OPERATIONS.

Advanced sheets were available of a paper by Mr. W. L. Saunders, who discussed and criticised some points of a paper of Mr. W. B. Clarke on electrical apparatus for coal mining. Mr. Saunders says in the beginning of his paper that there is no war between electricity and compressed air. Each one has its field of usefulness, and in that field each is supreme, but the general tendency of Mr. Saunders' paper is to show that compressed air is preferable for certain purposes.

"At least ten years ago, our engineering papers contained large advertisements and pages of reading matter about the application of electricity to mines, recording the introduction of numerous rock-drilling plants, and claiming that the problem had been solved, greatly to the advantage of the miner, and with promise of large profits to the manufacturers of electrical apparatus. Edison and Elihu Thomson labored to apply electricity to mines, and each believed that the probabilities of success were great. This was the period of the solenoid rock drill, which was admirably suited, theoretically, to the percussive principle, and in the development of which hundreds of thousands of dollars have been spent without satisfactory result. I have searched in vain for a standard mining equipment where electric rock drills are in constant commercial operation."

Mr. Saunders quotes several authors and points out that there is no place where the pneumatic engineer has an easier time when competing for the introduction of machinery than in a coal mine for the reason that air is exactly what is wanted in such a mine and electricity is what is not wanted, the one being safe and healthful, the other dangerous and destructive. Mr. Saunders says that there are places where electricity is particularly well adapted for mine haulage, and where it is to be preferred possibly to any other means, but that those places do not exist everywhere, and that it would be wrong to put down broad principles. He also holds that unless some one discovers a better way to drill rock than by the hammer blow it is likely that the air drill will stand supreme for many years to come. "No electric drill that has thus far been devised has equaled it in simplicity, and it is certain that no electric drill has ever equalled it in drilling capacity, which is really the measure of efficiency."

Alaska Cable.

Advices from Alaska state that the Signal Corps cable from Sitka to Juneau went into regular operation on October 3, and is now being worked in conjunction with the Skagway cable. General Greely, head of the Corps, has been superintending the operations in person.

The Electric Tramways of Kalgoorlie, Western Australia.

By S W. Childs.

In many respects, the continent of Australia offers opportunities for the investment of American capital, energy and brains unsurpassed by few other countries in the world. This is particularly true of the colony of Western Australia, occupying the western portion of the Island Continent. This section comprises an area of nearly 1,000,000 square miles, much of which is yet undeveloped, but which has large mining, agricultural and industrial possibilities. A description of the Kalgoorlie electric tramways will suffice to show, as a single instance, what has been and what can be accomplished in the transportation line alone there. Although the city is situated 400 miles inland from Perth, the nearest seacoast town, it now enjoys the facilities of an electric trolley system, built and operated according to the latest American practice, and not surpassed as far as engineering features are concerned, by any city of similar size in the Old or New World. Incidentally, a statement of some of the difficulties encountered in building the system may be of interest.

Kalgoorlie has a population of about 30,000 people, and the tramway lines were laid out to furnish transportation within the city itself, and to the gold fields lying in the outskirts of the city. The heaviest business handled by the tramway comes from the miners, who flock to the city in large crowds, particularly on Saturdays and Sundays. The tramway system comprises 16 miles of track, of which 10 miles are double-track and 6 miles are single-track lines. The fares are collected on the "flat" system; that is, the fare is 3 pence, or 6 cents for a ride within the municipal boundaries, and 6 pence, or 12 cents, to any point outside the city or into the Roadsboard district, as the suburbs are called. Cash fares are collected and registered as in the United States.

The tracks are laid in a soil which is practically a good natural cement of ironstone composition, which, though hard to work, forms a very good and permanent roadbed. In some cases, excavations for track were made by native laborers with pick and shovel, and in some cases with horse-drawn plows. The rail is a 90-pound girder, supplied partly by a Belgian house and partly by the Lorain Steel Company, of America. For ballast and road making, residue from the gold mines known as "blue metal" was used to good advantage. This is harder than granite and, when broken into sizes ranging from 1½ to 2½ in. in diameter and laid to a depth of 6 in. under the ties, forms a very hard and firm, yet elastic, roadbed. The rails are laid on ties of "jarrah" wood, a native wood as hard and fine as American mahogany. It is practically indestructible, proof against the attacks of the white ants, and impervious to moisture. It is now being used with great success as block paving in the streets of London. The ties are 6 x 8 in. x 7 ft. 6 in. foot laid —2 ft. between centers. The rails are joined with six-bolt fishplates with tie rods every 6 ft. The track is bonded with Mayer & Englund double bonds under the fishplates. It is interesting to know that during the track excavation work, gold nuggets were frequently turned to the surface by the plow—unfortunately, however, not in paying quantities. For double-track lines, the double-bracket style of overhead construction was employed with a single line of 35-ft. poles of jarrah wood between the tracks. The overhead brackets were also supplied from Philadelphia. On single-track lines single-bracket construction was used.

The car house measures 300 x 60 ft. It is built of steel throughout covered with galvanized iron. The steel for the building was furnished by the American Bridge Company. The pit arrangement at the car house is novel and is applicable to American conditions. The track rails upon which the cars rest in the car house are carried on cast-iron columns 5 in. in diameter, resting upon concrete cement piers. There is no flooring, strictly speaking, in the car barn, but all the work is done from the ground level. To expedite repair work, a bogie truck with flat-tired wheels is used, which can be moved about at will over the ground level. At the back of the barn on the lower level is a set of cross tracks so that armatures and truck and motor parts can be dropped to this level and taken under the cars to any part of the workshops on the bogie trucks. The workmen stand on the bogies when doing the truck and motor repair work.

Owing to the scarcity of fresh water in this locality, there have been constructed at the car barn two concrete cement tanks running the full width of the building, into which is drained all the rain water falling upon the roof. These tanks are 60 ft. long, 8 ft. deep and 5 ft. wide, and each year they catch and render available about $5,000 worth of water, which is used for washing the cars and for fire protection purposes. The car house is equipped with a complete system of automatic sprinklers in the roof, the water for the sprinkling system being drawn from the cement storage tanks by a pump and forced to an elevated tank near the car house by which means adequate pressure is maintained on the sprinkling system.

The company owns 10 double-truck cars and 15 single-truck cars, all of which are of the closed type and were furnished by the Brill Company, of Philadelphia. The cars are mounted on Brill trucks and in the case of the single-truck bodies they are equipped with two General Electric motors. The double-truck cars have four General Electric motors to each car, following accepted American practice.

Power is furnished by the Kalgoorlie Electric Power and Lighting Corporation, Limited, which also supplies electric power to the neighboring gold mines. This plant is capable of producing power economically, using during dry seasons water which is practically a saturated solution of ordinary and other salts. The entire plant was designed by J. G. White & Co., Limited, of London, which later secured the contract for its complete construction, and built a plant which is generally recognized as being unusually well done. The power house contains three vertical units, each consisting of an 800-hp engine made by D. Stewart & Co., of London and Glasgow, and direct-connected to a 500-kw General Electric alternator. These units supply two cycle alternating current at 600 volts, which for tramway purposes is changed to 550 direct current in two General Electric rotary converters, located at the power house. Steam is furnished by a battery of Babcock & Wilcox boilers using "Australian gum" wood as fuel. Up to a short time ago practically the only water available for power house purposes was a brackish liquid obtained from the low levels of the mines, and to fit this for boiler purposes it was necessary to maintain large evaporating and condensing plants. Lately, however, the Kalgoorlie water system has been completed, which is now pumping fresh river water from the coast 400 miles away.

The Kalgoorlie Electric Tramways, of which the writer was general manager, are owned by a London syndicate, but were built by J. G. White & Co. The tramways were opened to the public on May 20, 1902, and on the opening day souvenir tickets were sold for 50 cents each, at which price over 10,000 tickets were sold to people who were anxious to commemorate the event by riding on the opening day.

One of the difficulties in the way of economical operation is the climate, which is very dry for nine months in the year. These conditions giving rise to severe dust storms, the dust in the air at times becoming as thick as the proverbial London fog. Hence, it is difficult to maintain the exterior and interior finish of the cars in good shape, and the dust also hinders operation by filling in the groove of the rail. The only way of freeing the groove from this accumulation of dust is to force it out by a stream of water, fed under pressure to a nozzle attached to the sprinkling cars. As before stated, the water contains a large percentage of salt, and this is not conducive to long life of rails or motor equipments. The top soil is also saline and very detrimental to the rails.

Although the cost of building these tramways was very high, due to the transportation and tariff charges, it is interesting to know that the road was built at a cost of $5,000 per mile less than the original estimate. The cost of living in Australia is high, and labor is able to demand high wages. Ordinary laborers on the track receive 30 cents an hour and conductors and motormen are paid $3 per day, of eight hours.

China Objects to Wireless Telegraphy.

According to a dispatch from Pekin, the first wireless telegraph station of Marconi on the coast of China was opened October 17 in the presence of the Diplomatic and Military Corps and representatives of the Board of War and the Board of Foreign Affairs. Congratulatory messages were exchanged with the Italian flagship *Vettor Pisani*, which was lying off Taku. Wireless telegraphy, as an auxiliary defence for the legations was first suggested as a mutual plan between the legations, but to Italy is due the credit for the realization of the scheme. It is reported that the Chinese Government has already offered worship to heaven to confound the electrical spirits.

Methods and Means of Extending New Central Station Business.

At the meeting last week of the Ohio Electric Light Association, Mr. M. C. Hull, of the Columbus Railway & Light Company, presented a paper on the subject of methods and means for securing new business for central stations. In opening Mr. Hull said that one of the first and most important things to be taken into consideration when the question of how best to get new business is considered, is that of complete harmony between the department having that work in charge and the other departments upon which that particular one is dependent for support.

The contracting department creates the demand, and the men engaged in this work should be thoroughly acquainted with the business, in order to meet and cope with every situation which arises. It is really the sales department, and every solicitor is a salesman, for he meets all customers on their own ground and must of necessity work under exactly the same conditions as any commercial salesman. When the salesman, however, has landed his order and sends it into the house, it is now up to them to see that the customer gets his goods according to schedule; if he does not the salesman is apt to meet with a cool reception upon his next visit. In any case too much stress cannot be put upon the importance of showing every customer, however small, every consideration possible.

In planning a campaign for new business, it would be well to divide the work as much as possible into the various classes, such as power, factory and store lighting, sign and display window, residence, etc., and, if practicable, have a man especially fitted for each class of work, which plan, if it can be carried out, will bring the best results.

The territory to be solicited should be blocked out in districts, and each district worked carefully and systematically. The only satisfactory way to do this is to make a thorough house-to-house canvass, keeping a record of the result of each interview. These records can be kept on cards and indexed so that they can easily be referred to at any time. The interviews which give promise of results and and those which are discouraging should be kept on cards of different color, so that the promising ones can be more readily followed up. The others should not be dropped, however, without receiving at least one more call, for they frequently talk very differently at the second interview. The card records admit of such a wide range in detail that one can make as many sub-divisions as wished in classifying and recording this work.

In case of new buildings it is a good policy to address a personal letter to each party taking out a permit to build, suggesting the idea of wiring and the subsequent use of current, these letters to be followed by a personal call on the owner. It is also a good plan to keep in touch as much as possible with the architects and contractors, for they can in a great many cases be of considerable assistance. It has been the experience of Mr. Hull that a very small percentage of the new houses planned make any provision in the specifications for electric lighting, and the above method has been the means of securing business from probably more than half of them, which would otherwise have been finished without wiring.

The most desirable customer is, of course, the long-hour power user, and to get him means in most cases to educate him up to it. He can be found in every city and is usually running a steam or gas engine plant with his source of power located as far from the machinery he is operating as he possibly can get it, seemingly losing sight of the fact that a great deal of power is required to turn shafting and belting. As long as his present equipment will do the work required, it is next to impossible to make any impression on him. In the course of time he is compelled to figure on more power, either because his engine is wearing out or it has grown too small for his business, and then is the time to go after him. He seldom knows what it costs him to operate, and it is the business of the central station man to show him the advantages of economy of motor-driven machinery. The man to do this must study very carefully the conditions in each particular case, and must know the amount of power required to operate the different kinds of machines. If the prospective customer is wide awake and progressive he will readily see the force of the argument when he is shown how much he can save by the intelligent grouping of such machines as are running constantly, and operating them with a small motor located in the center of the group, thereby reducing to the minimum power lost in transmission. In the case of such machines as are used intermittently, individual motors should be installed which save expenditure of all power except when they are actually in operation A very favorable comparison of cost can be made on a plant operating under the above conditions, and one running under the old method of driving a long main shaft from one end. These are facts with which the majority of power users are unacquainted, and when they are presented to them in an intelligent manner one can nearly always get at least a part of their business. In the case of a manufacturing plant in Columbus, which removed within the past year to a new and larger factory, the question of power was taken up with them along the lines suggested above, with the result that they gave up their intention of installing a gas engine, and equipped their new plant with individual motors, and are well satisfied that they did so. In another instance where a call was made at a factory to solicit for lighting, conversation brought out the fact that they were just about to close a contract for a 40 hp gas engine. This information, of course, started an investigation as to their requirements, with the result that they were shown that they did not need nearly so much, and a contract was made with them to install 14 hp in three motors, which will furnish them ample power for some time to come.

By making a careful study of the conditions and requirements in small shops, and even in the larger ones, one will put himself in the way of securing a part of all of their power.

Next to the power user comes the long-hour lighting customer, and sign and display window lighting is also in this class. This sort of lighting should not be taken up along the same lines that you would follow in presenting a proposition for interior lighting. It is advertising of the best kind, and as such its features should be strongly brought out. Every merchant expects to, and does, spend a certain amount of money each year for advertising purposes, and until very recently the newspapers have been reaping the harvest of the money so spent. The central station, however, has come to the front with its better facilities for presenting the merchants' goods to the public, in the way of illuminated signs which designate his location by night as well as by day, and by attractive window lighting, which displays the goods themselves to every passerby on the street, thereby reaching a large number of people who do not read the advertisements in the newspapers. The solicitor who canvasses for this sort of business must be thoroughly posted on the subject, and use his knowledge for the benefit of the customer, who will nearly always leave it to him to decide what will give the best results.

As a matter of course, they will not all make the investment required to install an electric sign, but these signs are now put up in such an attractive manner and are being so extensively used that the merchant who is progressive must of necessity consider the question. The free use of current along these lines naturally lead him to try the experiment of making his interior more attractive, which he does by burning more light, and he soon finds it a paying proposition, so that in the end he becomes a customer who uses his installation a good part of the day as well as late into the night.

Residence lighting seems to be one of the hardest kind to get, mainly from the fact that nearly all people take it for granted that the cost is prohibitive. As a matter of fact it is not, for a house can be lighted just as cheaply and much more satisfactorily by the use of electric light properly distributed as it can by any other method of illumination, and here again the solicitor must get in his good work. He nearly always has his first interview with the lady of the house, and when he has shown her that electric light is not beyond her means a few suggestions as to other uses of current, such as a small smoothing iron for her fancy work, or an electric chafing dish for little lunches—these with the knowledge that she can have a turn-down light and obviate the use of matches, will make of her an advocate, and she will use her influence to get the service into the house.

Colorado Electric Light Association.

The Colorado Electric Light, Power and Railway Association will hold its first annual meeting at Denver on October 28 and 29. This association was organized last August. Mr. George B. Tripp, of Colorado Springs, is the secretary of the association.

Recent Electrochemical Developments.

TREATMENT OF COPPER NICKEL SULPHIDE ORES.

The treatment of the nickel-copper ores of Sudbury, Canada, is of great commercial importance and two processes there applied have achieved commercial success. The ores generally contain 1 per cent. of nickel and the same amount of copper, and also contain iron and sulphur. They are roasted and melted with an addition of limestone and coke; the resulting matte is treated in converters and then contains about 35 to 40 per cent. of copper, 35 to 40 per cent. of nickel and ½ to 1 per cent. of iron, the balance being sulphur. The problem is now to separate the nickel from the copper. Two methods have proven commercially successful for this purpose. The one is the Orford process, operated by the Orford Copper Company, and which is a purely chemical process; the other process, which is electrochemical, was devised by David H. Browne, and was in successful use for some years at the Cleveland plant of the Canadian Copper Company. The Browne process consists essentially in electrolizing first a solution of mixed nickel chloride, cuprous chloride, sodium chloride and ferrous chloride. In a bath with nickel-copper anodes and copper cathodes most of the copper is electrolytically deposited. By chemical means the rest of the copper in the solution is removed; then follows the removal of iron and of sodium chloride, so that finally the electrolyte is a solution of nickel chloride, which is electrolyzed between graphite anodes and nickel cathodes. Nickel is deposited on the cathodes and chlorine is evolved at the anodes and is then used for making new electrolyte.

In a patent recently granted to Messrs. Charles E. Baker and Arthur W. Burwell, of Cleveland, Ohio, the inventors try to solve the same problem in the following way: The ore is crushed and chlorinated. The chlorides of nickel, copper and iron are then brought into solution. "A sulphate" or sulphuric acid is added to change the chlorides into sulphates. The copper is removed by electrolysis using anodes of carbon, lead or nickel, and an e.m.f. insufficient to deposit nickel or iron. Ammonium oxalate or other salt is added to convert the nickel sulphate into such double nickel salt as may be desirable for the following electrodeposition of nickel. The latter electrolytic process is carried on with a current density insufficient to effect the deposition of iron. The iron remaining in the solution may finally be electrodeposited, briquetted and melted down.

The most obvious difference of this process from the Browne process and the older experiments of Hoepfner, is that the latter electrolyzed chloride solution, while in the new process the chloride solutions are changed into sulphates before electrolysis. Nothing is said in the specification of this patent concerning the advantages of the use of a sulphate over a chloride solution.

The chlorination stage of the process is described as follows: The ore, crushed to about 50 mesh, is placed in a revolving drum and heated by external means to about 150° C. Dry chlorine gas is introduced into the drum and combines with the sulphur to form sulphur chloride, S_2Cl_2, which volatilizes below this temperature and is, therefore, driven off to a suitable condenser and liquefied. The metals in the ore are thus changed into chlorides.

COMPOSITE METAL ROLL.

A patent, with the above title, recently granted to Mr. Charles J. Reed, of Philadelphia, does not disclose any new electrochemical principle, but is an interesting example of what can be accomplished by well-known electrochemical methods for specific purposes. The patent relates to composite metal rolls for use in the manufacture of paper and analogous operations which require rolls having hard, smooth and substantially non-corrodible surfaces. The inventor starts with a cast-iron drum with a coating of a solder which is an easily fusible alloy, and places over this coating a cover of rolled or drawn copper, nickel or brass or some other suitable alloy. A close union between this covering and the body of the roll is then effected by applying sufficient heat to weld this solder. Finally, a layer of similar or harder metal or alloy is electrolytically deposited upon the cover. In some cases it may be advantageous to deposit electrolytically an additional or third coating. For example, it is for some purposes advantageous to construct a roll of one layer of copper soldered to the cast-iron drum, electrolytically deposit a layer of tough copper upon the first copper layer, and, finally, electrolytically deposit a layer of nickel upon the second layer of copper. The advantages claimed for this roll are its ready and inexpensive manufacture, its durability in service and its smooth, non-porous cylindrical surface.

ELECTRIC FURNACE.

A patent was granted recently to Mr. Francis E. J. Hatch, of Green Bay, Wis., for a type of resistance furnace in which the current is confined to a series of heating conductors so arranged as to produce an even distribution of heat through the charge of the furnace. As will be seen in Fig. 1, which shows a cross-section of the furnace, there is an outer cylinder of metal having an interior lining of fire brick or other suitable refractory material. A number of straight tubes of porcelain or other highly refractory material traverse the cylinder lining in close proximity to its interior surface. These tubes contain the heating conductors, consisting of a series of small cylindrical carbon or graphite blocks of such a diameter as to snugly fit within the bore of the tube. At both ends of each tube springs are provided which press the graphite blocks in each tube together.

The advantages claimed for this construction are that the graphite or carbon conductors are efficiently protected from being wholly or partially destroyed by abrasive contact with the charge, and at the same time they are arranged to disseminate their heat at practically the interior surface of the lining of the furnace. The construction of each heating conductor in the form of a series of graphite blocks has the advantage that, although continually held in contact with each other by the action of the pressure devices at the opposite ends, the short sections of the carbon conductor never form a completely closed circuit throughout the entire sectional area of a block, and constantly incipient electric arcs are formed between adjoining blocks. The heating effect of such arcs is rapidly manifested, and by properly proportioning the blocks they may be brought to intense incandescence from end to end, so that practically the entire conductor is brought to an intense heat. The pressure of the springs upon the ends constantly tends to take up the wear due to the formation of the arcs and to maintain the blocks in proper contact.

PRODUCTION OF NITROGEN COMPOUNDS.

A patent, recently granted to Mr. Guillaume de Chalmot, of Leaksville, N. C., relates to the production of nitrides of metals or metalloids in the electric furnace and the production of ammonia from such nitrides. If oxides or salts are mixed with carbonaceous matter and heated in the electric furnace while a current of nitrogen is passed through the material, the formation of nitrides results with occasional traces of cyanides. Nitrides of calcium, barium, aluminum and titanium can thus be obtained. It is not sufficient to pass the nitrogen over the heated mass in the furnace, but it must be forced through the charge. To this end the inventor conducts the reaction with an excess of carbon whereby the material is rendered very porous, whereby the nitrogen can be forced through the entire porous mass and brought into intimate contact with all the reduced metal. In order to obtain ammonia from these nitrogen compounds, they are treated with steam at red heat. The steam should first be superheated, but if not it will become so on the contact with the hot compound. In the case of barium, calcium and other basic elements, the ammonia is easily obtained in this manner from their nitrides or cyanides. In the case of titanium it is preferable to mix its nitride with a basic oxide and then subject the mixture to superheated steam.

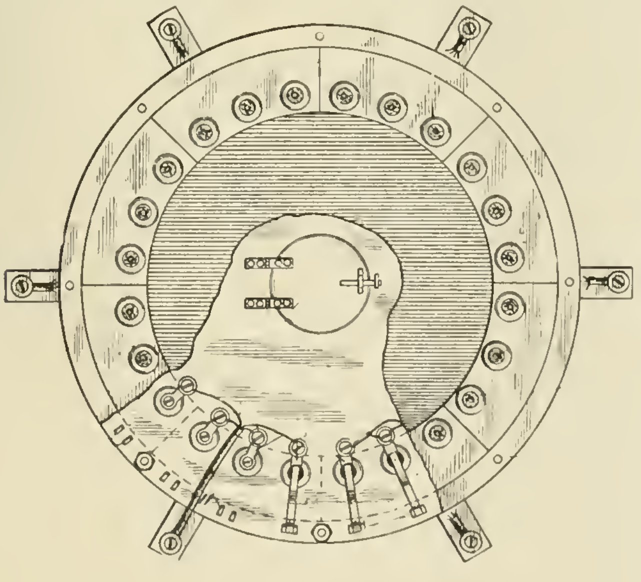


FIG. 1.—HATCH ELECTRIC FURNACE.

The inventor prefers to produce both the formation of the nitride and the production of ammonia in the electric furnace, by simultaneously forcing nitrogen and superheated steam through the charge. In order to make the operation continuous he feeds continually fresh material from above into the furnace and causes the charge to slowly descend at a rate to insure that the greater part of the material shall be acted upon and reduced by the electrically-generated heat in the furnace, the nitrogen being introduced at the top of the furnace and circulated downwards past the electrodes, and the superheated steam being introduced preferably beneath the electrodes. The entire mass gradually descends and is finally removed at the bottom of the furnace. As titanium takes up nitrogen more readily than any other element the inventor prefers to employ titanium oxide (rutile, brookite or anastase) or high-grade titaniferous ore.

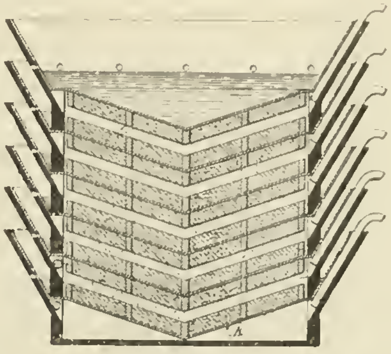


FIG. 2.—KENNEDY STORAGE BATTERY.

STORAGE BATTERY INVENTION.

A patent granted to Mr. Charles W. Kennedy, of Rutledge, Pa., for improvements in the field of storage batteries, relates to a series of cells, trays or cups nested to form a battery of required size. The general appearance of the battery, shown in Fig. 2, is quite similar to the former apparatus used in the Salom lead reduction process. There is provided a bottomless separator tray having flaring sides and an inner offset supporting portion. A metallic dish is supported by this offset portion and the positive and negative electrodes are supported by this dish.

A patent recently granted by Mr. I. L. Roberts, of New York City, describes a diaphragm for use in double fluid batteries. The diaphragm is made of glass cloth having its interstices filled with gelatinous material. Such diaphragms are said to resist the action of the strongest acids and, on account of their flexibility, they are easily secured in place in a battery, and will stand severe jolting without injury. The glass cloth which he has found best suited for the purpose is tightly woven of very finely spun filaments of glass, a large number of such filaments composing each thread of the warp and woof. This makes a fabric of close texture containing innumerable spaces or pores which are filled with a gelatinous electrolyte.

MISCELLANEOUS.

A patent recently granted to Mr. William H. Davis, of Boulder, Colo., refers to a process of treating cyanide solutions during or subsequent to their contact with the ore, whereby the double salts in the solution are dissociated and the regeneration of the cyanide in the solution is simultaneously accomplished with the purification of the solution. The process consists essentially in adding an alkaline hydrate to the contents of the storage or leaching tanks, and then subjecting the mixture to the action of an alternating electric current to break up the double salts and precipitate the base metals and combine the cyanogen radicle with the alkaline hydrates to regenerate the alkaline cyanide. Mr. George W. Frazier, of Allegheny, Pa., is the patentee of an apparatus for the electrolytic purification of water, the invention claimed referring to details of mechanical construction. A patent granted to Mr. Albert R. Pritchard, of Rochester, N. Y., relates to details of mechanical construction of an apparatus for plating sheets of metal on one side only; for instance, for coating parts of sheet metal ware vessels on one side with zinc.

Meeting of the Ohio Electric Light Association.

The ninth annual meeting of the Ohio Electric Light Association was held at Hotel Chittenden, Columbus, Ohio, on October 13-15, 1903. This Association comprising, as it does in its membership, all of the principal central stations of Ohio, always holds interesting meetings, and this was no exception. The programme of this year was a departure from the ordinary in that it gave considerable attention to boiler and engine room economy and equipment. The attendance of members, however, was somewhat below the average, and it is thought by some members that the dates are set too late in the fall, when the busy season keeps many from attending. On the other hand, representatives of electrical manufacturers and supply dealers were present in full force. President W. O. Thompson and the faculty of the Ohio State University, gave a reception to the members of the Association on Wednesday evening. Here the party was received by Profs. W. O. Thompson, Edward Orton, Jr., F. C. Caldwell, E. E. Hitchcock and W. T. Magruder.

Officers elected during the session for the ensuing year are as follows: President, S. M. Rust, Piqua; vice-president, J. H. Perkins, Youngstown; secretary-treasurer, D. L. Gaskill, Greenville. Advisory Committee—D. L. Gaskill, Greenville; Samuel Scovil, Cleveland; L. G. White, Columbus. Executive Committee—A. W. Field, Columbus, Ohio; W. F. Hubbell, Wauseon; A. C. Blinn, Sandusky; J. F. Bendure, Lima; C. Johnson, Akron. Finance Committee—E. H. McKnight, Middletown; Edward Plaisted, Kenton; E. F. Gwynn, Delaware. President Rust is familiar with conditions in the State, having been connected with the management of his home company for the past ten years, and will make a popular official. Mr. J. H. Perkins, of Youngstown, has for the past two years made a most painstaking and efficient secretary, and his advancement to the vice-presidency is a deserved recognition. The incoming secretary-treasurer, Hon. D. L. Gaskill, in addition to being a past-president, is a forceful man who doubtless will make many accessions to the membership during the coming year.

President A. W. Field, of Columbus, in his annual address, briefly reviewed the objects of the Association, viz., the fostering of the common interests of its members, the advancement of scientific and practical knowledge in matters relating to electric light and power companies, and the establishment of cordial and beneficial relations with kindred associations; and both in his address and at other times referred to the mutual interests of the members of the Association and representatives of electrical machinery and appliances. He referred to the benefits conferred upon the smaller plants, especially, and after thanking the Association for honors conferred upon himself, predicted that the Association would continue as in the past to maintain a high position of usefulness in its chosen field. Following are abstracts of the papers read and of their discussion:

Mr. W. D. Chester, in a paper entitled "Steam Boilers for Power Plants," after treating the principles of combustion, evaporation and fuels, described in general terms the various types of boilers now in use, and pointed out the advantages of the water tube boiler, dwelling upon its adaptability for high pressure and the quickness in which steam may be raised in it. As an illustration of this latter point he referred to a large power plant in Washington equipped with marine boilers in which it is necessary to begin to get up steam five to six hours before the peak load comes, or rather is due. As a contrast to this, and as showing the possibilities of the sectional water tube boiler a case was mentioned where a 265-hp water tube boiler was blowing off steam at 215 pounds' pressure in less than fifteen minutes after fire was lighted in a cold furnace with the water in the boiler at 72° F. An emergency capacity test of this same boiler of three and one-half hours' duration showed an average of 13½ pounds of water per hour, per square foot of heating surface, or four and one-half times its nominal rating, and that without the slightest sign of straining or overheating in any respect. The average rate of combustion on this test was 59½ pounds of Pocahontas coal per hour, per square foot of grate surface; and the water evaporation was 10.15 pounds of feed water from and at 212° F. per pound of combustible. This was a standard size and type of boiler which has repeatedly shown its ability to successfully, and without sign of distress, duplicate this performance.

Mr. D. S. Kohler, of the Columbus Railways & Light Company, opened the discussion on Mr. Chester's paper, and asked if the author had any data as to amount of saving from use of superheaters, and as to how the superheaters made by his company compared with those known as independent superheaters. Mr. Chester stated that his company made both kinds, but the separately-fired had not met with much success. A test of a McIntire compound steam engine in Columbus, Ohio, after running the same battery two days not superheated, and then two days superheated, showed a saving of ten or eleven per cent. in pounds water evaporated per kilowatt generated. Prof. Hitchcock, of the Ohio State University, asked in the case of a boiler being run at 50 per cent. overload, what will be its life of it comparatively speaking, with good water supplied and boiler cleaned properly? Mr. Chester said he could not answer definitely, generally speaking; the particular case cited by him in the paper was with forced draught, with boiler room enclosed. Mr. Goldsmith cited a test made by the Southwark Foundry & Machine Company, Chicago, at the Commonwealth Electric Light Station, where a 1,250-hp engine using 100° superheat, under 150 pounds pressure, showed a consumption of 10.7 pounds per indicated hp-hour. The engine was a Porter cross-compound, vertical, four valves for each cylinder. The test was for 6 hours on a water rheostat load. Inquiry made as to the advantage of enclosing the boiler room, as compared with enclosing separate ash pits, elicited the statement by Mr. Kohler that the former practice was a simpler arrangement, and on that account adopted.

The president suggested discussing in this connection methods of cleaning boilers, and asked for an expression from Mr. Perkins, of Youngstown. Mr. Perkins stated that the water there was as bad as Pittsburg water and developed a great deal of scale; he thought this difficulty had been much aggravated since they had used water tube boilers, and they had been compelled to find an efficient method to remedy the conditions.

He deprecated the use of a hammer on the tubes, and is using a Weinland tube cleaner. He had tried four different boiler compounds, with fair success, and had finally adopted a combined process of boiler compounds and mechanical cleaner, the latter operated by a motor running along in front of boiler. Mr. Kohler thought there was less scale with water tube boilers. Mr. Perkins said the trouble was not more scale, but one could not get at it so well to clean it out. Mr. Kohler referred to the advantage of standing outside and working a machine on a water tube rather than going inside and using a hammer. Mr. Kohler said he had found no trouble after cleaning the same tubes five years at least three times annually. The cleaner rather tended to put a polish on the tubes which protected them somewhat. Mr. Perkins coincided, and had also found no ill effects from boiler compounds as to pitting, although this might be possible with some compounds if used in sufficient quantity. Mr. McKnight in reply to inquiry stated that he used crude oil and found it to give good satisfaction, although their water was very bad. Referring to bagging, it was stated by Mr. Kohler that he never found a tube bagged above the first row. He had never heard a satisfactory explanation of this. Prof. Hitchcock declared in favor of a fire-brick arch or Dutch oven Turner furnace, especially with use of bituminous coals, as a means of protecting the heating surface, and tending to distribute the heat better. Mr. Kohler asked if any one had used the Shelby seamless drawn tubes, and with what results? Mr. Perkins stated that after careful investigation and keeping track of every tube by number, they had settled down to the Tyler charcoal iron tubes, which could be bought at three-fifths the cost of the Shelby. Mr. Kohler had not obtained any better results with the seamless than some others on the first row of tubes.

In a paper entitled "Engine Economy and Equipment," Mr. E. J. Bechtel, of Toledo, Ohio, referred in general terms to the several types of prime-movers, and pointed out that in designing the engine equipment for a central station it is neither the engine having the best steam economy on the one extreme nor the engine having the least first cost on the other extreme, which is to be considered the most efficient; but it is the engine which is best adapted to operate under local conditions as they exist, or under conditions which can be brought about. In other words, all conditions including interest on investment, etc., should be carefully studied, before deciding upon the proper equipment. Upon the combination of all conditions depends the advisability of using high-pressure steam, superheated steam, vertical or horizontal, simple or compound, condensing or non-condensing, high or low-speed engines, size of units, with or without steam jackets, reheating coils, superheaters and various other appliances, which tend to change the conditions of economy. The economy of the central station, moreover, does not depend entirely upon the design of the equipment, but also upon the operating force, which can in a great many cases lessen the efficiency of a well-designed station or increase the efficiency of a poorly-designed one by their method of operation. Thus, the importance of carefully selecting an operating force which will give maximum results with the least cost, is apparent. The force should be carefully made up of men capable of promotion with the knowledge that a defined line of promotion is before them, depending upon their ability and time of service, without any show of favoritism. In this way only will we be able to get the proper grade of help to begin at the bottom and at a salary in proportion to the position.

Mr. Bechtel regarded with some favor the possibilities of the steam turbine for central station requirements, their capacity at present, he stated, being limited to 500 kw per unit for direct-current work; gas engines he considered a doubtful factor.

In the discussion Mr. Gaskill asked as to the relative cost of the turbine as compared to the Corliss type of engine. This, Mr. Bechtel stated, depended upon the size of the unit; he had in mind a 2,000-kw unit, and the cost of that with an engine and generator as compared with a turbine and generator, is in about the proportion of 7 to 10, in favor of the turbine; that is, not including the condenser or air pump. He did not know the exact cost of the engine alone as compared with the turbine alone. As to the limit of 500 kw for direct-current when there is no such limit for alternating current, he said this is due to the commutator; the turbine necessarily having a high speed of 1,500 to 3,000 r.p.m., allows of only a small armature, and on 500 kw at 500 volts the ampere capacity would be about 1,000 amp. He had seen in operation a 500-kw, 500-volt, direct-current turbine, which had two commutators of about 15 in. diameter, and perhaps 15 in. to 20 in. face each, which was entirely out of proportion to the diameter. In reply to a question as to the advantage gained by using direct-connected instead of belted units, Mr. Bechtel said there was a little better efficiency in favor of the direct-driven. In reply to a question, he said that a 100-hp turbine operating condensing would require with 28-in. vacuum about 20.5 pounds of water per kw-hour. The main efficiency of the turbine is in the condensing apparatus. It is very essential to have a high vacuum, and also superheated steam if possible. The main economy is in these two points.

In the discussion following several members gave opinions unfavorable to the gas engine because of its unreliability, and disposition to go on "strike" just when its services were most desired. It was subject also to fluctuations which in an individual plant might be overlooked, but not in the case of a public lighting plant where the service is constantly open to criticism. Gas engines, Mr. Gaskill thought, were faulty in the two principal respects of unreliability and fluctuation. Mr. Field thought they could be used in railway work up to certain sizes, but concurred with other speakers as to unreliability for electric light work. Mr. McKnight had had a like experience. Perhaps the difficulty was mainly in getting a properly equipped engineer to look after the gas engine at the price most people could afford to pay them for units of smaller sizes.

Prof. Magruder said he thought the unfavorable opinions with respect to the gas engine had come from gentlemen who were unfamiliar with the gas engine's capabilities. He instanced a plant in Lancaster, Ohio, which had been using gas engines for five years for electric lighting work satisfactorily. Gas engines of 150 hp had generated on about 10 cu. ft. of gas per brake hp-hour, which he considered was equivalent to something under 12 pounds of steam per brake hp-hour; so that when it came to the question of heat units, the gas engine can deliver the goods. One of his German friends had written that he had designed a 5,000-hp unit, and one of his own students had designed a 45 x 54 crank-pin 20-in. diameter engine which is being built by the Allis-Chalmers Company. The foreign makers were guaranteeing regulation of their gas engines, and in America there is a great future for the gas engine.

Mr. J. H. Perkins presented a paper entitled "Development in the Engine Room," in which he dealt with improvements made in the plant of the Youngstown (Ohio) Consolidated Gas & Electric Company since 1900, in which year Mr. Perkins described the plant before the association in a paper entitled "Operation of a Combined Lighting and Power Plant." In this period the former belted machines have been replaced by direct-connected, two-phase generators. The former arc light circuits are supplied from constant-current transformers, and the 500-volt direct-current power service from rotary converters, where single-phase and two-phase motors have not been substituted.

One of the first difficulties when the change was made was in the parallel operation of the direct-connected units. There had been no trouble with belted machines, but considerable trouble with the first direct-connected machine, not when operating with the belted units, but in operating rotary converters and operating in parallel with the direct-connected machines. It was found that the trouble did not lie in the fly-wheel nor in the variation of the engine speed in each revolution. A good share of the trouble was found in the rotary converters, and a dash-pot on the governor of the engine was found to be a cure for almost any trouble in parallel operation. The troubles in the rotaries were easily remedied. Any engine in the plant will pump and cause all kinds of disturbance if the dash-pots are out of order, and some of them would not work an instant in parallel without a dash-pot. Mr. Perkins considers that it would be very much more difficult to get the same results by the use of heavier fly-wheels.

In the matter of engine regulation 3 per cent. was decided on as about the best that can be expected with good, reliable, parallel operation. Some of the manufacturers say that this should be fully 4 per cent., but it can be made as small as one pleases by taking all the kinks out of the governor by dash-pots or otherwise, thereby causing smooth rotation or regular angular velocity.

In the changes a backward step was taken in only one feature, namely, voltage regulation, and this seemed unavoidable. The main cause has been the greater increase of railway load as compared with lighting. With 50 per cent. lighting and 50 per cent. railway load, the service would be entirely satisfactory when operated from the same machines; but if railway load is added in greater proportions the disturbing effect will become noticeable, especially if the machines are overloaded. To overcome this at times when it seems desirable to operate both light and power together, a voltage regulator of the latest type is being installed. It is safe to say, however, that at all times a regulation is obtained that would be impossible under the same conditions of load and manner of running on any other systems, except by the use of a storage battery of ample size.

In the period from 1900 to date the lighting output has increased 142 per cent., the railway output about 800 per cent., and the power motor output about 200 per cent.; the increase in total output being about 440 per cent. The load factor has increased from about 25 per cent. to 50 per cent., and there has not been a single shut-down due to the engine room. The economy in the engine room has increased to a wonderful degree, not only in improving the load curve and by reason of the large output, but by reason of the change in the type of apparatus. The greater part of the saving has been made in labor and maintenance charges. For an increase of 225 per cent. in capacity the engine room labor has only increased 57 per cent. There has been a decided saving in maintenance of electrical apparatus, this account having dropped to almost nothing.

Questions were asked by Messrs. Bechtel, Hayler, Bailey, Prof. Caldwell, Mr. McKnight. Mr. Perkins said that they had to-day practically no trouble with their rotaries, although they had at first experienced some by reason of their not operating properly from the vertical engine. Some of his sub-stations are not inspected once in three months because not found necessary. They were understood to be the pioneers in the operations of 60-cycle rotaries, and had now found how to operate them without any trouble, the commutator being the principal thing that requires watching.

Mr. George Hayler, Jr., of Van Wert, Ohio, in a paper entitled "Steam Records," advocated the keeping of a steam logbook, in which the following entries should be made: The names of engineers and firemen on duty and the hours each works; the number of engines and boilers in service and the hours run by each; the amount of coal burned by each fireman or group of firemen, and the total coal burned in 24 hours; the amount of water pumped into the boilers during the same time and the approximate evaporation figured from these data; the steam pressure, temperature of feed water, atmospheric temperature and water, and the amount of cylinder and other oil used by each engineer and the amount used of waste and packing. Indicator cards should also be taken from time to time and a record made of the time of stopping and starting each engine. From the data of the record load curves should be constructed daily. The paper also dealt with the economics of the boiler room.

In the discussion of Mr. Hayler's paper Mr. Perkins told of some important and valuable results that had been reached through tabulation and study of records in saving in coal consumption, and illustrated his statements by plotting curves on the blackboard.

Burning about 90 tons of coal per day, they had in one instance saved through information thus derived some $40 per day in coal consumption. In answer to a query from Mr. Gaskill as to where the leak had been, he stated that it was because of operating the furnaces and boilers at under capacity—too much boiler capacity for the load. To get best results they had to operate at 25 to 30 per cent. over the rating of the boilers. He used 400 hp of Roney stokers.

Mr. A. C. Blinn, of Sandusky, Ohio, in a paper entitled "The Value of Station Records," argued strongly in favor of small central stations keeping complete records of plant performance. Aside of the value of such records in revealing where economies may be practised, is their advantage in case a plant is to be sold, through preventing underestimation by the prospective buyer.

In the discussion Mr. Bailey emphasized the value of records outside of as well as within the station proper, in which Mr. Blinn heartily concurred.

Mr. D. L. Gaskell, of Greenfield, Ohio, delivered an address upon the new Ohio municipal code as affecting Ohio electric light companies. He pointed out the steps that will have to be taken under the new code to contract with a municipality, and explained wherein they are different from the several requirements under the old rules. Mr. Gaskell, in conclusion, said that taken as a whole the new code will not make any material changes as affecting electric light companies, and that while it has cleared up a few ambiguities it has introduced others. He considers what is needed is a clear and comprehensive chapter of sections limiting the power of municipalities to engage in municipal ownership and giving the right to contract for a long term without restrictions as to vote and consents of any except the boards in charge of making city contracts.

Mr. Charles T. Mossman read a paper entitled "Notes on Certain Three-Wire Systems," which will be reprinted in full in the following issue.

The first paper of the session of Wednesday afternoon was read by Mr. K. C. Randall, of Pittsburg, on "Some Practical Considerations and Applications of Transformers." The writer took up four points as of especial interest to the station operator, viz.: (1) The first cost; (2) amount of power consumed in losses; (3) the continuous and overload capacity; (4) the life of the transformer. These were considered with reference to different classes of service, attention being paid to the time of heavy load and light load; also to the requirements where overload might exist. By means of definite examples the relative value of two transformers was illustrated; also the great superiority of a transformer, which normally operates at a low temperature rise, and, therefore, having large overload capacity, over one with a high temperature rise, and, therefore, little or no overload capacity. As a summary, durability, life and low temperature were shown to be practically synonymous, and the result of low losses in a good design. The features of the so-called double-ratio transformers were also illustrated by means of ratio curves, and several examples cited to illustrate their application.

During the discussion it was asked if the iron loss with such transformers when operated at a 9 to 1 ratio would not have an excessively high value. To this was replied that the purpose of the double-ratio transformer was to obtain a constant secondary voltage in spite of a variation of 5 to 10 per cent. in the primary voltage, so that when a constant secondary voltage was delivered, meaning no change in the induction density throughout the core of the transformer, no increase in the iron loss would result. Mr. Randall said that other features of the double-ratio transformers are that where an increased secondary voltage is desired for operating, say, induction motors on an all-day service, the slight increase of iron loss due to increase in the secondary voltage would be practically negligible, and still permit the operating of the motor at a higher voltage, and, therefore, reduce the copper loss. The importance of replacing many small transformers by a single larger one was dwelt on and illustrated by a definite example showing the actual monetary gain by such a change, as well as the gain due to putting several transformers in reserve which were replaced by the single larger transformer. To produce good transformer iron minute attention must be given to the iron in all its steps of treatment to prevent aging. Importance of accessibility, convenience of handling, for all transformers, and particularly the larger sizes, was referred to. A short reference was made to the use of balancing coils for operating three-wire systems, or obtaining a double voltage or heavy voltage, as might be desired. Transformers should be properly arranged for three-wire operation; this was illustrated by an example showing the trouble arising from an improper design. A number of examples with time and temperature and time load curves were given, showing how a transformer of small normal capacity but of large overload capacity should be used where a much larger transformer capacity would be required for short periods.

In the discussion Mr. Troy, of Schenectady, asked if the other qualities of a transformer, such as regulation, C^2R loss, etc., might not be limiting features just as much as heating? Most central station men are equally concerned with the matter of regulation and copper loss. The overload capacity of a transformer is just as much a function of the regulation and C^2R loss as it is of the heating. Mr. Troy urged the necessity and desirability of a fixed standard of temperature on which to base regulation and efficiency of transformers under discussion. If such a universal standard was accepted he thought the standard set by the American Institute of Electrical Engineers, namely, 50° C. maximum rise, is the logical one to accept. Mr. Troy asked the writer of the paper to state what is the regulation, C^2R loss and heating of a 5-kw transformer on the basis of a 5-kw and a 6 kw load?

To this Mr. Randall replied that in such case one would practically get the benefit of the low iron loss for the nominal load for 5 kw, and there would be a pronounced gain that way; the copper loss would be larger, but just how much he could not state.

Mr. Troy thought that in operating a line containing transformers of various ratios, the lamps on the line would be subjected to dangerous voltages under light load conditions, and it might well be asked how much would this voltage vary during different parts of the day in the example cited by Mr. Randall, where transformers of three different ratios, 9, 9½ and 10 to 1 were used on the same line? Would not the saving in line construction be more than offset by the poor all-day efficiency of the transformer, etc.?

Mr. Randall replied that if a 9-to-1 ratio is used all over, the iron losses, which are pointed out as being very prominent, would be increased, but would even then be quite low, while the gain in regulation and gain in reduced copper loss would perceptibly offset the iron loss, and there would be increased regulation, which would be a substantial gain. In reply to a question by Mr. Holt, regarding the relative efficiency of a 50-per-cent. and a 150-per-cent. load, Mr. Randall said this would depend upon the proportions of iron and copper loss. Assuming a transformer with an iron loss of say 1½ and a copper loss of say 2 per cent., at one-half load, the iron loss would come down about 66 per cent., or just about to 1 per cent., and the copper loss would go up to about 4½.

Mr. Turner thought that regulation is one of the most vital points in the distributing system; if one cannot maintain a uniform voltage on a distributing system, he loses one of the great advantages that electric light has in competition with other illuminants. If at light load the lamps will receive a very high voltage and are burning at standard voltage only at the time of maximum load, it not only means that the lamps' life is shortened, but that those customers who have their maximum current at an earlier period than others will notice the difference between the candle-power of their lamps at one time of the day and what it is at another time. The question of candle-power is mostly one of comparison. The best way to maintain a distributing system is by the use of feeders and subfeeders; otherwise uniform voltage cannot be maintained. Mr. Turner feared that some of the advice given was wrong in that it did not develop the distributing system along lines that are being to-day recognized by the larger stations as the proper lines for development.

Mr. Bechtel desired to emphasize the remarks of Mr. Turner; the use of the double-ratio transformers is equivalent to using, say, 110 volts at one station and 100 volts at the end of the line, with poor regulation; the tendency would be increased cost of current to the customer, just what to avoid. Mr. Bechtel thought the position taken by Mr. Randall of substituting one large transformer for a number of smaller ones was very good, although in many cases the point is overlooked.

Prof. F. C. Caldwell, of Columbus, Ohio, read a paper on the "Combined Use of Alternating and Direct Current for Central Station Work," in which he considered the question, "In what proportion should the alternating and direct current be used in any particular plant?" His conclusions are that in the case of newly-established plants of the present day the evidence seems to favor, for the smallest plants having no large concentrated load and little or no elevator work, a distribution entirely by alternating currents. For larger stations located near their load centers, there seems to be no doubt about the use of direct current supplemented by the storage battery for the district surrounding the station and including the concentrated load, and the generation of alternating current for transmission to and distribution in the regions more distant from the station. For the generation of power in this case, several different arrangements are possible; one of them is the use of double-current generators, but a difficulty presents itself here in that these are usually made for a frequency which is too low for satisfactory lighting. Another plan is the use of the direct-current generator and steam turbine alternator with a rotary converter to connect these, and make it possible to carry the whole load, when light, on either of the two machines alone. In some cases it may be possible to omit one or the other of the generators, at least temporarily, producing all the power as direct current and converting for the alternating-current distribution, or vice versa, according as the demand for one or the other form of current is the greatest. Lastly comes the case of larger towns where it is desirable to generate the power at a greater or less distance. Here the almost universal practice is to have rotary converter sub-stations at the center of the concentrated loads, where the alternating current generated at the main power station or stations is converted to direct current; this is then distributed as such with the aid of the battery located in the sub-station, while the more distant and less concentrated districts are supplied with the alternating current. Here the question of frequency comes in again as a complicating factor. Rotary converters operate more satisfactorily on low frequency, but this is not suitable for lighting purposes; the question, therefore, must be decided as to whether to sacrifice the best interests of the converter stations and use a frequency of 60, or to use 25 periods for the transmission to the sub-stations and to raise the frequency to 60 for use in the suburban districts. Of course, the relative importance of the two kinds of service would have considerable influence in deciding this question.

Next Prof. Caldwell considered the problem of the adaptation of plants already installed so as to fit them for modern conditions. Such plants, if located near the center of distribution, will generally be direct-current plants, and direct current will be retained for the service in the vicinity of the power house, alternating generators being added for the more distant districts. If the establishment of a distant generating station is warranted, the old power house will usually become a sub-station with rotary converters for supplying the old direct-current districts, alternating-current districts being supplied directly from the new generating station. The old machinery may be dispensed with entirely or maintained simply for emergency work, as for the peak load of nights during the Christmas holidays; if, however, the direct-current equipment is modern, it may be kept in constant commission to take care of the daily peak, the load during other hours being taken care of entirely from the main generating stations.

Assuming that the plant is to comprise both alternating and direct-current distribution, the question arises as to what part the direct and alternating currents should take, respectively, in the distribution. Three different arrangements are possible; the districts covered by the direct and alternating currents may be entirely separate, or the alternating and direct currents may both be available to the consumer throughout a considerable part of the system; or the alternating and direct-current districts, while in general separate, may overlap on their borders. The first of these conditions, if practicable financially, would be the most satisfactory to the consumer, making it possible for him to have either form of current as best suited to his particular needs. It is doubtful, however, whether conditions would often permit of such a double distribution unless it were in a case where polyphase alternating currents were used for the general distribution of light and power supplemented by a 500-volt direct-current circuit, used only for such motors as required this current for their satisfactory operation. Otherwise it would seem that the entire separation of the districts covered by the two forms of current would be the only arrangement that could be worked without danger of a considerable amount of friction with customers desiring a different form of current from that most available in their district.

At the conclusion of Prof. Caldwell's paper President Field said that he felt confident the Association highly appreciated the value of such a contribution to its proceedings. Mr. Bechtel said he had no criticism of the paper, which he thought had fully covered the ground; but it had suggested the thought to him of the great importance of stations designing their systems or modifications thereof with regard for the future. Designs that were not antiquated intrinsically often became useless because of their small size and inadequacy to meet the conditions of growth and extension. He called attention to the new lamp, the magnetite, recently designed by the General Electric Company, in which there is no depreciation of the copper electrode; a stick of magnetite ⅝ in. in diameter and 8 in. long burns about 150 hours without an inner globe, being really an open-arc lamp. It is not adapted to inside work on account of the smoky deposit, but is very good for street lighting. If adopted it will bring direct current into favor again and possibly revive the old Brush machines, unless a suitable converter can be found to transform alternating into direct current. The Westinghouse Company also has a luminous arc lamp called the Bremer. Both these lamps are very economical, the magnetite being an especially long-burning lamp. They consume about 300 watts and either of them will compare favorably with the present open arc at 450 watts. The rapid increase of interurban roads must also be considered by many stations and new installations, so that stations can be added to as may be necessary. In a new station the generating apparatus should be entirely alternating current; 25 cycles would be the best frequency. This would necessitate frequency-changing sets of 60 cycles for alternating-current lighting. From the 25-cycle generator could be operated all of the system by means of rotary converters. The mercury vapor or Cooper Hewitt lamp is a very efficient one, but Mr. Bechtel thought it would not come into commercial use soon. The alternating-current railway motor is liable to come into general use; both the General Electric and Westinghouse Companies are working on single-phase railway motors. In a trip taken on a car at Schenectady, while the car did not accelerate probably as fast as with a direct-current motor, it obtained good speed and picked up fast by sacrificing power factor at the start.

Mr. Turner stated that while he had not heard any figures given at this meeting, the general impression seemed to be that the area of direct current was very limited; he believed that it was generally conceded that direct current can be distributed over a radius of close to a mile at a greater advantage than alternating current, and that by the use of sub-stations and rotary converters that area can be very largely extended. Direct current has always the advantage that is at least up to date and of greater reliability of service than the alternating-current system. With a direct-current, low-tension system a network of mains and feeders and a storage battery, a city is practically sure of a 24-hour service with no interruption from one year's end to the other; and there are very few alternating stations that can point to a record of continuous operation for one year. Dr. Bedell, of Cornell, has worked a great deal on distributing both alternating and direct current over the same feeders and mains at both high and low tension.

In closing the discussion of his paper, Prof. Caldwell said that he had hoped that his paper would elicit some opinions as to the importance of the storage battery in the modern central station; whether it is so essential as to make it worth while to give up the advantages to be gotten from alternating-current distribution is a very live question at the present time. Along the line of Mr. Bechtel's comments, as to the Cooper Hewitt mercury vapor lamp, it might be added that when this lamp was first presented last July at the American Institute of Electrical Engineers' convention, they had a little musicale with refreshments on the lawn served by negro waiters; the negro waiters came out a beautiful pea green!

Mr. M. C. Hull, of Columbus, read an excellent paper entitled, "Methods and Means of Extending New Central Station Business, which is reprinted elsewhere in full. In the discussion of this paper. Prof. Caldwell said that the great convenience from the use of electric current was a point that could never be overdrawn when approaching a customer, especially in a natural gas territory where there was so much to contend with; the ease of turning on an electric light in a cellar or any remote part of the house without striking a light was a great inducement as a matter of convenience.

Mr. Bechtel spoke at some length on the contract department of the central station, and the advisability of keeping such a record of individual cases that even if the solicitor left the service, the new man would be at once prepared to take up his work where it was left off. With natural gas at 30 cents in a city Welsbachs were cheaper, but could be offset by other advantages offered by electric light; tact and looking after the interests of the customer were also powerful factors in soliciting and in making the public your friend.

Mr. Hayler urged that pains be taken to cultivate the architects and see to it that when the wiring is done it be put in as conveniently for the occupant as possible, and thus the customer would become the staunch adherent of the electric light. Mr. Perkins stated that Youngstown had no regular contracting department, but wherever they learned of new buildings it was arranged, if possible, so that nothing but electric light would be used. Keeping in touch with the architect is a very good thing. The architects come to the electric light company to get the form of their specifications, and naturally they are accommodated. Mr. McKnight had found his customers often his best friends; he instanced a case where a lady used electric light, although her husband was the manager of the gas company, because she found that the handsome decorations of her house had been nearly ruined by the gas fumes. Mr. Blinn reported that they suffered a great deal in his city (Sandusky) from bad wiring, and they had accordingly established a rule that connections would not be made for electric light unless the company had first inspected and favorably passed upon the wiring of the house; the rule had worked very satisfactorily.

Mr. W. F. Raber, of Mansfield, Ohio, in a paper entitled "Electrical Distribution in the Engine Room," described the equipment of the Mansfield Electric Light & Power Company, which, however, he did not hold up as an ideal one from the economic standpoint. It is the intention of this company to install three-phase generators direct-belted to each of the Corliss engines now installed, and to take from these power for all classes of lighting and for small motors and install rotary converters for direct-current power customers and for railway service. A storage battery will also be installed to float on the railway and power circuits, thus enabling the engines to do their work at the economical point, the battery to be depended upon also to take care of the peak loads. It is also proposed to install a steam turbine, the turbine to be run regularly and the other engines held in reserve or used when necessary to carry the heavy winter peaks on the lighting circuits.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY ON THE PACIFIC.—A special dispatch from Port Townsend, Wash., of October 17, says: "The plant of the Pacific Wireless Telegraph Company was thrown open to the public here to-day. The apparatus worked satisfactorily on the initial message, which advised President Roosevelt of the completion of connections at Fort Casey on Whidby Island with the land lines of the big telegraph companies. Following this a large number of congratulatory messages passed between Fort Casey and this city."

THE SNOWS OF YESTERYEAR.—A cable dispatch from Paris of October 17 has this melancholy item of news: "The last vestiges of the Exposition of 1900 are rapidly disappearing. The great statue and its supports on the Palace of Electricity were demolished this week. The gigantic female statue of the Genius of Electricity, weighing 30,000 kgm. and standing at a height of 80 m., was overthrown, causing a deafening noise and clouds of dust. Nothing remains of the beautiful palace but heaps of bent iron and shattered glass. The detonation caused a great disturbance among the cavalry horses now quartered in the machinery hall, but there were no accidents."

A LARGE FLUME.—The steel flume to be used by the Ontario Power Company at its plant at Niagara Falls, Ont., will have a diameter of 18 ft. and will be 5,880 ft. long, the plates being ½ in. thick. On account of the difficulties attending the transportation of so large a pipe, a temporary plant will be erected on the Canadian side for the purpose of constructing the flume. Its construction will require from 10 to 16 months. The flume will extend from the forebay of the Ontario Power Company along the base of the bluff, at the rear of Queen Victoria Park, to a point just below Table Rock, and there its waters will be diverted through penstocks to turbines to be installed in a power house at the water's edge.

NEW YORK ELECTRICAL SOCIETY.—The Society held its first meeting of the season on October 19 at the American Institute, when Prof. W. E. Ayrton, F.R.S., member of the Mosely Educational Commission, delivered an informal address on some electrical measuring instruments as developed in laboratory work upon a study of the resistance in the electric arc. To an audience of about 300 the speaker made his subject full of interest and instruction throughout the evening, the exposition being accompanied by references also to books, diagrams and lantern slides. Some of the data and results brought forward had not been previously made public, and will form the basis of subsequent papers. President J. J. Carty was in the chair, and among the speakers were Dr. Pupin and Messrs. L. B. Marks, Wilson S. Howell and T. C. Martin. The secretary, Mr. Guy, has prepared an admirable programme for the winter.

A BELATED PATENT.—A patent issued September 29 to the late O. B. Shallenberger is based on an application filed September 4, 1890, and has for its subject the well-known shunt box, which has been so largely employed in series alternating-current street lighting with incandescent lamps. It is almost ancient history to state that each lamp on the series circuit is placed in parallel with an individual inductance, through which, when the lamp is lighted, only a small magnetizing current passes; while should the filament break, the entire series current will flow through the inductance, the design being such that the e.m.f. then resulting will be practically that which existed between the terminals of the lamp. The original Shallenberger patent on this system was granted October 9, 1888, the present one covering the use of an adjustable inductance whereby on the same constant-current main circuit lamps may be installed requiring a greater or lesser quantity of current for normal operation.

PHASE ADJUSTMENT FOR MEASURING INSTRUMENTS.—A patent granted September 19 in the name of the late Oliver B. Shallenberger, on an application filed January 9, 1897—about a year before the death of Mr. Shallenberger—describes means for producing a given phase displacement between the impressed e.m.f. and the magnetic field of alternating-current measuring instruments. It is well known that by the introduction of self-induction into a circuit an alternating current is caused to lag behind the impressed e.m.f., and that the magnetic flux lags to a corresponding degree; this lag is, however, limited under practical conditions to an amount somewhat less than 90°. For certain measuring instruments it is desirable to augment this angular displacement of the magnetic flux from the impressed e.m.f., so that the flux may be as nearly as possible in quadrature with the impressed e.m.f., or with another magnetic flux having a definite phase relation to the impressed e.m.f. To attain this result a disc of conducting material is in inductive relation with several field coils; one side of the disc is provided with two field coils in series with the main alternating current, and on the other side of the disc there is another field coil in series with an inductance coil and shunted across the mains. A certain portion of this field coil is shunted by a non-inductive resistance. The exact phase relation desired is obtained by adjusting the amount of this resistance and the number of turns of the field coils which it shunts.

COMPENSATING FOR VOLTAGE DROP IN ALTERNATING-CURRENT TRANSMISSION LINES.—A patent was recently granted to Mr. Lawrence A. Hawkins, of Pittsfield, Mass., for an automatic method of compensating for the varying drop in voltage on alternating-current transmission lines due to varying loads and varying power factors; and also for the drop in voltage in alternating-current generators due to lagging currents of varying power factors. For compensating the drop due to a varying power factor, the arrangement consists of stationary coils in series with one phase and a movable coil in shunt with the other phase of a two-phase generator. The movable coil carries an arm which, as the coil revolves, moves over the contacts of a variable rheostat connected to the field circuit of the exciter. A decrease of the power factor in the system causes the movable coil to turn and to cut out resistance from the exciter circuit, so that the generator voltage is raised. The coils of the compensator may not be directly connected with the main circuits, but through intermediate series and shunt transformers. In order to compensate for voltage drop on non-inductive loads, the inventor provides a suitably proportioned choking coil in series with the fixed coils of the compensator. For application in a single-phase system, a condenser is inserted in the circuit of the movable coil. The application of this method is not limited to the generating end of the line. It may also be applied at the receiving end to maintain the excitation of a synchronous motor or rotary converter at a proper value to compensate for lagging current in the mains.

ELECTRICITY IN ALASKA.—Things are moving rapidly in Alaska according to Mr. W. R. Stewart, in the *World's Work* for October. Dawson is lighted by electricity, and has a good telephone system. "The telegraph has far outdistanced the iron horse, and remote corners, as yet long distances removed from any line of railroad, can flash their intelligence around the world. Since 1901 the Signal Corps of the United States Army has put in working order in Alaska more than fifteen hundred miles of land telegraph lines and submarine cables, and in the Canadian territories of the Yukon and North British Columbia the Dominion Government has displayed an equal activity. About two thousand miles of Canadian Government telegraph lines have been built from the international boundary, beyond Dawson, south to Port Simpson and Quesnelle. At the latter point connection is made with the regular commercial lines. Well-equipped telephone services have also been established between the towns, and scarcely a place of five hundred inhabitants in the mining country has not its local and long-distance telephone system."

TURBO-GENERATOR.—A combination steam turbine and polyphase generator is the subject of a patent granted October 13 to E. H. Porter and B. Currier, which involves several interesting features. A multiple set of rotors of an induction generator are carried on the turbo blades, all acting inductively on a stationary armature. This simple type of generator adapts itself particularly well to this type of machine, no insulation being required except the fire and moisture-proof insulation around the armature bars. It is claimed that the losses incident ordinarily with electric generation are in this machine returned to the steam itself, and that the steam, though maintaining in the generator a constant temperature, allows of extreme overloads. The machine is, in fact, so designed as materially to increase in it the ordinary electrical losses, thus maintaining the turbine blades at a slightly increased temperature and thereby avoiding losses due to the condensation of moisture at the turbine blades, this increasing the efficiency of the turbine. This also avoids the necessity of using fine laminations, plate construction being preferable and far less expensive. It is claimed that a machine of this construction and simplicity embodies high efficiency, limited floor space and ease of handling; that it can be started as an induction motor, running in conjunction with other generators, and then by applying full steam pressure, it will take its share of the load; or it can be brought to approximate synchronism by the turbine and simply thrown in without accurate adjustment.

POLYPHASE RAILWAY MOTOR.—A patent was issued October 13 to E. H. Porter and B. Currier on a variable-speed polyphase motor for railway service, in which the speed is varied by varying the number of poles. The motor may be of the usual synchronous or induction type without commutator, supplied by a low-voltage current transformed from a high-tension line current. The stator winding consists of heavy copper bars in multiple, but so connected that each bar or set of bars can be connected by suitable switches to any phase of the supply current; and according to the relative position of these bars with respect to different phases, the number of poles can be varied. These switches are operated by compressed air and controlled by a valve forming part of the motor itself. The valve when operated from the train pipe operates the switches transferring the stator bars to the proper supply, thereby giving any number of poles desired. While if all the switches were thrown at one instant there would undoubtedly be serious burning at the contacts, it is claimed that the transfer of any bar from one phase to another is accomplished without sparking owing to the large number of bars in multiple with it at the time the bar is temporarily removed from the circuit. This is especially true for low-frequency currents for which the motor is designed. It is also claimed that on account of the heavy stator bars and low voltage requiring comparatively light insulation, the temporary variation in the number of bars to each pole and phase during the progressive change of speed will have no injurious effect. The conductors are all in service at all times. A train equipped with motors as described above, by changing the number of poles slightly on arriving on top of a hill, would coast down a grade with a steady speed without brakes and would return the greater part of the energy to the distributing system and other trains. It is intended that the operation of the valves on the different motors which control the switches will be accomplished by the controlling valve at the head of the train, which would be operated entirely by compressed air, thus separating everything in the equipment from the high-tension mains, except the transformers, and thereby insuring perfect safety to the operator.

LETTER TO THE EDITORS.

Tests of Tangential Water Wheels.

To the Editors of Electrical World and Engineer:

Sirs:—We note in your issue of August 29, page 349, a letter addressed to you by Mr. George J. Henry, Jr., chief engineer of the Pelton Water Wheel Company, referring to an article in your issue of June 20, page 1071, entitled "Efficiency Tests of Tangential Water Wheels under 1,912 ft. Effective Head."

Mr. Henry states in this letter his opinion that the impression produced on a reader of this note might be that the Pelton wheel was lacking in efficiency, whereas an efficiency of 86.2 per cent. was shown in efficiency measurements made by "independent engineers." We fail, however, to find the Pelton wheel mentioned in the note to which Mr. Henry refers, and as far as its efficiency is concerned we refrained from taking this up in our communication to you of June 5, from which you made up your article, because the Pelton Water Wheel Company were not willing to enter any comparative test, although we had tried all inducements, and the Edison Electric Company had made arrangements for such a test.

The only comparative test by "independent engineers" at the Mill Creek plant was made on the 16th and 17th of April, 1903, namely by Prof. Hoskins, of Stanford University, and Messrs. Samuel Storrow and William H. Sanders, both consulting engineers of Los Angeles, who found a maximum efficiency of the Pelton wheel of approximately 80 per cent. at its most favorable load during a three-hour run.

This test was carried out most carefully, and every precaution was taken to make it as reliable as possible. The weir was checked up by both engineers, the leveling instruments were tested and five minute readings were taken throughout the entire range of the test. The water measurements were taken with very accurate hook gauges with the verniers reading to one-thousandth of a foot, and two hook gauges were used. The measurements were verified by all three engineers. At its most favorable point the Pelton wheel showed a lower efficiency than the Doble wheel. At points of partial load its efficiency was much lower. Although the specifications required that both wheels should carry an overload of 20 per cent. (the generators are 750 kw) the greatest load that the Pelton wheel would carry was under 780 kw, while the Doble wheel carried an output on the generator of 1,200 kw delivered to the switchboard. Even when carrying this great overload, the Doble wheel exceeded the efficiency of the Pelton wheel at its most favorable point. This test we regarded as merely preliminary, because the indicating wattmeters were not dead-beat and their accuracy was not known. Therefore, we have not published the exact results. This will be done when a final test is made before the close of the year.

The test made on the Pelton wheel, from which an efficiency of 86.2 per cent. was arrived at, was not made, as Mr. Henry states, by independent engineers, but by Mr. Henry himself with the assistance of Prof. Le Conte, of the University of California, in the following manner, which speaks for itself: The two gentlemen arrived at the plant without having provided a hook gauge to measure the water. Accordingly they had to improvise one, and they constructed what the chief engineer of the Power Company called a "shark hook." The hook is made of ⅜-in. round iron, is 6 in. across, and was pointed on an emery wheel. It is fastened on the end of a long staff, and the observer stood on a platform 6 ft. above the surface of the water. In getting the base line on this measuring staff from the edge of the weir (for this independent test) Mr. Henry, of the Pelton Company, sighted the level. The rod was simply a redwood stick with a pencil mark on it, transferred from the edge of the weir to the point of the hook without plumbing it. The base line on the stem of the "shark hook" was a knife cut, and the readings were taken off by measuring from a knife cut on the wooden pole to which the hook was attached at the lower end. The value of this test can be best appreciated when Mr. Henry pretends to announce the results down to tenths of a per cent. It was like measuring millimetres with an unmarked yardstick.

During the test made by Messrs. Hoskins, Storrow and Sanders very careful observations were made to guard against leakage around or under the weir, which is most important, as such a leakage would, of course, make the apparent efficiency materially higher than the actual one. The first thing done by Mr. Henry and Prof. Le Conte was to open up the bottom of the weir and let the water out of the measuring pond, so that the conditions, under which they conducted their test, were entirely different and must cast discredit on their results.

The weir was 8 ft. in width, and the small quantity of water going over this wide weir crest made the most accurate measurements of the height of the water of the greatest importance, as an error of a thousandth of a foot in reading this height would materially affect the percentage secured

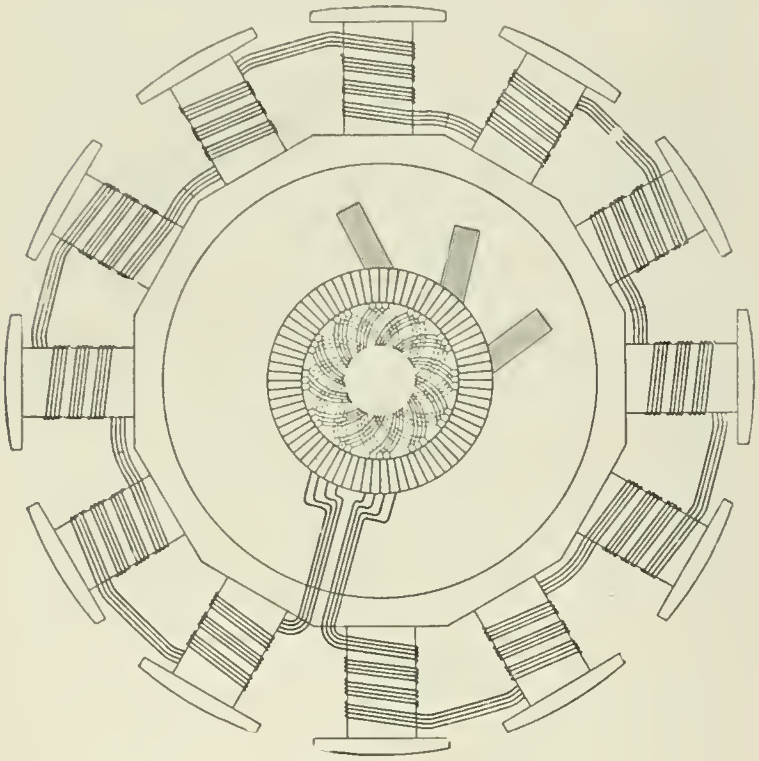
As to Mr. Henry's statement that the Edison Electric Company's orders for other wheels were placed before competitive measurements were made, and before the plant was put in service operation, we can only say that the tests were made on the 16th and 17th of April, 1903. The written order for the last wheel unit of this plant is under date of May 9, 1903. His statement, though also misleading, is accurate in that there have been no competitive tests properly speaking.

San Francisco, Cal. H. Homberger.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Compensation and Compounding of Alternating-Current Machines.—Heyland.—The author refers to the article by Meyer, recently noted in the Digest, and states that he concurs with the latter's opinion that the application of compensated non-synchronous machines, when they are motors, can be considered only in special cases. But he calls attention to the fact that for a long time he (the author) has advocated compensation and compounding of non-synchronous machines not so much for motors as for generators. The most interesting item in the further development of his compounded machines is the fact that these latest machines will be synchronous machines of the revolving magnet pole type. In explaining the principle of his new synchronous machine, he compares the rotor windings of synchronous and non-synchronous machines and shows that the mean length of a coil of the rotor winding of a non-synchronous machine averages at least twice as long as the mean length of the winding on the field pole of a synchronous machine with solid poles and an equal flux per pole. If it is assumed that the rotor of such a non-synchronous machine be wound for two-phase working, then the field, according to its momentary direction in the rotor, will be produced alternately by the one or the other of the two phases, and at the moment when the one phase has full current, the other phase has no current. If it is imagined now that the machine rotates in synchronism (which may happen, at times, with compound non-synchronous machines), and further, that this takes place at the moment when one of the two phases has full current, it will be seen that the other phase remains continually without current and might be left out entirely without increasing the losses in the least. The new machine, which is illustrated diagrammatically in the accompanying figure, is the outcome of these reflections. The slotted rotor is replaced by a magnet wheel, and instead of a two or multi-phase winding, this magnet wheel is provided with an ordinary simple pole winding, which (as in the case of the rotor phases of the non-synchronous machine) consists of several wires wound in parallel and connected to the commutator in a similar manner. The connection of the pole winding to the commutator does not correspond quite exactly to the connection of the phases of the non-synchronous rotor, but the indications given above give quite a good idea of the principle underlying the new machines. The phenomena which occur in these synchronous machines are somewhat different. The commutator serves in the first instance for splitting up the compounding current into two components, a power current and a wattless current, the latter only by reason of the brushes being properly spaced, being conducted to the active pole winding. On the other hand, the power currents which enter the winding flow in opposite directions through the various parallel-wound wires, thereby neutralizing each other. The parallel-wound wires are connected to the commutator in such a manner that the brush currents are not interrupted in any position, and that at interruptions of the current in the various wires the effect of the self-induction is neutralized by the remaining parallel circuits. By means of certain cross-connections between the various wires it has, in addition, been made possible to avoid any sparking at the commutator, even when employing relatively high voltages at the brushes. Considering the use of the machines as motors, the author states that the former non-synchronous rotors may be retained, but with a single-phase winding only. This represents the pole winding, and is connected to the commutator in the same way as described above; the slots in the middle of the winding may be omitted or filled up with iron, so that in this way the pole section is correspondingly increased. At starting this single-phase winding is used as starting winding by cutting the winding in the center, and, as is the case with non-synchronous motors, completing the circuit through slip rings and starting resistances. Such a motor starts with a large torque, similar to a non-synchronous motor which is fitted with a three-phase rotor having one phase open and the rotor winding short-circuited on itself through two slip rings only. The starting of such a machine is comparatively simple, requiring only two slip rings and a simple single-phase starting resistance. When running the single-phase winding serves as a pole winding, as in the case of the generators. The machine must be somewhat over-compounded and when the brushes are in their proper position it automatically speeds up to synchronism. If sufficiently over-excited, these machines, when working as motors, need not be overcompounded. The curve of the power factor will be similar to that of an ordinary non-synchronous motor. The new machines will be used chiefly as generators of the magnet wheel type.—Lond. *Elec.*, October 2.



COMPENSATION OF ALTERNATING-CURRENT MACHINES.

Parallel Working of Alternators.—Hopkinson.—A paper read before the recent meeting of the British Association for the Advancement of Science. The author proposes to co-ordinate the mathematical treatment of the subject with the practical rules which have been framed and are regarded as standard practice, and to point out the reason for certain phenomena which have been observed. He investigates mathematically the free oscillations which are executed by an alternator when disturbed by a temporary change of conditions, and the forced oscillations which are produced in the alternator by the uneven turning moment in the prime-mover. The possibility of parallel working, therefore, depends on the free oscillations being damped out within a short time of being set up and on the forced oscillations being of such moderate amplitude as not to interfere with the practical working. In discussing the forced oscillations, the author points out that the limitation of the angle by which the machine deviates from perfectly uniform rotation, is not precisely what is needed, and that it would be better to limit the amount of fluctuation in the rate at which energy is delivered by the machine to the bus-bars. As the speed is practically constant, this is proportional to the variations of the torque; hence, a machine with small self-induction will operate worse in parallel under a given amount of angular displacement than another one of large self-induction, supposing the condition of a long natural period to be fulfilled. The author states that the ordinary rules as to fly-wheel effect generally result in the natural period of oscillation being substantially greater than the period of revolution of the engine, but in a somewhat roundabout and accidental way. It seems highly desirable to pay more attention than has hitherto been usual to the natural period of oscillation of the alternator, when specifying fly-wheels. The period of oscillation of the governor of the engine should not be lost sight of; this is generally fairly long and may possibly give rise to resonant oscillations. He mentions the case of a motor generator, which could not be worked on account of resonance. Its natural period happened to be very nearly equal to that of the revolution of the generator, about two-thirds of a second, and it dropped out of step in a very short time, though the variation in turning moment must have been quite small. By altering the field current so as to increase the natural period about 25 per cent., the forced oscillations disappeared almost completely, showing that the difficulty was entirely due to resonance. This fact suggests the reflection to the author that it might possibly be better in some cases to put fly-wheels on the comparatively high-speed rotaries, and allow a small fly-wheel and a larger angular deviation in the slow-speed generators. He then investigates the question of free oscillations and the production of a damping effect by the "amortisseur" action. In conclusion, he states that "to sum the whole matter up, the proper way to deal with forced oscillations is to use the right fly-wheel, while damping coils must be used for giving stable free oscillations."—Lond. *Elec.*, September 18.

POWER.

Three-Phase Motors for Electrical Driving.—EBORALL.—The conclusion of his article, previously noted in the Digest, on the application of three-phase motors to the electrical driving of workshops and factories. The author gives a number of tables for various classes of machine tools, such as lathes for different purposes, boring, milling, drilling, etc., machines, showing the size of motor required, it being understood that the motors in question can carry overloads of at least 50 per cent. continuously. The author thinks that it pays, in fact, to use motors which are a little too small for the work, as they will then always be working on the flat position of the efficiency curve, and hence with maximum economy. For traveling crane work the author regards as the best practice using slip ring motors in all cases for the lifting motion, and if the motor is above 4 hp in size, also for the longitudinal motion of the crane, in order to have perfect control of the working of the crane. On the other hand, the motor for the cross-traverse of the crab can invariably be arranged with a permanently short-circuited rotor. The author next considers the application of the three-phase motors to textile mills and thinks that they meet the various requirements of the case better than direct-current motors can do, whether driving in groups or independently. He states that the ordinary loom in the silk-weaving industry actually requires about 0.25 hp to drive it, corresponding to 0.3 hp at the motor pulley. As a special point he lays emphasis on the fact that experience has shown that a belt connection between the motor and the loom is far preferable to any other form, like spur gearing, for instance, and he thinks it can only be a question of time before silk looms are universally electrically driven in this way.—Lond. *Elec.*, October 2.

Electrically-Operated Mine Haulage Plant.—A description of a recent installation at a German mine. The power station is at some distance and generates electricity for another mine also. There are two 500-hp engines direct-coupled to 300-kw, three-phase generators, which furnish current at 2,080 to 2,300 volts. A suitable fly-wheel keeps the cyclic irregularity down below 1/250th. Exciting current is furnished by two motor generators, one serving as reserve. Direct-coupled to the 20-hp, three-phase motor is the shunt dynamo, generating exciting current at 125 volts. The starting resistance of the three-phase motor is lodged in the armature. Six single-phase and three larger sized three-phase transformers of a total capacity of 295 kw, reducing the pressure from 2,200 volts to 220 and 110 volts, respectively, are used in connection with the lighting system and for the operation of the small auxiliary motors. Three-phase current is transmitted by a three-cored armored cable, 2,200 metres long, to the motor which drives the haulage plant. The latter is of the induction type, with 12 poles, and has a normal output of 120 hp, which may be exceeded by 100 per cent. for short periods. Current is supplied directly at 2,000 volts. The induced voltage in the rotor is about 500 volts. Slip rings are provided for starting and for speed regulation, the resistances being of the spirally-wound wire type. The "reversible starter" is so arranged that any one of the connections can be effected by a single lever. In the center position of the latter two phases of the motor circuit are opened and the motor stopped. By moving the lever in the one or other direction, the motor begins to rotate in that direction. The efficiency of the motor is 92 per cent. and the power factor at full load 0.9. The total efficiency of the haulage plant is about 72 per cent. The total steam consumption per hour of the plant amounts to 2,800 kgm., while a steam engine suitable for dealing with the same haulage requirements would consume about 4,500 kgm. The difference in favor of the electric plant is, therefore, about 38 per cent., meaning at the coal prices in that particular locality, a saving of about 58 cents per hour. The machine is capable of safely hauling a net load of 1,800 kgm. from a depth of 450 metres at a speed of 3 metres per second.—Lond. *Elec.*, September 25.

Electric Coal Cutting.—THOMAS-DAVIES.—An abstract and analysis of a paper by Walker on this subject, read before the Nottingham meeting of the Institution of Mining Engineers. The paper refers to practical experiences with electric coal cutting at the Digby Colliery Company. The difficulties encountered with electric cutters under the peculiar conditions at this colliery are discussed at length. When cutting to the dip with a 4½-ft. tapered bar, and making an undercut of from 3 ft. 8 in. to 4 ft. 2 in., the energy consumption measured near the dynamo was on an average about 2 kw-hours per square yard of holing. When cutting to the rise, using a 4-ft. taper bar with cleaning blade, and when using a 4½-ft. taper bar without the cleaning blade, the average consumption was in both cases 1.33 kw-hours per square yard of holing; cutting to the rise with a 4-ft. taper bar, with cleaning blades, the consumption was 1.22 kw-hours, while the 4-ft. parallel cutter, traversed to the rise, consumed on an average about 1 kw-hour per square yard of holing. About 75 per cent. of these figures would give the consumption of electrical energy at the motor.—Lond. *Elec.*, September 25.

REFERENCES.

Efficient High-Pressure Water Power Plant.—HENRY AND LE CONTE.—A description of the hydraulic features of the hydraulic power plant which has recently been started in Southern California by the Edison Electric Company, of Los Angeles. The Pelton water wheels and the method adopted for their regulation are described, and efficiency curves are given from which it appears that the efficiency of the wheel exceeds 86 per cent., including the losses in the gate valve and nozzle, the windage of the wheel and such slight losses as occur in the buckets. The results of tests undertaken for the purpose of determining the efficiency of the wheels for different loads and styles of nozzle tips, are also given.—*Eng'ing News*, October 8.

Congress of "Houille Blanche" in France.—BLOCH.—The conclusion of his article previously noted in the Digest. The present installment describes the utilization of water power in France and an illustrated description is given of the installation of Aristide Berges at Lancey, in the French Alpine regions. The power is obtained from a head of water of about 470 metres and current is furnished to a paper factory, to a system of lighting with a 12,000-volt line 44 km. long, and to a tramway 43 km. long. The installations are comparatively small, as the country is not thickly populated. —Lond. *Elec. Rev.*, September 25.

Electric Pumping for Irrigation.—Kilburn Scott.—A short review of the advantages of this method, as exemplified in the well-known Bakersfield (Cal.) plant which has been described in Electrical World and Engineer.—Lond. *Elec. Rev.*, September 25.

Electrically Driven Milling Machines.—A short illustrated article, giving examples of some recent construction in milling tools driven by electric power.—*Am. Machinist*, October 8.

TRACTION

Moulineaux Electric Power Station, Paris.—Allen.—An illustrated description of this station, which is owned by the Compagnie des Chemins de fer de l'Ouest, and supplies power for the suburban stretches of railway, extensive tramway systems, numerous cranes, machine tools and pumps, and to outside customers. The station is fed with steam from 27 boilers. It contains nine main generating sets, each consisting of a triple-expansion or compound horizontal engine directly coupled to an alternator of 800 to 1,000 kw output. The maximum output of the station is 9,900 kw. The generators are of the three-phase type, with rotating fields, running at 78 to 80 r.p.m. The field magnets carry 38 poles, giving a frequency of 25 cycles. The efficiency of the generators is stated to be 94 per cent., at a load of 800 kw, the power factor being 90 per cent. Current is generated at 5,000 volts and is transmitted to three sub stations, where it is converted into direct current at 500 volts for distribution to the railways, etc. There are four exciter sets, each consisting of a single-acting compound engine coupled to a multipolar dynamo of 125 kw output at 125 volts. The exciting current of each of the alternators is 175 amp. at no load and 195 at full load at 110 volts. The switchboard arrangements are very complete, there being a separate panel for each alternator and exciter, and five feeder panels. The high-pressure circuit-breakers are fitted at the top of the panels; they are of the long break type and are separated from each other by large marble barriers, which effectively prevent arcing from one pole to another. Each of the switches has a capacity of 100 amp. at 5,000 volts.—*Engineer*, October 15.

Electric Narrow Gauge Road Between Lausanne and Moudon.—An illustrated description of the transformer stations and the rolling stock. Polyphase current of 8,000 volts at 50 cycles is furnished to the transformer stations, each of which contains two motor generator groups of 200 hp each, one serving as reserve. One of the aggregates is driven by a non-synchronous and the other by a synchronous motor, on account of the necessity of furnishing lighting and traction current from the high voltage line. If no light is needed, the non-synchronous transformer is working, as it is less sensible to the varying demands of current or overloads than the synchronous motor. Both motors are for 8,000 volts and wound for 12 poles; they run at 500 r.p.m. The shunt machines which are directly coupled to these motors generate 750 to 900 volts direct current. One of the sub-stations contains a buffer battery of 385 cells, with 165 amp.-hour at one hour's discharge. The double-truck cars are furnished with four four-pole motors of 35 to 50 hp. Each two of these motors are connected in parallel at the start, while all of them work in parallel, when the car is running. The characteristic curves of the car motor are given in an illustration, as is also the arrangement of the controller connections for a single-truck car. —*Elek. Zeit.*, September 24.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Three-Phase Switch Gear.—Eborall.—The author discusses the construction of high-pressure polyphase switch gear and states that he is unable to agree with those engineers who consider that the cellular and backless type of switchboard is superior to all other constructions for use in connection with high-pressure polyphase systems. He considers that while such boards give excellent results in connection with single-phase work at moderate pressures, their sphere of utility is limited to single-phase, single-pole working at pressures not exceeding 3,000 volts. The adaptation of the cellular board to pressures of the order of 10,000 volts appears to the author an example of a good thing being carried too far. High-pressure switchboards, according to him, in order to attain safety, convenience and absolute reliability in working, must be constructed upon the following lines: 1. The whole of the high-pressure gear must be removed from the operating platform and isolated in fire-proof compartments below, above or at the back of the platform upon which the operating board is placed. This means the remote control of the high-pressure apparatus, which the author considers the essential feature of high-pressure, three-phase boards for controlling large amounts of energy. The only apparatus on the operating board should be that required in connection with the exciting arrangements, and in connection with the control of the distant high pressure gear, and the measurement of the current, energy, etc., of the distant machine and feeder panels. 2. All high-pressure fuses should be done away with, as far as those in main circuits are concerned. These should be replaced by automatic attachments on the main switches; that is, the latter are to be simply automatic circuit-breakers, which open at definite overloads or (if fitted with reverse-current attachments) with reverse currents. Protective devices in the separate generator circuits should be fitted with time or with reverse-current attachments, or both; otherwise they should not be used. 3. The high pressure bus-bars should be arranged in such a way that any portion of them can be isolated for cleaning while the remaining portions are alive, without interrupting the supply. Further, their arrangement should be such that any panel can be cut completely out of circuit without interrupting the supply, if necessary. 4. The high pressure bus-bars should be provided with properly arranged pressure dischargers, while similar dischargers should be used at the far ends of the feeders, and where practicable en route. 5. The whole arrangement of the low-pressure operating board should be such that the attendant has no excuse for getting confused in case of a break-down, which necessitates prompt measures being taken at the switchboard. 6. The whole arrangement of the high-pressure gear proper should be such that arcing from one part to another, or to earth, due to an accident, or to abnormal conditions, is rendered an absolute impossibility. Nothing should be cramped, plenty of space being allowed everywhere, with each piece of apparatus in plain view for inspection, and capable of easy dismantling or removal for repairs or renewal. 7. The whole of the high-pressure gear should be in oil, as far as it is possible to arrange this. The author then examines how these requirements are complied with in the best practice of to-day, and gives a dimensional sketch of a simple form of remote control board with the actual connections, which is described in detail and its advantages set forth. The construction of a cellular switchboard is also illustrated and the disadvantages and difficulties encountered with this type for really heavy polyphase work are discussed at some length, in order to justify the author's opinion, that it can only be a question of time before it disappears in favor of the "remote control" design of board. —*Eng'ing*, September 25.

Central Station Auxiliary Plant.—Davies.—The author considers in detail the arrangement of the auxiliary plant in central stations, such as the pumps, injectors and stoker and economizer gear. The pros and cons of electricity versus steam for the driving of pumps are taken up at some length. The author comes to the conclusion that, taking everything into consideration, it appears that the best method is to install both steam and motor pumps. The latter should do the bulk of the work on heavy load, and should be kept running at constant speed and as nearly at full load as possible, while the steam pump should be used simply for the small regulations that are constantly necessary, and for very light load. The installation of both sorts of pumps is also advisable as a safeguard against break-down of the steam or electric service. As feed pumps are such important items in the safety of a station, this precaution is necessary. The same procedure, namely, the installation of both steam and motor drive, is recommended for the stoking gear, the steam plant being looked upon chiefly as a stand-by. The author considers it best, when possible, to drive the economizer scraping gear from the stoker plant; but if the latter is not installed, or is too distant, motors alone should be used, as the steady load at constant speed allows them to run under excellent conditions. The author's opinion is that the practice in single-phase, alternating-current plants, of driving the auxiliaries by direct-current motors supplied from the exciter circuit, while allowing a gain in efficiency, is very liable on account of the risks attendant upon it, to cause that efficiency to be bought at too great a price, namely, in convenience in working or perhaps failure of supply, as the slightest interruption or unsteadiness of the exciting current will often lead to complications when alternators are in parallel. The carrying of loads from this circuit into all sorts of out-of-the-way places is, therefore, highly dangerous and the practice is obviously bad.—Lond. *Elec. Rev.*, September 25.

Protective Devices for High-Tension Electrical Systems.—Woodhouse.—A paper read before the recent meeting of the British Association for the Advancement of Science. The author discusses several points in connection with the operation of a high-tension polyphase transmission system, as to the design of the system and the stresses on it. He then deals with circuit-breakers, fuses, switches, overload relays, reverse-current relays, devices which prevent or relieve excessive rise of pressure and switching inductive apparatus. Under the head of fuses he gives the results of tests of several types in the form of curves in which the time taken for the fuse to blow after the application of a definite overload is marked as a point on the curve. It appears from them that the Ferranti type of fuse blows almost immediately after the current reaches the fusing value, whatever be the magnitude of the overload. The long fuse on the contrary takes many seconds to blow on a moderate overload, and an appreciable time even on a heavy overload. The one, therefore, has no appreciable time lag and the other has too much on heavy overloads. The author states that the practice is increasing of attaching an automatic relay to the switch and dispensing with the fuse altogether. Under the head of switches he describes and illustrates several recent types of European make.—Lond. *Elec.*, September 25.

ELECTRO-PHYSICS AND MAGNETISM.

REFERENCE.

Vaporization and Boiling of Metals.—Krafft.—An abstract of a paper giving the author's results in investigating the boiling points and vaporization points of metals when heated under a high vacuum in the electric furnace. The author used fused quartz vessels for carrying out his experiments and worked at temperatures of about 1200 to 1400° C.—*Zeit. f. Electrochem.*, September 17; from *Berichte Deutsch. Chem. Gesellschaft*, 36 p. 1690-1714.

ELECTRO-CHEMISTRY AND BATTERIES.

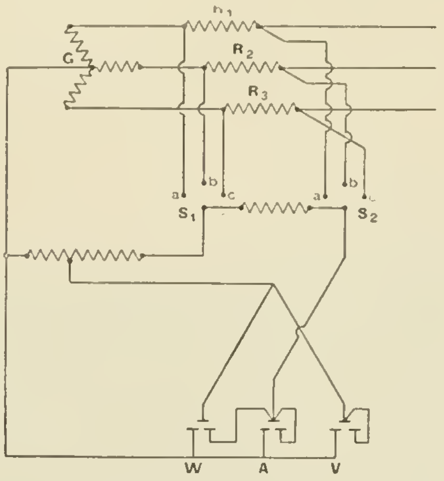
Elmore Copper Process.—An illustrated article in which the well-known Elmore process for the manufacture of copper tubes is briefly described. The illustrations shown refer to the German Elmore works at Schladern, which make use of 400 hp from steam and 550 hp from water power. These works produce some 2,600,000 pounds of copper per year, while the total weekly capacity of all three works, Schladern (Germany), Leeds (England) and Havre (France), is stated to be about 396,000 pounds. It is stated that the current density at the cathode amounts to 56 amp. per square foot, and that the deposition of a copper tube four to five mm. thick takes a week.—*Electrochemist & Metallurgist*, September.

REFERENCE.

Polishing and Plating of Metals.—Hawkins.—A continuation of an extract of a manual on the above subject. The author discusses the arrangement of plating shops, the kinds of dynamos to be used for electroplating and the troubles due to the prevalent ignorance of electroplaters on the subject of electricity. In his opinion a greater current density can be used if the thickness of the cathode is greater, and an attempt is made to explain the reason, which he believes is due to the better heat conductivity of the thicker cathode. —*Am. Jeweler*, September.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electrostatic Wattmeter.—Addenbrooke.—A long article in which the author deals with the electrostatic wattmeter, its calibration and adaptation for polyphase measurements. He first discusses the theory of the action of the wattmeter when coupled to circuits, and describes at considerable length the means by which it can be standardized and calibrated. The needle and one pair of quadrants are connected to the terminals of the circuit between which the voltage is to be measured. Between the connections to the two pairs of quadrants there is inserted a fixed resistance, through which the main current passes; hence, the difference of potential between the two serves to measure the current. The deflection of the needle being produced by both of these quantities is a measure of their product, namely, watts. To obtain all the factors required in measuring an alternating circuit containing inductance and capacity, the author employs, in addition to the wattmeter, a voltmeter and an ammeter. The two-phase measurement with two separate circuits is simple and resolves itself into two separate measurements. Two-phase measurement with a common third wire is best managed by putting resistances in each of the outer wires to enable the current flowing in each circuit to be measured separately, while the pressure connection for the voltmeter and wattmeter is made to the common return. To carry out measurements in this manner a switch has been worked out which enables all the instruments with the high resistance across the circuit, to be thrown over from one circuit to the other almost instantaneously. The adjoining figure shows the arrangements for measurements on three-phase circuits, where the working of each circuit can be completely separated from the others. *G* is the generator, *W*, *A* and *V* are the electrostatic wattmeter, ammeter and voltmeter, respectively, each indicated by three short lines, the upper one representing the needle and each of the lower ones a pair of quadrants; S_1 and S_2 are the switches. If the center of the star in the star connection cannot be got at, an artificial zero made by connecting three equal resistances radiating from a center and joined to the three phases, may sometimes be used with advantage. To obtain the elements of a delta-connected circuit, it is well to proceed in the manner proposed by Dr. Fleming in his handbook. The author states in conclusion that he has shown sufficiently on what a simple logical basis the making of electrical power measurements by means of electrostatic instruments rests.—Lond. *Elec.*, September 4, 11.



ELECTROSTATIC WATTMETER.

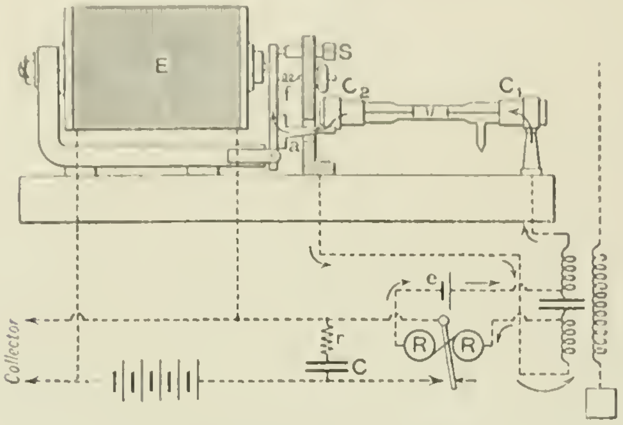
Capacities in Connection with Electrostatic Voltmeters.—Marchant and Worrall.—A paper read before the recent meeting of the British Association, on the use of capacities as multipliers, in connection with electrostatic voltmeters on alternating-current circuits. The authors describe experiments directed to the construction of a simple and easily made apparatus, by which low-reading electrostatic voltmeters may be employed on circuits of much higher tension. The voltmeters used were of the Kelvin multicellular and Ayrton and Mather electrostatic types. The method of combining the voltmeter with the capacities is to connect a capacity in series with the voltmeter across the mains and shunt another capacity across the terminals of the voltmeter, the latter capacity being large compared with the capacity of the voltmeter. The reading of the latter bears a constant ratio to the P. D. between the mains, and by varying the capacities any desired ratio may be obtained. Compactness and saving of material are gained by forming the two capacities into a condenser, in which one of the two sets of plates is itself divided into two groups, each group connected to its own related main, one group to the voltmeter and the voltmeter again to the undivided set. Two instruments are briefly described and illustrated in which those principles are embodied, one for measuring P. D.'s up to 300 volts on a 150-volt instrument, and having a ratio of ½, and the other for P. D.'s up to 10,000 volts, with a ratio of 1/40. The low-tension instrument is formed of alternate sheets of mica and tin foil of equal dimensions, held together between strong plates of ebonite. The high-tension instrument is similarly formed, except that copper foil is substituted for tin foil, the dielectric varies in thickness directly with the tension and the whole is damped between brass plates. The dielectric plates in the higher tension portion are made larger than those in the lower tension portion to avoid sparking over the surface and the entire instrument is suspended in oil for the same reason. Results of experiments for testing the accuracy of the instruments are given, the existing variations being well within the limits of experimental error. The authors hope that this device may be of considerable practical utility in simplifying the construction of high-tension voltmeters and in laboratory and experimental work.—Lond. *Elec. Eng.*, September 18.

REFERENCE.

Measurement of Cable Capacity.—Fleming.—An extract from a forthcoming book on testing. The cases of two-core, three-core, etc., cables and concentric cables are mathematically investigated.—Lond. *Elec.*, September 11.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Selective Wireless Telegraphy.—ANDERS BULL.—The author gives the results of experiments conducted with his system of wireless telegraphy, previously noted in the Digest. The stations were 55 km. apart, the experiments being conducted with the sole view of proving the possibility of secretly communicating between stations and of the further possibility of sending messages by means of selective telegraphy to several independent receivers at the same time. The author's arrangement, embodying his improvements, is shown in the adjoining figure. One pole, C_1, of the coherer is fixed, the other pole, C_2, being connected by means of a bracket, *a*, to the armature of the electromagnet, *E*. This armature is pressed by an insulated spring, *f*, against a screw contact, *s*, which limits the movement of the armature in the one direction and serves at the same time as contact for the coherer current. On the coherer becoming conductive, the current, supplied by the battery, *c*, flows as indicated by the arrows. The relay, *R*, being magnetized, causes the closing of the secondary circuit, in which are placed the collector magnet and the electromagnet, *E*. As soon as the armature of the electromagnet begins to move, the relay current is interrupted and its switch has time to go back to the off position before the coherer has ceased to vibrate. Since the coherer is tapped twice, first on the armature striking the core of the electromagnet, *E*, and second on the armature coming in contact with *s*, the decoherence is most complete, vibrations after the shocks being almost entirely absent. The armature movement need not exceed 0.1 mm. To avoid the formation of local sparking, condensers, *c*, were used, in series with which resistances were placed for diminishing oscillatory discharges. At first the tests were not successful, due to the fact that the capacity of one end of the coherer was augmented by that of the electromagnet, *E*, with the result that the potential differences, caused by the oscillations, were decreased. After the necessary alterations had been made, the tests are said to have proved satisfactory.—Lond. *Elec.*, October 2.



SELECTIVE WIRELESS TELEGRAPHY.

New Books.

SECONDARY BATTERIES. A Practical Handbook for Owners and Attendants. By an Engineer. London: H. Alabaster, Gatehouse & Company. 77 pages, illustrated. Price, 4 shillings.

The enormous growth in the use of accumulators during the last decade is reflected in the increasing literature of the subject. The present volume, which is small and unpretentious, is, we believe, the first one of recent date to treat the subject from a purely operating standpoint. Written by a "practical" man, the treatment is decidedly elementary and the author presupposes but little electrical and no battery knowledge on the part of his readers—a good point, considering the class of men he aims to reach.

The faults are largely sins of omission, conspicuous among which is the failure to describe the use of the cadmium auxiliary electrode, now so universally used, at least in this country. Boosters are dismissed with a paragraph or so, and no description given of their various uses, while only the simplest form of end-cell switch is described.

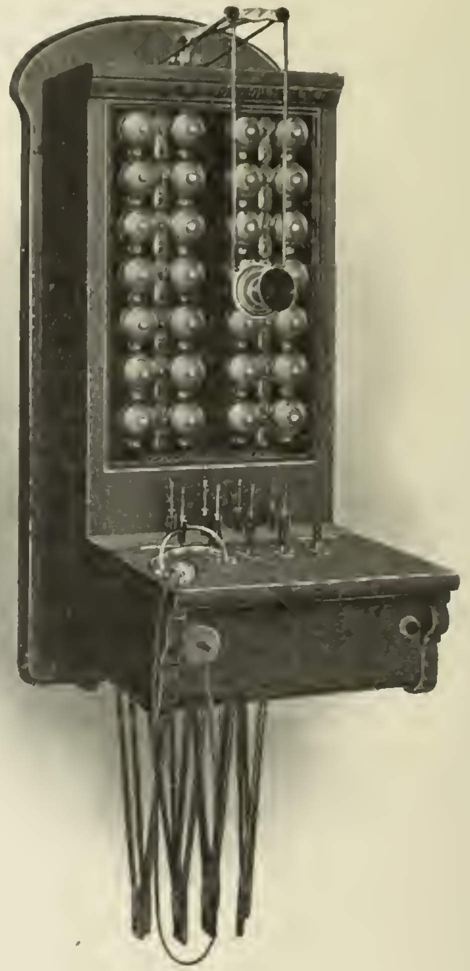
The arrangement seems not very logical, and more headings would be an improvement, though the lack of them is partly offset by a fairly complete index. Most of the advice given is sound, although some things apply only to English practice, and are of little use here. The appendix gives a number of useful tables, though several of these, too, would not apply in this country.

Taken as a whole, an engineer in charge of a small lighting or isolated plant, who has batteries to look after "on the side," might find here many useful hints; but for the care of large railway and lighting stations, the application would be decidedly limited. The care of automobile batteries is not touched upon.

Village Telephone Exchange Switchboard.

It has recently been pointed out in these columns how interesting and important is the development of rural or village telephony, this movement having gone so far already that one of the members of the United States Senate, Mr. Fairbanks, has proposed to modify the existing postal arrangements, so that the local postmaster can send special delivery telephone letters to farmers and remote dwellers in the rural districts by using the local telephone system.

A good deal of this new work is due to the energy and initiative of manufacturers in the independent field, some of whom have devised apparatus at once simple, durable and economical. An illustration of this fact is to be found in the illustration furnished herewith of the village exchange switchboard constructed and furnished by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago and Rochester, N. Y. This party line switchboard has each of the lines terminating in a spring jack and a polarized ringer signal. This board is intended especially for party line operation in rural districts, and is equipped with operator's telephone, hand generator, connecting cords, plugs, keys and all the necessary apparatus. The operation of such a system is obviously well within the capacity of persons of intelligence, even if they have no mechanical inclinations, and it has been found that little or no trouble is experienced in securing locally the talent necessary to carry on such systems successfully.



VILLAGE TELEPHONE EXCHANGE SWITCHBOARD.

Exhibits at Ohio Electric Light Convention.

The meeting at Columbus last week of the Ohio Electric Light Association was largely attended by representatives of electrical manufacturers and supply dealers, and the following exhibits were displayed:

The General Incandescent Arc Light Company exhibited its multiple and alternating and direct-current lamps in operation, and series alternating-current arc lamps in both shunt and differential types; it also showed a new knife switch, an automatic switch for remote control and a Wright demand meter. Emphasis was placed on the special feature of its 110-volt, direct-current lamp, consisting in an adjustment coil permitting change in adjustment from 3 amp. to 6 amp.

The J. A. Roebling's Sons Company made no display, but distributed souvenir wire gauges, which were in great demand.

The W. G. Nagel Electric Company, of Toledo, exhibited the Nernst lamp in operation in various sizes.

The General Electric Company had a special display of its new "Meridian" lamp, in competition with the Nernst lamp. It also showed a Christmas tree outfit, which attracted much attention, and had on view its concentric light diffuser with photographs illustrating the soft, even light, free from distinct shadows which this attachment insures.

The Stanley Electric Manufacturing Company showed its line of meters in operation.

The Bryan-Marsh Company had on exhibition its new type lamp, burning out at the 80 per cent. line of initial candle-power.

The exhibit of arc lamps by the Adams-Bagnall Electric Company, of Cleveland, handled by the Electric Appliance Company, of Chicago, was very complete, and attracted a constant throng of callers—the lamps made a fine appearance, the cases being of copper and constructed with interchangeable parts, the insulation being very thorough. Here were also shown the Gutmann wattmeter, the Packard incandescent lamp and Packard transformer.

The National Electric Company, of Milwaukee, successors to the Christensen Engineering Company, showed by means of enlarged photographs its various types of direct and alternating-current generators and motors, belt-driven and engine type, of various designs. Its representatives also gave away handsome steel tape measures to all callers.

The above were all the regular exhibits, but the traveling men from the other houses represented were ever present and made up in personal interviews what they lacked in material and physical exhibits. A theatre party Tuesday night was given by the Erner-Hopkins Company, the Columbus Railways & Light Company, and the General Electric Company.

Supply Men in Attendance.—Adams-Bagnall Electric Company, W. V. Orr, Cincinnati; F. L. Druliner, Cleveland; American District Steam Company, H. B. Kimbrough, Chicago; Bryan-Marsh Company, F. H. Haughton, F. W. Godfrey, Cincinnati, Ohio; Buckeye Electric Company, R. M. Barwise, Cleveland; R. N. Hemming, E.E., Columbus; Babcock & Wilcox Company, W. D. Chester, Pittsburg, Pa.; F. Bissell Company, C. M. Hamilton, Toledo; Bruce Electric Company, Columbus, Ohio; Crocker-Wheeler Company, H. A. Brown, E.E., Chicago; Hart Manufacturing, William Crichton; Doubleday-Hill Electric Company, C. P. Hill, Pittsburg; Elliott Reynolds; Electric Appliance Company, O. T. Kimmel, Columbus, Ohio; Perry R. Boole, Chicago; Erner Hopkins Company, W. A. Hopkins, Jr., Columbus; Fort Wayne Electric Works, T. J. Ryan, Cincinnati; George B. Edgar, Cincinnati; General Incandescent Arc Light Company, W. F. Geddes, 3rd, Cleveland, Ohio; H. B. Coles, Cincinnati; General Electric Company, W. M. Demming, manager, W. J. Hanley, H. C. Houck, S. D. Gilbert, Cincinnati; Matthew O. Troy, Schenectady, N. Y.; Kuhlman Electric Company, Elkhart, Ind.; W. G. Nagel Electric Company, W. G. Nagel, E. J. Paradis, J. M. Wood, Toledo, Ohio; Post-Glover Electric Company, Charles S. Kuntz, Cincinnati; Nernst Lamp Company, D. D. Strite, Pittsburg; National Electric Company, Charles G. Burton, Chicago; National Carbon Company, F. H. McDowell, Cleveland; Otis Elevator Company, A. H. Wright, Cleveland; J. A. Roebling's Sons Company, W. P. Bowman, I. W. Brooks, Cleveland, Ohio; W. W. Affleck, Cleveland, Ohio; Standard Electric Company, P. J. Williams, Cincinnati; Stanley Instrument Company, F. J. Alderson, Great Barrington, Mass.; Stanley Electric Manufacturing Company, O. H. P. Fant, Cincinnati; Sprague Electric Company, O. P. Fant, Cincinnati; Westinghouse Traction Brake Company, William D. Ray, Cleveland; Western Electric Company, Charles W. Cobb, Cleveland; Westinghouse Electric & Manufacturing Company, Nathaniel Paige, Jr., Leon Goldsmith, Columbus, Ohio; J. W. Schrantz, Cincinnati; K. C. Randall, E.E., Pittsburg.

Hoisting and Transferring Machinery.

Two types of machines are employed in the handling of heavy materials, viz.: 1. A hoist for vertical movement. 2. A crane or trolley for horizontal movement.

Where the load exceeds the lifting capacity of one or two men, the hoist is the absolutely essential factor, while the crane or trolley may or may not be necessary. In other words, in every machine of this class the hoist is the vital part. In considering apparatus for transferring material, this fact is sometimes overlooked, and chief attention given to the mechanism for horizontal motion. While this is important, the mechanism for vertical motion—that is, the hoist—is still more important.

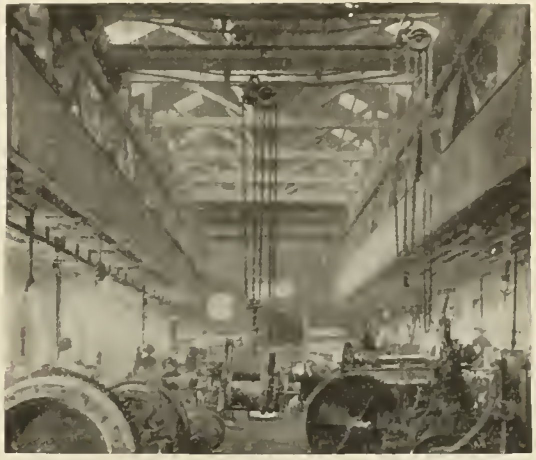


Fig. 1.—Hoisting and Transferring Machinery.

One of the simplest, most compact and most mechanical forms of hoist is the "triplex block," which has the further important advantage of possessing a high mechanical efficiency. In its standard form, it is a portable machine, intended to be hung by its hook to some overhead support, either fixed or movable; but it is also arranged to be built into a trolley intended to travel either on a crane or on an overhead tramway. It is thus available as the hoisting device in almost every type of machine for the handling of material.

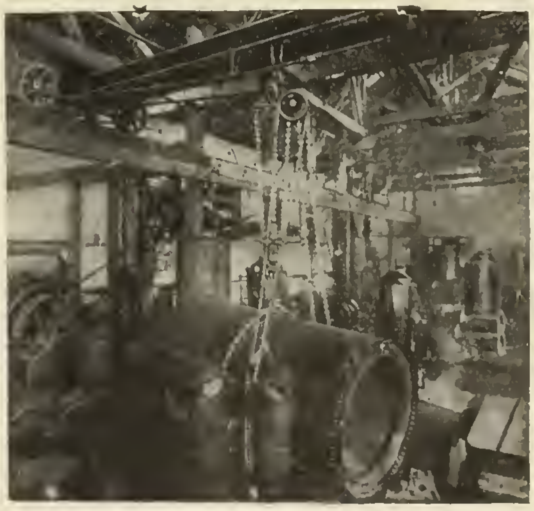


Fig. 2.—Hoisting and Transferring Machinery.

Twenty tons may be lifted with it 5 ft. in ten minutes, and 300 pounds or less 30 ft. a minute. Where the load is less than a hundred pounds a quick speed block often saves a great deal of unnecessary strain in reaching the required position.

The accompanying illustrations show two of the many possibilities offered by the triplex block of the Yale & Towne Manufacturing Company, New York City, as a hoisting device in apparatus designed for the transfer of material.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was somewhat steadier towards the end of the week, due to the rally in prices from the depression caused early in the week by adverse talk about conditions at Montreal, Pittsburg and other cities, and the further breaks in various industrial stocks. Transactions were restricted and professional. Railroad stocks showed firmness in the main, while industrials rallied somewhat. A good effect was produced by the declaration of the usual ½ per cent. dividend on Amalgamated copper. The United States Steel securities developed further weakness, making new low price records. At the close of the week, however, there was a firmer tone in these issues. Rather heavy liquidation took place in Brooklyn Rapid Transit, but on the other hand Manhattan Elevated received support, notwithstanding the threatening attitude of its motormen and the possibility of a strike. Brooklyn Rapid Transit closed the week with a net gain of 1½ points, the closing quotation being 33¾. Metropolitan Street Railway was also favorably affected and closed at 105¼, being a net gain of 3¼ points. Manhattan Elevated closed at 132½, a gain of 2¼ points. General Electric closed at the highest point of the week—148—which was a net gain of 4 points, and Westinghouse common gained 4 points, closing at 138, while first preferred lost 11 points, the last quotation being 101. Western Union remained steady at 82. Following are the closing quotations of October 20:

NEW YORK.

	Oct. 13	Oct. 20		Oct. 13	Oct. 20
American Tel. & Cable	78¼	78	General Electric	140⅛	117
American Tel. & Tel.		122	Hudson River Tel.	..	..
American Dist. Tel.	24	.	Metropolitan St. Ry.	103	105¼
Brooklyn Rapid Transit	31⅞	33⅜	N. E. Elec. Veh. Trus.	..	4¼
Commercial Cable	145	149	N. Y. & N. J. Tel.	..	..
Electric Boat	18	17	Marconi Tel.	.	..
Electric Boat pfd.	42	40	Western Union Tel.	81¾	81¾
Electric Lead Reduction	1¼	*1⅛	Westinghouse com.	131	131½
Electric Vehicle	4	5	Westinghouse pfd.	161½	160
Electric Vehicle pfd.	5	8			

BOSTON.

	Oct. 13	Oct. 20		Oct. 13	Oct. 20
American Tel. & Tel	120¼	123½	Western Tel. & Tel. pfd.	80	*77
Cumberland Telephone	....	*115¼	Mexican Telephone	1⅛	1
Edison Elec. Illum.	230	230	New England Telephone	*123	122½
General Electric	112	146	Mass. Elec. Ry.	18	18¾
Western Tel. & Tel	10	*10	Mass. Elec. Ry. pfd.	77½	77

PHILADELPHIA.

	Oct. 13	Oct. 20		Oct. 13	Oct. 20
American Railways	41	*42	Phila. Traction	93½	93⅝
Elec. Storage Battery	48	*50	Phila. Electric	5⅞	5⅞
Elec. Storage Battery pfd.	48	*50	Phila. Rapid Trans.	11¾	11¾
Elec. Co. of America	7¼	7¼			

CHICAGO.

	Oct. 13	Oct. 20		Oct. 13	Oct. 20
Central Union Tel.	..	..	National Carbon pfd.	*85½	86
Chicago Edison	143	..	Metropolitan Elev. com.	17	18
Chicago City Ry.	170	170	Union Traction	4	3½
Chicago Tel. Co	115	..	Union Traction pfd.	30	25
National Carbon	19	17			

* Asked

TROLLEY DEALS IN MICHIGAN.—H. B. Hollins & Company, No. 15 Wall Street, have been approached in the matter of consolidating the trolley lines west of Detroit, including those of Kalamazoo. The properties it is proposed to consolidate are the Detroit, Ypsilanti, Ann Arbor & Jackson, Detroit to Jackson, with the Ann Arbor city line and a branch from Ypsilanti to Saline, making in all about 100 miles. The Boland lines, including Jackson city, twelve miles; and Jackson-Albion road, about forty miles; from Jackson to Chelsea, twenty miles, and twelve miles east of Chelsea toward Ann Arbor. The Albion, Marshall, Battle Creek and Kalamazoo lines belonging to the Railway Companies General, forty-seven miles; and the Detroit, Plymouth & Northville, running from Wayne to Plymouth and Northville, sixteen miles, owned by the Boland syndicate, making a total of about 247 miles of electric lines. There is now outstanding in the Detroit, Ypsilanti, Ann Arbor & Jackson $2,600,000 in stock, the majority of which is held by Messrs. Hawks and Angus; first mortgage 5 per cent. gold bonds due February, 1926, $1,610,000; Detroit, Ypsilanti & Ann Arbor Railway Company first mortgage due 1924, $330,000 and Ypsilanti & Saline electric railway first mortgage 6 per cent bonds due July, 1910, $60,000, making a total bonded indebtedness of $2,600,000. The authorized amount of the consolidated mortgage of the Detroit, Ypsilanti & Ann Arbor Railway Company is $1,000,000, of which $600,000 is reserved to retire the first mortgage of the company and $70,000 have not been issued. The Detroit, Ypsilanti, Ann Arbor & Jackson issued $1,670,000 first consolidated mortgage 5 per cent. gold bonds due February 1, 1922. The authorized issue was $2,600,000, of which $900,000 are reserved to retire prior liens. The Union Trust Company, of Detroit, is trustee of all the mortgages and the par value of the stock is $100 a share.

BELL TELEPHONE STANDING.—In answer to a query as to the merits of Telephone & Telegraph stock, the Boston News Bureau says in its "Answers to Inquiries" column: The American Telephone & Telegraph Company is to day earning more upon its shares than ever before in its history. The last annual report showed net earnings of $7,835,272, or $1,250,868 above the 7½ per cent. dividends paid. This does not, however, represent the total share earnings of the company, as a large portion is left in the treasuries of the subsidiary companies, which pay dividends to the parent company. The dividends received from the sub-companies are almost equal to the dividend requirements of the parent company, and the latter has in addition its net earnings from the long distance lines, which it operates directly, and rentals of instruments, which are paid by the license companies in addition to dividends. The parent company is obliged to raise about $20,000,000 new money every year to provide for new construction. It does this by issuing new stock to stockholders at par. In former years the new issue created valuable rights, but this year, owing to the condition of the money market and to the temper of the public toward new issues of securities, the new issue was not so favorably received. At the present market price American Telephone yields 6¼ per cent. without allowance for "rights" to take new stock at par.

DIVIDENDS.—The Lowell, Mass., Electric Light Corporation has declared a semi-annual dividend of $4 per share, payable Nov. 2. Amalgamated Copper Company has declared a dividend of ½ of 1 per cent., payable Nov. 30. The U. S. Steel Corporation has declared a dividend of ½ of 1 per cent. on the common and the full 1¾ on the preferred. The directors of the American Light & Traction Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable Nov. 2. The directors of the Henry R. Worthington Company have declared the regular semi-annual dividend of 3½ per cent. on the preferred stock, payable Nov. 2. The directors of the International Steam Pump Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable Nov. 2. The Milwaukee Electric Railway & Light Company has declared the regular quarterly dividend of 1½ per cent. on its preferred stock, payable on Nov. 1. The Columbus Railway Company, of Columbus, Ohio, has declared a dividend of 1¼ per cent. on the preferred stock, payable Nov. 2.

SAO PAULO, BRAZIL, TROLLEYS.—Mr. F. S. Pearson, consulting engineer of the Sao Paulo Light, Heat & Tramway Company says: "With the additions to the various departments in operation, the company should this year earn 11 or 12 per cent. While it is proposed to increase the dividend, I do not think such a course will be adopted. I would rather favor the establishment of a reserve fund. The million dollars advanced a little over a year ago for construction work has resulted in the company being able to extend its mileage considerably and it has now been all completed. Fifteen of the 30 new cars are already in use and the remainder will be in use before the end of the month. In the month of September the earnings were $16,000 more than in the corresponding month last year and now the company will be in a position to make a more marked increase."

ELECTRIC LIGHT EARNINGS.—The Minneapolis General Electric Company showed a gross for August of $39,144, a little more than $3,000 better than last year. The gross for 12 months was $539,882 and net $131,154. The Edison Brockton Company for August showed gross of $7,256 against $6,320 last year, and $524 net. The gross for 12 months was $103,329 against $92,191, but the net was $18,220 against $26,209. ,

PHILADELPHIA ELECTRIC.—A director of the Philadelphia Electric Company says: "The Philadelphia Electric Company, at its present rate of earnings, will show for the present fiscal year about $600,000 net profits for the stock, equivalent to 8 per cent. Although we are able, therefore, to pay more than the standing rate of 5 per cent., there is no probability of an advance. At this time such a step would be unwise."

OTIS ELEVATOR COMMON STOCK.—The directors of the Otis Elevator Company have decided not to pay an October dividend on the common stock. The earnings of the company for the past six months warranted the distribution of a semi-annual dividend of 2 per cent., but so much work has been stopped by the building strikes it was considered more prudent to suspend the dividend for the present.

COMPETITION AT QUINCY, ILL.—In view of proposed competition in the electric lighting field, the Quincy (Ill.) Gas & Electric Company, through Mr. J. C. Sloan, manager, has issued a circular to the citizens in which it says: "The present stockholders and officers of the Quincy Gas & Electric Company took possession of the property of this company, and the management thereof, during the month of April, 1903. The new officials were, at the time, unacquainted with the business affairs of the company, but after entering upon their duties and acquainting themselves therewith were led to believe, and acted thereon, that a reduction in the price to consumers of electric current, in many instances, was demanded and that a uniformity, as to the price charged to customers, graded according to consumption, should be made. They thereupon at once reduced the price from 15 cents per 1,000 watts to 12 cents, which has been the price since then charged; also at once establishing a uniformity in price between customers graded according to the amount consumed. They believe that the rates, as now established, are fair to the consumer as well as to the stockholders of the company, and assure the patrons of the company that there is no extortion practiced, and that such rates realize but a low per cent. upon the actual value of the assets of the company. In anticipation of competition, the Independent Light & Power Company, which is now erecting a plant in the city, has taken contracts for the furnishing of current at a rate lower than that charged by this company, and, as the officers of this company are informed, are still importuning other users of electric current to enter into contract with it. This company fully understands what competition means and will assure its patrons that when such competition is to be met it will furnish electric current to the consumers thereof in the city of Quincy at a price less than our competitor, regardless of the loss it will cause this company. While this company would prefer to manufacture electric current at a reasonable manufacturer's profit, as it is now doing, it has decided to meet any and all competition at whatever cost. It will be to the advantage of our patrons, and to the consumers of electric current in Quincy, to await the time when competition shall have commenced before entering into any contract for the furnishing of current with either the old or the new company; for, as stated above, no matter what price the new company may furnish current for, this company will sell the same at a less price."

TRACTIONS IN NEW YORK.—Gossip, as follows, is given by the *Wall Street Journal.* Evidence is accumulating that the continued bear manipulation of local traction stocks by E. C. Potter & Company and other firms, is really in the interest of Interborough people. It is current rumor that the Belmont people have allied themselves with the Rockefeller-Gould interests in the management of Interborough and that this combination is bent upon consolidating all the traction and electric light and power interests of Greater New York. So far it is claimed that these interests have forced out very large sales of Metropolitan stocks as well as Brooklyn Rapid Transit, by driving down the prices of these securities. Some of the leading and largest holders of these stocks are not opposing the decline, but are not selling their own holdings because they believe that the movement of the Interborough people will be for the best interests of all concerned.

BOSTON EDISON REPORT.—The stockholders of the Boston Edison Electric Illuminating Company at their annual meeting on October 13 re-elected the directors. The report for the year ended June 30, 1903, shows a gross income of $2,667,808 and a total net income of $1,017,225. Some further figures were given in these pages last week. President Edgar said: "The company has purchased the past year seven acres of land adjoining the L street property in South Boston, and plans for a 75,000-hp station have been prepared. Contracts have already been let for the first section of the new station building, and upon the completion of this section of the plant, all of the towns reached by the suburban companies recently purchased will be supplied from your Boston station, and Boston prices for electricity will be adopted in these districts."

EARNINGS OF NATIONAL CARBON.—Representatives in Chicago of the National Carbon Company claim that the first eight months of 1903 show that the earnings of the concern will be fully equal to those of 1902, the net earnings of which were $594,371, out of which $315,000 for dividends and $254,396 for depreciation were deducted, leaving the small surplus of $22,734. The total surplus shown in the last statement was $156,000. If the directors follow their former policy of charging off a large sum to depreciation, the next statement of the year ending Jan. 31, 1904, will show that $1,000,000 has been charged to this account during the five years that the concern has been in business.

CINCINNATI BELL TELEPHONE STOCK INCREASE.—The directors of the Cincinnati Bell Telephone Company have decided on an increase of the company's capital stock, amounting to 4,581 shares with a par value of $242,500. The proceeds of the issue will be used in erecting and equipping the new exchange at Canal and Race Streets.

BOSTON EDISON INCREASE.—The Mass. Board of Gas and Electric Light Commissioners has granted the Boston Edison Company permission to issue 20,000 shares of new capital stock at $200 a share, to provide money for improvements and betterments.

Commercial Intelligence.

THE WEEK IN TRADE.—The urgent demand which has been conspicuous in general trade and industry at this season in late years is not in evidence this year. There are exceptions, however; in the southwest the demand as a whole is reported equal to that of last year and at some points in the northwest and on the Pacific coast. In the central west business is fair, but at the east the quietness is increasing, and reports from the south are rather less favorable. The shut-downs of iron furnaces fail to stimulate values in this line. Iron is weak and lower at all markets, and a heavy curtailment in output is expected this month. Finished products are very firm considering the heavy drop in raw materials. Good sales of rails are noted; and wire, nails and bars are active at the west. Money is easier at large centers; collections are still complained of as slow and colder weather is apparently needed to stimulate retail demand for various products. There are some favorable features in the situation, however. The cereal crop yield as a whole, though 10 per cent smaller than that of last year, is of better grade, and compared with 1901 a gain of 25 per cent. in the bulk yield is figured. Railway earnings indicate that a large volume of business is still being transacted. Reports of suspension of improvement work by railroads come earlier this year than usual, but sales of new rails, cars and supplies indicate that much of this is largely seasonal. The copper market continues dull and buyers are holding off, while producers are not pressing the market. A fair business was done for export at slightly lower prices. The closing quotations are 12⅝ to 12¾c. for Lake; 12½ to 12⅝c. for electrolytic; 12¼ to 12⅜c. for cathodes and casting stock. The business failures for the week ending October 15, as reported by *Bradstreet's,* numbered 203, against 197 the week previous, and 203 the corresponding week last year.

EQUIPMENT FOR COLD STORAGE PLANT.—Conron Bros., provision dealers, New York City, have let a contract to the Mackay Engineering Company, 149 Broadway, for various equipment. A 125-hp vertical compound engine has been ordered for direct-connection to a 75-kw generator; also a 150-hp engine for direct-connection to a 100-kw generator, also several motors of various capacity. The equipment will be used for lighting and power in a new cold storage plant being constructed by the Conron people. The engines will be built by the Reeves Engine Company, of Trenton, N. J. The Akron (Ohio) Electric Manufacturing Company will supply the generators and motors.

MEXICAN HYDRAULIC PLANT.—A large hydraulic power plant is to be constructed on the extensive Tanchachin estate in the Tampico division of the Mexican Central Railway, between Rascon and Micos. The property has just been sold by Mariano Barragan to D. J. Spillane, Daniel Spillane and George C. Hippertz, who are about to let contracts for the equipment of the plant. Power will be derived from a waterfall 272 ft. high, over which the waters of the Callinas, Tamasopo Sta, Maria, Rio Verde and Tamul Rivers flow.

STATEN ISLAND PLANT.—Milliken Brothers, Bowling Green Building, which concern is building an extensive plant at Staten Island for the manufacture of structural steel, will shortly let contracts for electrical equipment. The capacity will be 1000-kw. Several electric traveling cranes will be installed. The Shaw Electric Crane Company will build a number. The consulting engineer for the construction of the plant is G. K. Hooper, Bowling Green Building.

ELECTRIC HOISTING EQUIPMENT FOR WELSH STEEL PLANT.—Mr. W. A. Stadelman, of the Brown Hoisting Machinery Company, of Cleveland, Ohio, New York offices Havemeyer Building, has secured a contract for electric hoisting equipment for installation in the Ebbw Vale Iron & Steel Company's plant in South Wales. A contract for electric trolleys has also been secured through the export house of Henry W. Peabody & Co., 17 State Street, New York, for South Africa.

MOTORS OF BATTLESHIP IOWA.—The United States battleship *Iowa,* now under construction in the Brooklyn Navy Yard, is to be equipped with some 20 Holtzer-Cabot motors for driving ventilators. The Holtzer-Cabot Electric Company has also secured a contract for 30 motors of 1-5 capacity, and of special design for jewelers' polishing and grinding purposes. This contract came through W. Green & Co., 6 Maiden Lane.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, Ohio, has carried out during the past half year the design and construction of over 50,000 kw of large alternating and direct-current machinery. Among the more prominent contracts have been: Ten 1,000 kw generators and motors for the Shawinigan Water & Power Company in Montreal; five 3,000 kw alternators for the Kern River Power Company, of Los Angeles, Cal., three 1,500 kw alternators for the Pacific Electric Railway Company, of Los Angeles, Cal.; two 1,500-kw fly-wheel type alternators for the Mutual Electric Company, of San Francisco, Cal.; one 1,500 kw alternator for the Pacific Light & Power Company, of Los Angeles, Cal.; one 800 kw fly wheel type alternator for the Los Angeles Traction Company, of Los Angeles, Cal.; two 11,000-volt, 200-kw motor generator sets for the San Bernardino Valley Traction Company, San Bernardino, Cal.; one 1,500-kw fly-wheel type alternator for the Denver Gas & Electric Company, of Denver, Colo.; two 1,000 kw generators and five 400-kw rotary converters for the Scioto Valley Traction Company, Ohio; two 750-kw alternators for the New York Central & Hudson River Railroad; one 3,000-kw fly-wheel type alternator for the Cincinnati Gas & Electric Company, Cincinnati, Ohio; one 3,000 kw, direct-current generator for the Cincinnati Gas & Electric Company, of Cincinnati, Ohio; two 1,000-kw generators for the Niagara Falls Hydraulic Power & Manufacturing Company, Niagara Falls, N. Y.; two 200-kw, 12,000-volt generators for the Island Pond Electric Company, Island Pond, Vt.; one 1,000-kw generator for the Canadian Electric Light Company, Quebec.

EXPRESSAGE IN BROOKLYN, N. Y.—It has been understood for some time that Brooklyn Rapid Transit contemplated engaging in the business of hauling ashes, building material and other low grade freight over its lines at night when this could be done without disturbance to its passenger business. There are now on the Thirty-ninth Street pier at South Brooklyn, standing on flat cars of the Seaboard Air Line a number of new covered freight cars bearing the name of Brooklyn Rapid Transit, and which are designed for the transportation of packages of high class freight. The cars are in all respects similar to those of the National Express Company now operating on Brooklyn Rapid Transit lines except that the latter are blue, while the new ones are red and bear the name of the Transit and not of the Express Company. Inquiry develops the fact that the Brooklyn Rapid Transit Company has plans for the inauguration of a system of merchandise delivery from block to block with the establishment of convenient stations for the handling of packages. Such business will be largely carried on at night, but much can also be done in the day time on lines where this would not produce congestion. The system would thus be analogous to that of the Metropolitan Express Company in New York City.

VILTER COMPANY PLANTS.—The Vilter Manufacturing Company, builders of refrigerating and ice-making machinery, Corliss engines, etc., Milwaukee, Wis., has recently closed contracts with the following parties: Bay City Ice, Light & Power Company, Bay City, Tex., 15-ton ice plant, with 3-ton refrigerating machine; Dalhart Ice & Electric Company, Dalhart, Tex., 30-ton ice plant; Milwaukee Malting Company, Milwaukee, Wis., 24 x 42 Corliss engine; Hastings Wool Boot Company, Hastings, Mich., 18 x 28 x 42 cross-compound Corliss engine; Milwaukee-Western Malt Company, Milwaukee, Wis., 20 x 42 and 16 x 36 Corliss engine; Imperial Furniture Company, Grand Rapids, Mich., 18 x 42 Corliss engine; Menasha Wooden Ware Company, Menasha, Wis., 20 x 40 x 48 cross-compound Corliss engine; Independent Malting Company, Davenport, Iowa, 16 x 36 Corliss engine; Ward-Corby Company, Providence, R. I., 10 x 24 Corliss engine; North Branch Lumber Company, Chicago, Ill., 24 x 48 Corliss engine; Adam Schillo Lumber Company, Chicago, Ill., 22 x 42 Corliss engine; City of Algoma, Wis., 17 x 36 Corliss engine; C. A. Lawton Co., De Pere, Wis., 12 x 30 Corliss engine; C. F. Baum Company, Chicago, Ill., 12 x 36 Corliss engine.

ALLEN & DYER is the name of a new firm at Calle San Juan de Letran 5½, Mexico. Mr. Carlos E. Allen was at one time engaged in the mining districts of El Oro, Guanajuato, Jalisco and other Mexican States, and the last six years was with the State Government of Michoacan, Mexico, and for eleven years has had experience in operating and installing steam, electrical and mining machinery. Mr. Seth H. Dyer was at one time in the General Electric shops in the United States, and later with the Guanajuato Consolidated Light & Power Company and other companies in Mexico. The firm will undertake mechanical and electrical engineering and the erection of all kinds of machinery in Mexico, Central America and South America. They will also act as resident engineers for companies desiring such representation.

THE WESTINGHOUSE STEAM TURBINE is rapidly increasing its field of usefulness. The Eaton Cole & Burnham Company, of Bridgeport, Conn., is preparing plans for a turbine plant which will furnish power to its works at Bridgeport, Conn. Large extensions are now under way, and the entire plant will be operated by polyphase motors from the new power station. A 400 kw Westinghouse turbine unit will be immediately installed to provide additional power during the construction work. It will temporarily be placed in the present power house and will operate under 200 pounds steam pressure and 28 inch vacuum without superheat. The unit will furnish three phase current at 440 volts. The installation is in charge of Mr Geo. Hooper, engineer, No. 11 Broadway, New York.

EQUIPMENT FOR MONEY ORDER PLANT.—The Mackay Engineering Company, 149 Broadway, has secured a contract from Paul Herman for the equipment of the machinery which is to print the government money orders. Three Hoe cylinder presses, two Scott lithographic presses, together with two perforators and a paper cutter, will be electrically driven. The motors to operate the Hoe presses will be of 7½ hp capacity each. A 10 hp motor will drive the lithographic presses. The perforators will be worked by ½-hp motors and the cutter will be driven by a 3-hp motor. All the motors will be of Akron build. They will be of special slow-speed type, with latest improved Carpenter controllers, with variable-speed and safety devices and magnetic brakes.

THE HOLOPHANE SYSTEM IN CHICAGO.—The Windemere Hotel in Chicago has redesigned its system of lighting and installed the holophane system, saving thereby on an average 35 per cent. of its current consumption. The dining-room is entirely lighted by ceiling lights, which are practically out of the range of vision of people seated at the tables. The lighting of the billiard room is a special feature, absolutely no shadow of the balls or the cushions being cast on the table. At the same time the lights are hidden from view. The halls are all lighted by ten-inch holophane hemispheres, giving a soft and subdued yet powerful light. The work was designed and installed by the V. R. Lansingh Company, of Chicago.

ST. LOUIS EXPOSITION.—The steam power plant of the St. Louis Exposition, now being built by Messrs. Westinghouse, Church, Kerr & Company, will be fitted with two large central condensing units, each consisting of a 40-in. elevated condenser capable of handling 96,000 lbs. of steam per hour. These condensers are being built by Henry R. Worthington, of New York City, who will supply centrifugal pumps for handling the circulating water. That Company will also furnish the rotative dry vacuum pumps which will remove all air from the condenser system. The boiler feed-pumps of this immense power plant are likewise of Worthington make.

THE NORTHWESTERN ELECTRIC COMPANY, of Chicago, has been incorporated. S. H. Martin is president, M. J. Clark, vice-president, and J. R. Dean, secretary and treasurer. The members of the company are well known to the trade, having been connected with a well-known concern for a number of years. The company will make a specialty of buying and selling second-hand electrical machinery, and of expert electrical repairing. A factory at 71 West Washington Avenue has been equipped for that purpose. It is also the manufacturer of the well-known S. H. M. brush holders and of a line of ground detectors.

THE EUREKA ELECTRIC COMPANY, of Chicago and Genoa, Ill., has just closed contracts for immediate shipment of a very large outfit of its improved telephone apparatus for installation at Cebu, Philippine Islands. The company is this month making four shipments to foreign countries. The government of Salvador has just placed another contract for a large shipment with this company, after having used its apparatus for the last five years, proving its superiority when placed in comparison with foreign makes.

PITTSBURG STEEL COMPANY IN CANADA.—A deal has just been closed by which the Pittsburg Steel Company takes a lease of a portion of the Hoepfner refinery buildings in Hamilton, Ont., for one year. This means that the Pittsburg Steel Company will at once begin operations in Hamilton. A contract has been closed with the Cataract Power Company, of Hamilton, for electric power. It is expected that before the expiration of the lease, the company will have its own site and buildings.

ILLINOIS CENTRAL SIGNALS.—Arrangements have been made for the installation of the telegraphic block signal system on the entire system of the Illinois Central. It is estimated that the cost of the improvement will reach $1,000,000. According to the present intentions of the executive officials of the company the entire main line, about 3,000 miles, will be blocked as fast as possible, and it is expected three years will be consumed in completing the work.

BALL ENGINE ORDERS.—The Sheridan Iron Works, of Champlain, N. Y., have recently ordered a 70-hp direct-connected engine from the Ball Engine Company, Erie, Pa. The City Electric Light plant at Schuyler, Neb., will install a 175-hp engine, furnished by the Ball Engine Company. The Ball Engine Company has sold the Dundee Textile Company, Passaic, N. J., a 175-hp direct-connected unit.

General News.

THE TELEPHONE.

PHOENIX, ARIZ.—The Sunset Telephone & Telegraph Company has purchased a building here and fitted it up with the modern equipment. On October 1 the central energy system was inaugurated. Throughout the business portion of the city all cables have been laid underground.

LOS ANGELES, CAL.—The Home Telephone Company has begun service on its long-distance lines between this city and Long Beach, where it has 300 telephones installed.

SANDERSVILLE, GA.—A new telephone company is being organized at Sandersville with a capital stock of $12,000 to compete with the Southern Bell Company.

CARROLLTON, GA.—The Gainesboro Telephone Company, of this city, has secured the privilege to increase its capital stock from $40,000 to $150,000. It has built five large exchanges and strung some 300 miles of wire in this and the six adjoining counties and has 500 stations.

CHICAGO, ILL.—The Chicago Telephone Company made a total gain in September of 1603 telephones. The total now in use is 95,628.

EAST ST. LOUIS, ILL.—Arrangements are being made by the Kinloch Telephone Company to install a complete system of underground conduits for its wires in East St. Louis.

MONMOUTH, ILL.—The Central Union Telephone Company contemplates building an entirely new plant in this city to replace the one now in operation. The improvements will be made at an expense of about $25,000.

DECATUR, ILL.—A syndicate, including Col. James S. Culver, of Springfield, John H. Culver, of Decatur, E. W. Hight, of Assumption, has purchased the Douglas County Telephone Company, a concern operating in Eastern Illinois, with 500 miles of wire and 800 farmers' telephones. It is the intention to make extensions.

CHICAGO, ILL.—According to the new directory of the Illinois Telephone & Telegraph Company the company now has 625 subscribers in the down-town district. The contracting department is a way ahead of the constructing department, orders being received at the rate of 90 per day, while instruments are being installed at the rate of 75 per day.

CHICAGO, ILL.—The new Douglas Exchange of the Chicago Telephone Company was opened recently and the service of about 4,400 subscribers has been transferred to it from other exchanges. This exchange district embraces the territory between 29th Street on the north, the Union stock yards and Transit railroad track on the south, and the Rock Island railway track on the east. It is located at 35th Street and Grand Boulevard.

CHICAGO, ILL.—According to an opinion rendered by the corporation counsel, the Chicago Telephone Company owes the city more than $500,000 in back compensation. The city for years has claimed that the telephone company owed 3 per cent. compensation on its gross receipts in the towns of Hyde Park, Lake, Lake View and Cicero where, under the old ordinances of the towns, the latter paid no compensation. Steps are now to be taken to collect the amount.

DECATUR, IND.—At the annual election of the Citizens Telephone Company the following board of directors was elected: John Baker, Henry Hite, E. H. Ehniger, F. M. Schirmeyer and J. W. Tyndall.

ELWOOD, IND.—There are signs of a telephone war here between the Bell Company and the Delaware and Madison Company, the latter an independent concern. The independent company is trying to get exclusive control of the field, and it is endeavoring to induce business houses and citizens to discontinue the use of the Bell telephones.

ANDERSON, IND.—The Farmers Telephone Company has just completed a neighborhood line in this county. The line extends east and north of Alexandria and has 53 subscribers. It will connect with the Delaware and Madison County line at Alexandria. Marshall Walker organized the company and built the line.

CHESTERFIELD, IND.—The Chesterfield Telephone plant was burned out on Oct. 8 by the cable coming in contact with the trolley wire of the Union Traction Company. The entire system was destroyed and the three-story brick building in which the exchange was located was badly damaged by the resulting fire.

CEDAR FALLS, IA.—The Iowa Telephone Company, it is stated, will rebuild its exchange here.

SIOUX CITY, IA.—The Sioux City Telephone Company has been incorporated with a capital stock of $10,000. Mr. H. Woodruff is the only incorporator of this company.

GETTYSBURG, MD.—The United Telephone & Telegraph Company is rebuilding its lines in Adams County.

HUNTER, MD.—The Hunter Telephone Company has been organized with a capital stock of $5,000. It will build lines in different directions throughout this section.

BALTIMORE, MD.—The Maryland Telephone & Telegraph Company has concluded a traffic agreement with the United Telephone & Telegraph Company of Pennsylvania. Under this agreement the Maryland Company gets a connection with Hagerstown, Md., Winchester, Va., Chambersburg, Carlisle and Harrisburg, Pa., and many other places throughout a large territory.

TRAVERSE, MICH.—The Traverse Bay Telephone Company, of Central Lake, has been incorporated with a capital stock of $4,000.

HART, MICH.—The Oceana Telephone Company has built over 50 miles of new line this season and will soon have 700 telephones in operation. It pays a dividend of 6 per cent.

CHILLICOTHE, MO.—The Livingston County Telephone Company has filed articles of incorporation, the capital stock being $2,000. The shareholders are S. J. Miller, A. M. Shelton, F. S. Miller, Maude Miller and D. F. Williams.

LIVINGSTON, MONT.—The Yellowstone Park Telephone & Telegraph Company has been incorporated with a capital stock of $10,000 by Frank A. Hall, Geo. W. Boyce and George Cox.

JERSEY CITY, N. J.—Eastern Illinois Independent Telephone Company of Jersey City, N. J., has been incorporated, capital stock $500,000; capital in Illinois, $50,000.

MORRIS, N. Y.—The Butternut Valley Telephone Company, of this place, has increased its capital stock from $3,500 to $6,000.

OSWEGO, N. Y.—The Empire State Telegraph & Telephone Company is seeking a franchise in this city. It is stated that the company will spend $100,000 on a new exchange.

CHARLOTTE, N. C.—It is reported that a new telephone company, the third one in the city, will be organized here to install a local system.

REIDSVILLE, N. C.—The Southern Bell Telephone Company has absorbed the local independent exchange at Reidsville and will shortly put in a modern common battery system. A number of toll lines were included in the deal.

COLUMBUS GROVE, OHIO.—The village council has granted a franchise to the Bell Telephone Company.

SPRINGFIELD, OHIO.—Linemen employed by the Central Union Telephone Company here are on strike.

PLAINFIELD, OHIO.—The Plainfield Telephone Company has changed its name to Consolidated Telephone Company.

SPENCER, OHIO.—The Spencer Telephone Company, capital $5,000, has been incorporated by N. E. Fuller, F. T. Cavin, M. M. Freeman and C. S. Rice.

LORAIN, OHIO.—The Black River Telephone Company operates a 2,000-drop Sterling switchboard and furnishes service to 1,400 subscribers. It is adding new subscribers at the rate of two per day.

CINCINNATI, OHIO.—The telephone company has filed an application for a permit to erect a new exchange building at the corner of Race and Canal Streets. It will cost $45,000.

LOGAN, OHIO.—The Logan Home Telephone Company bought out the Standard Telephone Construction Company last March, changed the name and rebuilt the system. It expects to install 600 telephones. There are 350 subscribers to the exchange and 24 miles of toll line. The company expects to continue building farmers' lines.

CALEDONIA, OHIO.—The Caledonia Telephone Company has been incorporated with $25,000 capital stock by J. Pommert, C. E. Kelly, L. C. Donnenwirth, T. J. Pittman, Fred Busch and J. Rinker. The company has purchased the system in Marion County operated by Mr. Pommert. The company proposes to extend the system through Marion, Morrow and Crawford counties.

HAMILTON, OHIO.—A syndicate of Hamilton capitalists, headed by O. M. Bake and Louis P. Clawson, has bought from the Northwestern Construction Company, of Bryan, Ohio, the Hamilton Home Telephone Company, which is allied with the United States Telephone Company. Connections are now being completed with Dayton and an entrance to Cincinnati will probably soon be made.

MARION, OHIO.—The Marion County Telephone Company controls five rural exchanges, three of which have been in operation since July, the other two just being equipped. The Marion exchange has 1,237 subscribers. The company's officers are Mr. F. E. Guthery, president; Mr. S. E. Barlow, vice-president; Mr. Oswald Wollenweber, treasurer; Mr. French Crow, secretary, and Mr. D. M. Odaffer, general manager.

POND CREEK, O. T.—The Rural Telephone Company of Pond Creek has been incorporated with $5000 capital. The incorporators are Henry F. Wilkin, John H. Dunkin and S. D. Million.

LAMONT, O. T.—The Lamont and Eddy Rural Telephone Company, of Lamont, has been incorporated with a capital stock of $312. The incorporators are John B. Cowen, Art. Hollopeter and Swan Olson.

BLACKWELL, O. T.—The Blackwell Rural Telephone Company has been incorporated with a capital stock of $25,000. The incorporators are W. Harshman, William Risley, C. E. Fondrey and A. Durand.

ROCK HILL, S. C.—The Southern Bell Telephone Company is seeking franchises and installing systems in a number of smaller towns in South Carolina where independent systems are already in operation. Among the towns included are Rock Hill, Yorkville, Lancaster and Camden.

DEADWOOD, S. D.—The Nebraska Telephone Company will expend $30,000 on its local exchange in this city.

SPARTA, TENN.—The property of the defunct Overton Telephone Company has been purchased by the Gainsboro Telephone Company. The Gainsboro Company is extending its mileage in Tennessee and Kentucky and adding many new exchanges.

NASHVILLE, TENN.—The Tennessee Telephone Company has petitioned the City Council for permission to establish an independent telephone system in Nashville. A 50-year franchise is desired and the right is given the city to purchase the plant after 25 years. It is proposed to furnish telephones at $3 per month for business houses and $2.50 for residence instruments. Thirty free telephones will be given the city and a reduced rate made on additional ones which may be needed.

GAINESVILLE, TEX.—The People's Home Telephone Company, of this place, will build a copper wire telephone line to Cleburne.

CLEBURNE, TEX.—The new telephone exchange of the Automatic Telephone Company at this place will be opened in a few weeks. F. B. McElroy, of Fort Worth, is vice-president of the company.

SOUR LAKE, TEX.—The Sour Lake Telegraph & Telephone Company is installing a telephone exchange at this place. It placed 100 telephones in operation on October 2 and this number will be increased when the plant is completed.

TEXARKANA, TEX.—The New Long-Distance Telephone Company has been organized here with a capital stock of $200,000 for the purpose of establishing an extensive system of telephone lines in northeastern Texas. The incorporators of the company are John P. King and Joseph Huckins, Jr., of Texarkana, Tex.; John B. King and W. L. Estes, of Texarkana, Ark.; W. P. Harrison, T. M. Marrott and F. E. Harrison, of Ohio.

BEAUMONT, TEX.—The Beaumont & Northwestern Telephone Company is extending its system to Silsbee, Kountze and Saratoga. Preparations are being made by the company to build a copper metallic circuit between Beaumont and Sour Lake. The Beaumont & Northwestern Telephone Company is making arrangements to extend its line from Cleveland, Tex., to Japan, Tex., and thence to Houston by way of Humble. J. M. Smith is general manager. The same interests own the Beaumont and Northwestern and the Beaumont and Southwestern telephone systems.

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ELECTRIC LIGHT AND POWER.

ALAMEDA, CAL.—The City Trustees are considering the purchase of two 75-light transformers at a probablo cost of $4500.

LOS ANGELES, CAL.—The Pacific Light & Power Company, through M. C. Osborn, has petitioned the Town Trustees of Alhambra to advertise for sale a franchise for the operation of an electric light and power system in Alhambra, to cover a period of 50 years. Bids will be opened on November 24.

LOS ANGELES, CAL.—It is stated that H. E. Huntington is going into the San Bernardino Mountains after power and incidentally take from the Edison Electric Company, his rival, certain power rights which he alleges it has slept upon. Mr. Huntington is at the head of the Pacific Light & Power Company. The controversy centers on the right to use the water in Bear Creek between Corkscrew Falls and the junction of the Santa Ana River. John C. North, of Riverside, and a corps of surveyors are now in the mountains for the Huntington interests running lines and making preparations for the immediate erection of a power house.

EAST ST. LOUIS, ILL.—The Citizens' Light & Power Company has increased the number of its directors from three to five.

SHELBYVILLE, ILL.—The City Council has decided that the city shall operate the electric light plant, recently turned over by H. B. Trout, who has leased it for three years. As the law does not grant power to the city to conduct a plant for commercial lighting purposes, it is announced that the city will be enjoined from running this plant under a contract with Trout. The city paid $10 a year for each street light, but the actual cost of operating each was over $50. Until the plant is enlarged, which will cost $8000, the city will be in darkness.

EVANSTON, ILL.—The Yaryan Company, which has been heating most of the public buildings and many of the private residences of Evanston, will, it is rumored, abandon its franchise. Recent differences that have arisen between the company and its patrons are said to be the cause. The city council has refused to take any definite action. Many who have been patrons refused to install asbestos-covered pipes and storm doors and windows required by the company, which refuses to supply heat unless these conditions are fulfilled.

MARION, IND.—The City Council has granted a franchise to the Citizens' Light & Heating Company.

MUNCIE, IND.—The Delaware County Commissioners are discussing the building of an electric light and steam-heating plant for the county institutions.

BLOOMINGTON, IND.—Engineers G. W. Scott and O. A. Thelin, of Chicago, Ill., are at the university making preliminary surveys and estimates for erecting a $20,000 addition to the power house, for increasing the electric supply. The entire heating arrangements of the university will also be remodeled.

BEDFORD, IND.—The Secretary of State has granted charters to the Cope's Shoals Hydraulic Company and the Clark's Ferry Hydraulic Company with Wm. L. Stoy, of Odon, Ind.; D. A. Yoder, of Vincennes, and Harry T. Crook, of Washington, directors of both companies. They propose to construct and operate a water power plant at or near Cope's Shoals, on the east fork of White River to operate a street and interurban railway through Vincennes, Washington, Loogootee, Shoals, Indian Springs, West Baden and through Knox, Daviess, Martin and Orange counties.

MASON CITY, IA.—Jas. Rule and others have petitioned for a franchise for an electric light, gas and heating plant.

OTTAWA, KAN.—John Nelson is reported interested in the construction of a power plant to develop and distribute electrical power.

FRANKFORT, KY.—The council has voted to enter into a contract with the People's Electric Light & Power Company to furnish the city 72 arc lamps at $80 per year. The present lights cost $96 per year.

FAIRFIELD, ME.—A. F. Gerald, of Fairfield, has purchased the water power at Fairfield Rip on Sebasticook River and will establish electric generators, and run a line of wire to Kennebec River.

WEST BAY CITY, MICH.—The commercial lighting furnished by the municipal lighting plant has proven so popular that the village finds it necessary to increase the facilities of its plant and new equipment will be purchased in the near future.

FOSSTON, MINN.—Bids are wanted Oct. 28 for $4000 light and water bonds. W. F. Black is recorder.

COLUMBIA, MO.—The voters of this city have decided in favor of municipal ownership of the electric and water plant. Another election will be called to issue bonds for the construction of the plant.

JOPLIN, MO.—A movement is on foot by Eastern and local capitalists to establish a large electrical plant for the purpose of operating all the mines and mills of the Missouri-Kansas mining district. It is said the central plant will be located in Joplin, while smaller stations will be located in Galena and Webb City.

ATLANTIC CITY, N. J.—The Herbath Mitchell Company, of New York City, N. Y., is about to ask City Council for a franchise to lay conduits and run wires in this city to furnish electric lights to private consumers. The company desires to lay conduits under the boardwalk and later string wires throughout the city.

FORT STANTON, NEW MEX.—The United States government is installing an electric light plant at this military post. M. H. Fisher, manager of the Alamagordo Electric Light Company, of Alamagordo, New Mex., has the contract for the work.

TRUMANSBURG, N. Y.—F. C. Biggs and O. G. Noble are interested in the construction of an electric light plant.

MOHAWK, N. Y.—The citizens are considering the construction of water works and an electric light plant, at a cost of $30,000.

BATH, N. Y.—Bids will be received Nov. 12 by Geo. W. Dunn, President of the Board of Trustees, at the N. Y. State Soldiers' and Sailors' Home, for reconstructing and repairing the electric plant; also installing engines, generators, switchboard, branch steam and exhaust piping at the N. Y. State Soldiers' and Sailors' Home. Address G. L. Heins, State Architect, Capitol, Albany.

WILSON, N. C.—A proposition is being considered by this town to lease its electric light plant to the Flagler interests.

VALLEY CITY, N. D.—All bids opened on Oct. 5 for constructing the municipal electric light plant have been rejected.

ATHENS, OHIO.—The council has sold $15,300 worth of municipal light bonds to E. M. Strandsberry & Company, of McConnellsville. The new plant will be erected as soon as possible.

TROY, OHIO.—Bids will be received Oct. 31 by the Board of County Commissioners for furnishing material and installing an electric lighting plant in the court house. Address E. E. Pearson, the County Auditor.

MANSFIELD, OHIO.—The Mansfield Railway, Light & Power Company was the lowest bidder for the contract for lighting the city and the contract will be entered into as soon as the council can grant the company a franchise.

GUTHRIE, OKLA. TER.—The electric light plant at this place has been sold. New machinery will be installed by the new company.

PATTON, PA.—The Patton Township Electric Light Company has been incorporated with a capital of $5000.

ALLENTOWN, PA.—U. H. Wienland, of Allentown, has secured the contract for the electric light plant at the pumping station. The contract calls for engine, dynamos, switches, etc.

CHERAW, S. C.—L. F. Westerbund, of Chester, S. C., is installing a new electric lighting system at Cheraw with a capacity of 25 arc and 800 incandescent lights.

RICHMOND, VA.—The City Council has granted a franchise to the Merchants' Light & Power Company.

NEWPORT NEWS, VA.—It is stated that the Council will appoint a committee to report on the advisability of establishing a city electric light plant.

SEATTLE, WASH.—The Board of Public Works on Oct. 6 rejected all bids recently received for the generators for the municipal electric light plant. The lowest bid received was submitted by Kilbourne-Clark Company, of Seattle, for $16,933. New bids will be called for at once.

WAUTOMA, WIS.—The citizens have voted to issue bonds for the construction of an electric light plant.

RICHLAND CENTER, WIS.—The citizens on Oct. 6 voted to issue $20,000 bonds to purchase the electric light plant of G. H. Strong.

RANDOLPH, WIS.—The contract to install the municipal electric light plant has been awarded to Langstadt & Meyer, of Appleton.

TORONTO, ONT.—Negotiations are under way by which the Stark Electrical Company, of Toronto, Ont., hopes to take over the plant of the Humber Power & Light Company. The Stark people have a new system with which they expect to revolutionize the telephone service, and they are anxious to get it into operation at Toronto Junction while some day they intend to invade Toronto. The Humber Power & Light Company is capitalized at $100,000.

MONTREAL, QUE.—Mr. Charles F. Phelps, the Baltimore electrical engineer engaged as an expert by the special committee of the City Council of Montreal, named to enquire into the proposal of placing all wires in the city underground, states that he has completed estimates for a conduit system for the city. The plans permit of readjustments without materially altering the project as a whole, and will enable Montreal to put all its wires underground without any exceptional difficulty or cost.

MONTREAL, QUE.—The Montreal Light, Heat & Power Company is negotiating with the Shawinigan Power Company, of Shawinigan Falls, Que., for an additional supply of electric power to be delivered at as early a date as possible. The first contract for power supply, which was for 8,000 horse-power, has been successfully carried out and has proved so satisfactory, notwithstanding that this power supply comes from a distance of over 80 miles from Montreal, that the Montreal company now wants to get an additional 10,000 supply of horse-power immediately. It is said that the Montreal company can make a larger profit on the Shawinigan supply than it can from the power generated by the company itself at Chambly and Lachine close at hand.

THE ELECTRIC RAILWAY.

ANNISTON, ALA.—It is understood here that plans are forming for the construction of an electric railway from Pyriton to Lineville, a distance of 7 miles.

ENSLEY, ALA.—A franchise has been granted to the Birmingham & Steel Cities Railway Company to operate a street railway throughout the city.

TUCSON, ARIZ.—The Tucson Street Railway Company has asked for a 25-year franchise covering all the business streets of the city. The company also wants a franchise for an electric lighting system. As consideration, the city is offered 100 arc street lights at $5 a month. The application is opposed by the Tucson Electric Light Company, which is getting $10 a month from the city for each of the fifty-one street lights.

TUSCAN, CAL.—Bids are wanted for the construction and equipment of an electric railway from Red Bluff to Tuscan, a distance of about 9 miles. Address, Tuscan Mineral Springs Corps.

SAN FRANCISCO, CAL.—The question of issuing bonds by the city for the purchase and operation of the Geary Street cable railway was voted upon by the citizens on October 8. The result was adverse to the proposition, which was beaten by over 6000 votes.

LOS ANGELES, CAL.—The Fresno Traction Company has been incorporated in Fresno County with a capital stock of $5,000,000, the incorporators being W. G. Kerckhoff, A. C. Balch, H. P. Baumgartner and W. E. Durfee, of Los Angeles, and A. G. Wilson, of Fresno.

NORWICH, CONN.—At a meeting of the directors of the Groton-Stonington Street Railway Company, a committee was selected to engage an engineer to begin the construction of the road, and another committee was appointed to secure the necessary rights of way. The company has secured property at Mystic as a site for the new power house.

KANKAKEE, ILL.—The Kankakee Interurban Riverview Railway Company has been incorporated; capital stock, $2500. Incorporators: Haswell Wesley, James Bonfield, Gordon Hannah and John C. Dixon.

CHARLESTON, ILL.—The Charleston, Champaign & Northern Interurban Railroad Company, with a capital stock of $10,000, has been incorporated for the purpose of constructing an interurban line from Charleston to Homer.

MOLINE, ILL.—The Mississippi Valley Traction Company has been incorporated, with a capital stock of $600,000. Incorporators and directors: William P. Kopf, E. Scott, H. W. Nichols, Jr., Frederick W. Hill and Albert J. Claussen, Chicago.

AURORA, ILL.—An attempt was made by two men to hold up a car on the Riverview Park line just outside of the city limits on the night of October 8. The result was that one of the robbers was killed and the other probably fatally wounded.

CHICAGO, ILL.—The Blue Island, Riverdale and Hammond Street Railway, with offices at Chicago, Ill., and Oklahoma City, Okla., has been chartered at Guthrie, Okla., to operate a street railway in the suburbs of Chicago to Joliet, Finley Park and Lansing, Ill. The capital stock is $1,500,000.

CANTON, ILL.—The Illinois Central Electric Railway Company has been incorporated; capital, $300,000. The incorporators and first board of directors are Joseph David, Cleveland, Ohio; James A. Lawrence and James S. Hopkins, Chicago, Ill.; Fred A. Dolph, Aurora, Ill.; David J. Peffers, Jr., Evanston, Ill.

CHICAGO, ILL.—The council of Evanston has been asked to grant a fifty-year franchise to the Chicago & Milwaukee Railway Company, the purpose being to build a street car line through the west part of the suburb, in which the service has long been recognized as inadequate. The plan is to parallel the tracks of the Chicago Consolidated Traction Company.

CHICAGO, ILL.—The corporation counsel has rendered an opinion to the effect that the city ought to get compensation for advertising from the Northwestern Elevated Company, but that he cannot recommend a suit to recover such compensation because the city has no right to allow the elevated roads to advertise on platforms over streets and alleys. Five ordinances are now before the city council to give the various elevated roads this privilege.

PAOLI, IND.—Dispatches state that the Louisville and South Indiana Traction Company has filed a mortgage of $1,000,000 to cover the construction of an electric road from Louisville and New Albany to French Lick Springs.

INDIANAPOLIS, IND.—The Hoosier Power & Traction Company, of Vincennes, has been incorporated with a capital stock of $50,000. Directors: O. N. Greist, H. H. Crooke, W. L. Stoy and others.

NEW ALBANY, IND.—The Louisville & Southern Indiana Traction Company has asked the County Commissioners for a right of way through the county for an electric railway from New Albany to Paoli and French Lick and West Baden Springs.

MICHIGAN CITY, IND.—Judge Baker, of the Federal Court, has ordered the Lake Cities Electric Railway property to be sold under a decree of foreclosure in favor of the Metropolitan Trust Company, of New York. The decree directs that the road be sold at public auction at Laporte, and that no bid under $40,000 be accepted. Alexander A. Boyd, of Terre Haute, is receiver.

CEDAR RAPIDS, IA.—Col. W. G. Dows and Isaac B. Smith, of Cedar Rapids, who are now engaged in constructing the Cedar Rapids, Iowa City & Southern Interurban Railway, are considering plans for the construction of another interurban line. This new line will be built in a northwesterly direction from Cedar Rapids, through Linn, the objective ,point being Waterloo. The line will be about 54 miles in length. It is stated that financial arrangements have already been made, and that the work of constructing the line will commence in the spring

KANSAS CITY, KAN.—There is a project forming of building an electric railway from Kansas City to Jefferson City and thence to the lead and zinc fields of Missouri. This information has been given out by P. H. Coney, an attorney, of Topeka, Kan.

NAHANT, MASS.—The voters have at a special election decided in favor of an electric railway. The Selectmen will meet and consider the propositions of the two rival companies.

WORCESTER, MASS.—The project for a street railway between Worcester and Providence, R. I., which has been dormant for a year, has been revived. At a meeting in Milbury the subscribers to the $200,000 of stock it is proposed to issue chose these directors: Fred C. Hinds, of Newton; Charles H. Wilson, of Brookline; Henry F. Rice and Henry S. Stockwell, of Sutton; Dr. Silas D. Holbrook, of East Douglass; Henry B. Bullard, of West Sutton, and William E. Horne, of Millbury. There are assurances from the preliminary work that has been done that there will be no difficulty in getting the franchises.

TRAVERSE CITY, MICH.—L. N. Gibbs et al. have been granted a franchise for a street railway. They will at once organize the Traverse City & Peninsular Railway Company.

BENTON HARBOR, MICH.—Right of way is being secured for an electric railway from Benton Harbor to South Haven. Mr. Mueller, a Chicago lumberman, owns a large part of the property necessary for the right of way, and it is reported that he offers to donate land for the power house, besides a liberal cash donation when the road is completed.

BAY CITY, MICH.—The Bay Cities Consolidated Street Railway Company, which has been in the hands of a receiver for about three years, has been sold to H. D. Walbridge, of Detroit, representing the Bay City United Traction Company, a corporation recently organized to take over the property. There was but one bid,,the price offered being $500,000.

NEW YORK, N. Y.—An extension of the rapid transit system to Van Cortlandt Park is regarded as almost certain in view of the outcome of two auction sales of property in that neighborhood. The sales involved two tracts, one of about twelve acres and the other of less than one acre.

NEWARK, OHIO.—The Newark, Martinsburg & Mount Vernon Traction Company intends to build an extension to Wooster.

GREENVILLE, OHIO.—The People's Rapid Transit Company has secured a franchise in this place. The company will build a line from Toledo to Greenville.

GUELPH, ONT.—The by-law for taking over the Guelph Radial Railway Company by the city of Guelph has been voted on and passed. The cost will be $78,000.

BANGOR, PA.—The Bangor, East Bangor & Portland Street Railway Company has purchased the large plant of the Bangor Electric Light, Heat & Power Company. The trolley company intends making some alterations, after which it will extend the line from the present terminus at Portland to the Delaware Water Gap and Stroudsburg.

CONNELSVILLE, PA.—A charter has been granted the Monongahela & Clairton Street Railway Company. The incorporators are Paul W. McCully, W. P. Whitledge, John G. Parke, Jr., Cullin Armstrong, William H. Lewis, B. W. Castner, John W. Ailes, William H. Binns, J. N. Mullin and Oliver S. Scott. The capital stock of the company is $75,000.

PROVIDENCE, R. I.—The Providence & Burrillville Street Railway Company, which is planning to build a double-track electric railway between Woonsocket and Providence, connecting with the Rhode Island Company's system to the south and the Woonsocket Street Railway Company to the north, has organized. The following-named officers have been elected: President, E. H. Rathbun; general manager and treasurer, E. K. Ray; secretary, Frank E. Holden.

MEMPHIS, TENN.—It is reported that the Memphis Street Railway Company will build an 18-mile line to Collierville.

TRENTON, TENN.—The Gibson County Construction Company has been organized for the purpose of constructing an electric railway from Trenton to Eaten, Brazil and Gibson Wells. The projected route is about 17 miles long. A survey is to be made at once.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company has a large corps of men at work investigating and securing estimates on the amount of improvements to be made on the different lines of the company. It is said that during the next six months the road is to be entirely rebuilt in many places.

FORT WORTH, TEX.—The construction of an interurban electric railway from this city to Mineral Wells, Tex., is projected. The distance is about 57 miles. The route of the proposed road is through the towns of Azle, Reno, Springtown, Poolville, Whitt and Salersville. John W. McCracken, of Springtown, can give information in regard to the enterprise.

CORPUS CHRISTI, TEX.—C. B. Moling, of Moling Bros., who have had plans prepared for the establishment of a great pleasure resort here, says that more than $1,000,000 will be expended in the construction of the interurban electric street railway line that is to run from this place to Portland, Tex., and in other improvements which are to consist of a 600-room hotel, fifty cottages, opera house, casino, etc.

HOUSTON, TEX.—Ed Kennedy, the promoter of the proposed interurban electric railway that is to be built between Houston and Sour Lake has returned from Pittsburg, Pa., Cleveland and Columbus, Ohio, where he says he was successful in perfecting plans for financing the project. The right-of-way and survey for the road has been secured and the work of construction is to soon commence according to present plans. The central power station will be located at Liberty.

NORFOLK, VA.—Deeds have been filed here by the Newport News & Hampton Street Railway separating the interests of the Williams syndicate and of Alex. Brown & Sons, of Baltimore. The deeds are from the Richmond Trust & Safe Deposit Company and release the property and securities pledged under a deed of trust to secure an issue of $2,000,000 of income bonds issued in June, 1902.

NEW INDUSTRIAL COMPANIES.

THE BAKER MOTOR VEHICLE AGENCY, of New York, has been incorporated, capital, $2[illegible],000. Directors: J. E. Delmar, Louis Hall and A. R. Rulison, New York.

THE LANDERS ELECTRICAL COMPANY, of San Francisco, has been incorporated with a capital stock of $500,000. The subscribers to the stock are C. K. Harley and C. W. Landers.

THE AUTOMATIC ELECTRIC SIGNAL COMPANY has been incorporated at Newark, N. J.; capital, $200,000. Incorporators: Antonio Scarturro, Joseph Gituni and Walter C. Law.

THE EDISON AUTOMOBILE COMPANY, of Washington, D. C., has been incorporated at Camden, N. J., capital $100,000. Incorporators: Edward H. Chew, Wilfred R. Walcott and Norman Grey.

THE TOQUET MOTOR CAR AND CONSTRUCTION COMPANY has been incorporated at New York; Capital, $25,000. Directors: B. L. Toquet, Westport, Conn.; Oscar Wuerz, Conrad Stein, New York.

THE IMPROVED ELECTRIC LIGHT & HEAT COMPANY, of New York, has been incorporated; capital, $10,000. Directors: John Knobloch and G. K. Hartung, New York; G. W. Wallace, Mount Vernon.

THE ELECTRIC COTTON LEATHER BELTING COMPANY, of New York, has been incorporated; capital, $5000. Directors: W. J. Berg and J. S. Lawson, Brooklyn, and W. W. Benjamin, Arlington, N. J.

THE NEW YORK GARAGE COMPANY, of East Orange, N. J., has been incorporated with a capital stock of $50,000 to manufacture motor vehicles. The incorporators are James B. Richardson, Walter H. Bond and Gardner W. Kimball.

THE TOLEDO STORAGE BATTERY AND ELECTRICAL COMPANY, of Toledo, Ohio, has been incorporated with a capital stock of $100,000. The incorporators are G. L. Miller, C. R. Clapp, L. A. Alexander, M. H. Griffin and F. H. Alexander, of Toledo.

THE ROYSE-BATLEY ELECTRIC COMPANY, of Indianapolis, Ind., has been incorporated and has succeeded the business of Royse & Batley. The company's headquarters are at 16 E. Market Street, where it carries on a business as electrical contractors.

THE WACO ELECTRICAL SUPPLY & PLUMBING COMPANY has amended its charter, changing its name to the Duncan-Hobson Electric Company and removing its headquarters from Waco to Dallas. It has also increased its capital stock from $40,000 to $80,000.

THE WHEELER ELECTRIC COMPANY has been incorporated in New York to manufacture electrical machinery. The capital stock is $5,000 and the incorporators are Samuel W. Wheeler, New York City, Walter S. Sinclair, Sea Gate, and Geo. L. Lockwood, New York City.

THE AMERICAN ELECTRIC BRAKE COMPANY has been incorporated at Newark, N. J., the authorized capital stock being $100,000. The company will manufacture brakes for street vehicles. The incorporators are Thomas L. Nixon and Lester W. Cockefair, of New York, and Adrian I. Tichenor, of Newark.

THE HOLCOMB MANUFACTURING COMPANY has been incorporated at Hartford, Conn. The company, which is a New Haven concern, takes over the business of H. C. Holcomb, automobile manufacturer. The authorized capital is $50,000 and the incorporators are H. C. Holcomb, Henry W. B. Manson and Mr. Tolman.

LEGAL.

WESTERN UNION IN NEW ORLEANS.—The Western Union Telegraph Company has entered suit against the City of New Orleans and Foster Olroyd, city electrician, to enjoin the defendants from in any manner interfering with its wires in the city. The Western Union Telegraph Company controls and operates the National District Telegraph Company in that city. It wished to install a service in the United States Mint, and asked Mr. Olroyd for permission to do so. This was refused and Mr. Olroyd ordered the wires taken down. Mr. Olroyd claims that the National District Telegraph Company has no permission to operate in New Orleans.

TELEPHONE COMPANIES COMMON CARRIERS.—Judge Artman, of the Boone Circuit Court, in Indiana, has ruled that when a telephone company opened its switchboard and granted connection with another telephone company, it became a common carrier of oral messages, and as such cannot discriminate between companies in the county seeking connection with it; that it is bound under the law to admit all companies seeking such service on equal terms. The case involved was that of the Thorntown Co-operative Telephone Company which brought suit against the Lebanon Telephone Company to compel the latter to give the Thorntown Company switchboard connection. The Lebanon Company had already given such privileges to another Thorntown company. The ruling is interesting rural telephone companies who hope to obtain desirable connections if it is sustained by the higher court to which the case will be appealed.

NEW YORK CONDUITS.—New York City, by direction of Mayor Low, is going to sue the Consolidated Telegraph & Electrical Subway Company for an accounting of an indeterminate amount under the clause of the company's contract with the city which says that the annual profits in excess of 10 per cent. on the actual cash capital invested shall go to the city. Edward Owen, Commissioner of Accounts, has made a report to the Mayor to the effect that the profits have been more than 10 per cent. on the actual cash capital invested, and that the city has been deprived of a large revenue partly by a system adopted by the company of charging against earnings high rates of interest upon obligations to subsidiary companies, which would have been unnecessary if the company had begun with the necessary capital. The contract was entered into in 1886. The report gives the list of the company's shareholders. The largest holders of stock are the State Trust Company, 15,160 shares; Horace M. Kilborn, 2000 shares; Charles R. H. Gilbert, 550 shares; New York Edison Company, 138 shares, and Edward Lauterbach, 100 shares.

OBITUARY.

MR. JOHN GRAHAM MILLAR, manager of the roofing department of the H. W. Johns-Manville Company, New York, died at St. Luke's Hospital on October 15, 1903, in his forty-second year.

MR. R. P. SCALLS, formerly general manager of the Consolidated Car Heating Company, died last week. He was identified with the company for a number of years, having been the Chicago representative for five years, and general manager at Albany for two years. He retired from active participation in the selling branch of the company about a year ago. His death occurred in Boston.

PERSONAL.

S. W. CHILDS.

MR. S. W. CHILDS, recently general manager of the Kalgoorlie Electric Tramways, of Kalgoorlie, Western Australia, has just returned to this country after an absence of several years. Mr. Childs started in the electric railway business on the old Watervliet Turnpike R. R. at Albany, N. Y. He went to Boston in 1890 and remained in the employ of the old West End Street Railway Company for two years. He then went to Lincoln, Neb., where he was engaged in construction work. He went to Brooklyn in 1892 and was employed with the Atlantic Avenue R. R. under the late Deacon Richardson, well-known to many old electric railway men of this country. Mr. Childs left Brooklyn to enter the employ of J. G. White & Company, and was assigned to Baltimore, Md., where he had charge of track and overhead construction work. He next went to Columbus, Ohio, and was superintendent of construction for the Columbus Central Railway Company, for which he laid out the entire track, overhead and pleasure park system. He left Columbus in 1896 to take charge of construction work at Fort Wayne, Ind., for the Degnon Construction Company. He went to Charleston, S. C., in 1898 and had charge of construction work on the electric railways in that city. In the fall of 1898 he went to Australia for the first time and became assistant engineer for J. G. White & Company in connection with the electric tramways at Perth, Western Australia. He returned to America in 1901 and had charge of construction for the Toledo & Munroe Electric Railway. He left this position to return to Australia as manager of the Kalgoorlie Electric Tramways. Mr. Childs, on his recent trip to America, made an extensive tour of New Zealand, the Philippine Islands and a few cities in China and Japan, where electric tramways are contemplated or are being built. At each of these places Mr. Childs has increased his long list of friends and at the same time added substantially to his enviable record for carrying out work on a broad scale with unusual efficiency and energy and with uniformly good results.

MR. E. F. PECK, general manager of the Schenectady Railway Company, has been elected president of the gas part of the enterprise also.

MR. P. G. GOSSLER, chief engineer of the Montreal electric light and power system was a welcome visitor in New York City during the past week.

MR. M. J. HIGLEY, superintendent of the Belvidere, Ill., Gas & Electric Co., has resigned and has become manager of the Iowa City, Ia., Gas Light Company.

MAJOR BLAND, of the Royal Engineers, has, it is stated, lately been visiting Newfoundland to study the question of the protection of British cables across the Atlantic, in war time.

SIR W. H. PREECE, F.R.S., has recovered from his recent severe attack of pneumonia, and accompanied by two daughters is now making a tour of convalescence in Egypt and the Holy Land.

MR. PETER COOPER HEWITT has been abroad with his wife making a long automobile trip in Europe. Mr. Hewitt is greatly set up by the change and is expected to arrive in New York this week.

MR. E. S. LEA, of the De Laval Steam Turbine Company, has returned from a western trip. He says that business in the electrical line is much more flourishing in the west than it is in this section of the country.

MR. E. E. WEBSTER, formerly general manager of the Twin City Telephone Company, of Minneapolis, Minn., has been appointed general manager of the Independent Telephone Company, of Seattle, Wash., and has proceeded to assume his new duties.

MR. E. THURNAUER, head of the French Thomson-Houston Company, has returned to Paris this week after a long stay on this side, during which he has visited various parts of the country and looked up electrical progress on this side of the Atlantic.

MR. D. AMOSO MAZENET, of Mexico City, who is general manager of the Mexican General Electric Company, is now on a visit to the States. He will be here, according to present arrangements, for at least a month at General Electric headquarters.

MR. RICHARD H. RICE, formerly of the Rice & Sargent Engineering works, which are now part of the Providence, R. I., Engineering works, has been appointed to the management of the manufacturing end of the Curtis turbine business at Schenectady.

DR. CLAYTON H. SHARP, testing officer of the Lamp Testing Bureau of the Association of Edison Illuminating Companies, has sailed on the *Blucher* for England. He goes to London, Glasgow, Berlin, Munich and other places to study up the latest laboratory methods and ideas.

MR. S. W. ASHE, of the staff of the Brooklyn Polytechnic Institute, is delivering a course of engineering lectures at the Railroad Men's Building, in Brooklyn. It is understood there will be 48 lectures in the course, and the indications are that they will meet a marked educational want.

MR. HENRY RUSTIN, chief of the mechanical and electrical department of the St. Louis Exposition, is now visiting in New York State. He went recently to Colorado for his health and returned to St. Louis to clean up some work. Further rest and change are necessary, however, after the ordeal of the last two years.

MR. E. RATHENAU, who is so prominently connected with electrical interests in Germany, sailed on Tuesday by the North German Lloyd steamer, *Kaiser Wilhelm Second*, for home. He has spent a good deal of time with the General Electric representatives and is understood to have made a very thorough investigation of the Curtis steam turbine with his engineering staff.

MR. E. W. ROBERTS, who is well-known to the gas-engine trade as author of the gas-engine handbook and numerous other works on gas engines and automobiles, and as a designer and consulting engineer, is fitting up a laboratory at Clyde, Ohio, for the testing of gas and gasoline engines and gasoline automobiles as well as for calorimetry and analysis of both gas and liquid fuels.

NEW YORK ELECTRICAL SOCIETY.—The following-named gentlemen were elected members of the New York Electrical Society at the meeting of October 19: William Thomas Taylor, Schenectady, N. Y.; George W. Travis, Brooklyn, N. Y.; Sydney Hogerton, New York; Adolph G. Koenig, New York; Edgar H. Berry, New Brighton, N. Y.; Howard S. Rich, New York; Dr. John Woodman, New York.

ABADIE-BOLLING.—The wedding took place at Louisville, Ky., on October 5, of Mr. Eugene H. Abadie, to Miss Alice G. Bolling, member of a well-known old Southern family of that city. Mr. and Mrs. Abadie will make their residence in this city. Mr. Abadie has long been prominent in electrical matters through his connection with the Wagner Company, of St. Louis, and is now in the management of the Elblight Company of America.

MR. W. J. HAMMER, the consulting electrical engineer, whose recent lectures on radium have attracted so much attention, has now been placed under contract by the Pond Lyceum Bureau to deliver his lecture this winter before a number of well-known social and scientific bodies of high standing. Last winter Mr. Hammer lectured nine times and there is a great call for his services. The radium lecture is quite fascinating and very instructive.

MR. VAN RENSELLAER LANSINGH, the illuminating and electrical engineer, of Chicago, has been engaged to work out a preliminary scheme of general illumination for the Lewis & Clark centennial exposition, to be held at Portland, Ore., in 1905. The illumination of the buildings and the grounds will be made a special feature of the exposition. Four-candle power lamps will be adopted as the unit of illumination in place of the eight-candle-power lamps used at the Pan American Exposition and at the Louisiana Purchase Exposition.

DR. LEE DE FOREST sailed October 14 on the White Star steamer *Majestic*, for England, taking with him his chief assistant, H. M. Horton, and two outfits of De Forest wireless telegraph, at the request of prominent men connected with the British Post Office, the Admiralty and others. A demonstration is to be made between Holyhead and Dublin and all facilities of the Post Office have been put at Dr. De Forest's disposal towards this end. It is said that Sir William Preece is especially interested in the test. The matter of speed of transmission will be especially observed. It is the intention of those interested in Great Britain to incorporate the British Empire De Forest Company upon the completion of the tests.

Trade Notes.

OIL FILTERS FOR BUENOS AIRES.—The Burt Mfg. Co., Akron, Ohio, recently filled an order for four Cross oil filters from Buenos Aires, Argentine Republic.

MR. WM. T. PRINGLE, Philadelphia, the well-known switchboard constructor and manufacturer, has recently removed to 1906 North 6th Street, the change being necessary to secure increased facilities.

MALTBY LUMBER CO., Bay City, Mich., has issued a very neat little pamphlet in regard to its poles for telephone, traction and electric light purposes; and its ties for trolley lines and steam roads. It will go in an ordinary envelope, but contains a lot of information and is well illustrated of more than usual utility and some of it of permanent value.

THE ELECTRIC APPLIANCE COMPANY, Chicago, selling agent for McBride "Arkless" cartridge fuses, writes that these fuses are now made for voltages up to 500 volts. They are furnished in any capacity up to and including 30 amperes. They fit any and every style fuse connection in all style of fuse blocks, are easy to use, perfect in action, and are reliable.

DOUBLEDAY-HILL COMPANY.—This company will shortly issue its new catalogue, which will be one of the largest and most complete ever issued by an electrical supply house. The fact that it will contain considerably over 1000 pages gives some idea of its size and scope. Furthermore, there will be some very important and valuable features never embodied in a publication of this kind before.

THOS. G. GRIER COMPANY, 128 W. Jackson Boulevard, Chicago, Ill., has been appointed western representative for the sale of the Kinsman specialties. This company will carry a stock of the goods in Chicago so that immediate deliveries can be made. The goods will be sold at the same prices and terms as if they were bought direct from the manufacturer. All inquiries will receive the prompt and careful attention of Thos. G. Grier Company.

FIREMEN'S TOURNAMENT.—At the recent State Firemen's Tournament of Pennsylvania, held at Allentown, there were some fine lighting effects. The illuminations and lighting decorations were done by Mr. F. C. Gardner, of Summit, N. J., who used the Norbitt temporary socket. Mr. G. F. Rohn, of Milwaukee, writes the Pass & Seymour Company that within two months he had used upwards of 2000 of its new sockets on various kinds of work.

PACIFIC COAST POWER PLANTS.—Under the title of "Steam Power Plants of the Pacific Coast," Chas. C. Moore & Company, engineers, of San Francisco, have issued a very handsome pamphlet illustrating and describing a number of the fine plants which they have constructed and engineered during the past few years on the Pacific Coast and in the Hawaiian Islands. Many of the plants are for electric lighting, street railway or power transmission work.

SCHMIDT TELEPHONE APPARATUS.—The Lambert Schmidt Telephone Mfg. Company, Weehawken, N. J., has just installed in the new Butterick Building, New York, a 120-drop telephone switchboard, common-battery system. The New Amsterdam Theatre and the New York Theatre have recently been equipped with the Schmidt automatic intercommunicating telephone system. Other contracts just closed are equipments for the Adjutant General's office and Bureau of Ordnance in Washington, D. C.

PRAIRIE FIRE DRAG.—A folder describing the "Prairie Fire Drag," a device for extinguishing prairie fires, is being sent out by the H. W. Johns-Manville Co., 100 William St., New York. The drag consists of a chain mat covered with an asbestos smothering blanket supplied with chains at two corners, and may be easily and quickly adjusted to drag by the horn of a saddle or by single tree. A wash drawing by the well-known illustrator, Mabie, shows two mounted cowboys putting out a prairie fire with the drag.

"COMPRESSED FIBRE" is the name of a useful product intended to be used in place of hard rubber. It has been on the market for some time in the shape of photographic apparatus, but is now made for telephone receiver shells, telephone mouth pieces, battery jar covers, switch bases, etc. Certain particularly good features are present in Compressed Fibre which render it quite different in working from other hard rubber substitutes. The manufacturer is known as the Compressed Fibre Company and is located at 6 Beacon St., Boston, Mass. The president is George W. Nock, vice-president, George H. Hill and secretary, John C. Sherman.

THE THOS. E. CLARK WIRELESS TELEGRAPH-TELEPHONE COMPANY, of Detroit & Pontiac, Mich., announces that its business for this fall and winter looks exceedingly encouraging. It is getting out instruments for two stations for the government work at Washington and Baltimore, and numerous orders for colleges, universities, high schools and individual sets for short distances keeps it busy to the full capacity. The company is moving into its new factory at Pontiac. It is preparing instruments to be used at the Universal Exposition at St. Louis, where it will have three stations in constant operation. This company is now looking for students to take up wireless telegraph operation.

NEW MAGNETO TESTING APPARATUS.—The Eureka Electric Company at its new factory at Genoa, Ill., has just perfected improved apparatus for the purpose of testing each and every magneto telephone generator manufactured by this company, and in addition to the testing of its generators it has devised a very ingenious instrument for the purpose of testing and computing lines of force obtained in a generator magnet. By this method it is enabled to manufacture each and every generator exactly alike and secure absolute and improved results from every one of their machines. First, after assembling the generator, it is tested for milliamperes output and then its voltage, and any machine falling below a given standard, which standard is a very high one, it is rejected. Before the magnets reach the assembling room, each and every one of them after being magnetized is tested for lines of force or, in other words, its strength in magnetism. The Eureka Electric Company is now distributing its new No. 26 and 27 Bulletins, describing its high-grade line of apparatus, beautifully illustrating the same, in addition to its splendid Catalogue No. 23.

NAME PLATES.—Until recently, the manufacturer of dynamos, motors and other electrical machinery was content with labeling his product with any and every kind of name plate. In fact, this was considered such an unimportant detail that very little, if any, attention was given to it. As the manufacture of electrical machinery became more systematized, a great deal of attention was given to details and the general appearance of the finished product, whereupon the name plate also came to receive its share of attention. It was recognized that this ought to be of such a shape, character and finish that it would not detract from any favorable impression the machine itself might create. Recognizing the need for offering the best at the lowest possible price consistent with good workmanship, the Crowe Metal Mfg. Company, of Chicago, formerly the Bogue & Crowe Manufacturing Company, has made a specialty of this line, and has perfected what is known as the Crowe process, whereby a high-grade raised-letter name plate can be produced automatically from sheet metal of different qualities and thicknesses. It is also prepared to do embossed work on metal, or, in fact, any work of a similar nature. It has recently increased its facilities so as to be able to fill all orders promptly for its growing business. Among its customers it numbers some of the best-known manufacturing companies in the country.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 13, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

741,044. STORAGE BATTERY; Charles W. Kennedy, Rutledge, Pa. App. filed March 21, 1902. (See page 685.)

741,052. AUTOMATIC COUPLING FOR ELECTRICAL CONDUCTORS; Charles Mahon, Washington, D. C. App. filed Jan. 4, 1902. Two bars each having a seat containing a contact and a spring opposite the seat, so that when one member is forced into the other, one side of the circuit will be closed by the spring engaging a part of the opposite member and the other side by the contacts in the two seats coming together. When the joint is separated, the spring bears against the contact in the seat and bridges the ends of the circuit.

741,097. STREET RAILWAY SWITCH; Walter J. Bell, Los Angeles, Cal. App. filed Aug. 5, 1902. The switch tongue is moved by a pneumatic piston, the air being controlled by an electro-magnetic valve.

741,114. APPARATUS FOR TELEPHONE TRUNK-LINES; William W. Dean, Chicago, Ill. App. filed Jan. 14, 1902.

741,115. RELAY; William W. Dean, Chicago, Ill. App. filed Jan. 14, 1902.

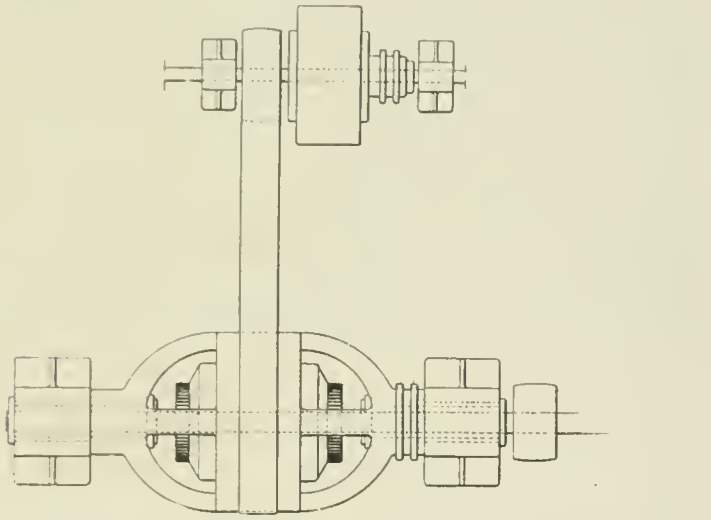
741,118. MEANS FOR OPERATING RAILWAY SWITCHES; Joseph O. Dimmick, Denver, Colo. App. filed Jan. 21, 1903. An oscillating shaft is made the core of an electro-magnet, the poles of which are projected towards the switch point and then rotated, causing the point to follow the poles by the magnetic attraction therebetween.

741,123. ELECTRIC TRACK INSTRUMENT; Taylor T. Fogel, Allentown, Pa. App. filed Aug. 8, 1902. An oscillating magnet is placed near the rail so that the car wheel in moving past it will exercise a magnetic influence to oscillate the magnet in the direction in which the train is moving and thus close a signal circuit which indicates the direction of movement of the train.

741,168. ELECTRIC SWITCH; Joseph H. Rusby, Nutley, N. J. App. filed March 20, 1902. Details.

741,206. ELECTRIC RHEOSTAT; Leonard Wilson, Pittsfield, Mass. App. filed April 6, 1903. The invention consists in cutting out parts of the resistance in series with a circuit and simultaneously cutting in a shunt resistance, thereby effecting a saving in resistance material while an even adjustment of circuit strength.

741,207. ELECTRIC RHEOSTAT; Leonard Wilson, Pittsfield, Mass. App. filed April 6, 1903. A modification of the preceding invention.



741,471.—Power Translating System.

741,231. PROCESS OF TREATING CYANIDE SOLUTIONS; William H. Davis, Boulder, Col. App. filed July 3, 1902. (See page 685.)

741,234. CONTINUOUS CURRENT MACHINE AND APPARATUS; Max Deri, Vienna, Austria-Hungary. App. filed March 6, 1903. A field magnet in the form of a continuous ring slotted on its inner periphery and carrying exciting coils and equally distributed compensating coils in the slots for the purpose of neutralizing any tendency to armature reaction.

741,239. CIRCUIT BREAKER; Joseph D. Forrer, Johnstown, Pa. App. filed March 12, 1902. The arcing is subdivided by breaking the circuit at a plurality of points in series.

741,245. ELECTRIC LAMP OR CANDLE; Conrad Hubert, New York, N. Y. App. filed Feb. 27, 1903. A structure resembling a candlestick and candle, an electric lamp being located where the flame usually occurs and the candle body containing a battery cell the current from which is controlled by a switch on the handle.

741,255. ELECTRIC ARC LAMP; George M. Lane, Brooklyn, N. Y. App. filed Nov. 18, 1902. Details of an improvement in gas checks.

741,268. QUICK ACTION MAKE AND BREAK SWITCH; William C. O'Brien, Baltimore, Md. App. filed May 14, 1902. Details of a switch having a quick movement on both the make and break.

741,271. TURBINE ELECTRIC GENERATOR; Edwin H. Porter and Burleigh Currier, Philadelphia, Pa. App. filed Oct. 9, 1902. (See Current News and Notes.)

741,272. ELECTRIC INDUCTION-MOTOR; Edwin H. Porter and Burleigh Currier, Philadelphia, Pa. App. filed Feb. 7, 1903. (See Current News and Notes.)

741,274. APPARATUS FOR ELECTROPLATING; Albert R. Pritchard, Rochester, N. Y. App. filed June 23, 1903. (See page 685.)

741,282. TELEPHONE SYSTEM; Charles B. Smith, New York, N. Y. App. filed Feb. 3, 1899.

741,283. TELEPHONE; Charles B. Smith, New York, N. Y. App. filed March 6, 1899.

741,284. TELEPHONE SYSTEM; Charles B. Smith, New York, N. Y. App. filed Dec. 18, 1899.

741,285. TELEPHONE SYSTEM; Charles B. Smith, New York, N. Y. App. filed Dec. 30, 1899.

741,290. MEANS FOR PREVENTING FLUCTUATIONS IN ROTARY MOTORS; James J. Wood, Fort Wayne, Ind. App. filed July 16, 1900. The fly-wheel is connected with its shaft through two reversely arranged spiral springs adapted to be wound and unwound by relative movements of the wheel and shaft, to prevent "hunting" and fluctuations generally.

741,312. RAILWAY SIGNALING SYSTEM; Adolph G. Dahmke, Chicago, Ill. App. filed Feb. 3, 1903. Details.

741,322. ELECTROLYTIC WATER-PURIFIER; George W. Frazier, Allegheny, Pa. App. filed Jan. 3, 1903. (See page 685.)

741,333. ELECTRIC FURNACE; Francis E. J. Hatch, Greenbay, Wis. App. filed Dec. 4, 1902. (See page 685.)

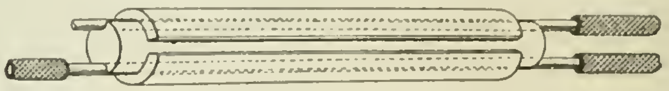
741,358. ELECTRIC CLOCK; Frank W. Moore, Maywood, Ill. App. filed May 24, 1897. The gong hammer is actuated at each stroke by an electromagnet, the hammer on the rebound moving the train.

741,371. APPARATUS FOR THE TREATMENT OF DEFECTIVE HEARING; Guy C. Powell and Allen D. Smith, Peoria, Ill. App. filed May 28, 1902. The tympanum of the ear is massaged by directing impulses of air against it; a bellows being actuated rapidly by an electro-magnet through which an interrupted current flows.

741,392. SHOE FOR THIRD RAILS; James E. Blakesley, Chicago, Ill. App. filed April 27, 1903. The shoe is pivoted to the end of a bell-crank and makes under contact with the rail.

741,393. SUPPORT OR CHAIR FOR THIRD RAILS; James E. Blakesley, Chicago, Ill. App. filed April 27, 1903. The support consists of a bracket to which an under contact rail is secured as well as a housing to protect the rail from the weather.

741,395. STEERING MECHANISM; Frank T. Cable, New Suffolk, N. Y. App. filed Nov. 7, 1902. The steering may be accomplished by hand or by an electric motor under the control of the hand. The motor is arrested automatically when it has shifted the rudder to an extent governed by the hand operated devices.



741,480.—Wire Connector.

741,396. PRODUCTION OF NITROGEN COMPOUNDS; Guillaume de Chalmot, Leaksville, N. C. App. filed Jan. 23, 1903. (See page 685.)

741,413. COMPOSITE METAL ROLL; Charles J. Reed, Philadelphia, Pa. App. filed April 4, 1902. (See page 684.)

741,439. PROCESS OF TREATING ORES; Charles E. Baker and Arthur W. Burwell, Cleveland, Ohio. App. filed Dec. 23, 1902. (See page 684.)

741,471. POWER TRANSLATING SYSTEM; Arthur C. Eastwood, Cleveland, Ohio. App. filed April 3, 1903. A method of transmitting power from a driving to a driven member, consisting in interposing a dynamo whose elements are movably connected respectively to the two members; the speed of the driven member is altered by varying the electrical characteristics of the two elements of the dynamo.

741,480. WIRE CONNECTOR; Frederick P. Fuller, New York, and John J. Walsh, Yonkers, N. Y. App. filed Feb. 7, 1903. A conical spring sleeve inclosing a conical plug having a groove on each side for the main and branch wires.

741,490. ELECTRIC SWITCH; Arthur E. Handy, Providence, R. I. App. filed April 15, 1903. Details.

741,527. ELECTRICITY METER; William M. Mordey and Guy C. Fricker, Westminster, England. App. filed April 7, 1902. An energy absorbing device disconnected from the armature is arranged to act upon the latter only when the same nears the end of, but before it completes, its stroke in each direction and to then exert a damping effect on the armature during the remaining portion of its stroke; this is to obtain a nearly constant amplitude of movement of the armature.

741,563. WIRE SUSPENDING DEVICE; Herbert E. Stevens, Windber, and Burt Gallatly, Pittsburg, Pa. App. filed June 26, 1903. A two-part bolt having inclined surfaces which firmly fix the bolt in a socket when the parts are driven in.

741,570. DETECTION OF ELECTRICAL OSCILLATIONS; Louis Heathcote Walter, London, and James Alfred Ewing, Cambridge, Eng. App. filed April 29, 1903.

741,571. RAILWAY SWITCH AND OPERATING MEANS THEREFOR; Arthur J. Backer, Syracuse, N. Y. App. filed Feb. 9, 1903. The switch point contains a chamber in which is located an electro-magnet; the magnet is fixed with respect to the switch point and when energized attracts the latter and moves it.

741,573. ALARM SYSTEM; Ernest H. Ballou, Binghamton, N. Y. App. filed Aug. 13, 1901. A jail in which the bars are tubular and form a pneumatic system, the air from which is allowed to escape when a door is opened, and an electric signal is operated by the escape of the air.

741,592. ELECTROLYTIC DIAPHRAGM; Isaiah L. Roberts, New York, N. Y. App. filed March 7, 1903. (See page 685.)

741,599. TROLLEY; Artemas B. Upham, Boston, Mass. App. filed April 13, 1903. A double trolley designed for trackless roads, the wheels being placed horizontally and making side contact with the overhead wires, the invention including a bracket designed to permit two wheels to pass each other on the same wire.

741,604. COMBINED TELEPHONE TRANSMITTER AND RECEIVER; Charles Yeack, Akron, Ohio. App. filed March 13, 1903.

741,605. ELECTRIC TERMINAL; Henry R. Young, New Orleans, La. App. filed Nov. 19, 1902. The terminal comprises a hollow body open at its end and having apertured lugs at one end and also having a lateral socket provided with set screws to engage the end of the conductor and a clevis for a retaining cable.

12,162. POLE CHANGER; William F. Warner, Muncie, Ind. App. filed Nov. 5, 1901. Details of a device for sending reverse current to line for ringing bells and signaling generally.

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STORAGE BATTERY AUTOMOBILES.

A little while ago we directed attention in these pages to some of the excellent results being achieved by storage battery automobiles in commercial service. The data were, indeed, remarkable, especially when the earlier setbacks and disasters are recalled. To-day any New Yorker can see for himself scores of these vehicles plying actively on their business errands; and the work can be seen, too, in other cities. All this has been, however, short-range operation, and when long-distance runs and endurance tests are under consideration, the possibilities of the storage battery have been referred to with mingled contempt and commiseration by the advocates of steam and gasoline types. Admitting as we do gladly all that can be claimed for the sturdy contestants that of late plowed their way from New York to Cleveland and Pittsburg even when the Pennsylvania and New York Central trains had to stop running, we are glad to note some recent performances by storage battery vehicles in long-distance trials. Hope springs eternal in our breast again as we direct attention to the item in our pages about the run from New York to Boston last week of Mr. Charles L. Edgar's tonneau equipped with the Edison cell. The distance, 249 miles, was made in 24 hours 56 minutes actual running time, an average of 10 miles an hour; and while charging facilities might have been better, they were certainly frequent and discoverable. On the famous Lester Hill, near Springfield, Mass., the battery had to give up 102 amperes of its precious current. Recharging appears to have been done at 20 and 40 amperes. We look for a renewal of these trials, with different types of batteries, and in the meantime hasten to commend the public spirit of Mr. Edgar in making them. As president of the National Electric Light Association, he is thus pointing the way to possible developments from which the central stations of the country may reap a rich harvest. In this connection, it is an encouraging fact that another storage battery vehicle also made the New York-Boston run recently, under comfortable circumstances. It is reported that the Helios-Upton battery was charged seven times, with an average distance per charge of 47 miles, and a cost per charge of about $1.30. Such figures lead to optimism, especially when followed up by the later report referred to above.

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THE RESULTS AT ZOSSEN.

Each new week sees a new record made at Zossen, in high-speed traction. We now have to note that a speed of 130⅔ miles an hour has been attained since this paper last went to press, and even that may have been excelled before our comment gets into type. Just how long our German friends are going to keep this up, we do not know, but it is safe to infer that they are still after that 150 miles an hour, which has been mentioned as their latest objective goal. At any rate, all that they have accomplished is vastly to their credit, even if they did not add another inch to their speed.

All this, moreover, is no idle *tour de force*. It has been supposed or suggested that the main idea was to get a method of transporting troops swiftly; but we ventured to intimate quietly some weeks ago that a new commercial road from Berlin to Hamburg might be found awaiting creation for high-speed purposes, after some of these problems had been solved. Confirmation of such a forecast is found in a cable dispatch this week from Germany stating that an electric road is to be equipped between Hamburg and Berlin, to operate at 100 miles an hour, and that the Emperor himself is deeply interested in the execution of the project. It is said, also, that this may be the first in a network of such roads covering the Empire. We take the distance between Hamburg and Berlin to be somewhat over 150 miles, and this will be made in 1½ hours on the new schedule. The carrying out of such a plan will be watched with deep interest in America, for we, with our vast stretches separating big centers of population, trying to get into closer touch all the time, have a great stake in the success of enterprises of this character. As to the suggested "network" of such roads, that is undoubtedly a very "large order" for the present stage of development. Many questions have still to be studied, not the least of which are the signaling on the technical side, and the profitable schedule on the commercial side. But there is some consolation in knowing that the limit of speed in transportation has been advanced, and that humanity is not restricted forever to the jog trot of the present steam régime with an average far below fifty miles an hour.

It would seem that demonstrations of this kind must attract the interest of railroad managers all over the world, and their practical views and objections to higher speed will be worth noting. Not long since the Pennsylvania Railroad had to abandon its high speed schedule between New York and Chicago, because of congested traffic. But congested traffic may arise from an absence of cars and particularly from a lack of terminal facilities, and it does not follow that faster running must forever be sacrificed on such grounds as that. We had hardly supposed there was enough passenger traffic between Hamburg and Berlin to warrant this new road, but it is not fair to judge from present conditions, for if one thing has been well proven it is that the introduction of electricity increases travel and traction receipts beyond any precedent.

Three-Wire Distribution.

Mr. Mosman's paper in the current issue is more than anything else a rather illuminating study of the high-pressure, direct-current, three-wire system which bid fair to make a serious impression on the art some two or three years ago. On the face of the proposition the use of 220-volt to 250-volt incandescent lamps on a three-wire distribution looked well. It implied a very great saving in copper and the possibility of competing successfully with alternating-current distributions over a fairly long radius. A good deal has been done with the system abroad, and a number of plants were installed in this country, but as experience was acquired certain practical difficulties appeared on which Mr. Mosman lays considerable stress. Chief among these was the trouble in getting proper lamps. We believe that our American lamps are the peers of any that the world produces, and our lamp makers know their business thoroughly; but it seems at present out of the question to produce a 250-volt lamp good enough to compete on even terms with the best lamps of half the voltage. For lamps of similar life the higher the voltage the less the efficiency, and except where energy can be very cheaply produced a low-efficiency lamp is a serious handicap.

The difficulty with arc lamps is still more serious, and all the accessories of the installation are more troublesome at the higher voltage. Mr. Mosman shows the increased cost of various items at the higher voltage in a table which is striking enough to make one think twice before doubling up on voltage. In the present stage of alternating distribution there seems to be little reason for a high-pressure, direct-current plant, for there is to-day no difficulty in providing a polyphase system quite capable of taking care of both lights and motors, and that most economically. As an illustration of this, we may point to the new Dublin polyphase plant, which displaces a direct-current plant and uses throughout a three-phase distribution. Even in manufacturing plants using power and incidental light, the present tendency is toward the use of induction motors on their merits. Until there is a radical change for the better in available illuminants for high-voltage distribution, we shall be inclined to look upon the 500-volt, three wire system as a makeshift useful in particular cases, but not at all to be taken seriously as a dominant factor in the future art.

Engineering Education in Great Britain and America.

The preliminary report has recently been printed of the principal of the Northampton Institute, a technological educational school in the city of London, the administrative board of which sent the principal, Dr. Mullineux Walmsley, to North America this spring on a three months' tour of inspection, to examine into the nature of engineering and technological educational training. The principal visited 34 educational establishments, of various classes, from night schools to universities, and interviewed 68 employers, manufacturers, or professional men, not counting teachers. The report sets forth briefly, clearly and with precision, the essential facts connected with the school and college training of engineering students in this country, as well as the general deductions concerning the subsequent careers of such students.

The main conclusions set forth in the report, so far as they relate to American students of engineering, are that the colleges endeavor to keep in touch with the industrial establishments of the country so as to give to the students a scientific training. This training enables the students to apply their knowledge subsequently to best industrial advantage under actual conditions of their practical work; also that the manufacturers and industrial establishments reciprocally favor the college graduates, and increasingly appreciate the advantages of securing technically trained assistants, as raw material for the development of their staff. It is to this mutual and reciprocal action of employers and technical colleges that we may look for the best national development in the future along industrial, manufacturing and constructive lines.

The Chief Competitor of Electric Light.

We print elsewhere the concluding portion of the report of the National Electric Light Photometric Committee, the first part of which was printed last week. The present section deals with the properties of the mantle gas burner. This has long been recognized as a cheap and useful means of illumination, but exact data on its performance in terms comparable with those used for electric light have not been easy to get. There have been a good many makers' tests, which, although doubtless substantially correct, are yet somewhat open to the suspicion which attaches to *ex parte* testimony. In this instance, however, the data are from an examination made in the interest of rivals, and hence it is safe to assume that the results, which we believe to be thoroughly impartial, can fairly be counted upon in commercial practice. Both the distribution and efficiency were measured for three types of mantle—the latest and most expensive form, a medium grade and a downright cheap grade. Since nearly all mantles have similar forms, it was a foregone conclusion that the distributions would be nearly alike and so they proved to be—showing nearly circular distribution in a horizontal plane, and in a vertical plane that nodal form with a maximum above the horizontal which the usual shape of mantle most necessarily give.

The most extraordinary feature of the test was that initially at least the three types of mantle gave about the same results in total light and in economy, the most costly mantles making the least satisfactory showing, and the burners as a whole showing a consumption of about 0.065 cubic foot per mean spherical candle-power. This is just about one-sixth the consumption found in an average open gas burner. Of course, the vital question is the life of the mantle and its retention of a decent color value. These points were not tested, but it will doubtless appear that the more expensive mantles have a material advantage in life. As to color, we have never seen any old mantles that did not burn green—some blue-green, others a curious yellowish green, but always offensively green. Until this color difficulty is obviated the mantle burner will be steadily at a disadvantage as compared with the electric light. The mantle loses efficiency in course of protracted burning much as an incandescent lamp does, and similarly should be thrown away after a certain amount of service, depending on the cost of the supply and the cost of renewal; but the light of an incandescent electric lamp does not undergo degradation of quality of any serious kind. It burns reddish orange after a while, but the color is not objectionable. It is often held that for outdoor use the mantle burner is little open to objection on account of change of color.

This claim is founded on fact, for things out of doors—the green of grass and trees, the gray of sidewalks and roadway and the neutral tints of frame houses—do not suffer much from a greenish hue in the lighting, particularly where the general illumination is low, as it usually is where mantle burners are installed. The same condition holds for the use of the mercury vapor lamp out of doors. But while we have never seen life tests of mantle burners used on the street, there is reason to suspect far more rapid detrioration than takes place indoors, and it is difficult to find a street lighted by mantle burners in which a considerable proportion of them are not deteriorated both in quality and quantity of light. An interesting feature of the report before us is a comparison of the illuminative effect of the mantle burners and Nernst lamps of similar power, at different distances from the lamp post. The latter holds the advantage near the post, but at ordinary spacing of lights there is very little difference, for the mantle burner has decidedly the best of the distribution question. The Nernst lamp should have a special diffusion system for street work to transfer the needlessly bright light under the lamp to a more useful point. Neither form of illuminant has any particular advantage for street work, though each has a useful field in general illumination. We hope that the N. E. L. A. committee will later take up the much vexed question of economical life and thus complete its very interesting investigation. Returning to the color problem, we understand that a new type of vapor lamp in several forms will presently be announced, which is claimed to meet the requirements of both exterior and interior illumination.

TESTING LARGE ALTERNATORS UNDER FULL-LOAD CONDITIONS.

In the early days of dynamo construction and up to about 1886 all generators, whether of alternating or direct current, were tested in the factory under full load. That is to say, the dynamos were driven by power, usually from a line shaft connected to a steam engine, and the full load applied at dynamo terminals. The load often consisted of banks of incandescent lamps. As the dynamos steadily increased in size and power, it became more and more inconvenient and burdensome to supply the load required for full-load operation. Dr. Hopkinson devised the method of circulating power between two similar machines mechanically connected, one serving as generator and the other as motor, a plan which only required the driving engine to supply the total power losses of both machines. In this way a comparatively small engine became capable of testing a large dynamo. The dynamo supplied its full load at terminals, but this power was not wasted in lighting lamps, or in heating rheostats. More recently Mr. Mordey applied the same idea to the test of a single alternator. Instead of using a mate to the machine, mechanically coupled as a motor, which would often entail keeping large sizes of dynamo machinery on the testing room floor solely for tests, he virtually divided the machine into two parts, respectively generator and motor, by dividing the armature against itself, one part of the armature acting as generator and the other part, reversed, acting in series therewith as motor. If the armature were divided into halves, the e.m.f. and c.e.m.f. would be equal and opposite; so that no armature current would flow. Consequently, the armature had to be unequally divided, leaving sufficient preponderance in the generator portion to drive full-load current through the armature on short-circuit.

In an article on page 715 of this issue, Mr. Behrend shows that with iron-clad armatures, the armature reaction, on short-circuit and with full-load current, may so greatly distort the magnetic flux distribution that the resultant field in the motor coils will always be much stronger than the resultant field in the generator coils. If about half the revolving armature carries a strong magnetic field with it, while the remainder carries a weak magnetic field, the armature will be subjected to a rotary side thrust changing in direction with the same speed as the armature, like the centrifugal thrust of an unbalanced mass of metal in the revolving armature, thus tending to set up powerful vibration and thumping in the journals. To avoid this difficulty, Mr. Behrend short-circuits the armature, and divides the field magnet system into opposed halves. By connecting these halves into separate exciting circuits, with independently controlled currents, he is able to make the resultant excitation on the generator half of the machine only a few per cent. greater than on the motor half, and just sufficient to drive full-load current strength through the armature coils on short-circuit. By this means the magnetic dissymmetry and the dissymmetry of mechanical force are practically suppressed.

The only disadvantage of the plan is that when the field system revolves as in most modern alternators, a third contact with the field has to be provided. In practice this should be a rubbing contact on a collector ring, rather than through the journal pedestals, since at full speed a well lubricated journal tends to insulate the shaft from the frame by the automatic injection of the lubricating film of oil, on which the shaft virtually floats. While Mr. Behrend's plan is described as working satisfactorily, and bears internal evidence of being suitable for the purpose, it is not the only one which may be employed. For years past it has been customary to test large alternators, at least in one factory, by dividing the armature into opposed halves, in series with each other and on short-circuit, leaving the field unchanged; or more conveniently in multiphases, by dividing the field into two opposed halves in series with each other, leaving the armature unchanged. In either case full-load excitation of the field will excite no appreciable resultant e.m.f. in the armature when the machine is at speed. This full-load field excitation provides for the full-load iron losses by hysteresis and eddies, but the armature is unable to deliver any current, and its I^2R losses will not be represented. But if the armature be supplied with a direct current of full-load strength from an external source, usually incandescent lighting mains, the I^2R losses and heating will be provided. This is the plan followed. It represents the full-load conditions of the generator, except, perhaps, that the magnetic distribution and iron losses may not be quite the same under artificial direct-current armature excitation, with a divided opposed field, as they would be under natural excitation. Mr. Behrend's method should provide a convenient alternative full-load method. It would be interesting to compare the results derived by the two methods.

Aluminum Patent Litigation.

An important decision was handed down last week from the United States Circuit Court of Appeals sitting at New York, sustaining the Bradley aluminum patent as against the Hall patent and ordering the lower court, which was reversed, to enter a decree in favor of the owners of the former patent for an injunction and an accounting with cost. This decision closes a long line of litigation beginning in 1890, which abounds in conflicting opinions of courts. Aside from a long litigation involving the Cowles and Hall patents, which was decided adversely to the former, there have been two principal issues, namely, the ownership of a patent granted February 2, 1892, on an application dated February 23, 1883, to Charles S. Bradley for an improvement in processes for separating electrically aluminum from its ores or compounds; and the status of this patent as against a patent granted April 2, 1889, to Charles M. Hall on a process of reducing aluminum by electrolysis. The Bradley patent as early as 1884 figured in interference proceedings in the Patent Office with some patent applications on aluminum processes by the Cowles Bros., and on May 18, 1885, the owners of the former patent, Messrs. Bradley and Crocker, were paid $5,000 for their interests in any and all discoveries and inventions relating to electrical smelting processes and furnaces, to all patents they had obtained and all applications then pending and caveats on file in the United States Patent Office relating to electrical smelting processes in furnaces which interfere with any application for patents made by the Cowles Brothers. When the Bradley patent was issued it appeared that the late Grosvenor P. Lowrey held an assignment of the same; this situation led to a protracted litigation over the ownership, which in 1895 was decided in favor of Mr. Lowrey, but which decision was reversed by a court of appeals in February, 1897.

In 1897 suit was brought under the Bradley patent against the owners of the Hall patent, which was decided in favor of the latter in 1901, and it is this decision which was reversed last week. Interwoven with the litigation above mentioned, has been the litigation above referred to between the same parties based upon the Cowles patent, which was finally decided adversely to the latter.

The opinion just rendered was written by Judge Coxe and concurred in by Judges Wallace and Lacombe. The opinion states that the main object of the Bradley patent consists in the employment of an electric current of greater intensity than is required to produce electrolytic decomposition alone. In this way the ores are maintained in a state of fusion by the heat developed by the passing of the current through the melted mass. The current performs two distinct functions: First, it keeps the ore melted by having a portion of its electrical energy converted into heat; second, it effects the desired electrolytical decomposition, by which means the heat, being produced in the ore itself, is concentrated at exactly the point where it is required to keep the ore in a state of fusion. Bradley dispenses with the crucible and uses a heap of the ore itself to constitute the vessel in which the reduction takes place, which is not destroyed as was the crucible in prior processes, and admits of the process being continuous, nothing being required but the charging of fresh ore as fast as the reduction goes on, either from without or from the sides or walls of the heap itself. The court says that it starts with the undisputed fact that prior to Bradley's invention no one had ever succeeded in separating aluminum from its compounds solely by the use of electricity; or in other words, no one had dispensed with external heat. References are then discussed to the work of Davy, Tessier, Siemens, Ball and Guest, Faure and Lane-Fox, and the conclusion reached that nothing in these publications anticipates or materially restricts the Bradley patent.

Then taking up the Hall patent, the opinion states that the judge of the circuit court was in error when he decided that the Hall invention is an entirely separate invention, for Hall's achievements should be considered in the light of an improvement upon Bradley's fundamental discovery. The Hall process is described as follows:

It uses a series of metal pots, the sides and bottom of each being lined with carbon, connected in series with a direct-current generator, each pot holding about 450 pounds of molten bath material. The bottom carbon lining is the cathode and a group of carbon cylinders, three inches in diameter, suitably suspended on copper stems and connected with the positive pole of the dynamo is the anode. Suitable conductors also extend from the metal shell of the pot to the negative pole of the dynamo. The bath material consists of a compound of fluoride of aluminum, fluoride of sodium and some fluoride of calcium. Alumina is added when the bath is in a molten condition and it is asserted that it dissolves freely upon being stirred in the bath. The electric current is sent through the solution by raising slightly the carbon rods and the alumina is decomposed, the metal going to the negative electrode at the bottom of the pot. The oxygen goes to the anode and escapes in the form of carbonic oxide gas. As the alumina is decomposed the bath is charged with fresh quantities, thus making the process continuous. No external fire is used. When a new pot is started the method usually adopted is to ladle into it the liquid material from an old pot, but sometimes a new pot is started from cold materials in which case the anodes are short-circuited for several hours and the current brings their ends and the adjacent parts of the lining to a red heat, the double fluoride is piled around the anodes and left for several hours until the compound is melted by the heat conducted from the lining. The alumina is then added and the process goes on as before.

Continuing, the opinion states that speaking generally most of the points at variance relied upon can be traced directly to the improvement introduced by Hall, namely, the use of cryolite as a solvent for alumina. Were it not for this change it is hardly probable that infringement would be denied. The opinion holds that the change of material does not create a new process, but a new way of working an old process. Hall starts by fusing cryolite and maintaining fusion by means of the electric current; so does Bradley, for in the example given in the patent cryolite is the ore mentioned. If any other ore were added to it the Hall processes up to this point would be identical. But Hall found that alumina is just as much an ore of aluminum as cryolite, it dissolves readily with cryolite as a solvent or flux, and he was able to produce a more efficient and cheaper electrolyte. The Bradley process is not confined to cryolite of aluminum, but relates to all ores or compounds of aluminum and all other refractory ores of a like type.

Cryolite is mentioned as an illustration in the specification, but it might as well have mentioned alumina or any other ore. That there is nothing in the patent or out of the patent requiring the limitation on the claims to cryolite seemed too plain for debate. The process may be used with cryolite alone or alumina alone or with both together whether applied synchronically or successively. In other words, the essential features of the process are appropriated. The contention that the Bradley claims are limited to an electric current twice as strong as that formerly employed when external heat was used, and that the defendant does not use such a current, is disposed of adversely, being untenable for the reason that the defendant does regulate the current, not, it is true, in the precise manner described in the patent, but in a manner clearly its equivalent. Various other limitations upon the Bradley claims are disposed of with the remark that they are of the same general nature and proceed upon the same initial fallacy.

The court held that in a patent like Bradley's the claims should be as broad as the invention and even if unnecessary and unreasonable limits are incorporated in the claims, the court should interpret them liberally and not permit the defendant to escape who reaches the same results by analogous means, though he may employ additional elements and improved mechanical appliances.

In regard to the contention that the Bradley process is not operative, the court says that having found that the defendant is using the process in producing an annual output now over 7,000,000 pounds, it is unnecessary to enter into an extended discussion of that problem. The reasons why the owners of the patent have not attempted to operate it are obvious, being due to the protracted litigation over the title, the suit based upon the Hall patent, the present suit and the impossibility of commercial competition with the defendant without using the so-called Hall improvement or some other improvement equally cheap and effective. The court adds that the cryolite-alumina electrolyte cannot be so used so long as the decision sustaining the validity of the Hall patent remains undistured.

In a circular issued previous to the above decision by the owners of the Bradley patent to stockholders, it is stated that should this patent be sustained a claim will be made for royalties on 50,000,000 pounds of aluminum that has been manufactured by the defendant. In 1901 the latter obtained against the Cowles Company an award of $293,970 for infringement of the Hall patent, the award being on the basis of a production of 170,825 pounds of aluminum; the circular states that the rules involved in arriving at this figure are the same rules that should apply in fixing the amount due to the plaintiff on the quantity of aluminum which has been manufactured by the defendant.

Transmission of Hudson River Power.—II.

THIS extensive network of transmission lines is carried on chestnut poles that vary from 35 ft. to 60 ft. in length, the 35-ft. poles being the standard. All poles were peeled, knots were cut close, and the following were the required dimensions:

Length of pole.	Circumference at top.	Circumference 6 inches from butt.	Depth in ground.
35 feet	24 inches	42 inches	5.5 feet
40 feet	24 inches	45 inches	6 feet
45 feet	24 inches	48 inches	6 feet
50 feet	24 inches	51 inches	7 feet
55 feet	24 inches	54 inches	
60 feet	22 inches	57 inches	8 feet
65 feet	22 inches	60 inches	

Poles on tangents were regularly spaced 100 ft. apart, but this spacing was reduced to 50 ft. near tangent points, and heavy corners were each turned with two or more poles. All poles were set straight, but on curves the tops of poles were pulled out radially with guy wires to a distance of 6 to 12 in. Each pole was cut with three gains 1½ in. deep and spaced 3 ft. between centers.

Standard cross arms for the line are 10 ft. 6 in. long, 4 in. thick and 6 in. deep, are chamfered ½ in. on their top edges and given two coats of metallic paint. Each cross arm is secured to the pole by a single through bolt 15 to 18 in. long and ⅞ in. in diameter. This bolt has a thread cut over 4 in. of its length, is used with its nut next to the cross arm, and has a washer 3¼ in. square and ¼ in. thick under both head and nut. All bolts, nuts and washers are galvanized. Each cross arm is braced with one piece of galvanized angle iron made from 2-in. x 2-in. x ¼-in. stock, 5 ft. long and bent into bow form, so that its center is 1 ft. below its ends when the brace is attached to the cross arm and pole. This brace is secured to the pole by one 5-in. x ⅝-in. fetter drive screw. Each end of a brace is secured to the under side of its cross arm by a single through bolt 7 in. x ⅝ in., threaded 2 in., and with a 3¼-in. square washer under the nut. Cross arms face in opposite directions on the two poles of each span, save that for spans of more than 100 ft. in length the cross arms are on the sides of poles opposite to the spans. On curves and corners either pole braces or guy cables were used to support each pole. The pole braces were not less than 22 in. in circumference at their tops. Guy cables are all made up of seven-strand No. 12 B.W.G. galvanized steel wire with an ultimate tensile strength of at least 80,000 pounds. Side guys were attached beneath the lower cross arm on poles in all cases, but head guys were attached above the lower arm in some instances. Clamps, thimbles, bolts and nuts for guy cables are all galvanized and of malleable or wrought iron or steel. Wooden guy anchors are 6 ft. long and not less than 30 in. in circumference. Guy rods are 8 ft. x ⅝ in., provided with an eye at one end, threaded 2 in. at the other, each fitted with two nuts and one washer, and all are of wrought iron or mild steel.

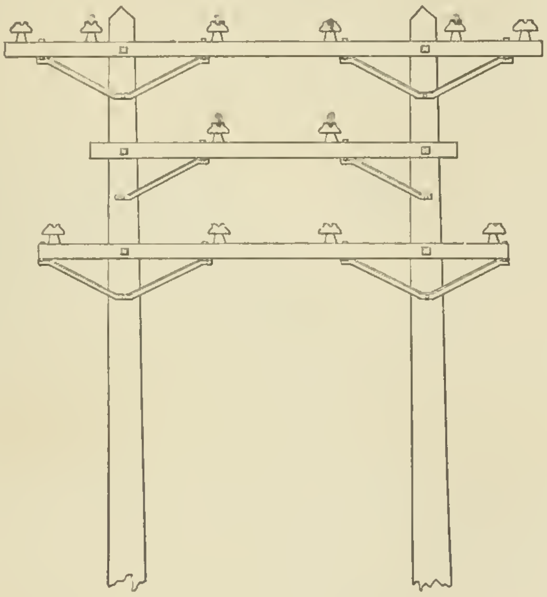


FIG. 7.—SPECIAL POLE CONSTRUCTION.

Each of the 10-ft., 6-in. arms that are standard on this work carry four insulator pins spaced 3 ft. apart on centers. All pins are iron and each pin is secured to its cross arm by a ¾-in. bolt or stud of wrought iron or steel that passes down through it and is secured underneath by a nut and washer. Two styles of pins are in use, one intended for straight lines and the other for curves and corners. The pin for straight work is made up of a malleable iron casting with a ¾-in. wrought iron or steel stud threaded into its base. This stud passes down through the cross arm and the casting stands above the arm and carries the insulator. In pins intended for curves and corners a bolt passes entirely through the cast-iron part and then down through the arm with a nut and washer underneath. For this strain pin the length of the ¾-in. through bolt is 16½ in. over all, the length of the cast-iron part that stands above the cross arm is 8¾ in., and the flange of the casting that bears on the arm is 3¾ x 5 in. The top of this casting is 1⅜ in. in diameter and has ¾-in. threads for the insulator.

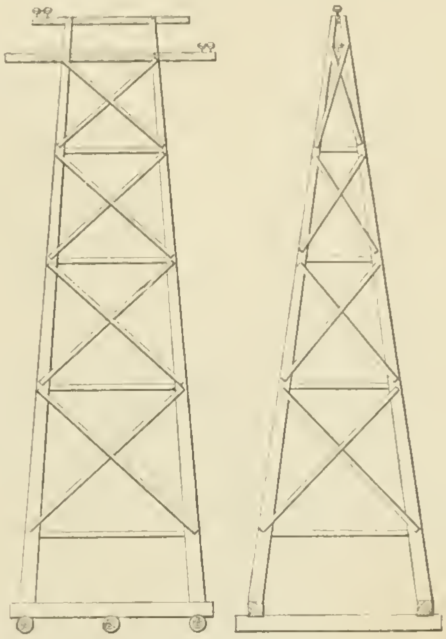


FIG. 8.—TOWER FOR TRANSMISSION LINES.

FIG. 9.—CROSSING D. & H. TRACKS AT SARATOGA.

All insulators used on these pins are of porcelain with brown glaze, and are in two styles. The type of insulator of which the greatest number have been used is cast in a single piece with double petticoats. The Locke insulator that has more recently been adopted is cast in three parts and then cemented together. On these insulators the required puncturing test is 80,000 volts during five minutes after the insulator has been soaked 24 hours in water. Each petticoat is tested separately with 40,000 volts. Each insulator was secured to its pin by liquid Portland cement poured into the pin hole of the insulator while the loose pin top was held in a central position. On the built-up insulators three petticoats are provided. When this insulator is in position on its pin and cross arm, its lowest petticoat is 4¼ in. above the top of the arm. The next higher petticoat is 6¾ in. above the arm, and the outside petticoat has its lower edge 7½ in from the arm. In diameter the highest or outside petticoat measures 8½ in., the middle petticoat 5½ in., and the lowest petticoat 4 in. When standing alone on its longest petticoat the height of this insulator is 6¾ in.

Both styles of porcelain insulators used permit the line wires to be tied to either their tops or sides, but in the construction the lines were tied to their sides. Insulators for the transmission lines were required to withstand a transverse strain of 3,000 pounds, and thick petticoats were specified in order to avoid breaking under shotgun practice. For the telephone wires which follow all the transmission circuits a Locke No. 7 porcelain insulator was employed.

All of the transmission circuits are made up of solid, hard-drawn bare copper wire, required to be of not less than 98.5 per cent. conductivity. Tie wires for all sizes of the transmission conductors were of No. 4 B. & S. G. soft-drawn bare copper wire, and each was approximately 30 in. in length.

Splices in the main conductors were made with trolley sleeves at least 12 in. long, and heat was applied only at the center of each sleeve, so as to avoid annealing the hard-drawn copper wire. The soldered joints thus made with sleeves were allowed to cool slowly to avoid the annealing just named. Wires were strung on the standard 100-ft. spans, with deflections depending on the temperature, according to the following table:

Degrees Fahrenheit	0	10	20	30	40	50	60	70
Deflection in inches	6	9	12	14	16	17	19	20

In each three-phase circuit the wires were transposed ⅓ of a turn for each section of 130 poles, so that each conductor passes through a complete circle every 7.5 miles, there being 52 poles per mile of straight line.

The three four-pin arms per pole permit the erection of four three-phase circuits with each wire 36 in. from any other. Two wires of a circuit were mounted on the two insulators that occupy that half of a top cross arm on one side of its pole. The third wire of this circuit was mounted on the insulator at the end of the next lower arm and directly beneath the outer of the two wires of that circuit on the top arm. This arrangement left the inner insulator on the same end of the middle arm and the two insulators on the corresponding end of the third or lowest cross arm for another three-wire circuit. On the other side of each pole the six wires of two circuits are arranged in an exactly similar way. Telephone lines over the transmission system are of No. 12 hard-drawn copper wire, 5 ft. below the power wires and transposed every three poles.

Special constructions were necessary at several points on the transmission lines. In Saratoga, where the circuits cross the tracks of the Delaware & Hudson Railway, a complete network of guard wires was built beneath the high-tension circuits. For this purpose special cross arms were mounted on two poles set about 9 ft. apart in a plane at right angles with the line. The top cross arm is 16 ft., the middle arm 10.5 ft., and the lowest arm 14 ft. long, there being three to each pair of poles. The top arm carries six insulators, the middle arm two insulators, and the lowest arm four insulators. On the four inside insulators of the top arm and the two insulators of the middle arm the two three-phase circuits are strung. On the end insulators of the top cross arm and on the four insulators of the bottom arm heavy galvanized iron wires are strung, and at short intervals along these iron wires between the several pairs of poles other iron wires are secured to the former transversely, so that a mesh of these interwoven guard wires extends entirely over the railway crossing and beneath the power circuits.

Before entering the Schenectady switch house at the works of the General Electric Company, the transmission lines cross the tracks of the New York Central Railway and the Erie Canal overhead. This crossing is made with wooden towers each 66.5 ft. high from base to the upper side of the top cross arm, and set 10.5 ft. in the ground. One of these towers measures 22 ft. square at its base and its two pairs of 65-ft. posts are 9 ft. apart on centers at the top. Two arms, each of 6 x 10-in. stock, carry the transmission lines, the top arm being 17 ft. and the lower arm 4 ft. beneath, 23 ft. long. Each wire of the transmission circuits on these arms is supported between two insulators set close together. Most of the timber in each of these towers, including the four 65-ft. posts, is Georgia pine, and the remainder is chestnut.

The timbers of the towers are treated with carbolinium avenarius, and all the iron plates and bolts on the underground parts are covered with coal tar. No guard wires for protection from lightning are used on any of the above transmission lines, and lightning arresters are connected to the wires only at the generating plants, sub-stations and switch houses. Before entering a generating or sub-station, or switch house, each bare copper conductor of the transmission circuits ends, and is connected to an insulated wire. Connection between each bare conductor and its insulated terminal is made with one of the trolley sleeves already mentioned. Each of these insulated terminal wires, regardless of its size, is covered first with a layer of rubber 9/32 in. thick, then with 9/32 in. of varnished cambric wound on, and finally with two layers of weather-proof braid outside of the cambric.

The standard voltage of transmission on lines running from the power plant at Spier Falls is 30,000, but lower voltages may be had by varying the connections of taps on the transformers. At the General Electric works and at the Watervliet sub-station energy is delivered from Spier Falls at a pressure of about 26,500 volts. Transmission lines from the power plant at Mechanicsville are supplied with current at about 12,000 volts, and deliver it to the General Electric works and the Watervliet sub-station at 10,800 volts approximately, also to the sub-stations of the lighting companies in Troy and Albany, and of the United Traction Company there at the same pressure.

At each generating plant, sub-station and switch house where the transmission lines enter or leave a weather shield is provided. Each of these weather shields is built up of boards on the side of the building where the high-tension circuits enter, and has a slanting roof with gutter so arranged that water falling on the roof is carried off at the sides and does not drip down onto the wires. The outside, vertical wall of each weather shield is about 4 ft. from the brick wall of the building through which the wires pass. In this outside, vertical wall of the weather shield there is a circular hole 10 in. in diameter for each wire that is to pass through it. These holes are spaced from 20 to 21 in. apart on centers, and the entering lines pass as nearly as possible through their centers. Between the outside, vertical wall of each weather shield and the brick wall parallel with it there are porcelain insulators to which the bare transmission lines are attached. Close to the point of this attachment on each line the joint between the bare conductor and the rubber and paper-insulated terminal cable already mentioned is made. Opposite each hole in the weather shield is a circular hole of 15 in. diameter in the brick wall of the building. Into this circular opening in the brickwork fits a wooden ring of 11 inside and 15 in. outside diameter and 2 in. thick. To this wooden ring is secured a disc of hard fibre 15 in. in diameter, ⅛ in. thick, and with a center hole just large enough to admit a porcelain tube of two in. internal diameter. Each of these porcelain tubes is 24 in. long, and one of the insulated terminal cables already mentioned passes through it. In this way each wire of the transmission lines enters the generating and sub-stations and switch houses so that rain or snow cannot

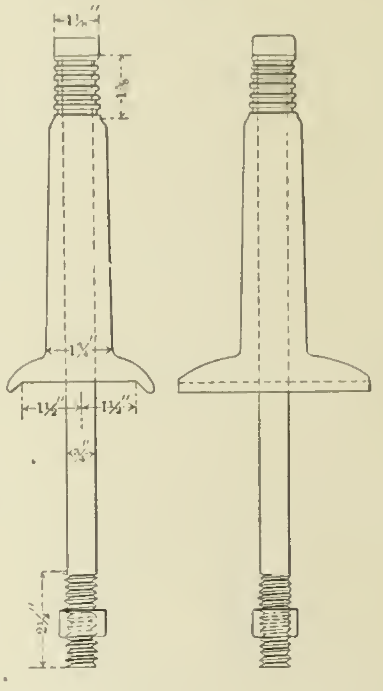


FIG. 10.—STRAIN INSULATOR PIN.

follow, as each opening through a brick wall is entirely closed. Just inside of the brick wall through which it passes, each insulated terminal cable, is secured to a porcelain insulator. Each outgoing line at a generating station and each incoming line at a switch house or sub-station is connected to the middle terminal of a single-pole, double-blade lever switch near the circular opening through which it passes in the brick wall. Switches used for this purpose are of a uniform type throughout the system, and each includes three large Locke porcelain insulators on which are mounted cast-iron caps that carry the contact parts. The middle insulator of the three carries two copper switch blades, each ¼ in. x 2 in. x 16½ in., that are in electrical connection. One of these switch blades is intended to make contact with the terminals on one of the other two insulators, and the other blade makes contact with the terminals of the remaining insulator. The terminals at one end of this switch are permanently joined to a group of lightning arresters, and the terminals at the other end connect with one pole of an oil switch. From the foregoing it may be seen that the wires of an outgoing line at a power station, or of an incoming line at a switch house or sub-station may be either disconnected from the lightning arresters and left connected to the oil switches, or vice versa. On the 30,000-volt lines twelve lightning arresters in series are connected to one terminal of the switch just mentioned, and each lightning arrester has four air-gaps and two carbon rods in series. For the group of twelve arresters this gives a series of 48 air-gaps and 24 carbon rods. The air-gaps are between short brass cylinders, and each is approximately 1/16 in. long. Each carbon rod is said to have a resistance of 200 ohms. Each group of lightning arresters is located in a brick and stone compartment approximately 9.5 ft. high, 2 ft. wide, 28 in. deep and open at the front, but these dimensions vary at different stations. In each compartment or cell the arresters are mounted on two wooden uprights each 3 in. x 3 in. x 7 ft. 9 in., and these uprights are in turn supported on four of the iron-capped insulators already named. The lever switches are secured to wooden uprights in cells similar to those provided for the lightning arresters.

Another important purpose to which the single-pole, double-blade lever switches are put is that of transferring any incoming to any outgoing line at a switch house or sub-station, when this is desirable, because of trouble or repairs. To provide for this result each wire of all the incoming lines is brought to a terminal at one end of a switch, and each wire of all the outgoing lines is brought to a terminal at the other end of a switch. To the third or center terminal of each switch, where the two independent blades are mounted, connection is made from one side of a single-pole, single-throw lever switch. The other terminals of these single-pole, single-throw switches may be connected in pairs, as desired, by cables. When both blades of the single-pole, double-throw switches are closed and the single-pole, single-throw switch connected therewith is open, the incoming and outgoing lines are connected in their regular order. By opening one blade on each of any two of the double-blade switches, and connecting the center points of these switches through their two single-blade switches, the incoming and outgoing lines of the former switches may be joined.

FIG. 11.—MOUNTAIN LINE.

At each generating station or sub-station or switch house the several groups of lightning arresters are connected to a common ground wire and plate. The standard construction for this ground connection includes a bare 4/0 copper wire leading from the lightning arresters to a cast-iron ground plate buried outside of the building. This cast-iron ground plate is 4 ft. square, ¾ in. thick and has a boss at one side that increases the thickness to 2.5 in. This boss is tapped for a 1.5-in. brass plug, and into this plug the 4/0 wire from the lightning arresters is soldered. Beneath the cast-iron plate a layer of broken coke is placed, and another layer of coke goes on top of the plate before the hole in which it is buried is filled with earth.

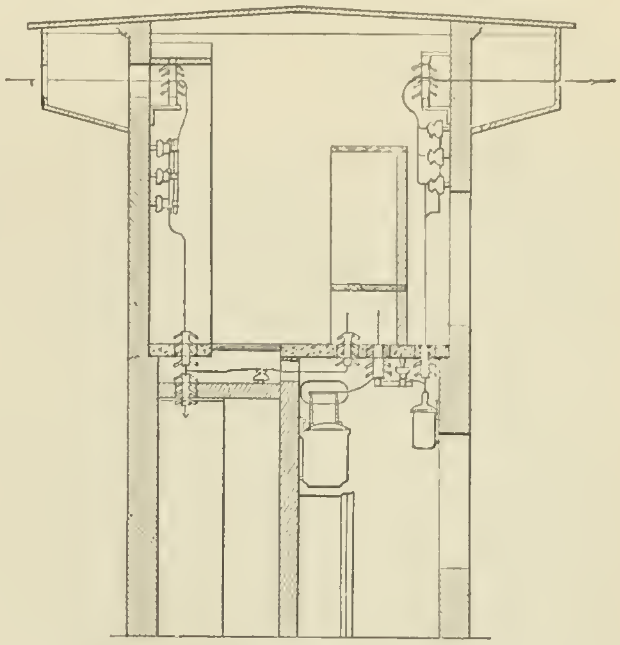


FIG. 12.—ELEVATION SHOWING ARRANGEMENT OF APPARATUS IN SCHENECTADY SWITCH HOUSE.

At generating stations, switch houses and sub-stations throughout this system the general plan is to give the greatest facility for the connection of any particular generator or step-up transformer to any transmission line, any transmission line to any step-down transformer, and any distribution line to the bus-bars supplied with energy from any generator. The result of this general plan may be traced, for instance, from the station at Spier Falls to the distribution circuits at any sub-station. At Spier Falls either 2,000-volt, three-phase generator may be connected by knife switches either to the primary coils of a particular group of transformers that raise the voltage to 30,000, or to a set of 2,000-volt bus-bars. By means of these bus-bars the particular generator in question may be operated in multiple with all of the other generators in the station, or may be connected to any desired group of transformers. Each group of three step-up transformers may in turn be connected on its primary side with any one generator, or may be fed from the 2,000-volt bus-bars.

After passing through a triple-pole, 30,000-volt oil switch the circuit from the secondary coils of each group of transformers goes to double-blade knife switches of the sort before mentioned, and these switches suffice to connect the circuit in question with either of two sets of 30,000-volt bus-bars. These bus-bars are divided into sections by other knife switches, so that the section of each set that is capable of being directly joined with a particular group of transformers may be isolated from the other sections of its set, or not, as desired. Either of the two bus-bar sections just mentioned may be connected with either of two 30,000-volt oil switches. Each of these oil switches is connected through knife switches with a three-phase transmission circuit. The net result of all these arrangements is that any transmission circuit may be supplied with energy either from all the generators and transformers operating in multiple, or from any particular sets of generators and transformers, or from any one generator and any one group of three transformers.

October Meeting of American Institute of Electrical Engineers.

The regular monthly meeting of the American Institute of Electrical Engineers was held in the chapter room of Carnegie Hall Friday evening, October 23, at which papers were presented by Dr. Cary T. Hutchinson and Mr. A. H. Armstrong. The increasing difficulty of securing a place of meeting for the Institute was indicated in an announcement by Secretary Pope, who said that the hall of the Academy of Medicine, in which the September meeting was held could not be rented for the coming season owing to a by-law of the Academy restricting the use of the hall to medical societies. The use of the hall of the Chemist's Club is being considered and meetings may be held there if dates can be made to conform to the schedule of the club.

Thirty four associate members were elected and the following members were transferred from associate to full membership: W. H. Cole, Singapore, Straits Settlements; W. A. Hall, Lynn, Mass.; W. W. Cole, Elmira, N. Y., and W. I. Slichter, Schenectady, N. Y.

The paper presented by Dr. Hutchinson is entitled "The Conditions Governing the Rise of Temperature in Electric Railway Motors in Service," and supplements a paper read before the Institute by Dr. Hutchinson, January, 1902. In this former paper a method was described for determining the motor capacity and energy consumption required to make any schedule speed for a run of any distance. In this paper it was roughly assumed that an ordinary railway motor would stand an average loss of 3 per cent. The recent paper extends the method to include the predetermination of the rise of temperature of a motor of any I^2R and core losses when the constants of the motor are known upon which the rise of temperature depends. In the first paper the time required for each of the three periods of the "type run" was first determined, this resolving itself into an algebraical problem, the solution of which involved the initial acceleration, the costing retardation, the retardation after braking, the length of the run and the average speed from start to stop. The method put forth reduced the variables from three—the average speed from start to stop, the length of run and the time—to two, namely, the length of run and acceleration. The previous investigation, as well as the present one, assumed a straight, level track, constant train friction and constant braking force, these assumptions being necessary to any general treatment since curvature and gradients are arbitrary. The paper, however, develops in part a method for making the necessary allowance for curves, grade and variable train friction in the form of corrections to the values found for the corresponding simple case. The paper proceeds to develop the various equations and includes a number of charts of curves, as well as examples worked out for specific cases. The application of the method to pre-determination of the rise of temperature is given in detail, with examples referring to particular types of motors from very complete data of tests of the same.

In conclusion Dr. Hutchinson states that the method as developed takes account of all the factors governing the rise of temperature of motors under conditions of service. While certain assumptions have of necessity been made, as for instance a constant value for train friction, it is perfectly feasible to recalculate the curve sheets for other values of train friction. A set of curve sheets, including as many maximum velocities as may seem desirable, can be prepared and used as constant curves from which the rise of temperature for any motor can be determined for any conditions of service. While the results obtained by the method are of necessity an approximation because of the number of assumptions it is necessary to make in developing the method, yet the numerous applications of the curve sheets and practical examples have shown that the approximation is close and that the curves furnish useful means of determining the proportions of a motor for any service. The paper, which includes 14 curve sheets, some of which are of large size, does not admit of abstract in detail. Upon concluding the reading of his paper, Dr. Hutchinson said that the curve sheets included, which are plotted for the half dozen motors made by each manufacturing company, should serve a useful purpose to engineers.

In the discussion President Arnold said that some engineers have found when they came to some problems connected with the railway motor that some of the conclusions in Dr. Hutchinson's original paper were nearer correct than they had been thought when the paper was presented. Mr. A. H. Armstrong criticized the omission as a factor of the inertia of rotative parts. This may not amount to much on slow-speed work, such as thirty miles an hour, but in rapid transit problems it would be considerable, reaching perhaps a factor of 12 or 15 per cent on such rapid transit problems as the New York elevated road. On suburban runs, reaching 60 miles, the acceleration of the small parts of the total energy consumed may not reach more than 3 or 5 per cent., due to the fact that the cars are operated for long distances at constant speed. Mr. Armstrong having criticized the employment of only one friction rate, Dr. Hutchinson pointed out that while the examples in his paper only considered one rate, similar curves could be laid out for as many rates as desired; and that a criticism as to the motor capacity arrived at in the paper was due to the fact that this capacity was on the basis of a run of 7,000 ft., while the figures of Mr. Armstrong applied to a run of one mile. In his remarks Mr. Armstrong showed that some of the deductions of Dr. Hutchinson agreed very exactly with results obtained by an absolutely different method of calculation.

Following the discussion of Dr. Hutchinson's paper, Mr. A. H. Armstrong read a paper entitled "A Graphic Recording Ammeter," which is reprinted in full elsewhere. At the conclusion of the paper Mr. Armstrong added that the instrument, which is the invention of Mr. Robinson, of the Research Department of the General Electric Company, enables accurate determinations to be made of current under the extreme conditions of violent fluctuations, jarring, etc., occurring in motor cars. Previously it had been the universal custom to have a number of observers taking readings at various intervals of time; two seconds is about as quick a time in which a man could take a reading; one observer read and another took down the results, all the men working at the stroke of the gong; the whole process was tedious and open to criticism of being more or less inaccurate. With the introduction of heavier railroad work, where the motors aggregate several hundred horsepower, where temperatures have to be reliable and where the actual duty of a motor could be plotted beforehand with a great degree of accuracy, the need of an instrument was felt that would enable preliminary tests to be made and the readings recorded with a considerable degree of accuracy. This instrument, he said, was brought out by the General Electric Company as the result of this universal need, not so much to put it commercially on the market or for general application, as to enable their engineers to make a better study, and let others have the benefit of that study, of the subject of railway motors in operation.

Lighting in Rochester, N. Y.

City Engineer Fisher, of the city of Rochester, N. Y., delivered an interesting address on "Rochester Street Lighting" before the annual convention of the American Society of Municipal Improvements, which was recently held at Indianapolis, Ind. He asserted that Rochester is one of the best lighted cities in this country and says Main Street is the best lighted street in the entire world. The city of Rochester has a total area of 11,365 acres, or 18.18 square miles. In this area are about 320 miles of streets and alleys. On January 1, 1903, the city was lighted by 2,804 electric arc lamps and 141 gas lamps. Omitting the gas lamps, the city had an average of one electric lamp for 3.68 acres and an average of 8¾ lamps per mile for the entire area. A portion of the city is not yet built up and has no street lights; therefore, the average number of lamps per acre, and per mile, for the portion lighted is somewhat larger. Going a little further into details, it should be stated that a portion of the business district is lighted by the double arc light system, two lamps on one pole.

The lamps, he said, are of the enclosed type, operated in parallel on a 115-volt current. The larger part of these lamps are operated on the direct current. The poles are of iron and serve also as trolley poles for the electric railway. The railway poles are generally 125 ft. apart. This condition was a controlling factor in locating the lamps.

On Main Street, in Rochester, the two principal street crossings have four double arc lamps, one on each corner. At the other street crossings two double lamps are placed. In a distance of 6,400 ft. there are 61 pairs, of 122 lamps, an average of one pair of lamps per 105 ft. of the street. The lamps are of 1,200 cp.

An Improved Method of Testing Large Alternators Under Full Load Conditions.

By B. A. Behrend.

Most electrical engineers are familiar with the method of circulating power originated by Dr. John Hopkinson and published in *Philosophical Transactions,* 1886. Dr. Hopkinson circulated power between a direct-current generator and a motor which were electrically and mechanically connected. Dr. Sumpner suggested a method of circulating alternating-current power between two transformers in *The Electrician*, of July, 1892. Mr. William M. Mordey first suggested the circulation of power for testing alternating-current generators of the synchronous type by using a single machine and connecting the armature coils in opposition in such a manner that the machine was operated at full current and full magnetic flux. Mr. Mordey's paper, which is extremely suggestive, is contained in the *Journal* of the Institution of Electrical Engineers, Vol. II, 1893, London.

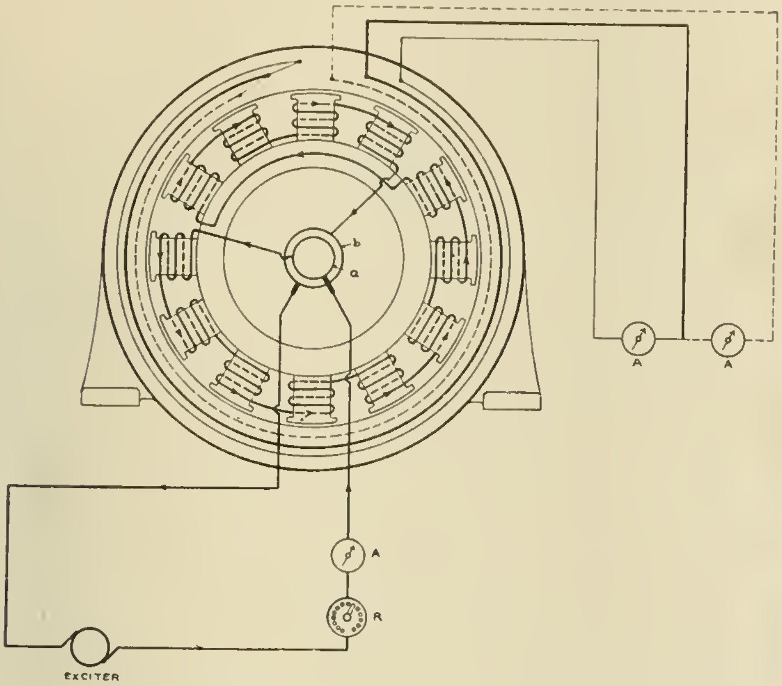


FIG. 1.—DIAGRAM OF MORDEY'S COMBINATION OF FIELD COILS FOR CIRCULATING POWER TEST.

Mr. Mordey's method applied, for instance, to a single-phase generator having twenty poles on each side of his single-exciting coil would be carried out by splitting the armature into two sections of eight and twelve coils respectively, and by connecting these sections in opposition, so that only four coils would be effective in regard to the circulation of current through the armature. The section of the armature which contains eight coils acts as motor, while the section containing twelve coils acts as generator. The current which circulates through the armature coils is almost in quadrature with the resultant e.m.f., and is, therefore, a wattless current. Hence the eight poles of the motor section of the machine will be strengthened by the armature current, whereas the twelve poles of the generator section of the machine will be weakened by the same current. This leads to a magnetic unbalancing of the machine, as the motor fields carry more resultant flux than the generator fields. In Mordey's machine this condition may not have caused trouble, as it does not contain iron in the armature, but in modern generators his method cannot be used on account of the magnetic unbalancing of the machine. Instead of dividing the armature into two sections and connecting these sections in opposition, it naturally suggests itself, especially on polyphase machines of the revolving field type, to split the field into two sections and to connect these sections in such a manner that the e.m.f's induced in the armature are in opposition. The writer tried many years ago to use this method, but he failed, as undoubtedly others did, on account of the magnetic unbalancing of the machine. The reason of this unbalancing being once clearly understood, a very simple method suggested itself, which is described below.

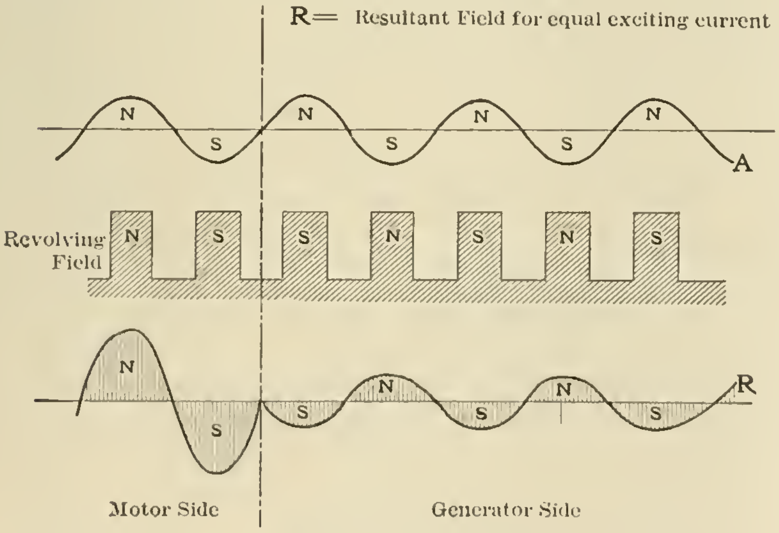


FIG. 2.—DIAGRAM SHOWING EFFECTS OF ARMATURE CURRENTS.

FIG. 3.—VIEW OF ALTERNATOR.

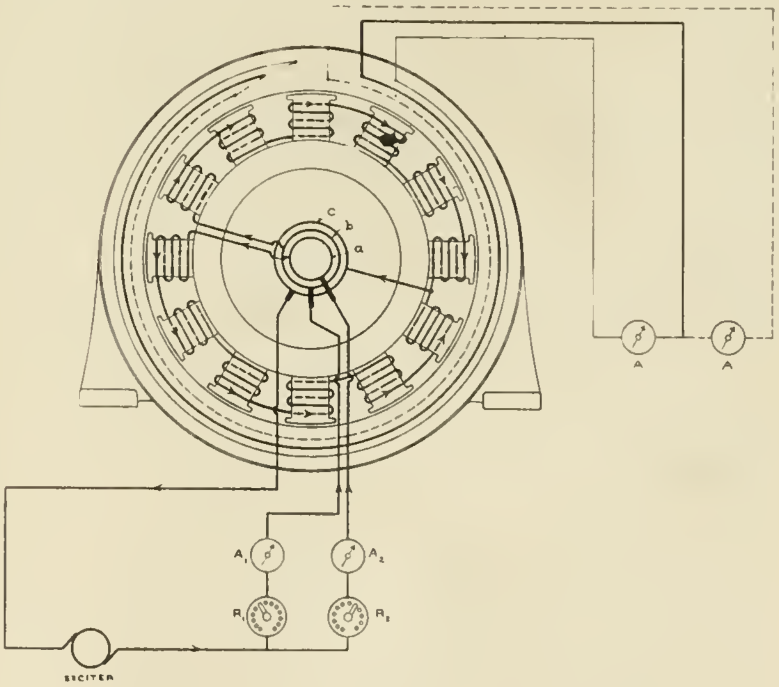


FIG. 4.—DIAGRAM OF COMBINATION OF FIELD COILS FOR CIRCULATING POWER TEST.

Let us assume that we have a twelve-pole alternating-current generator, as shown in Fig. 1. The fields are connected in such a manner that four field coils induce an e.m.f. in opposition to that induced by the other eight. The current in the armature strengthens the magnetism of the four poles as these act as the poles of the motor, and the same armature current weakens the eight poles which act as a generator. This is shown graphically in Fig. 2. The ordinates of the sinusoidal line *A* represent at a certain moment of time the induction in the air gap as produced by the armature current. The poles of the revolving field are represented below this curve in their respective phase relations, the armature current being in quadrature with the e.m.f., and therefore in phase with the field. One can easily plot the curve of resultant magnetism, which is represented by the wavy line, *R*. A glance at this line shows that the induction under the poles of the motor side is far in excess of the induction under the poles of the generator side, and it is, therefore, obvious that a machine connected in this manner must be subject to most violent vibrations. As a matter of fact, the writer tried this manner of connection on a 3,000 kw generator having twenty-six poles and operating at 231 r.p.m., having ten poles connected in opposition to sixteen. The machine of which a picture is shown in Fig. 3 threatened to break to pieces under the tremendous strains produced by the unbalanced magnetism, and it became necessary to stop the test.

In thinking over the causes of this phenomenon, the idea occurred that it would be easy to overcome this difficulty of magnetic balance by using different exciting currents for the motor section and for the generator section of the revolving field, so that the resultant field produced by the interaction of the impressed and induced fields would be the same or nearly the same for each pair of poles. The machine was connected so that thirteen poles were in opposition to the other thirteen poles, and the exciting current in each section could be regulated by a rheostat in series of each section. Fig. 4 shows this manner of connection, the common point of the fields being connected to a slide ring. Instead of connecting this point to a separate slide ring, it can be connected to the iron of the fields and the shaft, or even the base of the machine may be used to introduce the current. Now let the reactions for this case be plotted again. In Fig. 5 the sinusoidal curve, *A*, shows the distribution of magnetism as produced by the armature current. As the exciting current on the generator side is smaller than the exciting current on the motor side, neglecting local fields in the armature, the resultant field must be the same or nearly the same for both the motor and generator sides, thus obviating the trouble that arises from unbalancing.

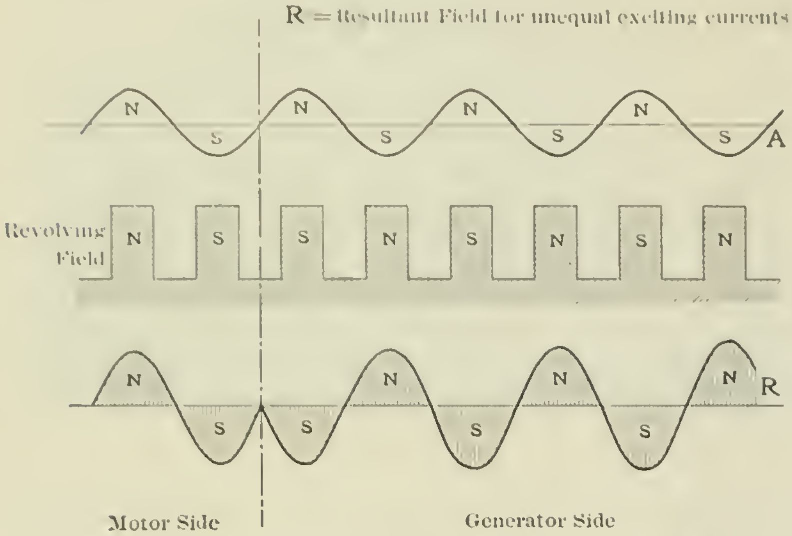


FIG. 5.—REACTION CURVES.

In this very simple manner, power was circulated in the machine represented in Fig. 3 amounting to 4,500 kilovolt amp. Not only can a satisfactory heat run be obtained in this manner, but the inductive regulation of an alternator may also be determined with an accuracy in all respects equal to that obtained by operating two machines together, as described and used in the author's experiments as published in the transactions of the American Institute of Electrical Engineers for June, 1903.

This brief notice may suffice to call attention to a most useful and simple method of testing large machines. A fuller account of this method in its application to the determination of regulation will be given later in connection with the tests carried out on one of five Bullock 3,000-kw alternators built and shipped from Cincinnati for the Kern Power Company, for the transmission of 15,000 kilovolt amp. from the Kern River, 120 miles from Los Angeles, Cal., to that city.

Candle-Power Tests of Welsbach Burners.

Below is an abstract of that part of the fourth progress report of the N. E. L. A. Committee for Investigating the Photometric Value of Arc Lamps, which deals with tests of mantle gas burners and of the naked gas flame.

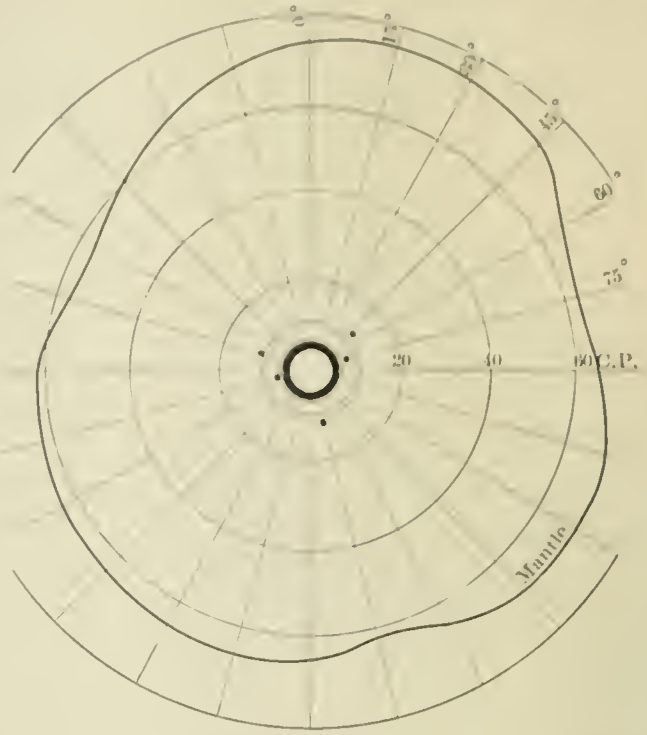


FIG. 1.—HORIZONTAL DISTRIBUTION OF CANDLE-POWER ABOUT AN INCANDESCENT MANTLE.

With a view of getting representative results on gas mantles of the Welsbach type, a variety of mantles were purchased in the open market. These mantles were classified according to their retail price, as follows:

Class A, retail price, thirty-five to sixty cents; class B, retail price, twenty to thirty cents; class C, retail price, below twenty cents.

It was found that the candle-power of a gas mantle is dependent in a marked degree upon the gas pressure. The report contains data on the relations of these two magnitudes. So important is this relation that comparative measurements on mantles become meaningless unless conducted under conditions of constant pressure. Fig. 1 shows the horizontal distribution of candle-power about an ordinary gas mantle mounted in a burner having three side supports for the mantle. It is clear that the distribution would be practically a circle were it not for the screening effects of these supporting rods. It will be noted that there are three depressions in the curve corresponding to the positions of the rods. The minimum horizontal candle-power in this instance is about 57, the maximum about 76.

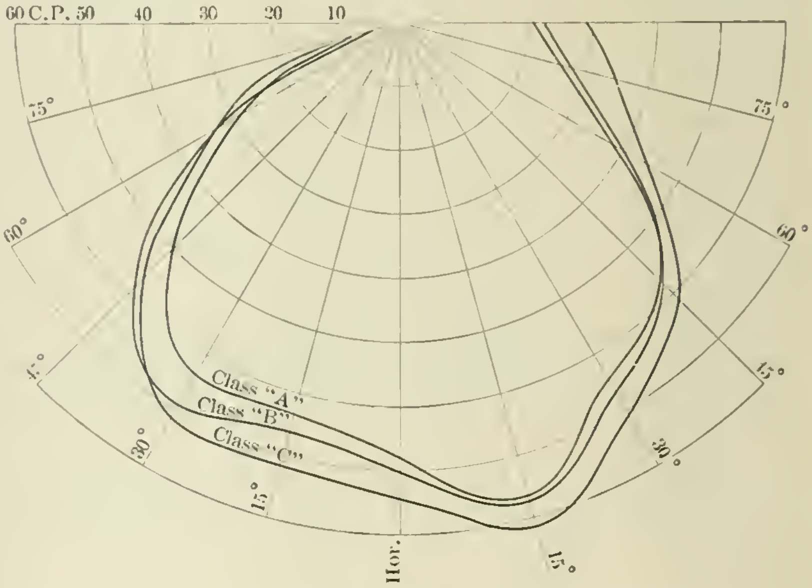


FIG. 2.—MEAN DISTRIBUTION OF CANDLE-POWER ABOUT AN INCANDESCENT GAS MANTLE.

The position of the supporting rods is indicated in the middle of the figure.

In Fig. 2 is shown the mean vertical distribution of candle-power from each of the three grades of mantles tested. This winged-shape distribution of candle-power in a vertical plane is characteristic of the ordinary gas mantle. The maximum candle-power is found at about 15° above the horizontal because from this point of view the visible area on incandescent surface is probably a maximum. On account of the position of the maximum candle-power in these curves, the mean hemispherical candle-power is uniformly larger above than below the horizontal. The mean gas consumption for Class A mantles working under a pressure of 2 in. of water is 3.79 cu. ft. per hour.* The values of gas consumption for grades B and C are, respectively, 3.66, 3.99 cu. ft. per hour. The mean spherical candle-power for the three grades is tabulated as 55.8, 58.8, 62.2. This means a gas consumption per candle-power of .068, .062 and .064 cu. ft. It is seen that the more expensive mantles give the least candle-power. Whether this is a general conclusion or not cannot be said without a larger number of tests than is here described. In point of gas used per mean spherical candle-power, Class B leads Classes C and A, following in the order named. The real economy of one grade of mantles over another cannot be told without a life test. Time was not available for such a test in connection with this work.

Fig. 3 exhibits the illumination on a plane normal to the ray produced by the mantle burner, placed at a height of 12 ft. above the street. The illumination varies from the maximum of .187 candle-feet at a distance of 10 ft., to .0105 candle-feet at a distance of 80 ft.

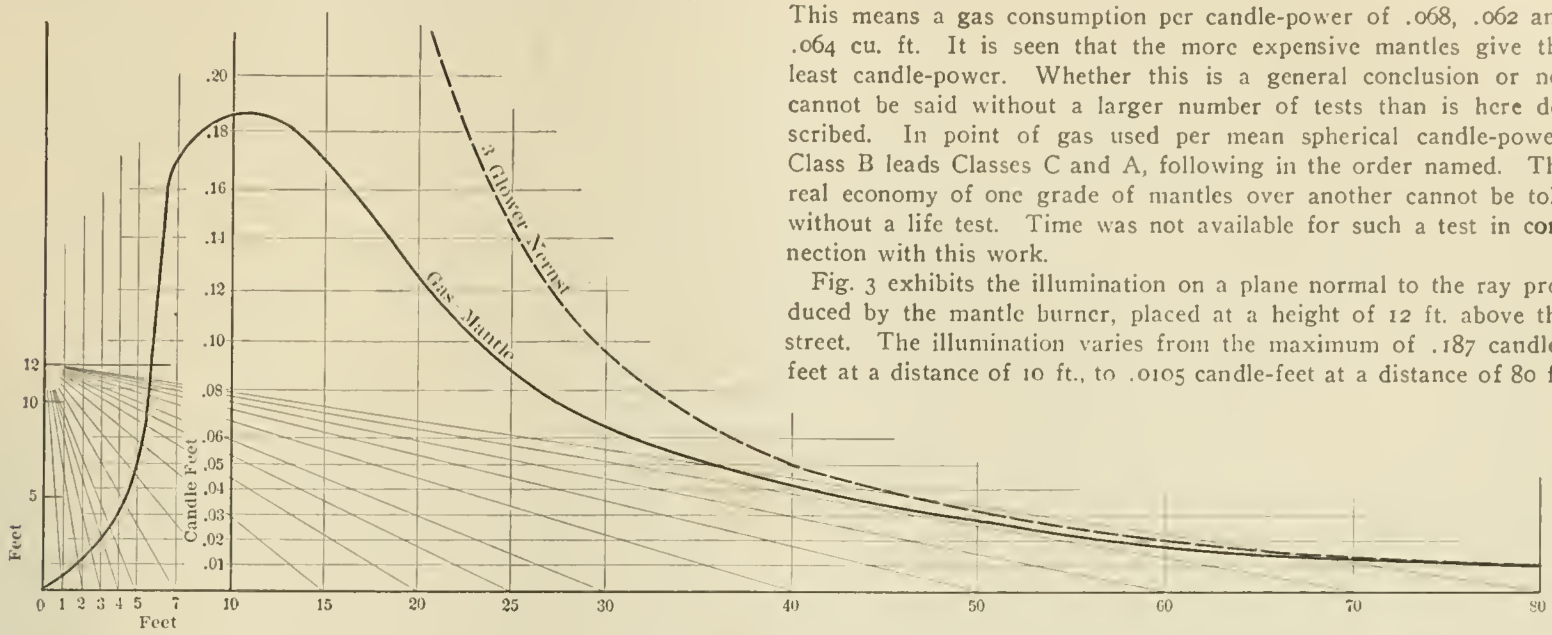


FIG. 3.—NORMAL ILLUMINATION CURVES FROM INCANDESCENT GAS MANTLE.

TABLE IV. OPEN GAS FLAME. (Pressure 1.2" of water.)

CANDLE-POWER.

Angle.	Tip No. 1. 0°	Tip No. 1. 90°	Tip No. 1. Mean 0° & 90°	Tip. No. 2. 0°	Tip. No. 2. 90°	Tip. No. 2. Mean 0° & 90°	Tip No. 3. 0°	Tip No. 3. 90°	Tip No. 3. Mean 0° & 90°	Tip No. 4. 0°	Tip No. 4. 90°	Tip No. 4. Mean 0° & 90°	Tip. No. 5. 0°	Tip. No. 5. 90°	Tip. No. 5. Mean 0° & 90°
75° A.	15.77	19.30	17.54	6.02	6.70	6.36	13.38	10.73	12.06	20.85	20.35	20.60	30.6	33.6	32.1
60° A.	13.38	17.27	15.33	6.90	5.23	6.07	10.40	10.80	10.60	15.12	17.68	16.40	26.2	29.4	27.8
45° A.	15.37	14.40	14.89	6.27	5.07	5.67	9.82	10.52	10.17	14.90	16.43	15.67	28.6	29.4	28.1
30° A.	13.90	14.45	14.18	5.96	6.49	6.23	11.21	10.86	11.04	17.02	19.15	18.09	26.4	29.8	28.1
15° A.	15.00	16.09	15.55	6.16	6.03	6.10	11.01	10.92	10.97	19.10	21.00	20.05	26.3	31.3	28.3
Hor.	12.00	14.85	13.43	5.46	4.99	5.23	9.85	9.55	9.70	15.20	18.00	16.50	25.1	29.7	27.4
15° B.	11.51	12.27	11.89	4.44	4.76	4.60	9.11	8.94	9.03	13.22	13.73	13.48	22.9	27.1	25.0
30° B.	12.82	12.96	12.98	5.99	5.30	5.65	10.20	11.67	10.94	15.15	16.40	15.78	26.6	30.8	28.7
45° B.	13.82	17.46	15.64	5.26	6.33	5.80	9.04	11.22	10.13	18.02	21.73	19.88	29.7	36.3	30.0
60° B.	13.43	17.80	15.62	5.24	6.49	5.87	8.95	11.92	10.44	16.90	18.20	17.55	28.0	38.5	33.3
75° B.	12.42	15.85	14.14	4.41	7.41	5.91	7.59	12.63	10.11	11.80	19.18	15.49	27.4	29.2	28.6
Cu. ft. gas used per hr.		5.75			3.64			4.45			6.20			9.7	
Mean hemispher. c.p., upper		15.00			6.00			10.67			17.96			28.60	
Mean hemispher. c.p., lower		13.88			5.42			9.93			16.38			29.20	
Mean spher. c.p.		14.44			5.71			10.30			17.17			28.90	
Cu.ft.gas per mean h.s.c.p.,upper.		.384			.607			.417			.345			.339	
Cu.ft.gas per mean h.s.c.p.,lower.		.414			.672			.448			.378			.332	
Cu. ft. gas per mean sph.c.p.		.399						.432			.362			.336	

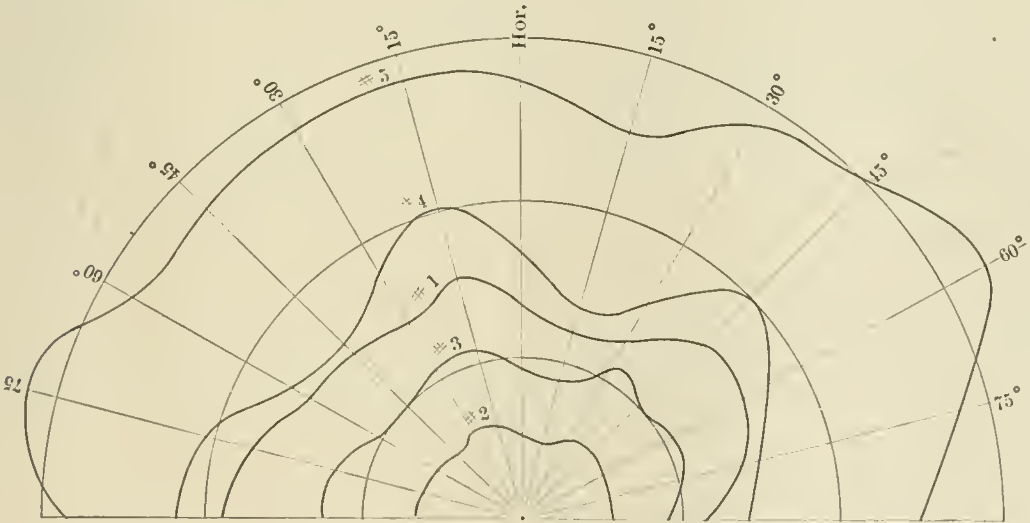


FIG. 4.—MEAN DISTRIBUTION OF CANDLE-POWER FOR VARIOUS OPEN GAS FLAMES.

Changing the height of the burner has but little effect on the illumination at points beyond 50 ft. from the lamp, but changes in a marked degree the illumination at points near by. The illumination at a distance 80 ft. from the lamp is practically .01 candle-feet for all heights of lamp between 8 and 20 ft. However, as the lamp is raised between these limits, the mean normal illumination will fall from .039 to .029 candle-feet.

The report concludes with a short series of tests of the candle-power and gas consumption of the ordinary open gas flame. An assortment of tips was secured from different dealers conveniently at hand. In seeking to test these it was soon found that the nominal rating of the tip had scarcely any significance, either as regards the gas consumption or candle-power.

Table IV and Fig. 4 summarize the tests on the open gas flame. It is evident from these tests that the candle-power of gas as found in ordinary commercial service, can be determined only by means of a very large number of tests.

Chemical analyses of the gas used in this work show a very considerable variation in the composition of the gas, at different times. An analysis made under the supervision of the Department of Chemistry of Purdue University, on April 23, 1903, concludes with the statement that "The gas is supposed to be a mixture of coal gas and water gas (enriched), but evidently contains a large quantity of natural gas."

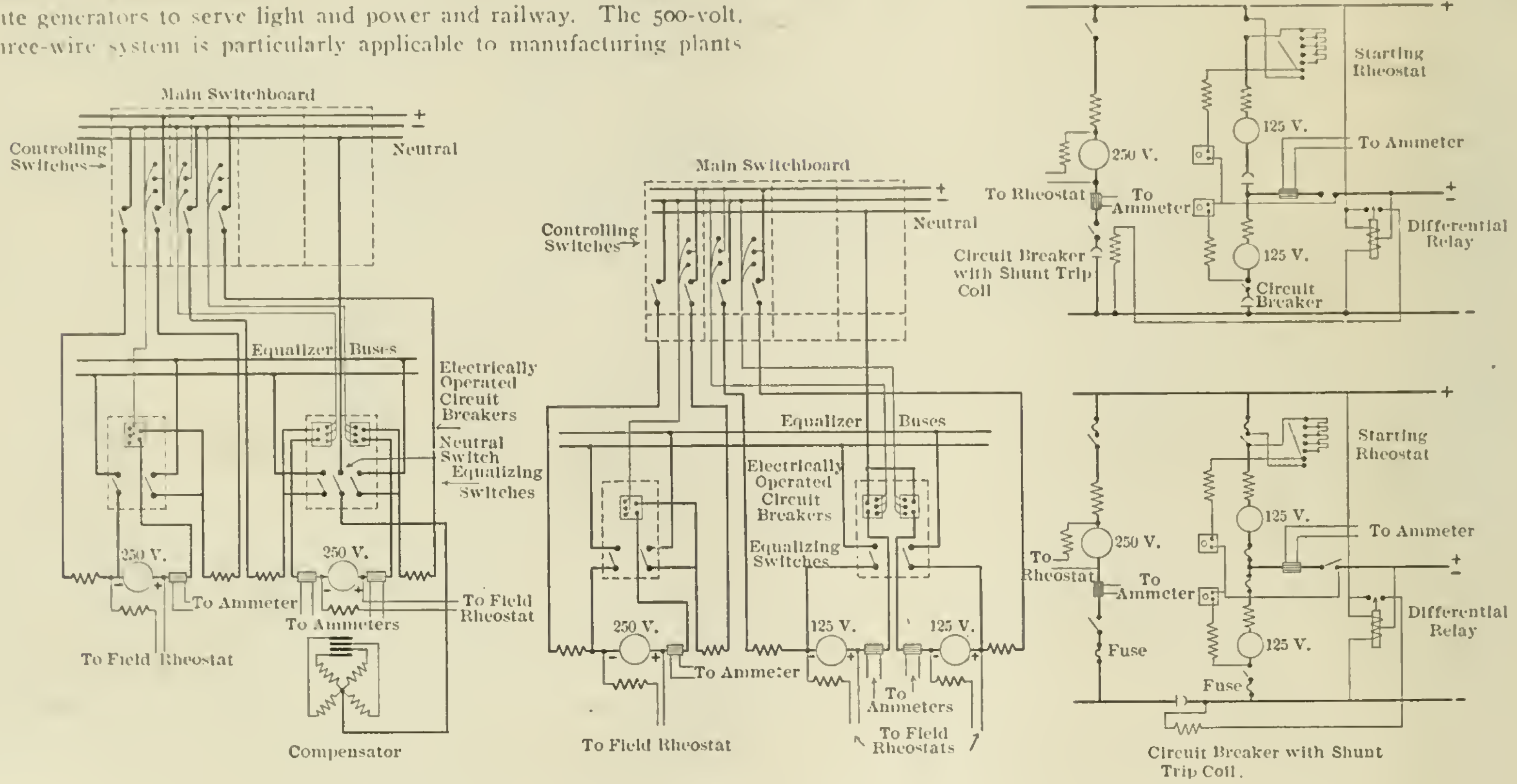
Notes on Certain Three-Wire Systems.*

By Charles F. Mosman

THE present tendency in electrical developments is toward the serving of large districts from large central stations. This tendency naturally leads to alternating current distribution for light and power where under other conditions direct current might be used. The new work of to-day is thus largely alternating, or alternating converted to direct current for final distribution.

Existing direct-current installations are continually expanding, and many are being adapted to receive power from large alternating current stations. It is necessary to consider carefully the new conditions to be met and the various methods and apparatus with which to meet them, before placing orders. New plants of a more or less isolated character may be best served by direct current, although where there is any doubt as to which is advisable, it is well to give the alternating current the preference on account of the ease with which such a system is extended. A discussion of direct-current systems in general would be an undertaking of large dimensions, hence attention will be directed to but one or two points which may prove interesting.

The direct-current lighting and power work of to-day in this country is principally three-wire. As the advantage of the three-wire system lies in the transmitting voltage being twice that of the receivers, upon the advent of the 250-volt incandescent lamps it was natural to expect an extensive adoption of a 500-volt, three-wire system, this system having the added advantage of enabling duplicate generators to serve light and power and railway. The 500-volt, three-wire system is particularly applicable to manufacturing plants using electricity principally for power, with incidental lighting, and to central stations serving a comparatively scattered load within a somewhat limited radius.



FIGS. 1, 2, 3 AND 4.—DIAGRAMS OF VARIOUS CONNECTIONS.

A comparison of 250-volt and 500-volt underground three-wire systems will show that the superiority of one over the other depends upon the density of the load, the proportion of the total load that is in incandescent lamps, the size of the motor units connected to the system, the cost of producing additional power and the cost per kilowatt of the generating equipment. In large cities served by a central generating station with many sub-stations containing converters for supplying the three-wire network, the load is quite dense, and it can be shown that in many cases the savings in copper and number of sub-stations, due to the higher voltage, is more than offset by the increased power required by the high-voltage lamps. The lower the density of the load, the lower the proportion of incandescent load to the total load, and the lower the cost of power and generating apparatus, the greater becomes the advantage of the 500-volt, three-wire system.

The 500-volt system is at a disadvantage due to the higher cost of arc lamps, meters, fan motors, incandescent lamps, cut-outs, rosettes, circuit breakers, etc., the prices being higher in approximate accordance with the following table:

Article	% higher price.	Basis
Incandescent lamp	11	3.8 watts per c.p.
Incandescent lamp	25	3.4 watts per c.p.
Arc lamp	33⅓	2 in series.
Arc lamp	50	twin carbon.
Wattmeters	30	3 wire.
Wattmeters	0	2 wire.
Cabinet panels	5	
Circuit breakers	25	D.P. 500 volts.
Switches	0	D.P. 250 volts.
Switches	75	D.P. 500 volts.
Fan motors	10	250 volts.
Rosettes	7	250 volts.
Fuse plugs	60	250 volts.
Snap switches	0	250 volts.
Lamp sockets	0	250 volts.

Two hundred and fifty-volt incandescent lamps may be obtained of 3.8 and 3.4 watts per candle-power, having the same useful life and candle-power area as the 3.1 watts per candle-power, 125-volt lamp. Arc lamps may be connected two in series with the disadvantage of comparatively complicated wiring and the necessity of burning two lamps when one only is required; or a twin-carbon lamp may be used with the disadvantage of a more complicated mechanism and probable high maintenance cost. A single-carbon, 250-volt lamp gives an objectionably purple and unsteady arc. This excess of purple rays necessitates the use of denser globes than those used with 125-volt lamps, in order to produce the same quality of light.

A decision in favor of a 500-volt, three-wire system should not be made without first giving due consideration to alternating current. The advantages of continuous current over alternating are mainly the following:

First, the possibility of the use of storage batteries. Second, the possibility of operating high-speed passenger elevators direct from the lighting distribution.

The efficiency of a storage battery is low and the maintenance usually high. For these reasons it cannot always be considered an economical investment. Storage batteries may, however, be considered essential for the proper service of a dense business district, on account of their value in supplying sudden demands for current due to summer showers or a break-down or burning off a short-circuit in an underground system. They are also of great value in maintaining good regulation.

The induction motor, with collector rings and variable external resistance will give good results on all but the higher speed elevators. A district in which a 500-volt, three-wire system is particularly applicable would probably not contain any high-speed elevators; such a district could well be served by alternating currents, using possibly a separate power circuit. A city of 100,000 inhabitants would probably have a dense business section containing high-speed elevators, and large residence districts having a comparatively light, scattered load. Such a city may be served by a three-phase generating system, a three-wire network, using high-efficiency, 125-volt lamps and fed by single-phase primary feeders, being used for the business district; the power load of which is carried by a 500-volt, direct-current power circuit fed by rotary converters or motor-generator sets. Three-phase feeders should be run through the residence districts, the lighting load being carried on one phase only, the third wire being run into such districts as offer light power load.

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* A paper read October 14 before the Ohio Electric Light Association.

The large cities contain extensive districts where the load is of such density that the 250-volt, three-wire system with high-efficiency lamps is most suitable. They also contain large suburban districts which may be best served by alternating current. A combined continuous-current and alternating-current generating system with rotaries or motor-generators to connect the two is well suited to such cities. Chicago, Boston, Philadelphia, Cleveland, Toledo and Columbus may be mentioned as examples of such an arrangement.

There are many cities which might be well served by an alternating-current system, which have had a three-wire, direct-current system in operation before the advent of large alternating central stations, and the systems have assumed such proportions as to preclude all consideration of alternating currents for the denser sections. This fact may explain the eventual use of a combined alternating and direct-current generating system by such cities. The ease with which an alternating system may take on surrounding towns through step-up transformers should not be lost sight of and constitutes a great advantage.

From the above it appears that there is little justification for an extensive use of the 500-volt, three-wire system in this country.

The larger three-wire systems are almost without exception served by shunt-wound generators. An increase of the generating capacity of such a plant is easily accomplished by adding units having the voltage of the outers. The smaller plants are using compound-wound generators, three-wire generators and sometimes balancer sets. The combination of compound-wound generators of different voltages on a three-wire system, for example, 125 and 250 volts, or 220 and 440 volts, requires special attention to the switching, equalizing and indicating arrangements in order to secure proper parallel operation.

Figs. 1 and 2 show desirable arrangements. The equalizer switches, ammeter shunts and circuit-breakers are placed on panels near the generators. The circuit-breakers are closed and tripped electrically from the main switchboard. The low-voltage machines have their series windings on the side opposite to that connected to the neutral wire, i. e., half of them are equalized on the positive side and half on the negative side. The high-voltage machines are provided with two series windings in order to admit of proper equalizing with the low-voltage machines. In the case of machines with compensators and collector rings for derived neutral, i. e., three-wire generators, two series windings are necessary in order to secure with unbalanced loads a compounding approximating to that with balanced loads.

It is desirable on lighting systems supplied by both low-voltage machines and three-wire machines, to provide switches in the connections between the neutrals of the compensators and the neutral bus-bar. With these switches open it is possible through the low-voltage machines to raise the voltage of one side of the system above that of the other to compensate for unequal line drop due to unbalanced load.

The proper sequence of operation of switches and circuit-breakers when connecting a machine to the bus-bars is as follows: First, close the equalizing switches. Second, go to the main switchboard and close the main switches. Third, having obtained the proper voltage relations, close the circuit-breakers by means of the controlling switches on the main switchboard. The inverse sequence should be followed when disconnecting a machine from the bus-bars.

Three-wire generators when operating separately, or in conjunction with others of the same class, or with compound machines of the same voltage, but without collector rings and compensator, may be connected as shown in Fig. 1. Low-voltage, compound-wound machines connected on the two-generator method should always be connected as shown in Fig. 2, whether or not other generators are connected across the outside wires.

The advisability of the indicated arrangement of series windings where both high and low-voltage machines are installed, has been explained above. It is desirable to use the same arrangement when installing only low-voltage machines, in order that high-voltage machines may be installed later without extensive changes in existing panels. With the series fields arranged as shown, the circuit-breakers should be placed as in the diagram, in order to minimize the chances of a short-circuit in the station wiring causing a machine to operate as a short-circuited series generator.

A great saving in cost of cables for the moderate and larger size generators results from the placing of circuit-breakers and equalizing switches near the generators, and for the sake of uniformity this arrangement may well be adopted for the smaller generators also.

A balancer set is sometimes depended upon to provide a neutral for a system having only high-voltage generators. The simplest way to start such a set is to connect the two armatures in series through a starting rheostat across the main buses. It is necessary when starting to disconnect the common connection of the fields from the common connection of the armatures. Otherwise, when starting up, the field of the machine having its armature connected to the starting rheostat will receive the full potential of the system, due to the other machine having its field short-circuited by its armature. If another balancer set or other means of obtaining a neutral is in use, it is essential that the common connection of the armatures be disconnected from the neutral bus when starting; otherwise, one side of the system will be short-circuited by one of the machines.

It is advisable that the shunt fields shall in normal operation be connected between the neutral bus and the main buses, in order to secure independent control of the voltages of both sides of the system. This may be obtained by means of one rheostat common to the two fields and in series therewith, having the switch blade of the rheostat connected to the neutral bus. (See Fig. 5.) This type of rheostat is objectionable due to the extreme difficulty in predetermining its design. Two independent rheostats should be used and may be the standard for the machines composing the balancer set.

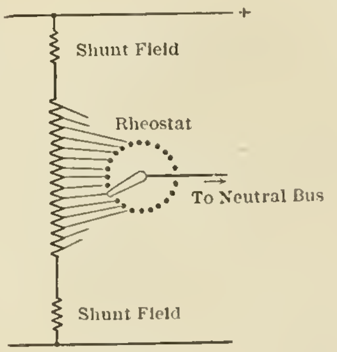

FIG. 5.—DIAGRAM OF RHEOSTAT CONNECTIONS.

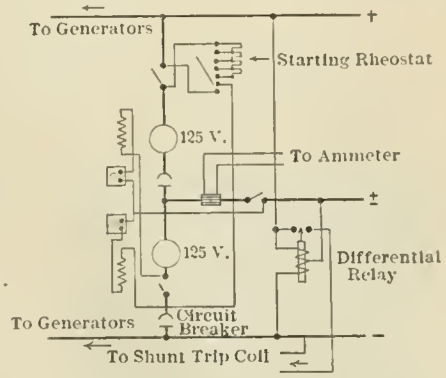

FIG. 6.—DIAGRAMS OF CONNECTIONS OF BALANCER SETS.

A system depending upon a balancer set for its neutral must be protected against the consequence of a short-circuit on one side of the system, causing the full potential of the main buses to be impressed upon the other side of the system, with destructive results to the lamps and other devices connected thereto. This may result from the automatic disconnection of the balancer set due to short-circuit, or, if the set is not provided with automatic circuit-opening devices, from the flashing over of the commutator of the machine on the short-circuited side. Protection may be afforded by a differentially-wound relay with coils connected across the two sides of the system and contacts normally closed. These contacts close a circuit through shunt trip coils on the circuit-breakers of the main generators. This relay will operate and trip the circuit-breakers in the event of an abnormal rise of potential on either side of the system. A system having the generators protected by fuses should include an electrically-tripped switch so placed in the main buses as to separate the balancer set and distributing system from the generators. The differential relay should be connected to trip this switch in event of a short-circuit or abnormal rise of potential on either side of the system.

The series field of balancer sets may be placed on the positive sides of both machines and equalized with other balancer sets in the usual manner. Fig. 3 indicates the proper connections of a compound-wound balancer set and compound-wound generators, both being protected by circuit-breakers. Fig. 4 indicates the proper connections of similar machines protected by fuses and with an electrically-tripped switch in the main buses.

The fields of shunt wound balancer sets should be connected as shown in Fig. 6. It is to be noted that each machine has its field connected across one side of the system and its armature to the other. This tends to maintain balanced potentials on the two sides of the system with unbalanced loads.

In the discussion of Mr. Mosman's paper, Mr. Bechtel stated that in Toledo they used a three-wire, direct-current system for downtown lighting business district, and single-phase alternating-current in the residence portion. The station is equipped with three phase, four-wire and single phase generators. The feeder system is arranged with main feeders and sub-feeders on the primary mains, so as to give as nearly equal distribution over the whole territory as possible. The three wire, direct-current system is entirely underground and consists of an interconnected network, the mains being fed at different points from the station by three-wire feeders. A rotary converter is used as a tie-in between the two systems, and converts alternating to direct current, or vice versa, making a very flexible system and requiring somewhat less machinery for peak load. The direct-current peak load comes at 5.30 P. M. in winter time, and the alternating-current peak at about 8.00 P. M.; this in a measure does away with duplicate machinery. Mr. White, of Columbus, stated that his company contemplates putting in a four-wire, three-phase system. Mr. Bechtel suggested that the matter of whether wiring already installed would take care of the new conditions was one that ought to be taken into consideration in contemplating a radical change in system.

Vacuum Tube Lighting in Photography.

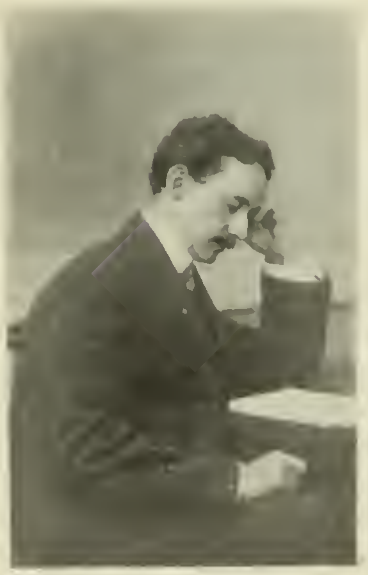

FIG. 1.—A THREE SECONDS' EXPOSURE.

The Moore vacuum tube lighting system is intended for general illumination, but we note an important adaptation of the light, for photographic purposes. The illustrations are of apparatus recently designed by Mr. D. McFarlan Moore and now used by Marceau, the well-known New York photographer, with great satisfaction, over 500 photographs of remarkable quality having been taken already. Since the intensity of this light is absolutely constant and the color values of objects appearing under it are identical with those of daylight, the results attained are actually superior to those obtained by natural light. uch apparatus solves the cloudy or rainy day problem for photographers, since they can be independent of the sun, avoid the necessity of leaky skylights and top floors, and take the finest of portraits—on the ground floor—with absolute certainty of results, without guessing at the length of exposures due to weather conditions. In winter time few sittings are now taken after 3 P. M., but with an "Artificial Daylight Window" the "photographer's day" can now be all night if necessary. Artistic posing is also greatly aided by the almost perfect color values, which reduce the amount of retouching to a minimum.

The portrait of Mr. Moore herewith reproduced, as an example, Fig. 1, was taken by this light, and the softness and texture speak for themselves.

It will be noticed from the illustration, Figs. 2 and 3, that the apparatus consists of a large flat window-like box. It is 5 ft. 6 in. long by 4 ft. 6 in. wide, pivoted at the center of its two sides between two uprights extending from a box-like base mounted on casters, so that as a whole it actually constitutes a movable "skylight," which is a great advantage in getting the light exactly focussed on the subject. Since the window proper is pivoted it is possible to get as much or as little "top light" as desired. The light all emanates from one vacuum tube, which is bent back and forth upon itself eight times, these eight principal lengths being arranged vertically over the entire surface of the front of the window and are, therefore, about 6 in. apart.

The ends of this tube, which has a total length of 43 ft., extend back through the face of the window, which is painted a dull white, and connect with the terminals placed in the back of the window.

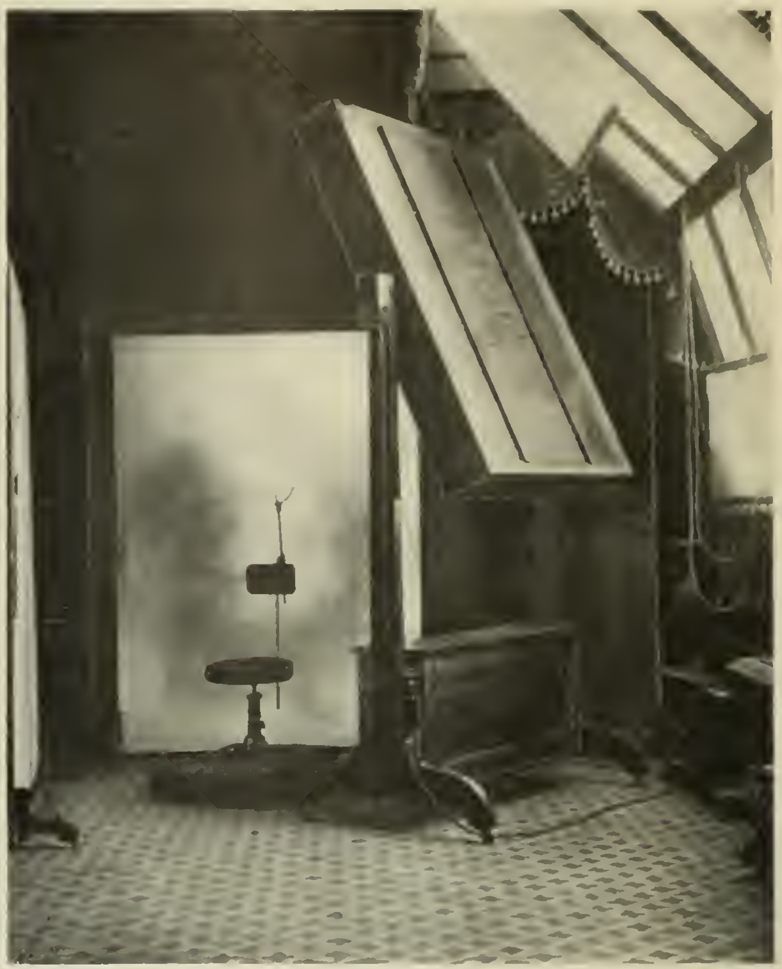

FIG. 2.—REAR VIEW OF APPARATUS.

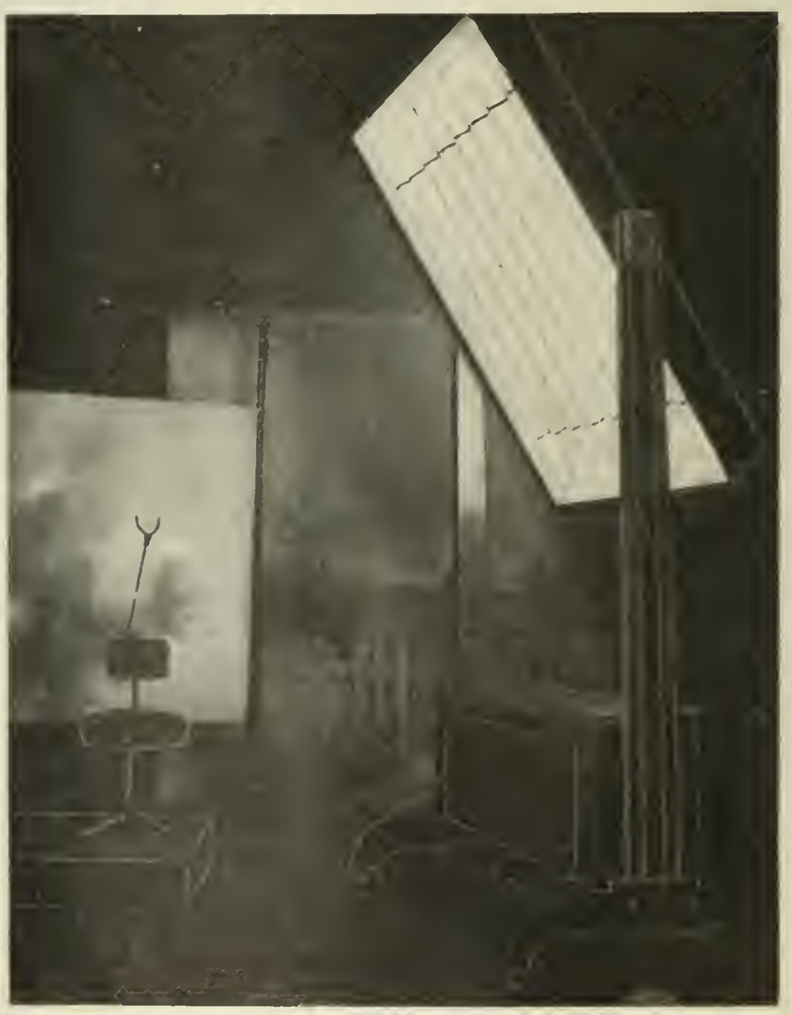

FIG. 3.—FRONT VIEW OF "MOVABLE SKYLIGHT."

which are in immediate connection with a transformer fed from any alternating source. Since the tube has a life of at least 1,000 hours, it is kept lighted constantly when pictures are to be made, in striking contrast to the objectionable flashlight powders heretofore used. When the tube is operating at about 5 cp per foot (about 200 cp total) the photographer can take pictures with an exposure identically the same as he would use under good daylight conditions, and the power required is about one-fifth as much, it is said, as would be necessary to obtain comparable results though greatly inferior, by means of arc lamps. Mr. Moore has also designed a somewhat similar apparatus, but with the light still more intense, for photographic printing. Another utilization of this frame, for which an immediate demand has sprung up, is the lighting of rear windows in deep buildings or store counters remote from outside light.

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A Graphic Recording Ammeter.*

By A. H. Armstrong.

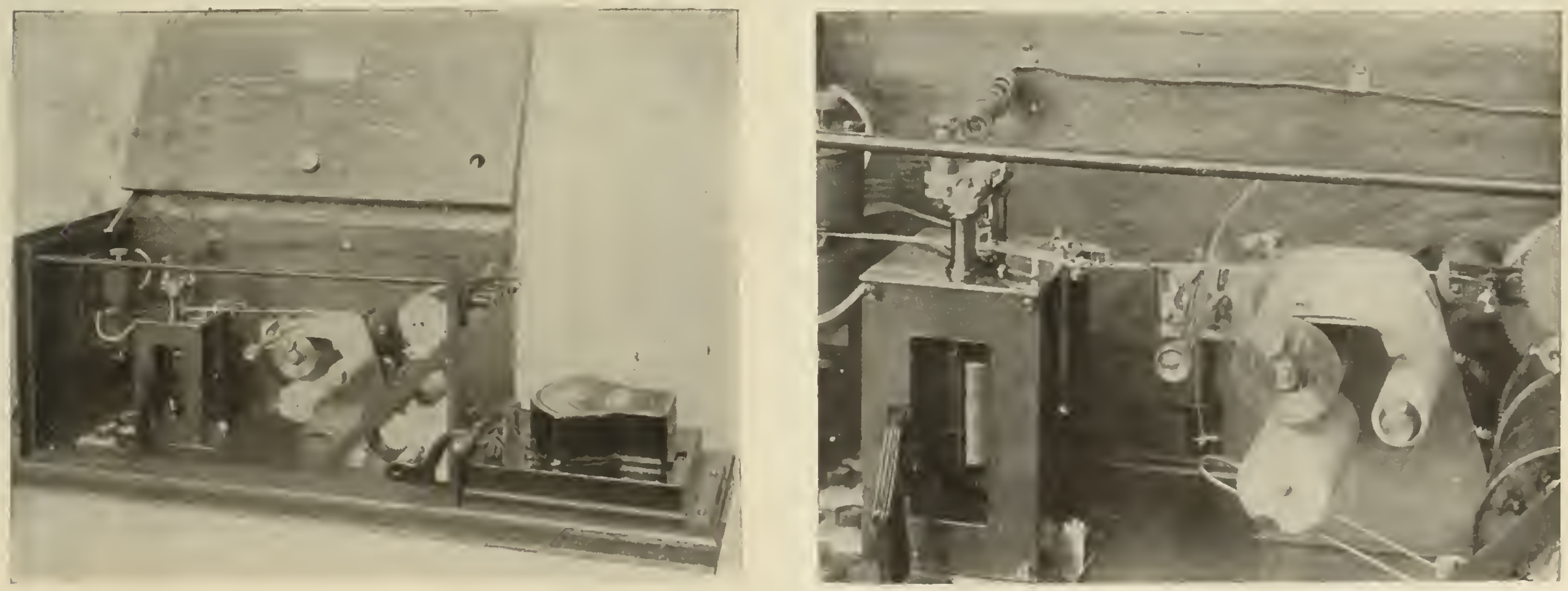
While the construction of the graphic recording ammeter is equally applicable to voltmeter and wattmeter, the following description is limited to the ammeter, since it embodies all the features contained in the other instruments.

With the advance of our understanding of rapid acceleration problems the need was felt for an instrument capable of registering accurately the violently fluctuating current readings. The instrument must, furthermore, be able to operate on cars moving at high rates of speed over more or less imperfect tracks, subjecting it to vibrations and shocks; this had all to be carefully considered in the design. The sudden changes in the quantities measured require that the instrument should have a short, quick period and give perfect damping; the swaying of the car and the rapid acceleration and retardation, make it necessary that the instrument be thoroughly balanced. In order to get a permanent record, ink was chosen, as even with the high torque employed a metal stylus or graphite pencil point could not be used with perfect freedom from sticking.

Several minor points contributing to the satisfactory operation of the instrument will be mentioned during a brief detailed description of the actual means employed to meet the conditions outlined.

To secure the required torque a dynamometer construction is employed, in which the current to be measured is carried by the fixed element, and the moving element carries a constant current supplied, preferably, by a small storage battery.

The moving coil is a small rectangle made up of several turns of wire, surrounding an iron core of cylindrical shape, carrying about one ampere. This coil and core are enclosed in the fixed coils. The moving coil is suspended by a control spring and held in position by this spring at the top and by a small steel shaft at the bottom. The bottom bearing is so made that when in use the moving system hangs freely from the control spring, but its vertical motion is so limited that any excessive vibration cannot damage the instrument. Current is led into and out of the moving coil by two spiral conductors of negligible elasticity in comparison with the control spring. The control spring is adjustable by changing its length.



Figs. 1 and 2.—Recording Ammeter.

The ampere-turns in the fixed coil of the ammeter are about 2,400, the ampere-turns in the moving coil about 80, and by this combination a torque at the end of the scale of about 200 gram cm. is secured. This is from 80 to 200 times the torque usually employed in measuring instruments in which the indications of a pointer on a scale are observed, and from 3 to 15 times that employed in the usual integrating or curve-drawing instruments. With this high torque the friction due to the pen moving over the paper is practically negligible.

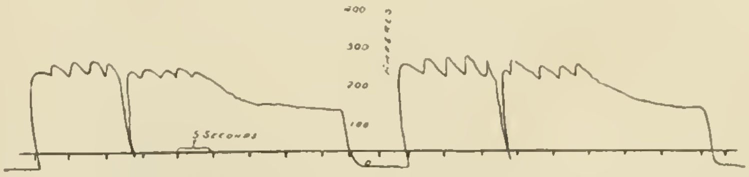


FIG. 3.—CURRENT CURVE, MULTIPLE UNIT CONTROL WITH AUTOMATIC ACCELERATING DEVICE.

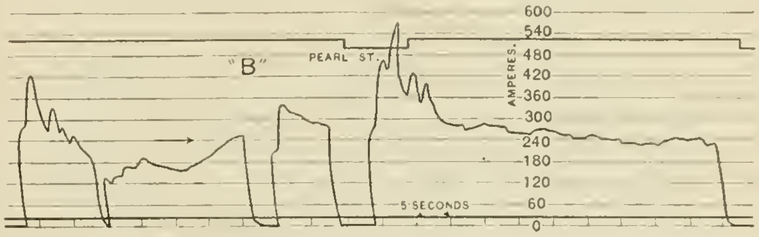


FIG. 4.—CURRENT CURVE, FOUR-MOTOR CAR CLIMBING A HEAVY GRADE WITH MOTORS IN SERIES.

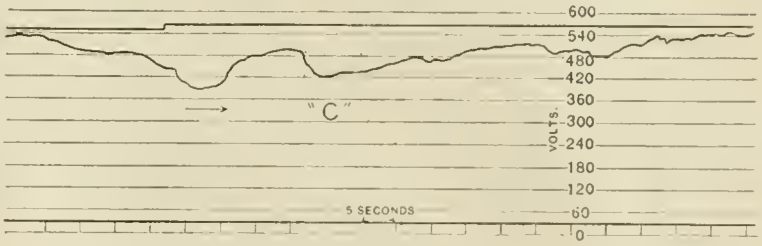


FIG. 5.—VOLTAGE CURVE, SCHENECTADY-ALBANY CAR.

The pen used consists of a capillary tube supplied by a siphon filled from an ink reservoir carried some distance from the recording point toward the axis of the instrument. By this means a fine line is drawn, a continual supply of ink is secured and no blotting takes place when the pen and paper are at rest. This construction also decreases the inertia of the moving system. It is necessary to adjust the contact of the pen with the recording surface, as the conditions under which the instrument is to be used require a considerable difference in the pressure of the pen on the paper.

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* A paper presented at the October meeting of the American Institute of Electrical Engineers.

If the instrument is used in a stationary position, the pen is almost on the point of leaving the paper; if high-speed tests are being made, the entire weight of the pointer can be allowed to rest on the paper. This adjustment is accomplished by means of a joint in the pointer and a small adjustable spring capable of supporting, if necessary, the entire weight of the movable part of the pointer. The paper used is about $3\frac{1}{2}$ in. wide and in rolls 65 ft. long, and it is usually run at a uniform rate of 6 in. per minute. The paper is driven by a spring motor similar to those used for driving phonographs and can be adjusted to maintain a uniform speed of from about 4 to 8 in. of paper per minute. The paper is punched and ruled by a special machine, and is passed through the instrument by means of a toothed wheel driven by the motor. With the machine which has been designed any desired ruling can be provided, and special paper, if necessary, can be made for each instrument; but it has been found that instruments of a given capacity are nearly enough alike to allow paper of uniform spacing to be used.

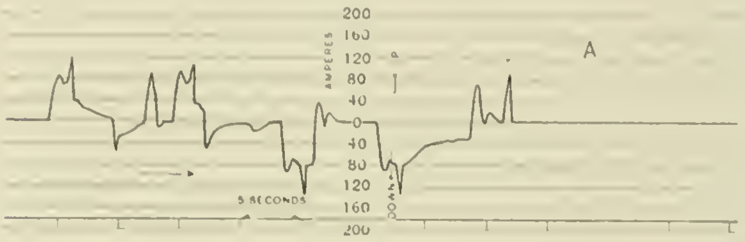


FIG. 6.—CURRENT CURVE, OTIS ELEVATOR MOTOR.

In testing with these instruments, it is usual to employ at least two, an ammeter and a voltmeter; and in order that the time can be accurately marked on the paper a time marker clock is employed. This operates a small pen on the record strip similar to the one used for the ampere or volt record, this contact being actuated by a small electromagnet which in turn is energized through a relay from a contact-making device driven by the clock and usually making the circuit every five seconds.

It is thus possible to obtain simultaneous readings by the instruments placed upon different cars in a train, a valuable feature where the different cars are each equipped with their own motive power. The marking device also serves the purpose of calibrating the speed at which the paper is moving, so that it is not necessary to spend considerable time in calibrating speed of paper by watch, which it would be necessary to do every few minutes without this device.

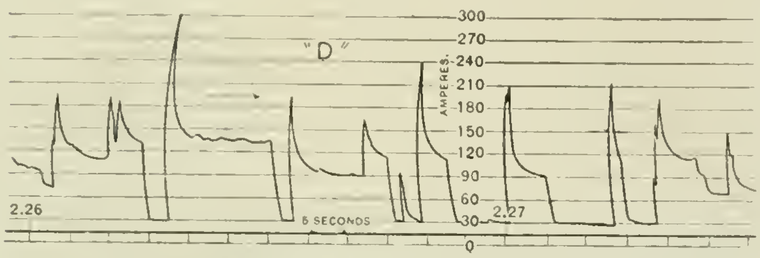


FIG. 7.—CURRENT CURVE, COMPOUND-WOUND GENERATOR.

With the introduction of a recording ammeter of great accuracy it is possible to obtain current readings and from them compute motor copper losses, with every assurance of obtaining consistent results. The recording instrument replaces the labors of the several men required by the old method of two-second readings, and gives results of greater accuracy. It therefore becomes a comparatively simple matter to run an all-day test upon a railway motor, taking a sufficient number of readings to obtain a fair average and thus determine its copper losses quickly and accurately. As both voltage and ampere input are accurately recorded it is also possible to compute from stand tests, the core losses of the motors, and in this manner obtain the total energy lost in heating the motor for a given class of service. The introduction of these instruments has made it comparatively easy to obtain the thermal capacity of the motor, and this, too, with the degree of accuracy that insures consistent results in comparing motors of different sizes and different designs.

GENERAL DATA

Length, 32[illegible]".
Width, $13\frac{1}{2}$".
Height, $11\frac{1}{4}$".
Approximate weight, 100 pounds.
Torque of ammeter, 210 gm. cm. (Full scale 21[illegible])
Torque of voltmeter, 200 gm. cm.
Period, 3.3 seconds for complete cycle.
Ampere-turns in fixed coil of ammeter, 2,400.
Ampere-turns in fixed coil of voltmeter, 950.
Ampere-turns in moving coil of ammeter, 80.
Ampere-turns in moving coil of voltmeter, 180.
Watts consumed in moving coil of ammeter, 1.
Watts consumed in moving coil of voltmeter, 3.3.
Watts consumed in fixed coil of ammeter, 130.
Watts consumed in fixed coil of voltmeter, 33.

* * *

New Telephone Patents.

MICROBE CATCHER.

After several weeks' quiescence the antiseptic transmitter attachment has again broken out, this time in a patent issued to S. J. Ballard, of Los Angeles, Cal. This device is of the sheet of paper type, novel in that the stock of paper is a roll carried above the mouthpiece. From the roll the paper strip passes over the mouthpiece, beneath a spring pressure ring, and thence over a small surface plate to a roller clamp and tearing edge. The presence of the surface plate beneath the paper permits of memoranda being jotted down on the paper strip, if one stands far enough away from the mouthpiece. But to use the transmitter properly and to use the plate at the same time, one would certainly find it necessary to wobble back and forth in a manner to rival the "balancing man" toys of some years ago.

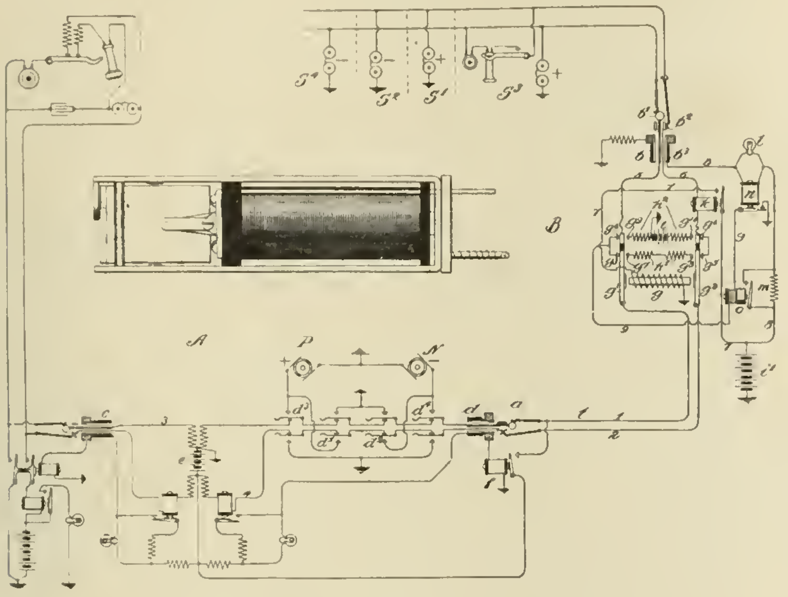
COMMON BATTERY TRUNK LINES.

While probably all telephone men know the meaning of the term "trunk line," only those having had experience with large exchange districts embodying several good-sized central offices can appreciate what a potent factor is trunking, in determining the quality of service. In such large systems, trunk lines are usually of two sorts: First, those over which traffic is sent, irrespective of from which end it approaches the trunk line; and second, those trunks which are used for traffic approaching from one direction only. This latter class is by far the more important, for a number of years ago it was shown to be economical to operate all large trunk groups on this basis. Now, when an exchange undergoes a transition from the magneto to the common battery or central energy system, the approved type of trunk circuit has usually involved a retrograde step from an operating standpoint, from the best-known trunk circuits of magneto practice. This retrogression is due to the fact that the standard common battery trunk is not "through ringing." By this we mean that the operator originally answering the calling party and requesting its extension in another central office, cannot directly signal the distant "called-for" party, but must depend upon the assisting trunk operator to do the calling. Ready, although rather expensive, means have long since been devised to meet the difficulty which is applicable for most kinds of calls, but for some few kinds, principally long-distance calls, through ringing is almost a necessity.

Before one can understand in a few words the means adopted to provide through ringing it is necessary to know why it is ordinarily impossible, and this lies in the fact that the repeating coils used in common battery practice, when designed for best talking properties, fail to repeat the low-periodicity ringing currents. Obviously, two methods of surmounting this difficulty suggest themselves: First, to cut out the repeating coil while the ringing process is continuing, and second, to relay around the repeating coil. Both methods have been tried with some success, and rather coincidentally both methods are represented this week in two patents issued to one inventor, Mr. W. W. Dean, of Chicago.

The patent to be discussed first is that for the relay shown in the middle of the accompanying illustration. This relay is designed to respond positively to ringing current, and is a primary means in the process of relaying such current around a trunk repeating coil. The view shown is a longitudinal section. The armature, a heavy block of iron, is swung on trunnions between the legs of a U-piece of sheet iron and directly in front of the pole of an electromagnet also contained within the U. Of course, the U forms a return pole-piece and this, together with the manner of suspending the armature, almost at its center of gravity, permits of the use of a very massive and, therefore, sluggish armature. The result is a relay that, with the proper circuit arrangements, will receive alternating ringing current over a trunk line irrespective of the repeating coil, and responding will, through a local switching relay, transmit the signal beyond the repeating coil.

The same figure also shows the circuit constituting the subject of Mr. Dean's second patent. This shows a through connection passing through two central offices and including the through ringing trunk wherein the disturbing repeating coil is cut out during ringing. Assuming that the reader is familiar with the purely subscriber's and cord circuits, we will consider the trunk circuit only. This latter extends from the jack, *d*, at *A*, to the plug, *b*, at *B*. It will be noted that h^1h^2, the disturbing trunk repeating coil, is normally disconnected from the circuit. At such time short straps, g^2g^3 and g^5g^6, complete the through circuit. When the operator at *A* depresses her ringing key the circuit may be readily traced to the called subscriber's bell. In tracing this circuit the relay, *k*, at *B*, will be found included therein. This relay does not, however, respond to the ringing current, because of the great impedance of the subscriber's bell. Now suppose the subscriber answers through his talking set across the line; then will relay *k* at once respond, receiving current either from the generator or battery at *A*, according to the position of *A's* ringing key at the instant. The operation at the relay, *g*, at once follows the closing of *k*, this relay, *g*, serving to properly insert in the line the trunk repeating coil. The remaining relays, *o*, *n* and *f*, serve to control the auxiliary supervisory and disconnect signals of trunking practice in a manner readily traceable. Both of these patents have been assigned to the Western Electric Company.



DEAN COMMON BATTERY TRUNK LINE SYSTEM.

NOVEL TELEPHONE INSTRUMENT.

A combined telephone transmitter and receiver is the title under which Charles Yeack, of Akron, Ohio, has patented a magneto telephone instrument of novel design. Mr. Yeack departs from the usual hand telephone form and within a receptacle in a longitudinal block places a permanent magnet with a consequent pole at the center. The soft iron telephone coil core arises laterally from this consequent pole, and with the usual fine wire coil is confronted with the diaphragm. Two other coils are provided, disposed on either end of the bar magnet. These are placed in series with the regular coil, the three being so arranged that currents arising from an advance of the diaphragm so pass about the permanent magnet as to tend to increase its strength, and vice versa, for the retreat of the diaphragm. It is the aim of the inventor to obtain increased volume and sensitiveness by this arrangement.

SWITCHBOARD CLOCK.

With the advent of pay stations and message rates with which the usual standard of charge is a conversation of a definite duration with pro rata increments for additional time, a satisfactory switchboard timing device became a sore necessity. The awkwardness of a clock at the top of the switchboard or upon a distant wall is at once apparent, and their use is accompanied by frequent mistakes. For long-distance calls, when the charge rate is sufficiently high to warrant, instruments of the calculagraph type have long since provided an efficient method of timing. For local traffic, however, such devices are not much in vogue because of the valuable keyboard space which they require and also because of the comparatively slow process of stamping call tickets. To provide a suitable timing device for local switchboards is the object of a recently-patented invention by Mr. B. F. Merritt, of East Orange, N. J.

This apparatus consists of two essentials: A master clock with a circuit-controlling attachment and a series of electrically-operated time indicators controlled by the clock. The time indicators are small and compact and are arranged to be mounted beneath the line jacks of the switchboard, a position just about in the usual line of sight of an operator performing her routine duties. The master clock controller makes and breaks an electric circuit ten times per minute. To each consequent electric impulse, each time indicator through the agency of a ratchet and electrically-controlled pawl, advances one step. Ten such steps complete a revolution of the most right-hand number wheel, bringing successively to view the figures 0 to 9, indicating thereby tenths of minutes. Three other number wheels are provided showing minutes, tens of minutes and hours. Any instant of time, therefore, reads directly in figures—thus, 10-16.5. The mechanisms of the device seem to be well worked out and of a very simple nature, and the whole seems calculated to properly perform a useful function.

TWO-PARTY LINE SYSTEMS.

Four other patents of last week's issue deal with party line systems. All of these have been granted to Charles B. Smith, of New York. A selective party line system by this inventor was noted in these columns a short time ago, in which selection depended upon the use of what may be termed master wires, which, singly or in pairs, controlled the signalling of groups of stations. One of the present patents deals with a secrecy or lock-out device for such system.

The other three patents relate to a novel scheme of party lines by which each party may have access both for calling and for receiving calls over any one of a number of lines, all being tapped to his premises for this purpose. By such an arrangement each line can handle more calls without more inconvenience to the subscribers. If the scheme were dropped here it might have considerable merit. Mr. Smith has, however, introduced much complicated apparatus at both the subscriber's station and at the central office to provide for automatic selection of idle lines and for secrecy. This is of such a nature as to undoubtedly defeat the whole cause, for surely simplicity is in telephony almost the first essential to success.

Recent Electrochemical Developments.

MANUFACTURE OF SUGAR FROM BEET JUICE.

Two patents were granted on October 20 to Mr. M. H. Miller, of Wiarton, Canada, for a process on treating and purifying the juices preparatory to the crystallization of sugar. In his system apparatus is used by which the juice is treated with an electric current, in order to separate albuminous foreign and coloring matter. At one stage of the process, current is passed through the juice between frames revolving within the body of the juice; and at another stage of the process the juice is allowed to drip or trickle over a metallic frame, which constitutes one terminal of an electric circuit. The process is stated to be applicable to the treatment of molasses, which is a by-product of the crystallization processes, and hitherto has been discarded for purposes of sugar making and used mainly for making alcohol.

MISCELLANEOUS.

An apparatus for purifying water by the electric current has been patented by Mr. O. M. R. Moeller, of Copenhagen, Denmark. In the lower part of the apparatus a number of perforated plates are arranged one above the other and connected alternately to the positive and negative terminals of the current. The water, while passing between the plates, is electrolyzed with the production of hydrogen and oxygen and some ozone. It is claimed that a thorough intermingling of the gases is produced "so that the ozone can perfectly purify the water, and so that the other gases generated can combine with ingredients in the water and further purify and cleanse the same."

A patent has been granted to Mr. C. T. Pratt, of Frankfort,

N. Y., for mechanical details of electroplating apparatus for plating slip nipples with zinc, with the bulk of the deposit on the interior surface.

A patent was granted to Mr. W. K. L. Dickson, of London, for a storage battery in which the containing vessel is provided with a metallic lining having projecting from its surface thorn-shaped spines, which hold a layer of active material in form of a paste. Within the case there are electrodes consisting of a light and perforated tubular core provided with projecting spines, which also hold layers of active material. Asbestos fibres are used as a binder for the active material.

Notes on Lighting in Europe.

Mr Arthur Williams, of the New York Edison Company, presented to the Association of Edison Illuminating Companies, at the Thousand Islands convention, a very interesting paper on what he had seen of European lighting practice during a recent trip abroad. One thing he observed was the absence of electrical effects upon special occasions, as for example, the visit of President Loubet to London. As to arc lighting in that city, he remarked that the prices paid by the municipality vary from $110 to $150 annually for an arc lamp of about the same size as our lamp rated at 2,000 candles. The practice is to place the lamps much nearer together, in many instances averaging not more than 100 feet apart, and the result is a degree of lighting which would offer a useful, impressive example to those in charge of that kind of service in most of our American municipalities. The city furnishes the posts and shades; the companies provide all else, giving the lamps the usual attention.

Enclosed arc lamps have made very little headway; the few to be seen are of a design less satisfactory than that with which we are familiar here, and for the most part they have not given satisfaction to the users. The reason the English engineers adhere so devotedly to the open lamps is that in London and other English and European cities, the price of labor and carbons is low, while the cost of current is high—the reverse being true in our American cities.

The Siemens-Halske Company has just placed upon the market a very small enclosed arc light, called the "Lilliput"; in deference to its lack of size. This lamp is so small that it can be used directly over a writing desk, near one's work, or, in fact, in any position sufficient for the usual incandescent lamp, and in which a large volume of light is required. It is even shown in the conventional desk standard, in which heretofore the incandescent lamp has been supposed to find an exclusive field. The lamp may be placed in any position without affecting its accuracy or steadiness of feed.

"Bremer" lamps are seen frequently on the streets. The outside of one hotel or restaurant on Piccadilly Circus is strikingly illuminated by them. The color of the light, however, is not pleasing, and he questioned whether, unless changed, the lamp will soon become very popular. It is said that about 150 are now used, with very great satisfaction, for lighting the streets of one district—that surrounding the East India docks. The lamp has recently been improved, and all now in use are to be replaced with the new type as soon as practicable. The object of the improvement is to do away with "fluttering," which heretofore has been a chronic defect. As all doubtless know, these lamps burn two in series, about 50 volts each, on a 110-120 volt circuit.

These lamps, as incandescent lamps and all other features of the installation, must be purchased by the consumer, but to insure good service, the manufacturers—The Westinghouse Company—arrange for their care at a cost of 10 shillings, or $2.50 weekly—for two—the price including, inspections, carbons, and repairs, but not the current supply. The responsibility of the company supplying electric current ends at the meter, and so everybody seems to understand. This Mr. Williams considers not conducive to best service. It compels the customers to purchase incandescent lamps, without expert knowledge and at a price in excess of the cost of lamps to the supplying company, tending thus to prolong their use until breakage, however blackened or low the candle power has fallen. The incandescent lighting standards are low, and as the service rendered by the companies is said to be very satisfactory—it is evident that they are carefully managed—the cause must be found in the lamps.

In the business sections one sees little gas lighting, and it is said that there is but one oil lamp installation in the city—and that that is going out. The "Lucas" lamp comparing with the "Northern" here, is used, but apparently not to any great extent. Electric light seems to have little, if any, serious competition.

Nernst lamps, large and small, are to be seen frequently on the principal thoroughfares, and the light is of very satisfactory quality. A number of stores use them exclusively. Plain, ground, or opalescent glass globes are used, with vertical spiral glowers—distinct from the horizontal straight glowers with which we are familiar in American practice. Large lamps, consuming about 250 watts, cost the retail consumer $5; small lamps, $1.25; large glowers cost 50 cents, the small, 37½ cents. They can be used with either alternating or direct current—those he saw using the direct current.

A Nernst projector lamp of 1,000 candle power has been made. The lamp consists of three glowers, in parallel, placed on a white enamel disc of about 2½ inches diameter. About 300 watts are consumed and hand control is substituted for the usual automatic control.

A representative of the manufacturers stated that 400,000 of these lamps, 60 per cent. small, the remainder large in size, were sold in England during the last year. It should be remembered that the incandescent lighting standards are generally low, and therefore a greater relative growth than would be possible here, should be expected.

There are 36 companies or vestries in London operating electric lighting plants. The aggregate of the installations, on the 16 candle basis, is 2,476,491 equivalents. This is largely incandescent lighting; the motor installations aggregate hardly more than 5,000 H. P., and the arc lamps something less than that number.

It has been stated that 13 of the companies or vestries use Wright meters, not exclusively, but in conjunction with their rates. The companies using these meters control about 45 per cent. of the total installations, but Mr. Williams got no data as to the number of meters used, or on the percentage of current sold through them. The manager of one of the largest companies stated that though he was reported as using this system of discount, he actually had only a few of the meters. The Shattner demand meter is also in use; one advantage being that it can be made fast or slow, as desired, by simply changing the medium through which the balls fall.

So much has been devised and said concerning electric lighting rates that it would seem as though nothing new were possible. Yet he had not previously heard of the rate recently adopted by the St. James & Pall Mall Company for long hour, usually hidden lighting; by hidden is meant the lighting of hotel, apartment house and club cellars, kitchen and servants' quarters, shops below the sidewalk level, basements and the public conveniences, which the city of London has liberally provided at the large intersections. The retail rates of this company are 12 cents a kilowatt hour for the first 4,000 kilowatt hours of annual use and 8 cents for all over, with a discount of 8 per cent. on all bills paid quickly—say within 30 days. To meet the competition of gas in the places mentioned, the company has adopted a new schedule, under which all "below street level" lighting is supplied at exactly half the usual rates. That is to say, the first 4,000 kilowatt hours are charged for at 6 cents instead of 12 cents, and the remainder at 4 cents instead of 8 cents—and the additional discount of 8 per cent. is also allowed.

If the consumer's premises are half above and half below the street level, he is given the benefit of a liberal interpretation of the schedule, and charged altogether at the low rates. Separate meters are provided where necessary to separate other parts of the premises supplied at the higher rates. This schedule has been very successful in competing with gas service.

English or perhaps London views regarding credit are interesting. Payment within 30 days is considered cash; nine months are not unusual.

It may be of interest to know that one company charges 12 cents a kilowatt hour for service at 100 volts and 10 cents where taken at 200 volts. This method has probably been adopted to encourage a general change of installations to the higher voltage. Another company, or rather one of the Borough Councils, charges 16 cents a kilowatt hour for the first hour of the maximum demand, and 2 cents for all over—a schedule representing the extreme views of Mr. Arthur Wright, in connection with the Wright demand system. Another company has recently entered upon a large contract for lighting and power service, under which the consumer pays $75 annually for each kilowatt of maximum demand and 2 cents for each kilowatt hour consumed. The demand rates of this company are also interesting: For the first quarter, ending with March, the charge is: for the first 6 kilowatt hours consumed per 8 candle power lamp, or equivalent, 16 cents a kilowatt hour, and for all excess, 4 cents; for the quarters ending with June and September only the first 3 kilowatt hours of average use are charged for at the higher rate, the remainder being charged for at the lower rate; the quarter ending with December, filling out the year, is again increased to an average of 6 units at the higher rate, as with the first quarter. Power is sold at 5 cents a kilowatt hour for the first 250 kilowatt hours of annual consumption per kilowatt of installation and 2 cents for all consumed in excess.

It should not be forgotten, when considering English terms, that the consumer buys everything beyond the meter, and therefore, on any prices given, fully 1½ cents a kilowatt hour should be added to get an American comparison.

The Shoreditch Destructor Works, of which so much has been said, are still in operation. This plant, it will be remembered, was erected for the purpose of burning the garbage of the district, utilizing the heat for making steam, the live steam for operating an electric light plant, and the exhaust for heating the water of the municipal bath of the district, and in winter for heating the district library. These several departments are located contiguously in the same block, but front on different thoroughfares. A second lighting station, some distance from the first, has now been erected, the capacity of which is about 1,600 kilowatts, but it is operated entirely with coal fuel. The works remain substantially as they were when first finished, though because of the larger demand for electric current and the somewhat lessened supply of debris, more coal is now being consumed than formerly. The consumable debris of the district amounts to 25,000 tons annually and gives sufficient heat to produce 1,000,000 kilowatt hours. It is estimated that garbage produces on the average one-tenth the heat of ordinary coal. Curiously, the garbage supply is decreasing. This is because dwelling houses are being gradually replaced, as the city pushes out, by factories and stores, which in proportion contribute less. The new inhabitants, however, demand more light and power service, so that the works can well afford to burn as much additional coal as may be required.

The figures showing the result of last year's operation seem to make it difficult to prove that the electrical are paying features of the plant. There was a balance of $20,000, after all charges were met, credited to the sinking fund, but this amounts to only 1.5 per cent. of the cost, a rate of depreciation demanding an active life in excess of 50 years to equal the original cost of the plant.

The use of arc lamps for the street lighting of Paris, as in London, has increased largely in the last two years, the greatest change being in the centre of the city. Open burning lamps are used, again because of the low cost of carbons and labor and the high cost of current. The lamps are spaced apart an average not exceeding one hundred feet; in some places the distances are much less. There seems to be no desire on the part of the city officials to utilize the private window lighting for the illumination of the thoroughfares, and this is well, for there is little, if any, display lighting of that order that is worth mentioning.

The companies supplying electric current are limited in their franchise to a maximum price equalling 30 cents a kilowatt hour, but there is no limitation upon the extent to which this price may be reduced. The average price obtained is about 22 cents a kilowatt hour.

Companies making electric current inside the city's walls pay a tax of 5 per cent. on their gross income, while those who generate outside the walls, thus avoiding the duty paid upon coal brought within the fortifications, pay 1 per cent. additional, or 6 per cent.

The cost of municipal arc lighting, where supplied by private companies, is at the rate of $240 annually, but the annual expenditure is in many cases lessened through the disconnection of the lamps at midnight or shortly thereafter. As the companies are taxed upon their gross income, this figure is reduced 5 per cent. or 6 per cent., as the case may be, so that the net cost is not far from $225 a lamp annually.

At the end of 1901 the five private companies and the municipal plant of Paris had 68,267 kilowatts of installation, equalling 1,365,340 sixteen candle equivalents. The capacity of all the stations was 38,000 kilowatts, or 56 per cent. of the installations. Twenty-seven million three hundred and twenty-two thousand kilowatt hours were sold, the consumption averaging about 400 hours per unit of installation.

A very interesting map has been prepared by the engineer in charge of the municipal works, showing in each of 83 small sections, into which he divided the city, the installation capacity in kilowatts, the kilowatt hours consumed annually, and the average use of each unit of installation. For example, one, a rich residential section, is shown where 3,387 kilowatts installation have an average use of only 161 hours annually; a second, next it, having 1,895 kilowatts, averages only 147 hours. The business and small shop sections appear better; in one 2,301 kilowatts were used an average of 585 hours; in another 1,717 kilowatts an average of 887 hours, and in still another, 135 kilowatts averaged 734 hours. A section in which the installations are largely for city lighting, having 102 units, averages 3,061 hours; another, also devoted to city lighting, having 26 units of installation, averages 2,284 hours. As stated previously, the average of all is 400 hours.

Three reasons are given explaining the very limited use of electric light in Paris. *First:* The high price, having little effect upon the rich, but largely restricting or preventing its use by others. *Second:* That electric light will always be very costly, even after reductions are made; that it cannot be used by "the little well-to-do." *Third:* The limited durance of the concessions, causing the supplying companies to withhold outlays for new equipments and extensions, requiring that they maintain a price abnormally high, to insure a fair return upon the investment they have made.

The New High Speed Work at Zossen.

The various features of the earlier work on high speed electric traction at Zossen have already been described and illustrated in these pages, and more recently we have discussed the system of financing, etc., under which the experiments have been carried out. The remarkable records made since the track was improved, were again beaten last week, when a speed was attained of 130 2-5 miles per hour. In due course the engineers and technical committee are to report the results in detail. Meantime, United States Consul General Mason has forwarded from Berlin some interesting general details as to the improved methods that have yielded the higher speeds.

During the twenty-two months that have elapsed since the close of the first experiments the track from Marienfeldt to Zossen had been taken up and relaid with new steel rails weighing 41 kilograms (86.1 pounds) per lineal meter, resting on heavy spruce ties 22 inches from center to center and heavily ballasted with broken basalt. The rails are set on each tie in a steel chair, strongly bolted down, and are joined perpendicularly by beveled joints, 7 inches in length, held firmly together by bolts passing horizontally through the fish plates, so that the effectiveness of a continuous rail is practically secured The old light rails, which had failed in 1901 and were therefore taken up, have been laid down flat as guard rails, resting horizontally on special cast-iron chairs in such a way that the flat bottom flange of the rail stands vertically along the inside line of each heavy rail and about 2 inches distant from the inner edge of its face. The track is a nearly level air line throughout its length, except one curve of 2,000 yards radius near its southern extremity, and is in all respects up to the highest standard of modern railway construction. The motors have been likewise improved in various minor details, but the cars are substantially the same as when first constructed. Each is 22 meters (72.18 feet) in length and weighs 90.5 metric tons, or about 200,000 pounds avoirdupois. Of this weight 48 metric tons comprise the body and running gear, and 42.5 tons are made up by the motors, transformers, and other details of the electrical equipment. Each end of the car rests on a six-wheel bogie truck of the American type, and the motors are four in number, one attached to the front and rear axle of each truck, the middle pair of wheels in each group running free. The wheels are 49 inches in diameter and are equipped with pneumatic brakes of the standard type. The transformers, which are hung beneath the middle section of the car, weigh 12 tons, besides which a storage battery of 631 pounds weight supplies the current for lighting purposes. The interior of the car is provided with upholstered seats lengthwise along the sides, and an open railing incloses at each end the space occupied by the driver, who, standing behind a curved front of plate glass within easy touch of volt and ampere meters, gauges which show the resistance of the air, and a dial that indicates and registers the speed, controls its movements by turning a pilot wheel.

Mr Mason reports that the passengers on the car traveled very comfortably at the highest speed, and that the track has now shown no deterioration; while the overhead contact devices have worked well on the three phase current and pressure of 13,500 volts

A cable dispatch from Berlin of October 20 says: "It was learned to-day that Kaiser William is resolved to make Germany the pioneer country in the matter of lightning travel by building an electric road from Berlin to Hamburg on which the normal speed shall be 100 miles an hour. The government is negotiating details with the Siemens-Halske Electrical Company. It is estimated that the cost of such a road would be double that of a steam railroad. The working expenses would also be double. If the plan now under advisement is successful a network of high speed railroads will be laid throughout Germany."

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Death of Prof. R. H. Thurston.

It is with deep regret that we record the sudden death of Dr. Robert H. Thurston, director of the Sibley College of Cornell University, Ithaca, N. Y. Dr. Thurston was 64 years old on October 25 and in celebration of his anniversary he had invited Andrew D. White, Dean Huffcutt, Prof. Hewitt and other colleagues to take dinner with him. He had just returned from a brisk walk across the campus and was in excellent spirits and health when he sat down in the drawing room to await the arrival of his guests. He suddenly fell into a stupor and Mrs. Thurston made a vain effort to arouse him, but before medical aid could reach the house he was dead. Dr. Thurston was one of the best-known members of the university faculty, and ranked very high in his profession. He was born at Providence, R. I., in 1839, and graduated from Brown University. He served with distinction in the Engineering Corps of the navy during the civil war, and at its close was assigned to the faculty of the Annapolis Naval Academy. In 1871 he became professor of engineering at Stevens Institute of Technology, where he made an enviable record as an instructor and in 1885 went to Cornell to take the directorship of Sibley College, then about to be organized. His administration was very successful. He was the author of many engineering treatises and was a member of the leading scientific societies of Europe and America. A series of articles on "Steam Engines," contributed to one of the journals now constituting the Electrical World and Engineer were afterwards issued very successfully in book form. To the "New Century" issue of this journal (January 5, 1901), Prof. Thurston contributed a valuable article entitled "The Steam Engine of To-day," in which he predicted the future supremacy of the steam turbine. One of Dr. Thurston's latest public appearances was his address before the New York Electrical Society last season on the subject of "Steam Turbines."

The Late Prof. Thurston.

Electric Automobiling From Boston to New York.

Mr. H M Wilson, driving a Columbia service wagon used by the Edison Electric Illuminating Company, of Boston, arrived at Central Bridge, New York City, at four p m on Saturday, October 24th, after a run that had occupied the best part of four days of leisurely travel. The machine was equipped with the new Edison storage battery, to test which the trip was partly undertaken. Two records were established for electric vehicles for the 245-mile course, one being the elapsed time from Boston, and the second the total cost for recharging en route, both of which cut under the marks set a few days previously by F. A. Babcock in a Buffalo electric surrey. Mr. Wilson figured the total cost of recharging at $7.50, a cut of one-half in that of Mr. Babcock's trip.

Mr. Wilson left Boston at noon on Tuesday, and his night stops were at Worcester, Springfield, New Haven and Stamford. The batteries were charged at Worcester, Springfield, Hartford, New Haven, Bridgeport and Stamford, all being short charges, averaging two hours at high rate. The longest run on a single charge was fifty-three miles, from Worcester to Springfield, and the machine could then have gone on for at least ten miles. The formidable Leicester Hill, of 18 per cent. grade, on the the run to Springfield, was successfully climbed, though one hundred and two amperes were required for the ascent. According to Mr. Wilson, the trip proved to his satisfaction the durability and flexibility of the new battery.

The only trouble en route was with hot motors on the heavy roads near Port Chester Saturday afternoon, when a stop was made to take off and clean the rear wheels and gears. The vehicle weighs 2,500 pounds. The wheels are fitted with solid tires. So far as known, the batteries came through in splendid condition. A notable feature is the general ease and facility with which charging arrangements can now be found along this and other routes.

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CURRENT NEWS AND NOTES.

SOUTHWESTERN ELECTRICAL ASSOCIATION.—The first meeting of the Southwestern Electrical Association was held at Oklahoma City Friday, October 9, and was a pronounced success. The following officers were elected for the ensuing year: President, J. W. Shartel, Oklahoma City; first vice-president, J. N. McLendon, Fayetteville, Ark.; second vice-president, L. F. Duggan, Wichita, Kan.; third vice-president, S. A. Hobson, Dallas, Tex.; secretary and treasurer, J. L. Ellis, Oklahoma City. It was voted to hold the next meeting of the association at Dallas, Tex., the latter part of April or beginning of May, 1904. The following papers were presented: "Possibilities of the Electric Railway in Oklahoma and Indian Territories," by John W. Shartel; "Heating from Central Station Lighting Plants," by T. K. Jackson; "Single-Phase Alternating-Current Motors as a Means of Increasing Central Station Earnings," by T. Bissel; "Central Station Accounting," by U. S. Hart; "The Nernst Lamp and Its Workings," by M. W. Hanks. Abstracts of these papers will appear in a following issue.

LONG-RANGE ORATORY.—The telephone is being freely used in England's present great political campaign. The other day Prime Minister Balfour delivered a notable speech in the Sheffield Drill Hall, every word of which was heard clearly in London by a large party of journalists. The trunk line from Glasgow to London was tapped at Sheffield and a connection made by the National Telephone Company into the Drill Hall, where specially powerful transmitters—six in number—were arranged about 4 ft. in front of the speaker. At the London end the connections were obtained by wires provided by the National Telephone Company into the premises of the Electrophone Company. Each auditor sat with a double receiver pressed against his ears, and, so provided, he simply sat and listened. The success of the experiment was undoubted. It is no exaggeration to say that those in London heard better than did the great majority of Mr. Balfour's Sheffield hearers, whose hearing would inevitably be "blurred" by the sounds of their individual and immediate surroundings. The record was absolutely startling in its clearness and nearness, and journalists of experience were agreed that at a distance of 220 miles they could more easily have reported the speech of Mr. Balfour than had they listened from the Press Gallery, and he had spoken from the front Treasury Bench.

TELEPHONY IN GUERNSEY.—The British island of Guernsey, in the English Channel, has a state telephone system. The number of lines is 1,073, the population being 40,300; so that there is an average of one telephone to every 37½ persons.

ELECTRIC CAR OZONE.—An Italian scientist has discovered that electric railways are important mediums in the disinfection of towns. By the operation of the car he says the electric current transforms the oxygen of the air into ozone, which has a purifying and disinfecting influence. This absurd idea was long ago put forward in America.

KEYBOARD TELEGRAPHIC PERFORATOR.—Mr. Patrick B. Delany has perfected a keyboard perforator for his latest system of rapid telegraphy, which can also be used as a transmitter of regular Morse if desired. One of the prominent features of the apparatus is that its use can be learned in a few weeks by a novice in telegraphy, and with it any typewriter can prepare tapes for transmitting messages.

VERBATIM REPORTS OF DISCUSSIONS OF PAPERS.—In a notice of the *Transactions* of the American Electrochemical Society, Vol. III, in the *London Electrician,* which is otherwise quite favorable, the reviewer says: "Fine confused reading is provided in abundance, and for the man of leisure, entertainment is afforded by the reporting of discussions in *oratio recta.* From a practical point of view this is a mistake, but as a picturesque adjunct to a paper otherwise sedative, it is valuable."

THE BRITISH INVENTOR.—In the course of an address delivered at the London Central Technical College, Sir Guilford Holesworth referred to invention as an expensive luxury, and said that 99 out of every 100 inventions were worthless, and 999 out of 1,000 were unremunerative. In former times—he did not know if it was so still—there was a very suggestive feature in the entrance to the Patent Office in Chancery Lane. On each side there was a door, one bearing on a brass plate the words "Commissioner of Bankruptcy," and on the other the inscription, "Commissioner of Lunacy."

THE SOUTHERN INDIANA INDEPENDENT TELEPHONE ASSOCIATION will hold its next annual convention in Evansville, Ind., on November 11. Independent systems are being established in many towns in that section, and by mutual arrangements telephone calls are interchangeable throughout southern Indiana over the various lines. By means of connections between the independent systems in New Albany, Ind., and Louisville, Ky., long-distance service is conducted between the two States. Mr. Charles D. Knoefel, of New Albany, is president of the association and Mr. E. W. Pickhardt, of Huntingburg, is secretary.

CHICAGO ELECTRICAL ASSOCIATION.—Dr. Robert A. Millikan, assistant professor of physics at Chicago University, lectured before the Chicago Electrical Association the evening of October 23 on "Radium and the Phenomena of Radioactivity." Prof. Millikan's lecture was in the main devoted to a history of the discoveries which led up to the discovery of radium, and a review of some of the theories connected with the phenomena of radioactivity. The lecture was illustrated with a few experiments with cathode rays, and after the lecture those desiring were given an opportunity to look at some radium under the fluoroscope.

HONOR TO TELEGRAPHERS.—So far as we are aware, the first monument doing honor to telegraphers is to be set up in Paris, always a center of light and leading in such matters. The sculptor, Bartholdi, who designed the Liberty colossus in New York Harbor, is about to see unveiled in Paris a monument to the balloonists who kept up communication between Paris and the rest of the country during the siege of the city in 1870-1. On one side is a view of Bartholdi's monument, with an inscription; on the other is a bird's-eye view of Paris taken from the fortifications. The words on this side are: "To the heroes of the post, the telegraph, the railways, 1870-1871." Where in this country is the kindred memorial to the gallant operators, whether Union or Confederate, who gave such glorious service during the Civil War?

GERMAN AUTOMOBILE LAW.—Mr. Richard Guenther, United States consul-general at Frankfort, Germany, says: "Some time ago the German Government ordered the collection of statistics of all accidents which were caused by motor vehicles within the last two preceding years. The secretary of the interior, Count Posadowsky, has now communicated with the governments of the various German States with a view of regulating the automobile traffic by a uniform federal law. All the governments have consented, so that a bill could be drafted which will probably be submitted to the Reichstag at its next session. The Federal Government has in this manner complied with the wishes of the automobile and bicycle associations, which have repeatedly petitioned that a uniform federal law be substituted for the local police regulations, which differ almost everywhere."

MUNICIPAL ELECTRIC LIGHTING IN GREAT BRITAIN.—In commenting on an article descriptive of the new municipal lighting plant of Dublin—which, by the way, employs three-phase, four-wire distribution—the *London Electrician* says that the fate of the old direct-current plant adds force to the contention urged over and over again in its columns that municipal electrical plants must set aside a depreciation fund in addition to the ordinary sinking fund if they are to be worked on sound financial lines. It was elicited at the Local Government Board inquiry that £90,000 had been spent on the old works, which have now been dismantled, and the mains in connection with them. The works were started in 1892, so that it will be many years before the capital has been paid off. Yet all that now remains are the buildings, the old network worth a few thousand pounds, and the sum of £3,590 realized by the sale of the old plant. It is thus evident that a far greater loss to capital account has taken place than has already been paid off by the sinking fund.

ELECTRIC HEATING.—The following incident is recorded by the *New York Sun:* "I was caught in the deluge the other day, and in spite of raincoat and umbrella arrived at my office thoroughly soaked from my knees down," said a sad-eyed suburbanite who was recounting the joys of country life. "I knew that to sit at my desk all day with wet feet and legs meant a severe cold or worse, and I was in a wretched state. I sat with the cold, wet things making me more and more miserable, when suddenly I had an idea. In my office are a number of swinging incandescent lights suspended by the wires only. Loosening the surplus wire to give the lights more play and removing the light shades, I turned on the current and, resting my legs on a chair, pushed a light up each leg of my trousers to a point between the knee and ankle. The heat from the lights was just the right quantity, and in about half a minute my legs began to feel a warm glow that was delightful, and the steam rose in miniature clouds. In half an hour both legs of my trousers were thoroughly dry. Then I pulled my wet socks over the bulbs, and they were dry in no time. The job was finished by putting the lights in my shoes, and I had dry shoes in a little over an hour."

ARGENTINE TELEGRAPHS.—Mr. E. W. Ames, of the United States consulate at Buenos Ayres, Argentine Republic, reports to the State Department as follows: "The open-circuit system of telegraph is used in the Argentine Republic and the messages are received on tapes, in conformity with the requirements of the telegraph law, for convenience in revision. The majority of operators receive by ear, but they must let the tape run for purposes of record. For the first telegraph lines constructed in the country iron poles were used, made by Siemens Brothers, of England. Since then the hard woods of the country (quebracho colorado, urunday, as well as some palms) have been used for poles. The wires rest on porcelain insulators set on wooden cross arms, which are fastened to the poles with iron clamps. The manufacturers from whom instruments and line materials are purchased are: Siemens Brothers, of London, and Felten & Guillaume, of Germany (wire). The amount annually expended for the maintenance of the national telegraph system is $78,000 national currency (about $33,500 United States currency). New lines are projected to the extent of 9,200 km. (5,717 miles). The telegraph system operated by the government is now 21,885 km. (13,600 miles) and the number of offices in operation 515. The extent of the telegraph lines belonging to railroads and to individuals under government control is 27,003 km (16,780 miles) and the number of offices in operation 996."

THE NOBEL PRIZES.—Mr. G. Marconi has just been awarded the annual Nobel prize in physics, by the Academy of Sciences at Copenhagen. Dr. Finsen gets that in medicine.

LETTER TO THE EDITORS.

Theories in Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

SIRS:—I have just read the letter by Mr. J. E. Taylor, published in your issue of October 17, in which he states that the wave theory of wireless telegraphy published by me did not originate with me, and claims that it was first propounded by him. In writing this letter Mr. Taylor has overlooked the following points:

1. That the theory published by Mr. Taylor in the *London Electrical Review* is entirely unlike that published by me in the *Transactions* of the American Institute of Electrical Engineers, there being more points of difference than of similarity.

2. That the points of similarity are not original with either Mr. Taylor or myself, but are to be found in the earlier publications of Delaricci and Blondel.

3. That as regards the points of difference, in which Mr. Taylor can claim originality, his theory is entirely wrong.

4. That even if Mr. Taylor had ever published a correct theory, he would hardly be entitled to claim credit for it as a *discovery*, for, where any one of a large number of theories is equally probable, the man who finds out the true one by making actual quantitative experiments and measurements is entitled to the credit of the discovery and not the lucky guesser.

So far, therefore, from disclaiming originality, as Mr. Taylor suggests, I have no hesitation in making the following statements:

1. That the correct theory of the propagation of the disturbances utilized in wireless telegraphy was published for the first time in my papers on the subject, and originated with me.

2. That the only experiments and measurements ever made, prior to the present year, which were competent to decide as to the correctness of the numerous theories advanced, were made by me.

I may here point out the reason for the failure of Mr. Taylor and others to give the correct theory, as it is an interesting example of the value of quantitative measurements. Those who have followed the subject are aware that any number of theories have been advanced, for example, the electrostatic theory of Preece, the current wave theory of Pupin, the earth conduction theory of some French scientists, the electromagnetic induction theory, the Hertz wave theory of Lodge and Slaby, the wobbling earth charge of Tesla and others, and the electrical image theories of Delaricci, Blondel and Taylor.

A priori, any one of these theories is possible. Applying mathematical treatment does not reduce the number to any extent, so long as the sensitiveness of the receiver is unknown. The "wobbling the earth charge" theory is eliminated, of course, for the reason that so far as wireless is concerned, "there ain't any such a pusson." Like the definition of a "unit magnetic pole," the statement that the capacity of a sphere is equal to its radius is one of those unfortunate formulæ which are forever causing confusion in the minds of those who are acquainted with the formulæ, but not with the limitations within which they are correct. Once it is understood that the capacity of a sphere is only equal to its radius when the oppositely-charged surface is removed to a distance which is very large compared with the radius of the sphere, the idea is seen to be a purely fictitious one so far as phenomena taking place on the earth is concerned. This, however, is not generally appreciated by amateur electricians, and as an example of the ridiculous mistakes caused by this lack of knowledge of elementary principles we may take the theory recently published at some length in the papers of the ELECTRICAL WORLD AND ENGINEER, where a theory was gravely put forward, depending on this wholly imaginary earth capacity, which called for the transmission of electrical disturbances at a velocity of several millions of miles per second.

The only way, however, to distinguish between the remaining theories is by direct quantitative experiment. The writer, therefore, first made careful quantitative measurements of the energy necessary to work the coherer. It was found that so far from being the "marvellously sensitive detector" assumed by previous experiments, the coherer was really a very inefficient instrument, taking several ergs to produce an indication. The following table gives the relative and absolute efficiencies of various types of receivers:

Type	Ergs. per dot
1. Marconi nickel-silver mercury coherer	4.000
2. Gold, 95 per cent., Bismuth, 5 per cent. alloy	1.000
3. Solari receiver and various types of carbon steel, steel aluminum and steel mercury receivers	0.22
4. Magnetic hysteresis receiver	0.100
5. Hot wire barretter	0.080
6. Liquid barretter	0.007

In making this comparison the coherers were adjusted so as to be as sensitive as possible without giving false signals, and the telephone indicator receivers were adjusted so as to be just stable when not acted upon, and to give a change of current of ten microamperes in the telephone. The comparison is more favorable to the hysteresis receiver than it should be, since the hysteresis receiver is badly adapted for sharp tuning, since the greater the hysteresis effect the worse the distortion of the wave.

Next, a few quantitative measurements at different distances at once eliminate the electrostatic, electromagnetic induction and Taylor theories, for according to Mr. Taylor's theory the intensity varies as the distance and the electrostatic and electromagnetic induction theories call for a high power of the distance, while the measurements show that the intensity falls off as the square of the distance.

The only instrument capable of deciding between the remaining theories is the hot-wire barretter. A hysteresis receiver depends upon the maximum intensity and not the integral value of the energy received, while the relation between energy received and indication is not uniform, and depends somewhat on the wave length, and in addition the distortion of the waves prevents accurate tuning, while the coils introduce additional induction in a varying amount, and lengthen the circuit.

On the other hand, the hot-wire barretter, being only about 0.01 in. long, adds no appreciable length, inductance or capacity to the receiving circuit, does not distort the wave form and gives the integral effect. In addition, it possesses the very remarkable quality that the relation between energy absorbed and increase of resistance is an absolutely straight line up to near the point of melting. This relation is entirely different from what was anticipated, but scores of measurements, both in air and X-ray vacuum, have given identical results. It is, moreover, easily standardized.

With the help of this instrument, then, and with the help of the additional devices mentioned by Mr. Collins, as the horizontal bundle of fine iron wires and the double copper triangles, the writer was enabled to plot all three co-ordinates of the waves accurately, and to arrive finally at the result published in the *Transactions* of the American Institute of Electrical Engineers December, 1899, the correct theory being there published for the first time, the methods used in the fuller investigation being first described in some communications to the German Patent Office in 1902 and in Mr. Collins's paper.

The fact was also ascertained that a mere grounding of the vertical conductor is not sufficient to insure operativeness, but that a natural or artificial wave chute extending at least one-quarter wave length must also be used, since even when the ground connection has only a few ohms resistance it is impossible to send signals unless the conducting surface is also present.

Until recently no experimental corroboration of these results by other experimenters had been obtained, but from references in foreign scientific journals it is understood that Dr. Slaby has repeated the experiments and arrived at the same conclusion.

That the waves were Hertz waves had been suggested by some, notably by Lodge. That this is not the case was settled experimentally by using the bundle of iron wires above referred to, when it was found that in the case of curvature of the surface the intensity was strongest near the ground and diminished upwards, instead of the reverse, as would have been the case if the effect had been due to diffraction. Mathematically, it was settled by calculating the rate at which diffraction effects should fall off, which rate was entirely different from that observed.

To return, then, to the image theories of Delaricci, Blondel, Taylor and the writer. Delaricci suggested the image effect, Blondel resuggested it and in addition stated that the waves were propagated over the surface, but did not give the complete theory or attempt any proof of it. Taylor followed Blondel, but in extending the theory made two vital mistakes: First, in stating that the intensity fell off as the distance instead of the square of the distance, and secondly in stating that the earth was the seat of currents. Not making any experiments, Mr. Taylor did not perceive and apparently has not yet recognized, that his theory was entirely incorrect, and relates to current waves such as exist in wires and not to true radiation of a new form, differing entirely from that of Hertz, in that, in consequence of what may be called an *in*flection, instead of a *re*flection, the waves follow the surface of the conductor.

The fact that there is no current flow is easily shown, either experimentally or mathematically, for the presence of a current in the earth would call for a violation of the law of conservation of energy.

In this connection it should be stated that the fact that there was no current flow in the earth accompanying the waves was probably first realized by Dr. John S. Stone, though I am not aware that he made any experiments to establish the fact.

In conclusion, I would point out a slip in Mr. Collins's article, in that he credits me with being the first to use and patent the method of prolonging the oscillations by means of a local circuit at the sending end. This should be qualified so as to read "by means of a local circuit at the sending end *tuned to the sending conductor.*" The fundamental difference between the method invented by Braun and that invented by me is that in Braun's method the local circuit is *not* tuned to the sending conductor and is not grounded, whilst in my method the local circuit *is* tuned and is preferably grounded. The fact that the Braun apparatus, as now constructed, follows the methods covered by my patent of December 15, 1899, in tuning and grounding probably accounts for Prof. Fleming's mistake in attributing this method to Braun.

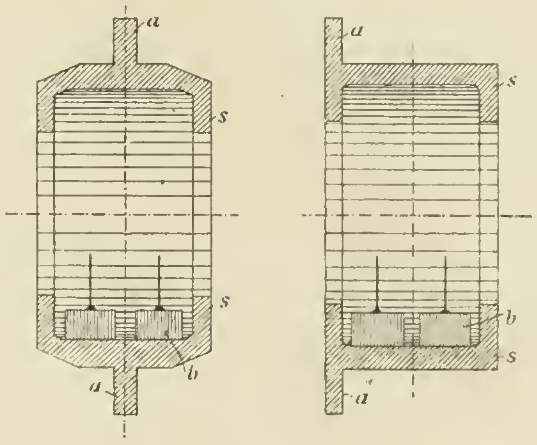
Washington, D. C. REGINALD A. FESSENDEN.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

New Compound Three-Phase Generator.—Kolben.—The author first discusses the actions in the rotor of compounded synchronous and non-synchronous machines, going over much the same ground as the Heyland did in an article on this subject noted in last week's Digest. He then discusses the construction of the new compounded three-phase generators built by Kolben & Co., Prig, with Heyland's compounded magnet winding. The sparking at the commutator is gotten rid of by winding the magnet poles with several parallel wires, whereby the effect is obtained that if one wire is momentarily disconnected a wire wound parallel is left connected, and thus neutralizes the action of the self-induction of the disconnected wire. Practically the winding, however, is not made with two wires, but with a larger number of parallel wires, which has the advantage that the tension at the brushes can be chosen higher and therefore the brush current lower, without sparking at the commutator. The single wires, starting from the middle, are connected together at certain intervals, with the result that the difference of potential between two adjacent commutator segments is also subdivided into certain steps. The arrangement also has the advantage that the watt currents flow only through a comparatively small part of the pole winding, thereby also reducing the losses. The article contains illustrations of the connections of a six-pole generator, which was given in the Digest of August 8, 1903, page 227. An illustration is also given of a cross-section and a perspective view of a normal three-phase machine, which was provided with a commutator, and the winding of the magnet poles described above. On account of the reduction of the air-gap thus made possible, the copper on the poles was reduced from 70 to 50 kgm. In spite of the lesser weight of copper, the copper loss in the poles measured at inductive load with $\cos \phi = 0.8$, fell from 4 per cent. in the normal machine to 2 per cent. in the compounded machine. It has been found advantageous to use a number of small brushes, each of which is set back a certain amount relatively to the other in the direction of rotation, so that altogether they cover the desired number of commutator segments. A table is given with experimental results from a six-pole, 20-kw machine, of 250 volts and 50 cycles. This is a normal three-phase generator, the exciter of which was replaced by a commutator and the magnet pole winding changed. It is stated that a larger number of generators, compounded after the above principle, are at present in course of construction, amongst them some of 1,500 kw.—*Elek. Zeit.*, October 8.

Commutator Brushes Running Under Oil.—Osnos.—The author first discusses briefly the ideas which had been proposed for the solution of this problem. He then outlines a construction of his own, as shown in the adjoining figure. The brushes, *b*, run on the inner circumference of a hollow commutator containing some oil; the commutator segments, *s*, are provided with radial ribs; *a* is for the connection of the commutator segment with the armature winding. The author states that in order to get along with only two brushes, which are both on the lower part of the commutator, it is preferable to make the armature winding a pure series winding. At higher speeds there will be a layer of oil at the upper part, due to centrifugal force, and in that case the brushes can be arranged as usual. As advantages of running the brushes in oil, the author enumerates the following: 1. The armature can be wound in such a manner that short-circuit currents are entirely obviated. This is done by winding the armature with two parallel, electrically-separated, coils, which are connected to alternate commutator segments, and making the thickness of the brush smaller than the width of one commutator segment. With the ordinary commutator arrangement this cannot be done, on account of the heavy sparking, but this is obviated when the brushes run under oil. As sparking at the commutator is excluded, many windings can be used per commutator segment and few segments, for a given voltage. 3. Metallic brushes can be used and, therefore, the length of the commutator and the cost of the machine becomes less, and the losses due to contact resistance as well as the friction losses, are decreased. 4. As the contact surface with metallic brushes can be made small, it is possible to always use a series winding with only two brushes on the commutator, and therefore an exact adjustment of the position of the brushes, which otherwise would be necessary for the above armature winding, can be dispensed with. He points to the importance of the advantages 1 and 2 for the commutator of single-phase alternating-current motors, and believes that it will be possible with this arrangement to use single-phase series motors directly for high voltage, without transformers.—*Zeit. f. Elek.*, October 11.



BRUSHES UNDER OIL.

Designing of Direct-Current Machines.—Hobart.—The author discusses the influence of the number of revolutions on the designing of direct-current machines. He considers a case of designing a machine for 100 kw at 500 volts, with the usual guarantee of less than 45° C. rise of temperature at any part of the machine and sparkless running with constant position of the brushes from no load to 25 per cent. overload, the dynamo to be compounded for constant voltage at all loads. The example is calculated at considerable length with tables of costs for machines of various speeds and cost curves. The following points are noted in conclusion: 1. Direct-current machines are best suitable for a low number of revolutions. For each output there is a speed, at which the price of the machine becomes a minimum. 2. Direct current machines of equal output but of different speeds, ought to have the same armature diameter. 3. The cost of production of a machine is proportional to $D \times L$, where L = the diameter of the armature and L = the length of the armature, measured between the ends of the winding.—*Elek. Zeit.*, October 1.

LIGHTS AND LIGHTING.

Osmium Lamps.—A description of the manufacture of incandescent wires for osmium lamps, based on recently issued German patent specifications. It has been found possible to produce suitable osmium wires by bringing the osmium in a finely-divided state, mixed with a carrier or binder, into the form of a wire. The wire thus formed is treated in the electric furnace by heating it by means of the current to a high temperature, above that of the vaporization point of platinum. The binding material is thereby destroyed and the individual osmium particles are welded together. The heating of the osmium wire must be carried only to a point at which it still remains finely porous, as dense wires are liable to break in the lamp. The manufacture of a filament consisting of an osmium platinum alloy is carried out by heating a thin platinum wire by the current in a reducing atmosphere, which must contain hydrocarbons, a considerable amount of water vapor and vapors of perosmic acid. Metallic osmium will separate on the platinum wire, which is then heated above the vaporization point of the platinum. The residual filament consists of an elastic tube, consisting mainly of osmium, but still containing some platinum. Various methods are described for the manufacture of osmium carbon filaments, which can also be mixed with thorium or zirconium oxide.—*Zeit. f. Beleucht*, September 30.

REFERENCE.

Efficient Light.—A description of a method by which light was produced about 30 times as efficiently as in the incandescent electric lamp, is given in an abstract entitled "Slow Cathode Rays," under "Electrophysics."

POWER.

Compressed Air in Connection with Electric Cranes.—JORDAN.—The author discusses at great length and with the aid of many diagrams and drawings, the disadvantages which are encountered in the application of magnetic brakes to cranes and other lifting appliances, which are operated by electric power. He advocates the use of compressed air for braking purposes, and illustrates a compressor which is actuated by the lifting mechanism of the crane, and shows its application to an electric crane. The advantages of this method of braking are claimed to be as follows: 1, smaller cost of installation; 2, much smaller weight; 3, much smaller consumption of power; 4, greater safety of running; 5, smoothness of braking; 6, taking the load off the lifting motor during the period of stoppage, and with polyphase currents also great saving of energy by doing away with the electric braking during this period; 7, simple and safer handling of the steering gear and longer life of the controller by reason of doing away with the gradual insertion of resistances in stopping; 8, increase of working time of the crane by reason of smaller periods of stoppage; 9, increase of efficiency of the lifting mechanism by using the compressed air for cooling the motor.—*Dingler's Polyt. Jour.*, September 19. 26.

Air Compressors for Mining, Driven by Electricity.—An illustrated general description of several constructions of mine drilling apparatus embodying the so-called electropneumatic system; that is, the employment of air compressors for the actual drilling, the compressors themselves being driven by electricity. This system is said to combine the advantages of the pneumatic and the electric systems, as it has the high efficiency, easy mode of installation and cheapness of transmission of the electric system, and the reliability and ease of manipulation of the pneumatic system. A table is given for the efficiency of an electric installation, which works out to 35.5 per cent., while the efficiency of the pneumatic system only reaches a maximum of 20 per cent. The efficiency for the electropneumatic system is stated to be 36 per cent.—*Glueckauf*, October 3.

REFERENCES.

Polyphase Plant in Collieries.—An abstract with particulars of the three-phase equipment of several English collieries. Four of them are equipped with a slow-speed compound condensing engine, running at 90 r.p.m., and directly coupled to a 40-pole, 375-kw alternator, of the revolving armature type. The fifth colliery has two 200-kw alternators, directly coupled to engines running at 300 r.p.m. The output of the plant of all the collieries aggregates 3,500 hp. Three-phase motors are largely used in connection with both surface and underground work. Lond. *Elec.*, October 9; from *Iron & Coal Trades Rev.*

Triphase-Current Transmission.—GUARINI.—A well-illustrated description of the installation for a triphase-current transmission at 30,000 volts for a distance of 11 miles, to the Oerlikon Works, where it is used to operate the plant. The mean total energy at the two hydraulic power stations is 550 kw. They are 1¼ miles distant from each other, the energy from the smaller one, 120 kw, at 5,000 volts, being transmitted to the larger, where it is stepped up to 30,000. The larger station includes three turbines and 3 generators running at 100 volts, 50 cycles and 1,200 amp. Each generator is direct-connected to a triphase transformer of 150 kw. The line comprises 4 conductors .157 in. in diameter, spaced 20 in. apart.—*Scien. Am. Supp.*, October 17.

TRACTION.

Recent Electric Locomotives.—BRUNN.—The continuation of the serial previously noted in the Digest. The present issue contains the illustrated description of a machine, several of which are running on a local railroad near Budapest, Hungary. The machine has two direct-current motors of about 30 to 40 hp each, which drive the axles by means of simple gears. The locomotive is able to draw two cars, of a total weight of 25 tons, over a 10-per-cent. grade with a speed of 20 km. per hour.—*Zeit. f. Electrotechnik und Moschinenbau*, September 16.

Mine Locomotives.—EGGER.—A description, with plans and cross-section of an electric mine locomotive for narrow gauge. The machine draws a total load of 5 tons at a grade of 18 per cent., with a speed of 12 km. per hour. Two 9-hp motors are used running at 300 volts with 750 r.p.m. A diagram of the electrical connections is also given. Measurements at the dynamo switchboard, when the mine railway was in full operation, indicated a consumption of 20 to 60 amp. at 330 to 370 volts, an average of 14 kw. A calculation of the saving effected over the method of hauling with horses shows a considerable economy resulting from the use of electricity.—*Elek. Zeit.*, October 1.

REFERENCES.

Safety Appliances for Electric Railroads.—An illustrated description of several recent German fender constructions.—*Elek. Rundschau*, October 1.

Electricity in Automobiles.—BIBOLINI.—A long paper, in which the author reviews the applications of electricity for the propulsion of automobiles and compares different types.—*Annali della Societa degli Ingegneri e degli Architetti Italiani*, No. 3, 1903.

French Electric Railway Statistics.—SOULIER.—A statistical article on the electric railroads and traction roads actually running or in course of construction in France on the first of January, 1903. The tables give the name of each company, the constructor, the length of the line, the gauge, type and weight of rails, the maximum grade, the minimum diameter of the curves, the number, origin and power of the generators, the total motive power, the voltage of distribution, the system adopted for transmission, the number of motor cars and trailers, the number and power of motors per car and other details.—*L'Ind. Elec.*, September 25.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Three-Phase Switch Gear.—EBORALL.—The continuation of his article previously noted in the Digest. The author first considers the objections against the "remote control" type of switchboard, mainly on account of its being expensive. He then gives a sketch of a simple form of the so-called "bench board" type of high-pressure switchboard arranged for distant control and discusses and illustrates several forms of bus-bar arrangements. The subject of protective overload devices for high-pressure, three-phase circuits, is then taken up. The question is one of automatic oil switches versus oil fuses; he has had occasion to observe the working of such fuses on 7,000 and 10,000 volts polyphase systems; they often worked excellently and sometimes quite the reverse, with serious consequences to the whole installation. He concluded that the application of fuses at all to this class of work was wrong in principle. The principal advantages of automatically-operated oil circuit-breakers in comparison with fuses for protecting high-pressure circuits transmitting large amounts of energy, are summarized by the author as follows: *a*, saving of the considerable space required by the fuse on the high-pressure panel; *b*, much better arrangement of the whole switchboard; *c*, no necessity of renewing the protective device on the part of the attendant, as the automatic switch is reset from the platform, and there is a consequent saving of time; *d*, the switch is a thoroughly mechanical arrangement, which a fuse with its porcelain pots or tubes, etc., certainly is not; *e*, the switch can be underset or overset temporarily, and operates with absolute certainty at a given value of current; *f*, the fuse has no selective action and cannot discriminate between forward and reverse currents or operate after a certain definite time has elapsed; *g*, the switch operates quickly without noise or disturbance.—Lond. *Eng'ing*, October 2.

Electricity Supply in Dublin.—A long illustrated description of the new electricity works. Steam is furnished by five Lancashire boilers and four water tube boilers. The main generating sets are four in number, two of 1,000 kw and two of 500-kw capacity. The engines are of the vertical Corliss compound inverted type, the fly-wheel being 14 ft. in diameter by 28 in. wide, the pole pieces of the three-phase generators being attached to the periphery of the fly-wheel. Current is generated directly at 5,000 volts, 50 cycles. The windings of the three phases are not connected on the machine itself, but are brought to a terminal box at the side of the casting, and thence three separate concentric cables run to the switchboard, the star connection of the machines being made at the switchboard by an earth bus-bar. Six-pole exciters, supplying a maximum current of 260 and 320 amp. respectively at 100 volts, are driven by the main engine shaft, their armatures being overhung. When running at the normal speed of 83½ r.p.m. and with a working steam pressure of 150 pounds and 26-in. vacuum, the ihp of each of the engines is 1,620 and the output of the generator 1,000 kw. The specified steam consumptions are 19 pounds of steam per kw-hour for the larger sets and 21 pounds for the smaller sets. The valve gear on the engines is illustrated and described in detail, as are also the arrangements for condensation. There is also a motor generator for charging a battery of 58 cells, each containing 27 plates. At a normal six-hour discharge rate the capacity of the battery is 1,200 amp.-hours and the maximum discharge rate is 650 amp. The battery is used for the lighting of the works at 100 volts, and provision is made for exciting the alternators from the cells in the case of failure of any exciter.—Lond. *Elec.*, September 25, October 2.

Bexley (England) Electric Lighting and Tramway Installation.—An illustrated description of the recently-opened installation. The generating plant comprises two engines of 150 kw each, each engine being coupled to two generators. One of these is a 16-pole, single-phase, 150-kw, 50-cycle alternator, running at 2,100 volts, and the other a 150-kw, direct-current, compound-wound, 4-pole railway generator of 550 volts. The alternators are of the revolving field type, the rotor spider being of cast iron. A battery of 240 cells has been installed, which is capable of giving 50 amp. at 500 volts for eight hours, 200 amp. for one hour and 400 amp. for a short period. It is worked in conjunction with an automatic motor, booster and exciter, coupled together, and running at 950 r.p.m. The motor and exciter both get current from the tramway bus-bars and the booster will give a maximum voltage of 120, a normal current of 200 and a maximum of 400 amp. The switchboard installation is given in detail, as are also the boiler room installation, auxiliaries, etc.—Lond. *Elec. Rev.*, October 9.

New Graphite Resistance.—Hopfelt.—An article describing several new forms of graphite rheostats and experiments on their ohmic resistance under the action of varying currents. The graphite is used in the form of powder and is introduced into iron rings, which are closed on both sides by iron plates, which are, however, insulated from the rings by asbestos and mica. The iron plates quickly conduct away the heat, which is generated in the interior, and serve at the same time as current connectors.—*Elek. Zeit.*, October 8.

REFERENCE.

Graphic Calculation of Motor Starters.—Krause.—An article illustrated by diagrams, in which the author discusses a graphical method for the calculation of starters for shunt, series and non-synchronous polyphase motors.—*Zeit. f. Elek.*, October 4.

Wires, Wiring and Conduits.

REFERENCE.

Copper Wires for Electric Purposes.—Schwieger.—An illustrated review of the manufacture of copper wires for electrical conductors. A description is given of a modern installation in which individual electric driving of the tools is employed. The operation of rolling and drawing the wires is explained.—*Elek. Anz.*, September 24; October 1.

Electro-Physics and Magnetism.

Law of the Condenser in the Induction Coil.—Ives.—The author uses the term "optimum capacity," in an induction coil, to define that capacity of the condenser, which, when placed around the break, will give the longest spark in the secondary. This has also been found by experiment to be the least capacity that causes the sparking at the break to disappear, or if not entirely to disappear, to become very small. The author tried to find by experiment the relation between the optimum capacity and the other constants of the primary circuit, viz.: the current, the resistance and the inductance. The break consisted of an amalgamated copper wire one millimeter in diameter, dipping into a cup of mercury. The surface of the mercury was covered by two or three centimetres of distilled water and the breaking was done by hand. In summing up he makes the following statements with regard to the optimum capacity for the particular kind of mercury break used. It depends upon the sign of the breaking pole; it is, in general, proportional to a power of the primary current, greater than the square and less than the cube; it depends very markedly upon the resistance of the connections leading both to the break and to the condenser; it is a function of the inductance of the primary, but for large inductances becomes practically independent of it.—*Phil. Mag.*, October.

Distribution of Electric Lines of Force.—Seddig.—An illustrated abstract of a thesis on the representation of the distribution of the electric lines of force and especially the change of direction which is brought about by the influence of dielectrics. The author used the suspension method for rendering the lines of force visible. He immersed two electrodes, connected to the poles of an influence machine, in a non-conducting liquid (turpentine oil), which contained a large number of fine suspended particles of glycerin or chinin sulphate. If an electrostatic field is generated between the electrodes, the suspended particles arrange themselves in the direction of the electric lines of force, and falling down to the bottom of the vessel they form a sediment in which the lines of force are represented in characteristic lines. Illustrations are given of the appearance of the lines of force between two small charged balls, between two charged condenser plates with a metallic ring between them, and between two condenser plates with a hard rubber ring between. In the first case they look much like the magnetic lines of force. The second illustration shows clearly the curving in of the lines of force into the ring and the screening action of the metallic ring. In the case of the hard rubber ring between two condenser plates the illustration shows also lines of force in the interior of the ring and a small outward curvature of the lines, on account of the somewhat smaller dielectric constant of the hard rubber compared to that of the suspension.—*Elek. Zeit.*, September 24.

Slow Cathode Rays.—Lenard.—An abstract giving the author's results of his work with "slow" cathode rays. He discovered in 1899 that the impact of ultra-violet light upon a negatively-charged conductor causes the latter to give out rays which have all the characteristics of cathode rays, but which travel at a rate of only one-thirtieth of the velocity of light. He has now investigated them by means of phosphorescence, which is somewhat difficult to produce, owing to the slowness of the rays. He also studied the effect of these slow rays on various gases and found that they make the gases themselves emit cathode rays. The rays may be made visible on a screen by a suitable adjustment of the potentials of the electrode and the screen. If the former is charged to — 500 volts the rays just produce a luminous patch on the uncharged screen. But if the latter is charged to 4,000 volts, the potential of the electrode exposed to the ultra-violet light may be reduced to — 4 volts without stopping the phosphorescence. The distance between electrode and screen is 14 cm. When the electrode is neutral the rays do not go further than 8 cm., owing to diffusion and the influence of the magnetic field of the earth. The substance employed for the screens was a mixture of cadmium sulphide, bismuth and sodium thiosulphate. The luminous effect is very considerable and amounts to 10 Hefner units per watt, which is more than 30 times the 0.3 Hefner units per watt of the incandescent lamp. Lond. *Elec.*, October 9; from *Annalen der Physik.*, No. 11, 1903

Ferromagnetic Substances. Honda and Shimizer. The authors give the results of their investigation of the change of length of ferromagnetic substances under high and low temperatures, by magnetization. Heating of the substances was effected by an electric current: the low temperature researches were conducted at the temperature of liquid air. The substances investigated were soft iron, tungsten steel, cast and annealed cobalt and nickel. Curves are given for these materials. The general conclusion of the authors is that for soft iron, tungsten steel, cast and annealed cobalt, the changes of length, which are so very different from each other at the ordinary temperature, assume an extraordinarily simple character at high temperatures, in so far as they tend to become proportional to the magnetic force.—*Phil Mag.*, October.

Electro-Chemistry and Batteries.

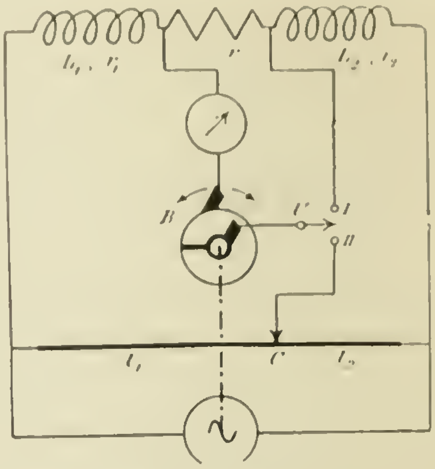
Electrolytic Estimation of Minute Quantities of Arsenic.—Thorpe.—The author describes a method for the analysis of substances containing small amounts of arsenic, especially brewing materials. The apparatus used by him is illustrated and described at considerable length. The principle of the method consists in the employment of a vessel with a porous cup. The platinum cathode is arranged within the cup, and the solution to be electrolyzed is also placed in the cup. When the current is allowed to act, the hydrogen, which is generated at the platinum cathode, forms hydrogen arsenide with the arsenic contained in the material, which latter is collected and heated in order to form a deposit of arsenic, a so-called arsenic mirror. The mirrors thus obtained are then compared with standard mirrors, gotten by treating solutions with a known amount of arsenic. The preparation and testing of the solutions, and the advantages of this electrolytic method over the ordinary methods of analysis are set forth at length.—*Electrochemist & Metallurgist*, September.

REFERENCES.

The Electric Furnace.—Minet.—The continuation of his illustrated serial on the electric furnace, its origin, development and forms of application, previously noted in the Digest. In the present installment he describes the furnaces of Menges, Kleiner-Fiertz, Rouleaux, Rogerson, Gerard-Lecuyer and Stassans. He then begins the discussion of the electrolytic furnaces, beginning with Heroult's construction.—*Electrochem. Zeit.*, October.

Units, Measurements and Instruments.

Measurement of Self-Induction.—Hohage.—The author describes a zero method for the comparison of self-induction coefficients by means of a galvanometer. He has shown previously that when two self-inductions, which are to be compared, are inserted into an alternating circuit as branches of a Wheatstone bridge, their ratio is equal to that of the ohmic resistances in the other two branches, if the voltage between the junction of the self-inductions and the junction of the resistances, is in phase with the current; the ohmic resistances of the self-inductions are without influence. A Joubert disc and a galvanometer are now connected to the bridge wire between the junction of the self-inductions and the junction of the resistances, which disc runs synchronously with the alternating-current generator. If now the contact brush of the disc is put into such a position that the circuit of the galvanometer is closed only at the instant when the wave of the current has reached a zero value, the deflection of the galvanometer will disappear when the voltage and the current have the same phase, all waves being supposed to be sinusoidal. The arrangement which the author uses is shown in the accompanying illustration, where *B* is the Joubert disc and *U* a commutator switch. To obtain the right position of the contact brush, an inductionless resistance, *r*, is inserted, which must, however, be so small that it does not appreciably lessen the phase displacement. The galvanometer and the Joubert disc are connected to the ends of this resistance. The measurement is made as follows: The switch, *U*, is put into position *I* and the brush, *B*, is turned until the deflection of the galvanometer becomes zero; then the switch, *U*, is put on *II* and the measuring wire contact, *C*, is moved about until the galvanometer deflection is zero; then $L_1/L_2 = l_1/l_2$, in which l_1 and l_2 are ohmic resistances. If in position *I* of the switch, *U*, the brush, *B*, is not regulated for the deflection 0, but for the maximum deflection, and in position *II* the contact, *C*, as above, is set for the deflection zero, then $r_1/r_2 = l_1^1/l_2^2$; that is, the ratio of the ohmic resistances of the induction coils is obtained, uninfluenced by their self-induction. The method is stated to be very accurate, even with very small values, and a small number of alternations.—*Elek. Zeit.*, October 1.



MEASUREMENT OF SELF-INDUCTION.

Telegraphy, Telephony and Signals.

Portsmouth (England) Telephone Exchange.—An illustrated description of the exchange, which is an independent municipal undertaking. The system of distribution employed is a combination of underground cables with overhead distribution from the ends of these cables. The main cables are led into the testing room and connected to the main distributing board for testing purposes; they are also fited with taps for pumping dry air into the lead covering. The lines are then cross-connected on to the lightning arresters and high-tension guards, from where they are led to the switchboard. The switching system adopted is the central battery signal with local batteries in the subscriber's instrument. The operation of the central battery multiple switchboard is described and illustrated by cuts and diagrams. The power plant, consisting of a motor generator, which converts the alternating 100-volt town supply into direct current, and of duplicate sets of storage batteries, is also described. The dynamo is fitted with choking coils so that in the case of break-down of the accumulators, which are connected in shunt, all the circuits can be worked directly on the machine.—Lond. *Elec. Eng.*, October 9.

Wireless Telegraphy Stations.—Albrecht.—A description of a wireless installation between Aussig and Teplitz, Austria. The two stations are 14 km. apart. The apparatus is constructed for the Slaby-Arco system, and is described in detail. The station in Aussig was situated in the grounds of a large exposition. An interesting and very troublesome phenomenon made its appearance in Aussig, namely, that during the sending of messages strong sparks passed between the wires of the neighboring electric light circuits, which drew the 220-volt light pressure after them and caused violent short-circuits. On account of this all light circuits have to be disconnected during the period of wireless communication. At the other station in the electrotechnical school in Teplitz it was also possible to draw sparks 5 to 10 mm. long from all circuits, which are fed quite independently with 100 volts, and have nothing whatever to do with the 220-volt circuit for the wireless telegraph.—*Zeit. f. Elek.*, October 4.

REFERENCES.

German Telephone Switchboards.—Perkins.—An article illustrated with diagrams, describing the general arrangement, details of construction and connections employed by the Actiengesellschaft Mix and Genest, in their system for business and factory telephones. The system is devised for the purpose of combining the regular house telephones of large establishments with the regular commercial service in such a way that by the turning of a single switch either service can be obtained.—*Tel. Mag.*, October.

Transmitting Speech by Electrophone.—An illustrated description of the arrangements and the instruments used for transmitting Mr. Balfour's address from Sheffield to London. The arrangement consisted of a number of microphones connected to numerous telephones.—Lond. *Elec.*, October 9.

MISCELLANEOUS.

Safety of Workingmen in Electric Plants.—KATH.—An abstract of a paper read before the Society of German Supervising Engineers. The author points out that direct current, the potential of which seldom exceeds 500 volts, will, as a rule, involve real danger only when several particularly unfortunate conditions are present at the same time. Temperate and normal persons are said to be able to safely stand as high as 0.03 amp., and exceptionally strong persons may sustain 0.11 amp., the dangerous limit at which fatal results have been recorded being, as a rule, about 0.1 amp. The following figures are given of some resistances of special importance: "The resistance of the palm of the hand, provided it be not moistened with an acid or salt solution, will be: (1) In the case of the point of one finger being the contact surface, 50,000 ohms; (2) when holding a metal tongs, 5,000 ohms; (3) in the case of the whole palm being clamped around, 500 ohms." The resistance of the body across the arms or in a longitudinal direction, is about 500 ohms. The resistance of the boots touching the ground is, in the case of both the boots and the soil being wet, 5,000 ohms, whereas for dry boots and wet soil figures as high as 10,000 ohms, and for dry soil upwards of 200,000 ohms are recorded. From measurements made by the author it appears that the resistance of the body of a workman, measured from the hands through the feet to the nearest metallic object in connection with the ground, will be from 20,000 to 200,000 ohms in a dry room, whereas in wet rooms values of only about 1,000 ohms are noted. As to whether alternating or direct currents are the more dangerous, the author thinks that no satisfactory conclusion has so far been reached. (The statements of the data are, unfortunately, vague and incomplete.)—*Engineer*, October 15.

New Books.

ELECTRICAL ENGINEERING MEASURING INSTRUMENTS. By G. D. Aspinwall Parr. New York: D. Van Nostrand Company. 322 pages, 370 illustrations. Price, $3.50.

Prefix the word "English" to the title of this volume or add the phrase "in use in England" and one will have a very fair idea of the nature of its contents. The programme followed in writing it seems to have been, first, a wholesale raid with paste pot and scissors on the catalogues of all parties supplying indicating, recording or integrating instruments in Great Britain, and then a careful sorting over and classification of the spoils according to a scheme by no means badly thought out. Although the sub-title implies that laboratory as well as commercial forms of instruments are included in the scope of the treatise, no mention is made of the various forms of fibre suspension reflecting galvanometers and other "ometers" that are still a necessary evil for the laboratory worker. Strange to say, no apparatus for the measurement of resistance finds place in the whole book, although both the Wheatstone bridge and the Evershed ohmmeter, without whose aid we should be in sore straits, had their origin in England. That devices for magnetic measurements are also excluded is perhaps proper in a work of this kind; but after stating in the preface that without measuring instruments, dynamos, motors and transformers could never have been evolved or, if evolved, successfully utilized, it is surely fair to expect that the author would have devoted some space to instruments for determining the magnetic qualities of the all important iron entering into the construction of such apparatus.

The classification of instruments as worked out by Mr. Parr in the order taken up by him is, first, indicating instruments, next recorders, next miscellaneous instruments and last integrating, or, to use the happier English term, electricity meters. The indicating instrument section has chapters devoted to moving needle electromagnetic instruments, moving coil electromagnetic instruments, hot wire and electrostatic instruments, and electromagnetic wattmeters. One chapter apiece suffices for each of the other headings.

The indicating instrument section is the best, giving as it does examples and good descriptions of several representative meters of each class. The chapter on standards might as well have been omitted, as the only two described are the Kelvin balance and the Crompton potentiometer, both in terms that will be found familiar by those who have read the makers' catalogues.

The recorder section is well enough as far as it goes, but only one class of this kind of instrument—that in which a V-shaped pen is dragged across the surface of the record chart by the effort exerted by a magnified indicating instrument mechanism—is mentioned, several interesting Continental meters making periodic records having escaped attention.

The integrating meter chapter is the longest in the book and as good as the indicating instrument section, the descriptions of the meters due to Wright, Schlatter, Aron and others being judiciously full and well illustrated.

While containing a full share of minor misstatements, the work as a whole may be pronounced a good reference book for those who require a meter for some particular work and wish to compare the mechanisms and merits of the various makes available in England before reaching a decision. It is also a good book to recommend to those desirous of obtaining general information as to the principles and construction of the volt, ampere and wattmeters in everyday use.

Motors in an Elevator Factory and Machine Shop.

It is always interesting and often instructive to visit a large modern machine shop and study the methods of operation and special processes employed, particularly if the shop is one in which a great variety of work is undertaken. In its works at Harrison, N. J., the Marine Engine & Machine Company is engaged not only in the manufacture regularly of engines for launches, stationary oil engines, ice machines, electric elevators and the accessory equipment for each, but special foundry and machine work. Naturally such a wide range demands a great variety of machine tools, standard, special and in all sizes. Originally the concern was known as the Marine Vapor Engine Company, being at that time devoted to the building of launches and equipping them with engines and boilers in which alcohol vapor was used instead of steam. Later the actual building of the boats and all in connection with them except the making and installing of the engines was discontinued, general machine and foundry work was made a part of the regular business and the name was changed to the Marine Engine & Machine Company. Since then the business has grown very rapidly, two very important factors in its increase having been the effecting of arrangements with the Buffalo Refrigerating Machine Company whereby it now builds all of its ice machines and refrigerating apparatus, and with the General Power Company for the manufacture of its Secor oil engines. Of all the work which the company produces, however, it is probably best known for the electric elevator and hoists which it has developed in the last few years. These are made in numerous types and sizes and are equipped with Crocker-Wheeler motors.

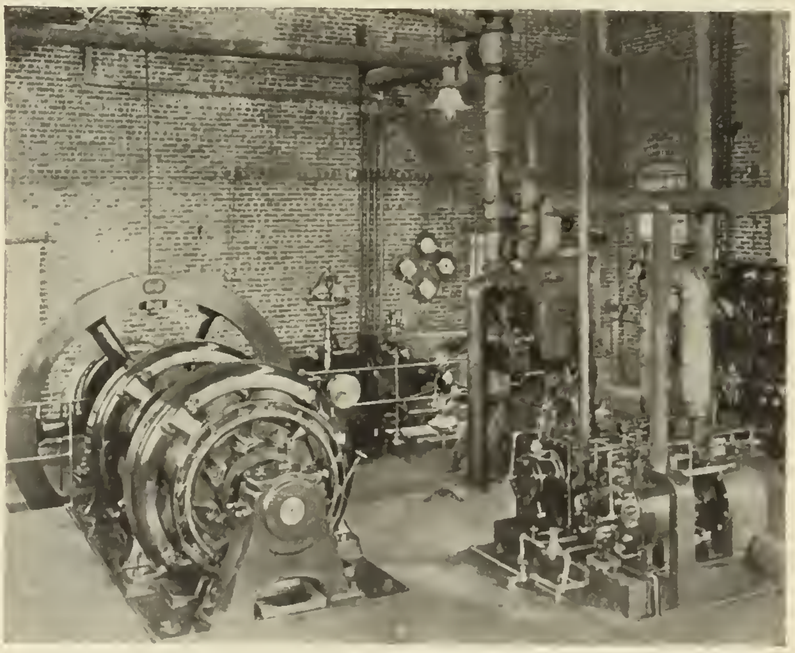


FIG. 1.—VIEW OF ENGINE ROOM.

The plant is on the Passaic River. The buildings are located in a group about the intersection of First and Middlesex Streets and include office, machine shop, forge shop, foundry, cleaning room and pattern shop, power plant, pattern storage and sheet iron shop, and storage sheds for patterns, lumber, coke and sand.

The largest building is the machine shop, which is 332 ft. long by 100 ft. wide. It is of the mill type of construction with a space through the middle open to the roof, and bays at the sides containing galleries. The scheme for the disposition of work and tools is a neat one. To begin with, all large machines handling very heavy work are placed in the high middle space where they may be served by the traveling cranes. Moderate sized work and the tools required by it are provided for on the main floor of the bays, and all light work, such as automatic screw-cutting, etc., is done in the galleries. Roughly the work is apportioned about the shop as follows: West half of south bay, for refrigerating machinery; gallery overhead, launch storage; middle of west end, launch repairs; west half of north bay, launch paint shop and carpenter shop; entire north gallery, machine work on small parts for all departments; east half of main floor, including both bays, elevator construction, and east half of south gallery, assembling of elevator controllers and Secor engines.

The regular shop crane is a Shaw electric, operated by Crocker-Wheeler motors, and has a capacity of 15 tons. Throughout the shop power is supplied by direct-current electric motors, both group and individual drive being employed. Current is distributed by the three-wire system at a pressure of 115 volts between each pair of adjacent wires and 230 volts across the outside wires. The lighting and all constant-speed motors use current at 230 volts, and the variable-speed motors at 115 for medium and 230 volts for high speeds, with resistance in the armature circuit for slow and intermediate speeds. All machines on the north side downstairs are driven from a single long line shaft, belted near its middle to a 60-hp shunt motor running at 830 r.p.m. At one end this shaft is coupled to another one extending into the carpenter shop and furnishing power to a planer, a circular saw and a band saw. The main floor on the south side receives its drive from a 15-hp motor running at 800 r.p.m., and the gallery overhead near the east and has a 2-hp motor driving two small lathes for winding magnet bobbins for electric elevator control boards. In this gallery there is also a 1½-kw semi-enclosed rotary transformer used for converting 230-volt direct current into 150-volt alternating. The alternating current is delivered through a transformer which is arranged to raise the voltage to 1,000, 2,000 or 3,000 volts, and is used for testing insulation resistance. The gallery on the north side, containing all the automatic screw machines, a number of small lathes, shapers, etc., is driven from a 32-hp motor running at 1,000 r.p.m. The foregoing, covering all the motors that are used for group drive and the rotary converter are of Crocker-Wheeler make. In addition, there are a number of machines having individual drive which include a 62-in. Bullard double-head boring mill, belt-driven by a 7½-hp motor; a 72-in. Pond radial drill driven by a 3-hp motor; a planer built by the G. A. Gray Company, of Cincinnati, having a bed 7 ft. wide and 12 ft. long, driven by a 20-hp motor (shown in an accompanying cut); a Bullard 42-in. boring mill driven by a 5-hp motor, and a Betts 14-ft. boring mill driven by a 15-hp Storey motor. With the exception of the last named, these are also Crocker-Wheeler motors.

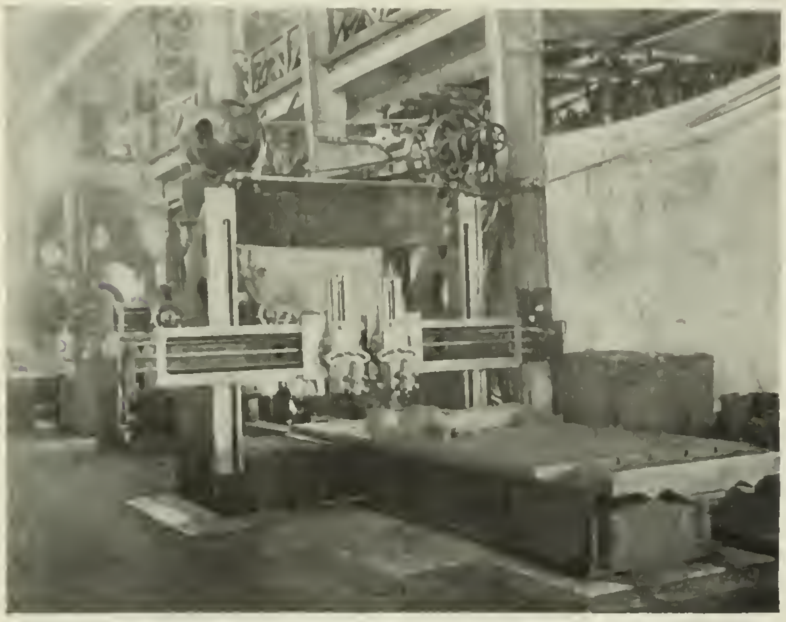


FIG. 2.—MOTOR-DRIVEN PLANER.

Among the machines not individually driven, three deserve special mention. The largest of the several big engine lathes has a 48-in. swing and a 16 ft. bed, and was built by the Fifield Tool Company, of Lowell, Mass. This and the Betts boring mill previously mentioned, are the two largest machines, but probably the two most remarkable are the automatic thread-cutting lathe, which cuts the worms used in the elevator equipments and the special spiral gear-cutting machine, both located near the northeast end of the main shop. The thread-cutting lathe was built by the Automatic Machine Company, of Bridgeport, Conn., and is used for cutting right or left hand worms directly from solid blanks forged in one piece with the shaft. It is capable of taking stock up to 8 in. in diameter and 8 ft. long, and will cut from 16 threads to the inch to one thread in four inches. In a comprehensive sense the term automatic is well applied to this machine, for from the time it is started with the blank in position until the worm is completed no attention is required from the operator. The carriage travels and reverses automatically and the cutting feed is automatically regulated to vary from a maximum depth at the start to zero when the thread is finished.

The gear-cutter is of Gould & Eberhardt make known as their "60-in. semi-automatic spiral gear-cutting machine." It is an exceptionally useful machine for the work which it has to perform, as it cuts spiral gears, spur gears, hobs worm wheels, and in short is capable of doing all the operations required in the most complex gear cutting. One job in particular for which it is used here consists of cutting on the same blank spiral gear teeth entirely across the face and worm wheel teeth in the center. The accompanying view of the shop was taken at a time when rather an interesting piece of work was being executed, the job requiring the cutting of 94 spur gear teeth with a 2½-in. circular pitch on the outside of a heavy drum 76.4 in. in diameter and weighing in the neighborhood of 7,000 pounds. This was both too great in diameter and too heavy to be supported on the regular index spindle. To overcome the first difficulty, a special arbor and index gears were made, and the drum mounted on the arm, which normally carries an outboard support for the regular spindle, while to relieve the tool of the excessive weight, a counterbalance was rigged as shown in the photograph. By this device the capacity of the machine has been increased to diameters up to 10 ft.

Another of the accompanying cuts shows the elevator testing equipment. This consists of two elevator shafts of steel frame work 45 ft. high accommodating counterweighted cars 5 ft. square. The supporting ropes of the cars are strong enough to allow the loading of each up to 10,000 pounds. On the floor at the base of the tower is a massive plate 15 ft. square with a number of T-slots across its surface resembling those of a planer bed. To this the hoist to be tested may be quickly bolted. The illustration shows two outfits in position, together with the switchboards supporting the electric controlling apparatus. After the hoists are tested, if they come up to the requirements in speed, power and continued running without overheating, they are removed and are ready for shipment, but if any defects develop they are first corrected and the test repeated.

The heating of this building is accomplished by means of a plenum air system, which is rather uncommon for a machine shop. Presumably it was adopted more to preserve an even temperature than to provide ventilation, as the shop is large and allows a great deal more than the amount of air space per man commonly considered necessary. Instead of drawing in cold air from outdoors, the fan merely keeps the contained air in constant circulation by distributing it through an overhead system of round galvanized iron ducts. A great saving in steam is thus effected, and the leakage caused by the ordinary opening of doors and windows replaces the air faster than it becomes vitiated. The heating apparatus is located about the center of the north bay and consists of a stack of seven sections of pipe coils containing in all 6,865 linear feet of one-inch pipe, placed in the intake of an 84-in. Buffalo Forge Company's steel plate blower, belt-driven from the line shaft. The pipe coils in common with the direct radiation used in all other parts of the plant are supplied with steam in accordance with the Webster vacuum system of heating, and have thermostatic control on the supplies. Alongside of the heating apparatus there is a high-pressure blower, size 3, made by the American Gas Furnace Company, of Elizabeth, N. J., which is used for furnishing air to the adjoining forge shop for the forge fires. The forge shop is about 40 ft. square and contains three blacksmith forges, a steam hammer, a furnace for tempering, case-hardening and annealing, and blow pipes for brazing.

The foundry is 100 ft. wide by 168 ft. 8 in. long, and is similar in construction to the machine shop, having a high central portion flanked with a bay on either side. The main part is served by two 20-ton Shaw electric cranes, each having an auxiliary 5-ton hoist. The extra heavy castings are made in this part, the cranes being used for the handling of them and their patterns, and also the metal ladles. The south bay has two hand-traveling cranes equipped with pneumatic hoists each with a capacity of 3,000 pounds and is used for all small casting work. In the middle of the north side there are two cupolas; one with a capacity of 10 to 12 tons an hour is of the Newton type, manufactured by the Northern Engineering Works, and the other with a capacity of 5 tons an hour was installed by the Whiting Foundry & Equipment Company. The blast for the latter is furnished by a No. 10 Buffalo Forge Company's blower driven at 1,500 r.p.m. by a Crocker-Wheeler 20-hp motor, and the blast for the Newton cupola by a No. 11 Buffalo blower driven at 1,200 r.p.m. by a 45-hp motor of same make. Adjoining the northwest corner of the foundry is a 50 x 77-ft. building, the first floor of which is the cleaning shop. The second floor is the pattern shop and contains the usual wood-working machines, power being furnished by a 25-hp motor.

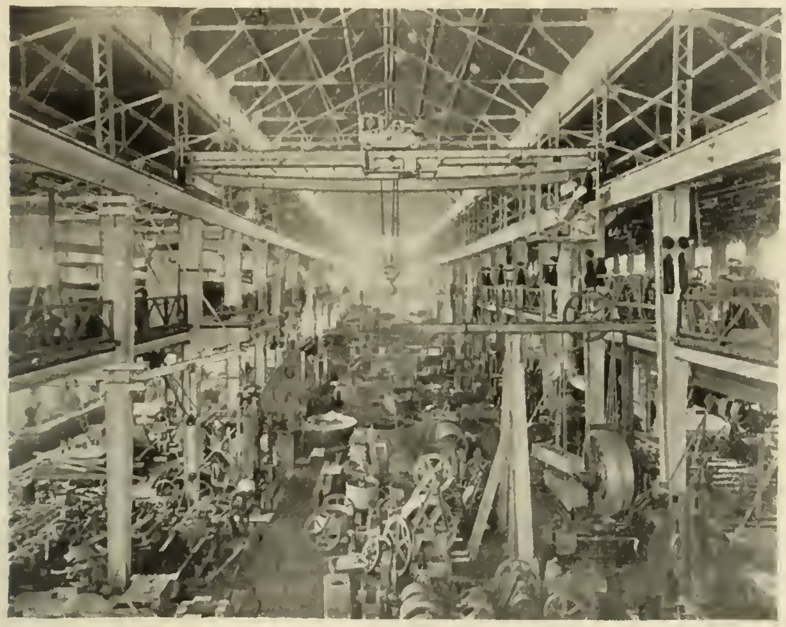


FIG. 3.—INTERIOR VIEW OF MACHINE SHOP.

The power plant is located in an isolated building near the water front at the northwest corner of the machine shop, and contains a boiler and an engine room separated by a fire wall. The former is 41 ft. wide by 46 ft. long and contains two Aultman & Taylor water tube boilers of 150 hp each, with space for the future installation of two more. A breeching at the rear of the boilers conveys the smoke to the base of a 6-ft. stack 150 ft. high, built by the Alphons Custodis Company. Normally the steam pressure is maintained at 120 pounds, but in the afternoon with the foundry in operation, the increased load on the engines make it necessary to raise the pressure to 135 pounds. A 6-ft. loop connection from each boiler delivers into a 12-in. steam main, which, continuing through the wall to the engine room, supplies by a 4-in. connection, a Hewes & Phillips 175-hp tandem-compound engine, a Deane circulating pump and jet condenser, a cross-compound air compressor, a Harrisburg horizontal high-speed 40-hp engine, a Knowles vacuum pump, a Blake duplex boiler feed pump and an artesian well pump. The large engine has cylinders 10 and 18 x 30 in., runs at 125 r.p.m., and drives directly two 50-kw Crocker-Wheeler generators on the same side of the engine and on the same shaft with the fly wheel, the total length of the shaft being 16 ft. Except in seasons when the exhaust steam is used for heating, the engines are run condensing. The generators each deliver direct current at 115 volts and are connected in series to supply the three-wire distributing system described above. This generating set has an excellent record to its credit, for since its installation two years ago it has never been stopped for repairs during working hours but once, when a bent connecting rod stopped the running for four hours. The Deane circulating pump, which operates as a jet condenser, has cylinders 10 and 14 x 10 in., maintains a vacuum of from 27 to 28 in., and exhausts into the feed water heater. River water is used for the condensing and is wasted back to its source.

The air compressor was built by the McKiernan Drill Company, of New York City. The steam cylinders are 10 and 18 x 10 in. and the air cylinders are of the same size, giving a two-stage compression, the first to 50 and the second to 100 pounds. It runs condensing and maintains the required air pressure automatically by means of a governor acting on its steam supply. The compressed air is passed through a receiver 50 in. in diameter by 10 ft. high to cushion the pulsations, and is used for pneumatic hoists, chipping tools, rammers, etc.

The Harrisburg engine is a self-contained 10 x 10-in. simple engine, running at 350 r.p.m., and is belted to two 30-kw Bullock generators. These are used occasionally to carry the lighting load. Also on certain occasions when a 550-volt pressure is required for testing purposes, these are operated as boosters by connecting them in series with the main generators.

The pressure used for heating is normally one-half pound and is never allowed to exceed one pound. A loop seal is arranged so that should the pressure accidentally exceed that amount, the steam will blow through to the air and warn the engineer. The heating system is relieved of all condensation by a 6 x 9 x 10-in. Knowles duplex pump maintaining a vacuum of 5 in. and delivering into a 2 x 5-ft. receiver suspended from the ceiling. From this the water flows by gravity into a Webster 200-hp feed water heater, after which it is passed to the boilers by a Blake duplex plunger pattern 6 x 3½ x 6-in. pump. When the returns of the heating system are insufficient for the boiler feed, the extra amount is taken from the city mains. The artesian well water is raised by a 4½ x 6 x 4-in. pump and distributed about the plant at a pressure of about 60 pounds to be used for washing and foundry purposes.

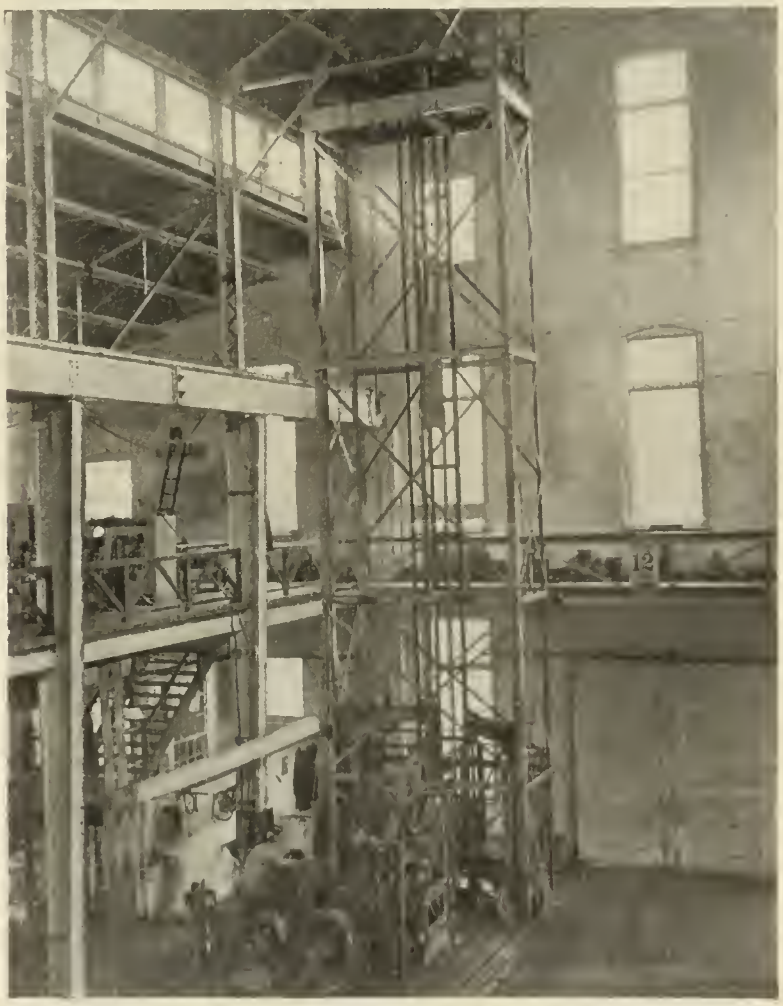


FIG. 4.—ELEVATOR TESTING APPARATUS.

All of the foregoing apparatus occupies but little over half of the available area in the engine room, which is 56½ ft. long by 41 ft. wide. There is, therefore, ample room for the inevitable extension of the power equipment that must be made if the present rapid growth of the business continues.

Ancient and Modern Lights.

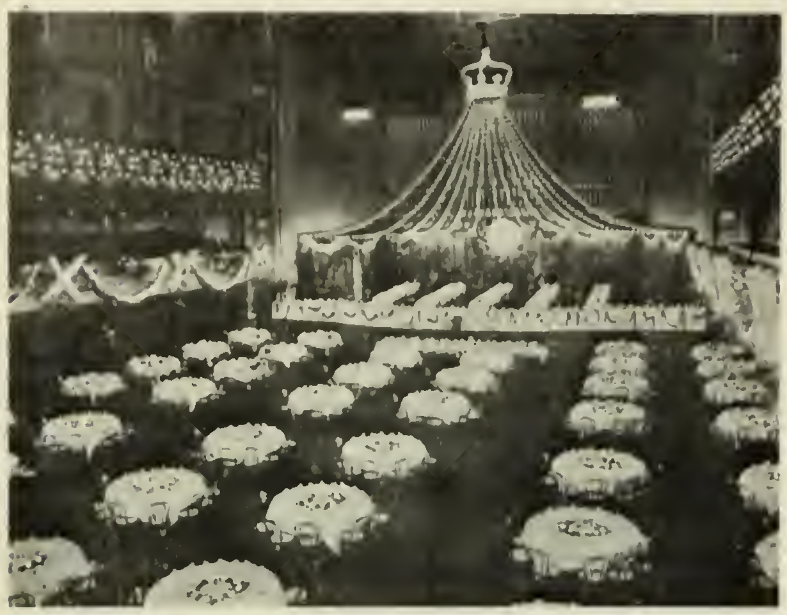


FIG. 1.—ELECTRIC LIGHT DECORATIONS, SYMPHONY HALL, BOSTON.

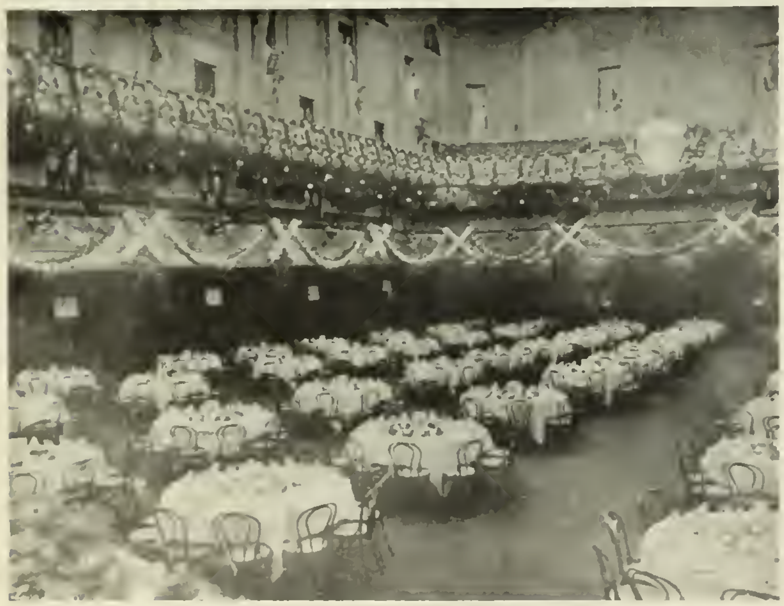


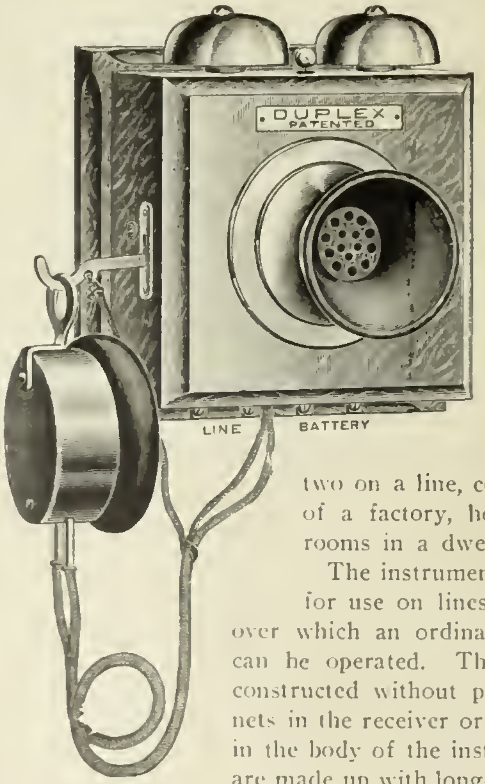
FIG. 2.—ELECTRIC LIGHT DECORATIONS.

It will be within the recent recollection of our readers that the Honorable Artillery Company, of London, has been entertained lately by the Ancient and Honorable Artillery Company of Massachusetts, these two military bodies of common origin and ancestry dating back through the centuries almost as far as the discovery of this country by Columbus. Some few years ago the Massachusetts body was entertained in England, and in reciprocating the hospitalities then extended the organization in New England has endeavored to leave nothing undone to express its cordial friendship and appreciation. One of the features of the reception in Boston was a banquet given in Symphony Hall, attended by the highest officials of the State and the city, and including the representatives of the nation and of the army and navy. This banquet took place on October 5, and as will be gathered from the illustrations which we are enabled to publish herewith, in equal rivalry with the oratory and the luxuriant menu were the illuminations which had been specially devised for the occasion. This work of lighting and decoration had been entrusted to the Elblight Company of America, and the manager, Mr. Russell Spaulding, is entitled to rest content upon the laurels which he won in the various effects. Several thousand incandescent lamps were employed for the purpose, and these were associated with a background of hemlocks and young firs with bay trees interspersed, as well as with garlands of roses, trailing vines and coils of smilax, not forgetting English laurel. Some idea of the amount of Elblight cable required may be formed from the fact that 12,000 yards of English laurel, 100 cases of southern smilax and 8,000 roses were employed to wreath the cable and in other parts of the decorative effects. All the structural features of the Symphony Hall were outlined with lights, including the galleries and balconies and all the pilasters. Over 2,000,000 ft. of wire were required.

One of the leading features of the illuminations built up of Elblight material was a massive golden crown 10 ft. high and 8 ft. wide, sparkling with colored incandescent lamps as gems, with streamers of lamps, Maltese crosses, etc., reaching down to the main guest table. On one side of this was the date 1537, when the London body was chartered, and on the other side the date 1638, when the Massachusetts body was organized. At the back of the hall in the middle of the centre balcony was a glory of flags made up of the Stars and Stripes and the British Union Jack, flanking the arms of the Ancient and Honorable Company of Massachusetts, and a gigantic American eagle all in lights. The seals were jeweled with electric lights. Facing this and directly over the principal table of honor appeared the arms of the Honorable Artillery Company of London with its motto standing forth in letters of electric light. These were the main features, associated with wreaths and festoons of lamps in every direction, and accompanied by various effects, such as cross cannon picked out in incandescent lamps. In addition to this every table had a heavy coil of smilax upon it concealing an Elblight cable into which rose-pink incandescent bulbs had been inserted. Not only did the effects shown elicit heartiest enthusiasm on the part of all present, but Lord Denbigh, Colonel of the British contingent, took occasion in his speech of acknowledgments to refer to the gorgeous spectacle he was looking upon as a scene such as he had never contemplated before. When one recalls the long history of these kindred military organizations, it will be realized that they compass practically the whole history of illumination, illustrating the fact that while means and methods may change, and new inventions, new weapons and new implements come to the front, and while ancient lights are exchanged for those whose breath is electricity, the warlike spirit of the Anglo-Saxon race has remained unaltered and unquenched through the ages.

Duplex Telephone Set.

A new battery telephone set recently introduced is the "Duplex" of the Connecticut Telephone & Electric Company, of Meriden, Conn., who have developed it from an earlier set placed on the market about a year ago. The instruments are intended to be used two on a line, connecting parts of a factory, house and barn, rooms in a dwelling, etc.



BATTERY TELEPHONE.

The instruments are designed for use on lines of any length over which an ordinary electric bell can be operated. The apparatus is constructed without permanent magnets in the receiver or induction coils in the body of the instrument. They are made up with long-distance transmitters, high-grade "Duplex" battery bells, tempered-steel hook springs, with phosphor-bronze contact springs tipped with pure silver. The receiver is built up from a steel cup, over which is forced a heavily-nickeled brass cap, in which is mounted a magnetic coil wound with silk-insulated wire. The receiver cord is also of silk, and is so attached that even if the receiver is left off the hook, the batteries will not be run down. In case the apparatus is required for more extensive work, it can be built up for central battery operation.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a great deal of irregularity in the securities market, the transactions being narrow and decidedly professional. There was a rather stronger tone, however. One of the incidents of the week was the handing down of an adverse decision in important cases against the Amalgamated Copper Company by a Montana court, and the announcement that the management of the concern, pending an appeal, had decided to shut down all of its properties in that State. This stock had previously advanced on the declaration of the regular dividend and covering of shorts, but broke on the announcement of the decision of the court. Apart from this movement there were no particularly significant features in the share list. The United States Steel securities showed a tendency to recover on the absence of further liquidation, and intimations that the interests at Pittsburg and elsewhere had no more stock to offer. Other industrial stocks were generally heavy, but recoveries from the previous week's low prices were noted in a number of them, although the transactions were on the whole trifling and the demand very light. Tractions were fairly active, the sales of Brooklyn Rapid Transit being 49,900, the closing price of this stock being 33½, which is a net loss of ¼ point. Metropolitan Street Railway made a net gain of 1¾, closing at 107, the extreme prices being 103⅛ and 108. General Electric, on sales of 3,450 shares, fluctuated between 144 and 149½, closing at 148. Westinghouse common closed at 131, being a net loss of 7 points, and preferred at 160, a loss of 1 point. Western Union closed at 82 and was steady throughout the week, the sales aggregating 3,650 shares. Following are the closing quotations of October 27:

NEW YORK.

	Oct. 20	Oct. 27		Oct. 20	Oct. 27
American Tel. & Cable......	78	78	General Electric.	147	150
American Tel. & Tel........	122	123	Hudson River Tel...........	..	..
American Dist. Tel	..	24	Metropolitan St. Ry.........	105¼	110
Brooklyn Rapid Transit ..	33½	34⅞	N. E. Elec. Veh. Trns........	..	..
Commercial Cable.	140	..	N. Y. & N. J. Tel............	..	..
Electric Boat.	17	17	Marconi Tel.	.	..
Electric Boat pfd......	40	41	Western Union Tel...... ...	81¾	82⅝
Electric Lead Reduction.. .	*1⅛	*1⅛	Westinghouse com....	131½	137½
Electric Vehicle............	5	5	Westinghouse pfd...........	160	165
Electric Vehicle pfd........	8	8			

BOSTON.

	Oct. 20	Oct. 27		Oct. 20	Oct. 27
American Tel. & Tel	123½	123¼	Western Tel. & Tel. pfd....	*77	..
Cumberland Telephone....	*115¼	*115	Mexican Telephone.........	1	*1⅜
Edison Elec. Illum..........	230	231	New England Telephone.	122½	123
General Electric.............	146	145	Mass. Elec. Ry..	18¾	19
Western Tel. & Tel	*10	*10	Mass. Elec. Ry. pfd.... . .	77	77½

PHILADELPHIA.

	Oct. 20	Oct. 27		Oct. 20	Oct. 27
American Railways	*42	42½	Phila. Traction..	93⅝	94
Elec. Storage Battery	*50	*50	Phila. Electric	5⅞	5⅞
Elec. Storage Battery pfd.	*50	*50	Phila. Rapid Trans.........	11¾	12⅛
Elec. Co. of America.	7¼	7⅜			

CHICAGO.

	Oct. 20	Oct. 27		Oct. 20	Oct. 27
Central Union Tel.	..	..	National Carbon pfd........	86	85
Chicago Edison........	..	.	Metropolitan Elev. com.....	18	17
Chicago City Ry....	170	169	Union Traction	3½	7¼
Chicago Tel. Co	..	..	Union Traction pfd.........	25	32
National Carbon	17	15			

*Asked

DIVIDENDS.—The directors of United Electric Securities Company have declared a semi-annual dividend of $3.50 per share on the preferred stock of that company, payable November 2. The Hudson River Telephone Company, of Albany, has declared the regular quarterly dividend of 1½ per cent. Chicago Metropolitan Elevated reports for the year ending June 30 gross earnings, $2,094,008 and net, $1,056,827. The gross is $267,055 more than last year and the net is $11,084. The National Carbon Company has declared the preferred regular quarterly dividend of 1¾ per cent., payable November 14. The directors of the Chicago Edison Company have declared the regular quarterly dividend of 2 per cent., payable November 2. The directors of Twin City Rapid Transit have declared the regular quarterly dividend of 1¼ per cent. on the common stock, payable November 14. The National Steel & Wire Company has declared the regular dividend of 1¾ per cent. on the preferred stock. The Tampa Electrical Company has declared a regular semi-annual dividend of $5 per share, payable November 16 to stock of record November 5.

EVERETT-MOORE AFFAIRS.—A meeting of the creditors of the Everett-Moore syndicate and the bankers in charge of the syndicate's affairs was held in Cleveland a few days ago, and an agreement was reached by which the creditors have granted a further extension of time to April 1, 1905, in order to give the syndicate that much additional time to clear up all outstanding indebtedness. It developed at the meeting that since the bankers' committee took charge of the syndicate's affairs January 1, 1902, over $12,000,000 of obligations have been paid off, and in addition about $2,000,000 of new money has been put into the various concerns. The traction properties have been entirely cleared up and the telephone properties are in a fair way to right themselves. There still remains about $3,500,000 of obligations outstanding, nearly all of this against the telephone properties. Several plans had been proposed for refinancing the Federal Telephone Company, but owing to the stringency of the money market these plans had been interfered with; hence the necessity for the extension.

CHICAGO LAKE STREET L.—At Chicago on October 24 the Lake Street Elevated Railroad Company, capitalized at $10,000,000, was placed in the hands of a receiver in pursuance of a resolution passed by the board of directors asking for the appointment. The order was entered in the Cook County Circuit Court before Judge Tuthill, who appointed the Equitable Trust Company receiver for all the property of the company. In the bill, which was filed by James Bolton and Daniel F. Crilly, stockholders in the company, it is alleged that the company is hopelessly insolvent, and that this condition has resulted "from the reckless extravagance and fraudulent conduct of Charles T. Yerkes and his associates, and the mismanagement of Charles A. Knight, as his representative."

CHICAGO UNION TRACTION EARNINGS.—Receivers of the Chicago Union Traction Company state that the earnings of the surface roads of the company in Chicago during September were $80,000 greater than for the same period a year ago.

Commercial Intelligence.

THE WEEK IN TRADE.—There is an evident increase in the conservatism which has ruled in many lines for some time past, and irregularity in trade as a whole seems to be indicated in the varied character of the reports rendered. The bank clearings still reflect curtailment in speculation, the totals for the entire country being one-fifth smaller than those a year ago, but outside of New York there is still shown a gain. Railway gross earnings are more moderate than earlier in the year, but still reflect good gains in the volume of traffic as compared with a year ago. October earnings so far reported show a gain of 7½ per cent., while August net returns, excluding the coal roads, show 8 per cent. on a gross gain of 12 per cent. Outside of the lumber trade there is little complaint of car shortages. The iron and steel trades remain practically unchanged and prices are weak. In finished lines there is greater relative strength, but the demand is quiet. Rails and structural forms are in fair request. There are signs of reawakening interest in the copper trade. The prices of copper advanced as a result of the closing down of the Amalgamated Copper Company's mines in Montana. It is thought that the action of the Amalgamated Company will result in still further advances in the price of the metal. Under this influence the price of Lake copper advanced to 14c. It is claimed that all of the independent copper mining companies will necessarily derive benefit from the present condition of the market. It is stated by the United Metals Selling Company, which is the selling agent of the Amalgamated Copper Company, that all the August output of the Amalgamated Company has been sold, and that if it has any stock on hand it must have accumulated since August, and therefore cannot be very large. *Bradstreet's* reports the number of business failures for the week ending October 22 as 216, against 203 the week previous, and 194 the corresponding week last year.

SWITCH AND SIGNAL CONTRACTS.—The Long Island Railroad has given the Union Switch & Signal Company a contract for electropneumatic switches in which about 125 levers will be used. The Interborough Rapid Transit Company has placed a contract for switches for all the subways and the elevated lines, which is one of the largest such orders ever placed. The factory now has a greater number of orders than ever before in its history.

LEVEL-HEADED LABOR.—Mr. James O'Connell, president of the International Association of Machinists, has officially declared off the protracted Westinghouse strike in Pittsburg, and the lodges throughout the country have been instructed to end all disputes as easily as possible and as quickly as possible. In a circular to those for whom he acts in his official capacity, Mr. O'Connell says: "Wage reductions are threatened in various quarters and prospects are not particularly bright for employment during the winter months. While the machine shops of the country, according to the latest reports, have a good supply of orders on the books, there is an uncertainty, and members are advised to arrange all differences by arbitration." It is a pity that this advice could not be more often and more generally given and followed among the unions.

25,000 HP TRANSMISSION PLANT IN MINNESOTA.—The Minneapolis General Electric Company, of Minneapolis, Minn., has recently purchased and secured the complete control of a large and important water power on the St. Croix River at Taylor's Falls, Minn. This power is one of the most important in the Northwest, and the only large power remaining undeveloped in the vicinity of Minneapolis, from which it is distant only about 45 miles. The Minneapolis General Electric Company purchased the falls and land surrounding same from the Staples estate, which for over a generation has controlled this valuable power, but owing to litigation among the heirs it has heretofore been withheld from sale. In addition to the falls there have been secured flowage lands on both sides of the river extending 11 miles up stream, so that with the 50-ft. dam contemplated there will be an enormous reservoir insuring ample storage facilities. The development to start with will be for 25,000 hp, which it is expected will be used entirely in Minneapolis. The development will cost about $2,500,000, and will be carried out by Stone & Webster, of Boston, who control the Minneapolis General Electric Company, and who have retained Mr. Henry Floy as consulting engineer in connection with this work. Active construction work will not begin before next summer, but the plans have been already largely completed. Some idea of the size and importance of the St. Croix River may be gained from the fact that it is larger at Taylor's Falls than is the Mississippi at Minneapolis.

CROCKER-WHEELER ORDERS.—In the past fortnight a number of notable orders have been received by the Crocker-Wheeler Company, of Ampere, N. J. These being fairly evenly distributed among its larger branch offices, indicate that the improving condition of business is not local to any one section. One order, from the Lorain Steel Company, Lorain, Ohio, received through the Pittsburg office, called for 41 motors ranging in size from 2½ to 360 hp, and representing a total of 1,423 hp. Another large order came from the New Jersey Zinc Company, of Hazard, Pa., through the New York office, for one 125 and two 600-kw generators, and 37 motors aggregating 401 hp. The Philadelphia office placed an order from the Warren Foundry & Machine Company, of Phillipsburg, N. J., for one 200-kw generator, four 35-hp and two 60-hp motors; and through the Chicago office the G. H. Hammond Company ordered for its packing plant at the Union Stock Yards in that city, one 50, one 25 and two 20-hp motors, and an 800-kw, 550-volt, engine type generator. This last is a duplicate of one now building for the St. Louis Exposition, the entire intramural plant for which will be operated by generators supplied by the Crocker-Wheeler Company.

EL ORO POWER TRANSMISSION.—Preparatory work is practically completed and construction will begin within the next two months or so on the power transmission line to be built by the Mexican Light & Power Company, Limited, between its huge hydraulic plant at Necaxa and the El Oro district, one of the leading mining regions in the southern republic. The length of the line between those two points will be about 100 miles. As previously mentioned, exclusively in Electrical World and Engineer, the company is also to generate power at the Necaxa plant for transmission to Mexico City, over 90 miles. The initial capacity of the plant will be 45,000 hp. It is estimated that fully 50,000 hp could be utilized for the mines at El Oro and for railways. At the present time only four properties utilize electricity as a motive power in that territory. The equipment is of Westinghouse, Sprague and Eddy manufacture. The New York offices of the Mexican Light & Power Company are in the Columbia Building. Hugh L. Cooper is the chief engineer. He is now in Mexico.

SIEMENS-HALSKE GENERATORS FOR MEXICO.—Another important contract for equipment has been awarded to foreign interests by the Mexican Light & Power Company. As already exclusively mentioned in Electrical World and Engineer, the contract for the turbines to be installed in the initial plant at Necaxa, Mexico, has been let to the Swiss engineering firm of Escher, Wyss & Co., of Zurich. The contract just let calls for generators, six units of 5,000-kw capacity each, and has been taken by Siemens & Halske. Delivery is to be made in nine months. The award was principally on the question of price, the Siemens & Halske figures having been several thousand dollars less than the lowest quotations submitted by American concerns. Further contracts for various equipment are expected to be decided on within the next ten days. Mr. F. S. Pearson is one of the leading spirits of the Mexican concern.

DE LAVAL TURBINE CONTRACTS.—The De Laval Steam Turbine Company, 74 Cortlandt Street, reports contracts on hand which will test all its facilities for the next ten months. Within the last eighteen months nearly 100 plants throughout the country have been equipped with De Laval turbines. Recent orders include one for three 300 hp units for installation in the Jacksonville, Fla., municipal lighting plant. The contracts for the generators went to the Bullock Electric Manufacturing Company for two machines and to the General Electric Company for one machine—all of 200-kw capacity each. The Drew Lumber Company of Mayo, Fla., ordered two 300-hp turbines for direct connection to 200 kw Sprague generators. The Belt Light & Power Company of Deadwood, S. D., has ordered two 300 hp turbines for direct connection to Stanley generators of 200 kw capacity each.

GERMAN CLAY BEDS.—A member of the McCullough-Dalzell Crucible Company has just received what is probably the largest lump of crucible clay ever brought into America, and gives some interesting data of the old town of Klingenberg, Germany, whence comes this famous clay, used in making its crucibles. The citizens own these clay beds in common and divide all profits. Hours of work are few, holidays many and the yearly output is closely restricted. Orders must be placed months ahead, or lay over until another year, being filled absolutely and impartially in rotation. But so perfect is the clay that the consumers are forced to conform with the city's requirements, and make up their orders in advance of needing them.

I. FAJANS ELECTRICAL CONSTRUCTION COMPANY.—The sheriff is in charge of the place of business of the I. Fajans Electrical Construction Company, New York City, at 42 East Twenty-third Street, on two executions in favor of the India Rubber & Gutta Percha Insulating Company for $1,108 and the Northern Engineering Company for $389. There are other judgments against the company aggregating $1,166. The company was incorporated on August 16, 1901, with a capital stock of $5,000. A committee of creditors was recently appointed to examine the affairs of the company and report on an extension. The liabilities are reported to be $15,000 and assets $6,000.

EQUIPMENT FOR DE LAVAL SEPARATOR PLANT.—The De Laval Separator Company is building an extensive plant at Poughkeepsie, N. Y., which will be electrically operated. Four 75-kw De Laval steam turbines will be installed with Sprague generators. The condenser will be of Alberger high vacuum type. The boilers will be Geary water tube, and the superheaters will be supplied by the Power Specialty Company. A feature of the plant will be the introduction of turbines, two of 10-kw capacity each, for the purpose of driving the centrifugal pumps by circulating water.

D. & W. FUSE FACTORY.—The D. & W. Fuse Company, of Providence, R. I., have found enlargement necessary and Mr. W. S. Sisson writes us that they have secured a fine piece of property of more than four acres in extent, along the main line of the New York, New Haven & Hartford Railroad, just within the city line. They have arranged for a spur track for the ready handling of coal and freight and expect to make provision soon for the erection of the new plant.

WATER WHEEL PLANT WANTED.—The Manistique Light Company, of Manistique, Mich., expect to move and rebuild their plant. They are now contemplating an increase of their water power and will be in the market for wheels, shafting, gearing, governors, etc. Mr. B. Gero is president, Mr. G. H. Orr is vice-president, Mr. Fred Miller is secretary and treasurer, and Mr. V. X. Lyon is superintendent.

WIRE WORKS STARTING UP.—The rod, the wire and the galvanizing mills of the Rankin plant of the American Steel & Wire Company, at Pittsburg, have resumed operations after a shut-down of two weeks. The entire plant will be on in full. The Enterprise plant of the company at Joliet, Ill., has also started up again, and the Joliet plant of the Illinois Steel Company is again in operation, employing 2,000 men.

MEXICAN HYDRAULIC POWER SCHEME.—Justo Prieto, of Mexico City, is primarily interested in a project to construct a large hydraulic plant on the Del Valle river at a point called Baquilla de Talamantes, in the district of Jimenez, State of Chihuahua. The concession granted by the Mexican authorities permits of the use of over 100,000,000 cubic meters of water.

BULLOCK EQUIPMENT FOR POWDER MILLS.—The Bullock Electric Manufacturing Company of Cincinnati, Ohio, has secured a contract for equipment in the new plant at Bluefields, W. Va., of the Dupont Powder Company. The machinery will include two 200-kw direct current generators and 10 motors varying in capacity from 10-hp to 90-hp, making 500-hp in all.

THE BARRIETT ELECTRIC COMPANY, of Cincinnati, Ohio, has shipped twelve 2-hp Barriett motors to the Guarantee Electric Company, of Chicago, which is going to install them for a large printing house in Chicago.

General News.

THE TELEPHONE.

EQUALITY, ALA.—Dr. R. S. Nolen, of Equality, has succeeded in establishing about 100 miles of telephone lines in this section and it is said that 100 farmers in the rural districts have subscribed to the service.

BREMEN, GA.—The Gainsborough Telephone Company is extending its lines to Buchanan and Waco.

SPRINGFIELD, ILL.—The Illinois Telephone Company will build a line from Jacksonville, Ill., to this city.

ROCK ISLAND, ILL.—The Henry County Mutual Telephone Company has voted $5000 to erect a modern exchange in this town.

DICKSON, ILL.—The Farmers' Telephone Company of Lee County has been incorporated with a capital stock of $2500. Mr. A. W. Crawford is president.

CARTERVILLE, ILL.—The Williamson & Adjoining Counties Telephone Company has been incorporated with a capital stock of $2450. J. M. Cain is one of the directors.

WESTFIELD, ILL.—The Louisville, Hoosier, Bible Grove and Ingraham Telephone Company has been organized to connect the towns named. The following officers have been elected: President, W. A. Harmon; secretary and treasurer, J. L. McKnight.

UNION CITY, IND.—Much feeling has developed in this city over the apparent determination of the Central Union Telephone Company to employ only men as managers of exchanges. Miss Lola Farra has been dismissed as manager of the local exchange and the only cause assigned is that the company desires to fill such places with men.

WABASH, IND.—The Central Union Telephone Company has been granted a new franchise by the city council extending over a period of 10 years. The company's franchise expired some time ago and it has been doing business since by the sufferance of the council. E. M. Bostwick, the local manager, assured the council that the company will entirely rebuild its plant here, which has fallen into decay. The Home Telephone Company controls the local field.

MUNCIE, IND.—The directors of the Delaware and Madison County Telephone Company and the Gas Belt Belt Construction Company held a conference in this city a few days ago to decide upon a plan for the beginning of an extensive system of telephone lines which will extend through both counties and connect with all the important towns. It is said to be the intention of the company to inaugurate a new system whereby farmers will have toll-line connections with the various other systems without additional cost. The company has put in an underground system in this city and is now offering radical competition to other companies.

INDIANAPOLIS, IND.—Harry B. Gates, of this city; George W. Beers, of Ft. Wayne; Max Silbert, August Fabel and C. B. Wing, of Cincinnati, Ohio, recently filed articles of incorporation for the Queen City Telephone Company, of Cincinnati, Ohio. The company is to have a capital of $1,000,000. The purpose of the company is to secure a franchise and operate a telephone system in Cincinnati. The same parties incorporated the Hamilton County Construction Company as an allied institution for the purpose of constructing the system. The prime movers in both companies are Messrs. Gates and Beers, of Indiana, who are practical and successful telephone men. They are proposing to the citizens of Cincinnati, in case a franchise is granted them, to construct a $4,000,000 system and promise that the rate shall not exceed $72 per year for unlimited service. The rates charged by the local company are $125 and $150 per year. The new company promises to connect with small systems in the various cities and towns of Ohio, Indiana and Kentucky. While there is neither admission nor denial it is generally believed that the United States Telephone Company is behind the scheme being promoted by the Indiana men.

BURLINGTON, IA.—An independent toll telephone line is projected from Burlington to Chicago.

STRATFORD, IA.—The Stratford Independent Telephone Company and the Chamberlain Telephone Company are to be consolidated.

BOONE, IA.—The Boone County Telephone Company will install a modern switchboard to cost $20,000, and will expend a like sum on new lines.

COUNCIL BLUFFS, IA.—The Nebraska Telephone Company is erecting a large brick telephone exchange building in this city at a cost of $20,000.

BOONE, IA.—Representatives of 15 rural telephone companies have effected the organization of the Farmers' Co-operative Telephone Company, the object of which is to promote their general interests. Mr. Arthur Wills was elected president; E. J. Hughes, secretary, and D. P. Ives, treasurer.

SIOUX CITY, IA.—By an overwhelming vote at a popular election a franchise for an independent telephone system was recently granted at Sioux City. Under the State law if the City Council fails to grant a franchise the applicants may, by petition to the Mayor with the indorsement of a requisite number of bona fide citizens and by paying the cost of such election, put the question of a franchise to the vote of the citizens. It is by this method that the franchise was secured.

HOPKINSVILLE, KY.—The City Council has voted to sell a telephone franchise in this city on October 23. The life of the franchise will be twenty years. The city attorney was instructed to take the necessary steps to annul the contract existing between this city and the Cumberland Telephone Company of Nashville.

NEWBERRY, MICH.—A municipal telephone plant is to be installed here. The village already operates an electric light and water plant and it is stated that both are paying handsome profits.

DETROIT, MICH.—Don M. Dickinson states that a plan may be adopted whereby the syndicate which will acquire the property of the Michigan Bell Telephone Company will entertain overtures for a division of Michigan territory with independent companies, thereby eliminating ruinous competition and double expenses. Independent companies are particularly strong in western Michigan, while the Michigan company has a hold on the eastern part of the state.

MINNEAPOLIS, MINN.—The Northwestern Telephone Company will build a $12,000 addition to its East Side exchange for the accommodation of toll lines.

NATCHEZ, MISS.—The Cumberland Telephone Company is extending its lines to Kingston.

WEEPING WATERS, NEB.—The Nebraska Telephone Company is seeking a franchise for an exchange in this place.

LINCOLN, NEB.—The Nebraska Bell Telephone Company has voted $600,000 additional stock to provide for extensions and additions. This makes the total issue now $2,400,000.

PLYMOUTH, NEB.—The Plymouth Telephone Company has been incorporated by Messrs. Henry Heiliger, Fred Brockholdt, C. W. Harvey, James Wrigley and H. D. Gerhardt.

OMAHA, NEB.—The Postal Telegraph Company has recently completed the building of its lines along the Chicago Great Western Railway which has just been extended to this city.

LINCOLN, NEB.—Work of installing the independent telephone system in Lincoln is progressing nicely and it is declared by the promoters that by the time the station is completed they will have connections with Minneapolis, St. Paul, Sioux Falls, Sioux City and South Omaha. An effort is being made to be ready for business at the Lincoln exchange by January 1 next.

HOWES, NEB.—The Farmers' Mutual Telephone Company has filed articles of incorporation with the following board of directors: Messrs. Lucien Coeur, James A. Smith, E. J. Tucker, J. A. Mayer, Jr., Frank Hertzel, George Matthews, George Williams, Thomas H. Jones and H. G. Rhodes. Officers: J. W. Mayer, Jr., president; W. H. Lohr, secretary; John T. Cox, treasurer.

JOHNSTOWN, N. Y.—The Glen Telephone Company has increased its capital stock from $100,000 to $300,000.

WATERTOWN, N. Y.—The Citizens' Telephone Company uses Connecticut Telephone and Electric apparatus. It has 585 subscribers who pay $18 and $30 per annum.

CHAMPLAIN, N. Y.—The Champlain Telephone Company has been incorporated with a capital stock of $2,000 by W. O. Clark, T. H. Dickinson and Wm. Fraser, of Champlain, N. Y.

ALBANY, N. Y.—The Seneca Castle-Orleans Telephone Company has been incorporated with a capital stock of $5,000. The incorporators are Robert B. Peck, Willis C. Ellis and Wm. H. Burke.

ROCKINGHAM, N. C.—The addition of 60 telephones is planned by the Rockingham Telephone Exchange which has at present 132 subscribers.

MOORESBORO, N. C.—An addition of 25 telephones is projected by the Lattimore Telephone Company which has at present 110 subscribers using "Sumter" telephones.

WAXHAM, N. C.—The Waxham Telephone Company has recently been incorporated. A switchboard of 60 drops of Telephone Manufacturing Company's make has been installed.

LENOIR, N. C.—The Lenoir Electric Company is anticipating an increase of about 5 per cent. per month. "Sumter" apparatus is used; there are 27 miles of toll line and 110 subscribers. The rate is $24 per annum.

REIDSVILLE, N. C.—There are 150 connections on the lines of the Reidsville Telephone & Telegraph Company, of which Mr. R. J. Oliver is manager. "American" and other apparatus is employed.

LAURINBURG, N. C.—Mr. J. B. Maxwell operates a 100-drop "American" switchboard at Gibson and a 100-drop "Sumter" board at Laurinburg, serving about 200 subscribers who pay $1.50 for city and $1 for country service per month.

RUTHERFORD, N. C.—New subscribers are being added every week to the Rutherford Telephone Company which has 178 patrons. The company expects to build a toll line of about 20 miles to Columbus, N. C. The rate is $1.25 per month.

NORTH WILKESBORO, N. C.—The exchange at this place and one at Elkin, with 110 and 75 subscribers respectively, are owned by Messrs. H. W. & J. B. Horton. It is their purpose to invest from $500 to $1,000 this winter in increasing the capacity of the plant at North Wilkesboro. The subscribers pay $18 for business and $12 for residence service.

OTTAWA, OHIO.—The Putnam Telephone Co. operates 200 miles of toll line and has 1,400 subscribers.

MARSHFIELD, OHIO.—A 50-drop North board is operated by the Marshfield Telephone Company, which has 72 subscribers paying $1 per month.

NORTH AMHERST, OHIO.—The Amherst Telephone Company uses Rawson Electric telephones for its 130 subscribers, who pay from $12 to $24 a year.

PIQUA, OHIO.—The Piqua Home Telephone Company reports excellent progress, the system having now 1,230 patrons. Two hundred were added since the first of the year.

WEST ALEXANDRIA, OHIO.—An American Electric 100-drop switchboard and Kellogg telephones are used by the West Alexandria Telephone Company with its 127 subscribers. A 50 per cent. increase is looked for.

WILLIAMSTOWN, OHIO.—The Williamstown Telephone & Supply Company has been incorporated with $50,000 by C. J. Collins, P. G. Kassulker, W. C. Hine, C. W. Hunt and A. A. Miller.

PIONEER, OHIO.—The Pioneer Telephone Company plans to build a number of rural lines. At Pioneer there are 115 subscribers, of which 45 have recently been added. "American" apparatus is used.

HAMILTON, OHIO.—The Springfield & Xenia Telephone Company has filed a mortgage for $750,000 in favor of the Cleveland Trust Company, of Cleveland. The company is completing a fine exchange in Springfield.

PAYNE, OHIO.—The Payne Home Telephone Company has been incorporated with a capital stock of $15,000. The incorporators are Chas. E. Hyman, James A. Woolard, John W. Venick, Chas. A. Barber and Fred Paul.

WEST MILTON, OHIO.—Messrs. Charles Ammons, Charles Emrick, W. H. H. Kessler, C. S. Petry, Laban Jenks, H. Coppock and others of West Milton have purchased the property of the Progress Telephone & Telegraph Company.

NEW BREMEN, OHIO.—The New Bremen Telephone Company reports an encouraging outlook for farmers' lines. A 200-drop Sterling switchboard is in operation and there are 116 subscribers who pay $1 for residence, $1.75 for business service.

PLAIN CITY, OHIO.—It is the intention of the Home Telephone Company to improve its service and to install about 42 more telephones. Of the 386 subscribers 20 per cent. have recently been added. Stromberg Carlson instruments are employed.

ORANGEVILLE, OHIO.—The Jefferson & Warren Telephone Company operates six exchanges at Orangeville, Kinsman, Contend, West Farmington, Orwell and Jefferson, numbering 700 subscribers. It intends to erect an exchange of 50 subscribers and make additions to others.

NEWARK, OHIO.—A full common battery, lamp signal system is in operation by the Newark Telephone Company which controls the exchange at Granville also. The Newark exchange has 1150 patrons and an increase to 2,000 is looked for. The toll lines of this company cover the entire county. It has 35 toll stations.

MT. BLANCHARD, OHIO.—The People's Telephone Company has lines on nearly every wagon road in the township and will cover the entire township in another year. The company expects to add 100 more telephones within the next year. American Electric apparatus is used. The company has 198 subscribers and 40 miles of toll line.

MT. VERNON, OHIO.—The Mt. Vernon Telephone Company, with 863 subscribers in Mt. Vernon, operates exchanges in the following named places: Fredericktown, 270 subscribers; Gambier, 169 subscribers; Centerburg, 133 subscribers; Brandon, 33 subscribers, and Twin City 29 subscribers. North and "American" apparauts is used. The company has installed 277 telephones since April and the outlook is good for about 300 more by April, 1904.

NORWALK, OHIO.—Mr. C. L. Hook, manager of the Local Telephone Company claims that his is the first independent telephone exchange built in Ohio. The system has been growing very rapidly and it has just installed the latest type Kellogg board, each key being equipped for selective ringing. It has also installed its own power plant, gas engine and generator, and has its own steam heating plant all located on the second floor. It is the intention to build some more farmers' lines.

FLEETVILLE, PA.—The Northern Lackawanna Telephone Company, of Fleetville, has been incorporated with a capital of $5,000.

WELLSBORO, PA.—The Liberty & Jackson Telephone Company has been organized to build a line between Nauboo and Liberty Borough. Mr. L. Hartsock is one of the directors.

PARKWOOD, PA.—The Parkwood Telephone Company has been organized here and the following-named officers elected: President, T. E. Wachob; vice-president, William Craig; secretary, Thomas Anderson; treasurer, John Craig.

FREEMAN, S. D.—The Freeman Rural Telephone Company has been formed to build rural lines.

COLUMBIA, S. C.—The Manning Telephone Company has been incorporated with a capital stock of $5000. Mr. W. E. Jenkinson is president.

HENDERSON, S. C.—An important concern has recently been chartered at Henderson having the privilege of buying up all of the telephone lines in North Carolina. The company is known as the Home Telephone & Telepragh Company and has an authorized capital of $500,000, of which over $200,000 has been subscribed. W. T. Gentry, of Atlanta, is one of the largest stockholders. The company proposes to make a great combination of telephone and possibly of telegraph lines.

CLARKSVILLE, TENN.—The capital stock of the Clarksville Home Telephone Company has been increased from $100,000 to $150,000. The company is extending its lines throughout this and adjacent counties.

TEXARKANA, TEX.—The New Long Distance Telephone Company has been incorporated with a capital stock of $200,000. J. B. King is one of the directors.

SALT LAKE CITY, UTAH.—Extensive improvements are being made here in the system of the Rocky Mountain Bell Telephone Company. Underground cables are being substituted throughout the city for overhead single wires.

McGAHEYSVILLE, VA.—The Stonewall Telephone Company has been incorporated with a capital stock of $50,000. Mr. T. M. Armentrout is president.

ROANOKE, VA.—The Bell Telephone Company proposes to put its wires in this city underground. It also proposes to erect a new exchange building, the total cost of these improvements being $100,000.

MANCHESTER, VA.—The Common Council of Manchester has sold a telephone franchise to the Southern Bell Telephone Company for $25, and an ordinance has been passed along lines previously agreed upon. The matter has been sent to the board for concurrence.

MILWAUKEE, WIS.—The Badger-Farmers' Telephone Company has been incorporated with a capital stock of $10,000. W. J. Whitehead is one of the directors.

HUDSON, WIS.—The Prentice Telephone Company has been incorporated with a capital stock of $5000. Mr. F. J. Carr is one of the directors.

RIB LAKE, WIS.—The Rib Lake Telephone Company has been incorporated with a capital stock of $5000. One of the directors is Mr. F. J. Carr.

SHEBOYGAN, WIS.—The Northwestern Telephone Company, Sheboygan Falls and Sheboygan County Telephone exchanges were consolidated at a recent meeting. The new company will be known as the Citizens' Telephone Company. The Sheboygan Falls exchange will be entirely rebuilt and the wires in all the main streets will be laid underground.

ELECTRIC LIGHT AND POWER.

FT. PAYNE, ALA.—H. R. Godfrey has petitioned the Board of Aldermen for a franchise to construct and operate an electric light plant.

HARTSELLS, ALA.—The Shipp & Tapscott Mfg. Company has decided to construct an electric light plant in connection with its stave plant, and will probably supply the town with lights.

SAUSALITO, CAL.—The Town Trustees have granted Thos. Frost a franchise for electric lighting.

THOMASTON, CONN.—The buildings and machinery of the Thomaston Electric Lighting Company were destroyed by fire on Oct. 12.

ATLANTA, GA.—The development of the immense water power at Dunlap Falls on the Chattahoochee river in Georgia is one of the biggest electrical developments in the State. The big dam, 300 feet long and costing $160,000 when completed, will probably be finished in November. The estimated horse power to be developed is placed at 3500. Gen. A. J. Warren, of Ohio, has been the leading spirit in this undertaking. The new company expects also to have cars running between Dahlonega and Gainesville in one year.

JONESBORO, IND.—It is reported that new equipment will be purchased for the electric light plant. L. Pemberton is superintendent.

FORTVILLE, IND.—The officers of the town government are negotiating with the city of Anderson for the sale of its old electric lighting plant to be removed and reinstalled here. This property will make an excellent plant for Fortville which is rapidly becoming a resident locality for Indianapolis business men.

BEDFORD, IND.—The Indian Falls Hydraulic Company has been incorporated, to construct a dam across White River at Indian Falls, to utilize and generate hydraulic and other power for a railway proposed between Shoals, Indian Springs and West Baden. Wm. L. Story, Harry H. Cooke and A. F. Story are among the incorporators.

LOGAN, IA.—The Electric Light, Heat & Power Company, of Missouri Valley, has asked the City Council for a twenty-five-year extension of its franchise. The company contemplates an issue of bonds to build a $30,000 gas plant.

CURRIE, MINN.—Bids will be received Nov. 6 by the Village Council for $2500 bonds to be used for constructing an electric lighting plant. C. H. Cooper is Village Recorder.

SANTA FE, N. M.—It is stated that the water works and the electric light plant of the Santa Fe Water & Light Company are to be improved.

MOHAWK, N. Y.—The citizens have voted to issue $30,000 bonds to be used for constructing an electric light plant and improving the water works.

BROOKHAVEN, N. Y.—The Brookhaven Electric Light Company, of Brookhaven, N. Y., has been incorporated; capital, $10,000. Directors: C. A. Squires, O. T. Fanning and Thomas O'Donnell, Port Jefferson.

LANGDON, N. D.—It is proposed to remove the electric light plant to the new city hall, and install a new outfit.

COLUMBIANA, OHIO.—It is proposed to install an arc light system for the lighting of the village streets.

WOODSFIELD, OHIO.—The Woodsfield Heat & Light Company has been incorporated with $25,000 capital stock, and will build a lighting plant.

MANSFIELD, OHIO.—The Mansfield Electric Light & Power Company has elected the following-named directors: W. C. Hedges, W. S. Kerr, E. H. Keiser, J. S. Hedges, H. M. Weaver, C. W. Upson and C. N. Gaumer.

WEST CHESTER, PA.—There is a movement here looking to the construction of a municipal electric light plant.

YORK, PA.—The Edison Electric Company has secured the contract to light the streets for one year at 11 cts. per light per night.

EL PASO, TEX.—The capacity of the electric light and power plant here is to be increased.

VENUS, TEX.—The Merchants' Association is interested in the construction of water works and an electric light plant.

SALT LAKE CITY, UTAH.—The Utah Light & Power Company has made arrangements to secure additional power for its plant by the construction of a transmission line from the plant of the Utah Sugar Company on Bear River. The transmission line will be 45 miles in length and will connect with the company's plant at Ogden.

WILLIAMSBURG, VA.—An electric light plant, to cost about $5000, is being installed at William and Mary College at Williamsburg.

RICHMOND, VA.—A franchise for an electric light and power plant has been granted to the Merchants' Co-operative Light & Power Company, of which Samuel Cohen is treasurer.

SEATTLE, WASH.—New bids will be received by the Board of Public Works on Oct. 31 for generators for the municipal electric light plant.

NEENAH, WIS.—The city officials are discussing the proposition of building a municipal plant to furnish both gas and electric light.

THE ELECTRIC RAILWAY.

CANTON, ILL.—Incorporation papers have been granted to the Illinois Central Electric Railway Company to construct a street railroad at Canton, and interurban roads branching from that city. The incorporators are Joseph David, of Cleveland, Ohio; James H. Lawrence, James S. Hopkins, Fred A. Dolph and David J. Peffers.

CHARLESTON, ILL.—The organization of the Charleston, Champaign & Northern Interurban Traction Company has been effected by the election of eighteen directors and officers for one year. The officers are: President, Dr. W. R. Patton; vice-president, W. F. Jenkins; secretary, S. S. Anderson; treasurer, George W. Gray. The company is incorporated for $5,000, and its object is to build an electric line to Homer, in Champaign County.

DANVILLE, ILL.—Articles of incorporation of the Hoopeston Street Railway & Light Company have been filed. The directors are James H. Dyer, John L. Hamilton, Alfred H. Trego, Charles S. Crary, J. S. McFerren and Charles A. Allen, all of Hoopeston. The charter entitles the company to operate an electric street railway system in the city of Hoopeston and to manufacture gas, coke, tar, electricity or steam for the use of fuel, light or motive power.

VINCENNES, IND.—The Vincennes Street Railway has been sold to the E. M. Dean syndicate, of Grand Rapids, Mich., for $100,000.

WABASH, IND.—The consolidation of the Fort Wayne & Southwestern Railway, operating between this city and Fort Wayne, and the Logansport & Wabash Valley Company, operating between this city and Logansport, has been consummated by the organization of a new company to take over the two properties, and stock and securities of the consolidated company will be issued for the stock of the old corporation.

COLUMBUS, OHIO.—The Toledo, Columbus & Cincinnati Railway Company has been incorporated with $10,000 capital stock, by T. A. Wright, H. C. Headlee, F. J. Bulack, C. L. Held and H. J. Jarvis.

SALEM, OHIO.—The Salem & Eastern Railroad Company has been incorporated, with $5000 capital, by E. S. Cook, F. S. McGowan, T. T. Brewer, J. W. Tyler and L. M. Fowler, of Cleveland. It is the intention to build a road from Sebring to East Palestine by way of Salem and from Salem to Lisbon.

TIFFIN, OHIO.—The City Council has granted a twenty-five-year franchise to the Tiffin Electric Railway & Power Company; also a twenty-five-year franchise to the Tiffin Edison Electric Illuminating Company. Both are owned by the same people. A project is on foot to merge the two interests and construct an interurban line from Tiffin to Fremont.

CINCINNATI, OHIO.—The Cincinnati, Milford & Loveland Traction Company has elected officers as follows: B. H. Kroger, president; Thorne Baker, vice-president; J. N. Roberts, secretary; L. J. Van Lahr, treasurer. The company has about completed the construction of the first eight miles of its road from Hyde Park to Milford. Power will be furnishel temporarily by the Cincinnati, Georgetown & Portsmouth Railway from its station at Olive Branch.

LANCASTER, PA.—The charter of the Lancaster & Eastern Street Railway Company has been filed. The capital stock is $48,000, and this will be increased as soon as the right of way is secured. The officers are: President, Samuel R. Slaymaker; secretary, Milo B. Herr; treasurer, Joseph H. Esbenshade.

TRENTON, TENN.—The Gibson County Construction Company has been organized to construct an electric railway from Trenton to Eaton, Brazil and Gibson Wells. The projected route is about 17 miles long. In the next few days parties will survey the route.

MEMPHIS, TENN.—The Shelby County Traction Company has filed application for a charter for the purpose of building an interurban railway connecting Memphis and Colliersville, Tenn., a distance of 25 miles, and furnishing electric lights to all towns and homes between the two places. The nominal capitalization is $50,000, though $200,000 will be used.

DYERSBURG, TENN.—The Tennessee Western Railroad Company, which proposes to build and operate an electric railway from Dyersburg to Humboldt, has organized by the election of W. H. Skivington, president; James S. Brown, vice-president; H. E. Nichols, secretary. The company was formed in July and authorized to issue $10,000 capital stock. It has been agreed to make application for an amendment to the charter so as to authorize an increase of capital stock to $2,000,000. The routes have been surveyed, and it is estimated that it will cost $1,500,000 to construct and equip the road.

MORGANTOWN, W. VA.—A trolley line between Morgantown and Fairmont had its beginning recently in the purchase of the West Side line of the Union Utility Company by the Fairmont, Morgantown & Cheat River Company. The line is now two miles long, and Senator Elkins says it will be extended at once.

LEGAL.

SUBMARINE BOAT SUIT.—The Electric Boat Company of New Jersey has brought suit in the United States Court at Hartford, Conn., against the Lake Torpedo Boat Company, of Bridgeport. The complainant asks for $100,000 damages or more and an injunction for an alleged infringement of patent in the manufacture of submarine boats. According to the complaint, John P. Holland, of Newark, N. J., is the inventor of a submarine boat and the exclusive rights of building and sale were given by the inventor to the company that brings this suit. An injunction is asked for and damages of $100,000.

AUTOMOBILE LITIGATION.—Suit has been filed in the United States Circuit Court, in the southern district of New York, by the Electric Vehicle Company against C. A. Duerr & Company and the Ford Motor Company, under the Selden patent controlling all gasoline automobiles. This is the sixth suit under the pioneer Selden patent said to cover all gasoline automobiles. The other five, filed during the past 3½ years, have all terminated, the decrees entered in all of them sustained the patent. Before the Electric Vehicle Company acquired its control of the Selden patents, patent searches were made all over Europe, as well as the United States, and the results of the search being submitted to lawyers familiar with patents in the United States, it was in view of their report that the Vehicle Company acquired the exclusive license. In the present suit, Messrs. Betts, Betts, Sheffield & Betts are the complainant solicitors, while Frederick H. Betts and Wm. A. Redding are of counsel, the same who have successfully conducted the previous suits. It is understood that all such suits are to be defended by the Patent Title and Guarantee Company on behalf of the "independents" in the automobile field.

CITY LIGHTING CONTRACTS.—In the Supreme Court of Pennsylvania, in the appealed case of the Borough of Lansdowne vs. the Citizens' Electric Light & Power Company, of that place, the following points were made as to the validity of an acceptance of lighting contract: 1. Where an electric light company offers to do the public lighting for a borough, and the borough accepts the offer within the time stipulated for such acceptance, and the company thereafter takes certain steps as if to carry out the contract, the company is bound thereby, though the borough, between the date of the offer and the time of the acceptance, advertised and received bids for the public lighting. 2. Where a borough council is authorized by ordinance to contract for the public lighting, the action of the council in accepting a bid thereunder is ministerial, and not such an enactment or ordinance as must be recorded in the ordinance book, and advertised under the act. 3. The bid of an electric light company for the public lighting of a borough was accepted by a resolution of the council, which contemplated the execution of a formal contract. The company sent a form of agreement, acceptable to the solicitor of the borough, who thereupon prepared the agreement as desired by the company, and delivered it to its general manager. It was held that the agreement was binding on the company, though not executed by it.

PERSONAL.

MR. S. M. RUST, superintendent and manager of the Miami Light, Heat & Power Company, of Piqua, Ohio, has been elected president of the Ohio Electric Light Association, as was announced in these columns last week in connection with the annual convention at Columbus. Mr. Rust has been an active member of the Association since it was started and has taken an enthusiastic interest in its affairs. He has been engaged in central station work for the past sixteen years and with the Piqua plant for the last twelve years. This system is one of the most extensive and best managed in the State and Mr. Rust's efforts there have been crowned with very satisfactory results alike to the company and himself.

S. M. RUST.

S. L. BARRIETT.

MR. S. L. BARRIETT, the subject of this sketch, is the designer of the well known Cincinnati motor, and has been identified with the design of electric motors for many years. In 1889 he patented the automatic magnetic release starting box that is so extensively used on electric motors to-day, and in 1890 he patented the self-oiling bearing, which also accompanies modern electric motors. Mr. Barriett, while associated with the Sprague Electric Company, worked out various controlling devices for that company. In 1896 he left the Sprague Company and took charge of the tool designing at West Point Foundry, and was shortly after promoted to master mechanic and had charge of the work during the late Spanish-American war, where he again earned a reputation as an organizer and economizer in the manufacture of projectiles. Mr. Barriett resigned his position at West Point Foundry shortly after the war, went to Cincinnati, and organized the Cincinnati Electric Motor Company. He devoted over two years in designing special tools and machinery for the manufacture of electric motors, ranging from ½ to 10-hp. The Cincinnati Electric Motor Company has met with much success, due to the efforts of Mr. Barriett. At a meeting held on July 1st, 1903, it was decided to change the name of the Cincinnati Electric Motor Company to the Barriett Electric Company, which will manufacture the Cincinnati motor, also a new motor which Mr. Barriett is now designing, and which will be called the "Barriett motor." Mr. Barriett's productions have already become widely known outside Cincinnati, and an agency has recently been opened in New York City for his motors. Mr. Barriett is also an expert telegrapher and the inventor of several telephone devices.

MR. R. R. HAMBLIN has tendered his resignation as general manager of the Toledo Home Telephone Company.

DR. HANS GOLDSCHMIDT, of Essen, Germany, discoverer of the remarkable "Thermit" process of welding, will arrive this week on a short visit to the United States.

MR. R. LESTER THAYER has recently taken the management of the new Chicago office of the Triumph Electric Company with headquarters at 1600 Tribune Building, that city.

COMR. BRADLEY A. FISKE contributes to the latest issue of the proceedings of the U. S. Naval Institute articles on the Fiske semaphore system and a naval telescope and mount.

MR. GEORGE W. COLLES, M. Am. Soc. M. E., has resigned his position as chief engineer of Marion & Marion, Montreal, and has opened an office as consulting mechanical and electrical engineer in Milwaukee, Wis.

MR. BURCHAM HARDING, for several years with the Westinghouse Electric & Mfg. Company, has resigned his position to become manager of the local office of a leading real estate company, of Pittsburg, Pa.

MR. ENOCH MOORE, JR., formerly with the Moore & Sons Ship Building Company, has severed his connection with that company and is now associated with the Morris Electric Company, of Wilmington, Del.

MR. FRANK G. BOLLES, who has been abroad in the interests of the Bullock Electric Manufacturing Company, of whose export and foreign department he is manager, has recently returned home to Cincinnati.

MR. H. B. HEWITT, the Missouri representative of the Stromberg-Carlson Telephone Mfg. Company, of Chicago, was located hitherto at Keithsburg, Ill., but will now have his office permanently at Chillicothe, Mo.

MR. E. H. MULLIN, of the General Electric Company, has been nominated by President Carty to fill a vacancy in the board of the New York Electrical Society, as vice-president, and has been duly elected by the members.

PRES. F. P. FISH, of the American Telephone & Telegraph Company, is now visiting the west, making one of those periodical trips of inspection he has instituted with so much profit to the activity and homogeneity of the Bell telephone system.

MR. C. H. HINES, electrical engineer of the Canadian Pacific Railroad shops, etc., has been making a visit to this country, and was in New York this week. The C. P. R. is a progressive institution and is now going in for a general equipment of its big machine shops with electric drive and light.

MR. R. J. RUSSELL, of St. Louis, has severed his connection with the Wagner Electric Mfg. Company as assistant manager of sales, and has accepted the position of business and sales manager of the H. E. Lindsey Electrical Supply Company, which is not only engaged in the supply trade, but manufactures alternating current ceiling fan motors.

MR. WALTON E. NIMS has purchased the stock that was formerly owned by the Waterloo & Cedar Falls Electric Light Company, of Cedar Falls, Ia. He has been associated with the company for some years past, and will now devote himself to the supply trade. He will carry on his office with the Electric Light Company at the Cedar Falls National Bank Building.

MR. A. W. FIELD, general manager and secretary of the Columbus Edison Electric Light Company, has resigned, to take effect November 1. The company has recently passed into the control of the Columbus Railway & Light Company, a holding company, and Mr. Field's work will be handled by Mr. L. G. White, assistant general superintendent of that company.

MR. HENRY EDMONDS, who is well-known in electrical circles in this country, is now here again from England, with his family. It is fourteen years since Mr. Edmonds was last in New York, and he naturally notes many evidences of growth. Mr. Edmonds is staying at the Holland House, this city, and hopes to see as many of his old friends as possible before returning to London.

DR. LEONARD F. PITKIN, surgeon of the Interborough Rapid Transit Company, has just completed the collection of data for a series of articles in one of the medical journals and for a report to his company on the abuse of the law under which actions for damages as the result of personal injuries are brought against the surface and elevated railroads in this city; as a record of "graft" it is unique.

MR. W. L. ELKINS.—A special telegram from Philadelphia, of October 26, says: The condition of William L. Elkins, the multi-millionaire an dstreet railway promoter, who is dangerously ill at his home here, is reported to-day to be slightly improved. The report that surgeons had found it necessary to amputate the patient's leg in order to check the spread of gangrene was positively denied by members of the family.

MR. E. B. RAYMOND.—A new office has been created at Schenectady by the General Electric Company, namely that of general superintendent of the works. The first incumbent is Mr. E. B. Raymond with H. Farquhar, W. S. Clark and J. F. Madgett as assistants. Mr. Raymond is no newcomer, having been the Thomson-Houston Company in Lynn until the consolidation, when he went first to Chicago for the General Electric Company and afterwards to their Schenectady works.

MR. A. K. WARREN, E. E., of thiscity, son of the late Rev. Dr. E. Walpole Warren and grandson of the famous author of "Ten Thousand A Year," has been willed by his father the manuscript of that novel which once made so great a sensation in the English literary world, and which has been popular ever since. In case of sale, the British Museum is to have the first opportunity to acquire the manuscript. It is interesting to note the coincidence that with the consent of the family, a revised edition of the story is now being brought out.

MR. F. B. DUNCAN has recently been appointed manager of the Akron Electrical Manufacturing Company. About two years ago, Mr. Duncan resigned his position of general superintendent, which he held for about five years with the Northern Electrical Manufacturing Company, Madison, Wis., to accept a similar position in the Akron Company and his present promotion is an evidence of the company's appreciation of his services. During his connection with the Akron Company, he has redesigned their entire line of machines and the growth of business has been notable.

MR. NORMAN G. KENAN has been elected president of the Cincinnati Gas & Electric Company, of Cincinnati, succeeding General Andrew Hickenlooper who resigned May 21, 1903, on account of ill health. Mr. Kenan has been vice-president of the company for several years and has practically grown up with the company, having become identified with the old gas company in 1868. In 1890 Mr. Kenan supervised the erection of the first lighting station installed by the Cincinnati Gas & Electric Company and he has been active in the management of the electric lighting end of the business since that time.

DR. F. B. HERZOG has enjoyed a growing reputation as a pastellist, In artistic circles, and some of his work, notably the "Diana," has been seen at the National Arts Club and reproduced. The meeting of the American Institute of Electrical Engineers was held in the Carnegie Building last week, and as Dr. Herzog has a studio there, the opportunity was also afforded a few of his engineering friends to note the excellence of his work in this direction. As an amateur, Dr. Herzog has long devoted a good deal of time to art, dating back to the old undergraduate days when his facile pencil adorned the pages of the "Columbia Spectator."

MR. W. O. WOOD, general superintendent of the Rapid Railway system, of Detroit, Mich., part of the Detroit United Railway Company, has been appointed superintendent of the elevated division of the Brooklyn Rapid Transit Company, of Brooklyn, N. Y., in place of Mr. Geo. W. Edwards, who has resigned. Mr. Wood was for ten years connected with the Illinois Central Railroad as train master and secretary to the second vice-president and previously five years with the Louisville & Nashville Railroad. Mr. Wood will apply to the Brooklyn elevated lines the merit system of discipline recently adopted by the company, and work out a standard system of train despatching.

MR. L. M. HANCOCK, general superintendent of the Bay Counties Electric Power Company, California, has been appointed by the New Zealand government to inquire into the subject of the utilization of the water powers of the colony. Private advices from that part of the world state that the minister of public works has declared that in a short time 75 per cent. of the machinery now operated by steam power throughout New Zealand would be driven by electricity. As previously mentioned in these columns, another Californian engineer, Mr. E. E. Stark, of the Bay Counties Company, has been selected as electrical expert by the Waipori Falls Electric Power Company, Limited, one of the largest projects of its description in the Antipodes.

DR. W. J. MORTON contributed recently to the *International Journal of Surgery* a valuable paper on the treatment of cancer by the Roentgen ray, with remarks on the use of radium. This has now been reprinted in pamphlet form rendering it more accessible. Dr. Morton has been one of the first to work in this country with the ray and to take up the study of radium. Details are given of some notable tests and applications, and some of the radiographs are striking. Dr. Morton sums up the situation as follows: "It is the writer's belief that in no branch of the practice of medicine or surgery is expert knowledge more essential than in radiotherapy, and that a great number of the failures to succeed must be attributed to the indiscriminate and thoughtless manner in which the treatment has been applied. Under the best management it is only too clear that a universally applicable panacea for this dread disease has not been discovered as yet, but certainly in radiotherapy there probably exists to-day a greater chance of cure in the average cases of cancer than in any other known procedure whether medical or surgical."

Trade Notes.

WIRT ELECTRIC COMPANY has removed its New York office to No. 26 Cortlandt Street, the Havemeyer Building.

ITALIAN ADDRESS.—The Societa Lombarda per distribuzione di energia elettrica, of Milan, Italy, requests us to note that it has changed its address in that city to Via Principe Umberto 17.

TWENTY-FIRST OIL FILTER ORDER.—The Burt Mfg. Co., Akron, Ohio, recently received the twenty-first order from the American Sheet Steel Co., New York, N. Y., for Cross oil filters.

WARNER ARC LAMPS.—Mr. W. F. Warner, Muncie, Ind., in an illustrated circular on the subject of his arc lamps states that the city of Muncie is entirely lighted with his enclosed series type, 230 in all being used.

CLEVELAND CRANE & CAR COMPANY, Wickliffe, Ohio, issues bulletins with illustrated text in regard to its electric traveling cranes, and hand and electric jib, post and car crane types. Another bulletin deals with its Armington electric hoists.

EMERSON MOTORS.—A pocket price-list folder has been issued on its automatic start induction motors by the Emerson Electric Manufacturing Company, St. Louis. It covers such motors in sizes from 1-20 to ½-hp as listed in its bulletins which give fuller details.

STANLEY & PATTERSON, 93 Liberty Street, New York City, call attention to the fact that they are carrying on a department devoted exclusively to electrical engineering, electrical construction and repair work, in connection with their manufacturing and supply business.

THE SCHOENMAN ELECTRIC MFG. COMPANY, Pittsburg, Pa., recently published a catalogue in booklet form showing illustrations of the various types of switches which it builds as well as some of its recent switchboard work. Prices are given in tabular form for all capacities between 25 and 2000 amperes.

H. B. COHO & COMPANY, contracting engineers, have issued from their headquarters, 114 Liberty Street, New York City, a neat little pamphlet illustrative and descriptive of their plans, methods and work. The company makes complete installations of steam and hydraulic electrical plants, etc., and invites correspondence.

McLEOD, WARD & COMPANY, of New York City, inform use that H. P. White Company, of Philadelphia, Pa., will be their representative for Pennsylvania, and will carry a stock of their well-known electric lighting specialties in Philadelphia so as to be able to make prompt shipments on all orders in that territory.

BRYAN-MARSH LAMPS.—The Ewing-Merkle Electric Company, of St. Louis, Mo., has recently issued some excellent trade literature in regard to the new Imperial lamps of the Bryan-Marsh Company, and also with regard to the Jandus enclosed arc lamp which it handles. This pushing concern is earning the good will of its customers by active attention to orders, at lowest prices.

CRESCENT ELECTRICAL MFG. COMPANY.—A twenty-four page catalogue of envelope size issued by the Crescent Electrical Mfg. Company, Rochester, N. Y., shows illustrations and prices of its complete line of switches, cut-outs, porcelain sockets and other electrical supplies. The catalogue is very attractively gotten up and will be sent to anyone who is interested.

THE ALLEN SOLDERING STICK is made in Chicago by L. B. Allen & Company. It is a good soldering stick and has found very much commendation. The operations of the company are to be extended by pushing this commodity very vigorously and a sole New York agent who has been appointed in Mr. Francis Granger, 26 Cortlandt St. It will work in very well with the other specialties which Mr. Granger handles.

CROCKER-WHEELER COMPANY, Ampere, N. J., devotes its Bulletin No. 38 of October to small motors, designated as type L., and to dynamos of the same general type and class. They are intended for direct belt or gear driving, and the motor sizes range from ¼ up to 3-hp. The various sizes and outputs meet any condition requiring small power and high economy. The apparatus is illustrated and described in detail.

ADAMS-BAGNALL.—The Adams-Bagnall Electric Company, manufacturers of arc lamps, of Cleveland, Ohio, opened a branch office at Atlanta, Ga., in order to get into closer touch with the electrical trade in that part of the country, from which it is receiving large orders. Mr. A. J. Mitchell, its special agent, has opened headquarters at 323-4 Empire Building, Atlanta, and invites correspondence and inquiries there from Southern purchasers of arc lamps.

THE YOST ELECTRIC MANUFACTURING COMPANY, of Toledo, Ohio, is preparing to build a new addition to its factory which will more than double its floor space. The demand for Yost specialties has increased so rapidly that at no time since the first of the year has the company been able to keep up with its orders. Last May the company erected a large addition to its plant, but even this did not suffice to take care of the increased business.

STOW MFG. COMPANY, of Binghamton, N. Y., has issued in its Bulletin No. 52, a very thorough account of the Stow multispeed motors and their varied applications. A number of excellent cuts bring to notice the different types, and the text gives a clear and interesting description of the features embraced in their ingenious method of varying the field strength by the plunger core working in the pole piece. The pamphlet illustrates both bipolar and multipolar machines.

FORT WAYNE ELECTRIC WORKS, of Fort Wayne, Ind., have issued Bulletin No. 1048 in regard to their belted direct current generators; catalogue of parts No. 2007 devoted to type C. direct-current Wood arc lamps; and a pamphlet on transformer insulation by Mr. E. A. Wagner, a feature of the latter being two-color cuts showing the difference between transformer coils that are untreated and those that are made compact and solid by the vacuum drying process adopted by the concern.

THE H. T. PAISTE COMPANY, Philadelphia, reports most gratifying sales for its 3-screw fixture sockets. The many advantages of the use of this socket, in its holding together under all sorts of strains in places such as trolley and railway cars, where some such extra fastening is necessary, are being appreciated by the trade. The company has just completed shipment of its large order for the U. S. Government Printing Office, Washington, D. C. This contract particularly specified these sockets as being able to stand the vibration of the building, due to the running of the large presses.

THE KANSAS CITY & OLATHE ROAD, now in process of construction, is using a special cedar tie that is proving very satisfactory, as regards both price and wearing qualities. The grade is the same as that used by all "steam" roads, the only difference being that the tie is slightly smaller. The much lower price, however, enables the road to space the ties close together and still have a cheaper, but no less durable road bed than if the larger tie were used. The ties are being furnished in large lots by the Maltby Lumber Company, of Bay City, Michigan, some 50 cars having gone forward in the last three weeks.

CORRESPONDENCE SCHOOL TUITION.—A notable instance of the efficiency of the modern correspondence school in aiding students to solve problems in actual work was given recently in Cleveland, Ohio. Mr. George F. Tinkham, for a number of years the engineer of the Upson Nut Company, has, through native skill and knowledge gained by correspondence study, invented and patented a hydro-carbon device for increasing the efficiency of a brick furnace. It was decided by the officers of the company to determine, by actual test, the merits of the two systems on two of the seven boilers of the plant using this device. Agreeing to this trial of his invention, Mr. Tinkham immediately wrote to the American School of Correspondence who suggested Mr. Carl S. Dow, chief of the Department of Mechanical Engineering, as a man best fitted to give an impartial judgment in the matter and look out for his interests. Upon his request Mr. Dow immediately proceeded to Cleveland and gave his whole time for four days to the test. By means of this device steam is taken from the boiler and conducted through the fire-brick setting to the furnace. It is claimed by the inventor that the steam is superheated and then broken up into its elements, hydrogen and oxygen. This superheating is accomplished by the intense heat of the incandescent fire-brick and by flowing from a ¾ inch pipe through small holes 5-22 inch in diameter. According to his own statement, Mr. Tinkham owes nearly all his knowledge of the theory of engineering to his courses with the American School of Correspondence. His schooling ending when he was eleven years old, and he took up correspondence work at the age of forty-six.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 20, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

741,325. MOTOR; Sabin A. Gibbs, Tacoma, Wash. App. filed Jan. 5, 1903. The motor consists of a series of coils arranged around a center and having a track running through them upon which is supported an iron ring-core. As the coils are successively energized, the core rotates and its motion is taken off at the periphery by gears.

741,613. THIRD RAIL CONDUCTOR; Frank T. Bailey and Charles S. Mickey, Baltimore, Md. App. filed March 4, 1903. Conductor bars are set edgewise in a grooved insulating string piece.

741,622. SYSTEM OF WIRELESS TELEGRAPHY; Sidney G. Brown, Bournemouth, England. App. filed Jan. 23, 1900. A parabolic mirror comprising parallel wires adapted to reflect the waves in a definite direction, is used in connection with a generator of etheric waves.

741,623. ELECTRIC SHOE; John S. Busky, Jr., New York, N. Y. App. filed July 18, 1903. A small secondary cell is inserted in the heel of the shoe and is charged by a last or tree containing a primary battery and having terminals which touch those of the secondary battery when it is inserted in the shoe.

741,631. CONTINUOUS POWER CHAIN OF WATER-LIFTS; George A. Crofutt, Hoboken, N. J. App. filed Jan. 29, 1901. A number of pumps located over a district to be irrigated, are driven by individual electric motors connected to a common circuit; the motors are individually started and stopped automatically by the level of water in the wells.

741,632. WATER LIFT FOR IRRIGATION; George A. Crofutt, Hoboken, N. J. App. filed Jan. 29, 1901. Relates to the construction of the automatic mechanism applied to each pump referred to in the preceding patent.

741,662. ELECTRIC HEATER FOR CARS; Edwin M. Herr, Pittsburg, Pa. App. filed Feb. 14, 1901. The heating coil serves at the same time as a motor controlling resistance and can be readily moved from its position inside of the car to another outside thereof, depending upon whether it is desired to heat the car or not.

741,665. DIRECT AND ALTERNATING CURRENT REVERSE MECHANISM FOR ELECTRIC GENERATORS; Oliver Higgins, Napoleon, Ohio. App. filed June 2, 1903. The magneto-machine is constructed so that by turning the crank in one direction a continuous current will be sent over a telephone line to call central office only, while by turning the crank in the opposite direction an alternating current is generated to call any particular station on the line.

741,675. ACCUMULATOR; William Kennedy-Laurie Dickson, London, England. App. filed May 16, 1901. (See page 724.)

741,676. ARMATURE FOR ELECTRIC MOTORS AND GENERATORS; Charles D. Knight, Milwaukee, Wis. App. filed Jan. 2, 1903. Consists in a peculiar dovetailed connection between the spider and the inner surface of a laminated ring armature.

741,689. SUGAR-MAKING; Martin Hocker Miller, Wiarton, Canada. App. filed Nov. 24, 1902. (See page 723.)

741,690. WATER-PURIFIER; Oscar M. R. Moller, Copenhagen, Denmark. App. filed Jan. 27, 1903. (See page 723.)

741,713. CIRCUITS AND APPARATUS FOR TELEPHONE SWITCHBOARDS; Spencer B. Prentiss, Washington, D. C. App. filed May 18, 1901.

741,719. ELECTRIC RAILWAY; Frederick W. Rockler New York, N. Y. App. filed May 6, 1903. A spring arranged to regulate the friction between the contact shoe and third rail.

741,735. INDICATING SYSTEM AND TIME BEATER; William Stanley, Great Barrington, Mass. App. filed Feb. 14, 1903. A coil is moved in one direction by passing a current through it and in the opposite direction by a spring; the current is automatically controlled so that the device will beat time.

741,741. MEANS FOR THE ATTACHMENT OF INCANDESCENT LAMPS; William C. Tregoing, Hartford, Conn. App. filed July 17, 1903. A receptacle of that type in which an inner piece carrying the contacts is applied to the face of the molding, so that the wires can run over it without being cut, and an outer piece or cap to cover the inner piece and protect the contacts.

741,744. AUTOMATIC SWITCH; Melvin D. Van Why, East Stroudsburg, Pa. App. filed April 1, 1903. A device for locking and unlocking a switch throwing mechanism from the car or train.

741,759. OVERFLOW ALARM; Wilbert J. Bishop, Buffalo, N. Y. App. filed June 4, 1903. An alarm actuated by a float.

741,767. COHERER FOR WIRELESS SIGNALING; Thomas E. Clark, Detroit, Mich. App. filed Sept. 10, 1902. Details of construction relating to the metallic ends of the coherer tube and to spring clamps for holding the coherer in position.

741,785. NON-ARCING CLAMP; Henry L. Fritze, Jersey City, N. J. App. filed March 6, 1903. An inclined clamp for trolley wires forming a hood to prevent ice from gathering on the wire.

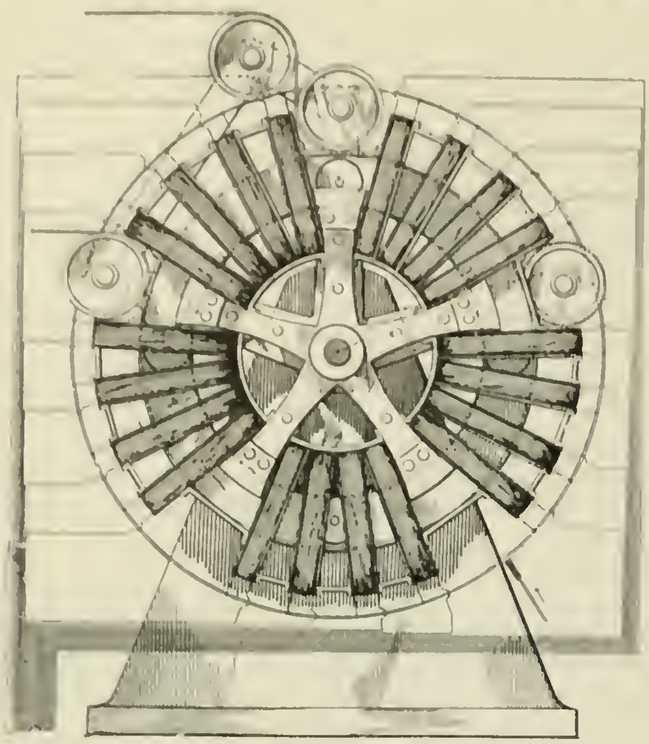
741,786. TROLLEY STAND; John J. Goodrich, Methuen, and James H. McPherson, Haverhill, Mass. App. filed Nov. 20, 1902. An arrangement of springs is used to keep the upward pressure on the pole uniform regardless of the angular position of the pole.

741,796. MOTOR CONTROL; John D. Ihlder, Yonkers, N. Y. App. filed May 5, 1902. The starting resistance is controlled by a number of magnets arranged for a high time constant and operating successively, each magnet controlling the circuit of the magnet next to operate.

741,804. CIRCUIT CONTROLLER; Adam Lungen, New York, N. Y. App. filed Nov. 13, 1902. A double push snap-switch designed for suspension. from a flexible conductor.

741,807. CENTRAL ENERGY TELEPHONE SYSTEM; Kempster B. Miller, Chicago, Ill. App. filed Feb. 4, 1901.

741,814. AUTOMATIC RHEOSTAT; Joseph W. Moore, Newton Highlands Mass. App. filed March 2, 1903. The contacts are divided into two sets, an arm moving over each and both arms connected to the core of a solenoid in such manner that the latter will have a comparatively short movement to cover a given number of contacts.



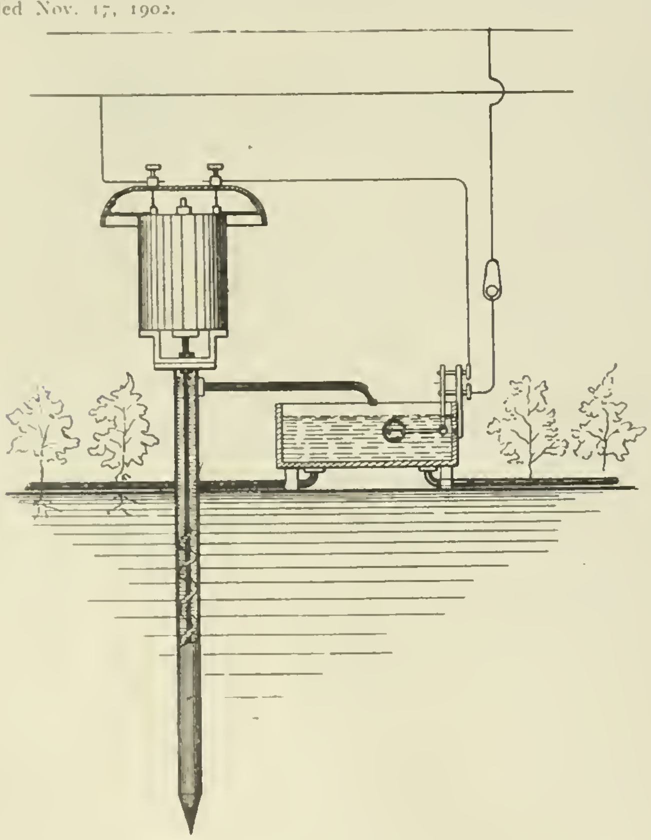
741,325.—Motor.

741,825. INDICATING MECHANISM FOR SNAP SWITCHES; Charles G. Perkins, Hartford, Conn. App. filed Aug. 14, 1903. A method of connecting a dial plate to the shaft of snap-switches by an arrangement of rivets on the shaft engaging with a hub on the dial.

741,837. CONTROLLING DEVICE FOR MOTOR VEHICLES; Joseph Sachs, Hartford, Conn. App. filed April 21, 1900. The weight of a person on the seat is required to make the controlling mechanism operative.

741,830. AUTOMATIC RHEOSTAT; Alois B. Saliger, New York, N. Y. App. filed March 14, 1903. Details of a rheostat operated by a solenoid whose action is resisted by a retarding fly.

741,847. TELEPHONE SYSTEM; David F. Stakes, Philadelphia, Pa. App. filed Nov. 17, 1902.



741,631. Continuous Power Chain of Water Lifts.

741,853. PUSH BUTTON ELECTRIC SWITCH; William C. Tregoing, Hartford, Conn. App. filed June 10, 1903. The poles of the switch are oscillated by a spring which is made tense by the reciprocation of push buttons.

741,864. ELECTROLYTIC DECOMPOSITION OF ALKALINE SALTS; Meyer Wildermann, London, England. App. filed May 5, 1902. In order to successfully operate with a deep mercury seal under the partitions of the cell, the amalgam in the decomposing compartment is mixed intimately with the mercury so that it will pass readily under the partitions into the combining compartment.

741,895. MAGNETIC CLUTCH; Charles I. Earll, New York, N. Y. App. filed April 17, 1903. The friction surfaces are drawn together by the combined action of magnetism and a screw connection with the shaft

741,899. TELEPHONE SUBSTATION APPARATUS; Hart F. Farwell, Chicago, Ill. App. filed Aug. 26, 1901.

741,90[illegible]. PUSH BUTTON; Edwin W. Ham, Worcester, Mass. App. filed Jan. 10, 1903. Details.

741,924. ELECTRIC LAMP SOCKET; Mortimer Norden, New York, N. Y. App. filed Jan. 12, 1903. A receptacle in which engagement with the line conductors is made by two pointed screws entering an external flange in the porcelain around the outside of the socket.

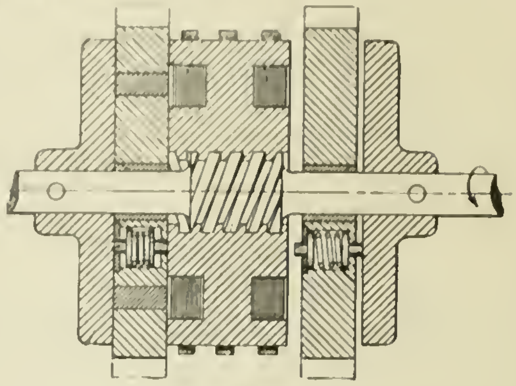
741,927. ELECTRIC HEATER; Edwin F. Porter, Boston, Mass. App. filed Jan. 21, 1899. Two heating resistances, one in series and the other in shunt with an electric motor coupled to a fan for blowing air through the resistances, suitable switches being used to control the current.

741,945. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; Milton E. Thompson, Ridgway, Pa. App. filed March 6, 1903. Details of construction.

741,952. ELECTRIC SIGNALING SYSTEM FOR RAILROADS; James N. Baskett, Mexico, Mo. App. filed July 10, 1902. Details of a signal system.

741,955. ELECTRIC RAILWAY SIGNAL; Howard Brooks, Wheaton, Ill. App. filed Nov. 14, 1902. Details.

741,992. ELECTRIC JAIL ALARM; Robert F. Adams, Birmingham, Ala. App. filed March 6, 1903. Details.



741,895.—Magnetic Clutch.

741,995. ELECTRIC CAPSTAN; William D. Baldwin, New York, and August Sundh, Yonkers, N. Y. App. filed Jan. 20, 1902. The capstan is operated by two motors and a series-parallel controller.

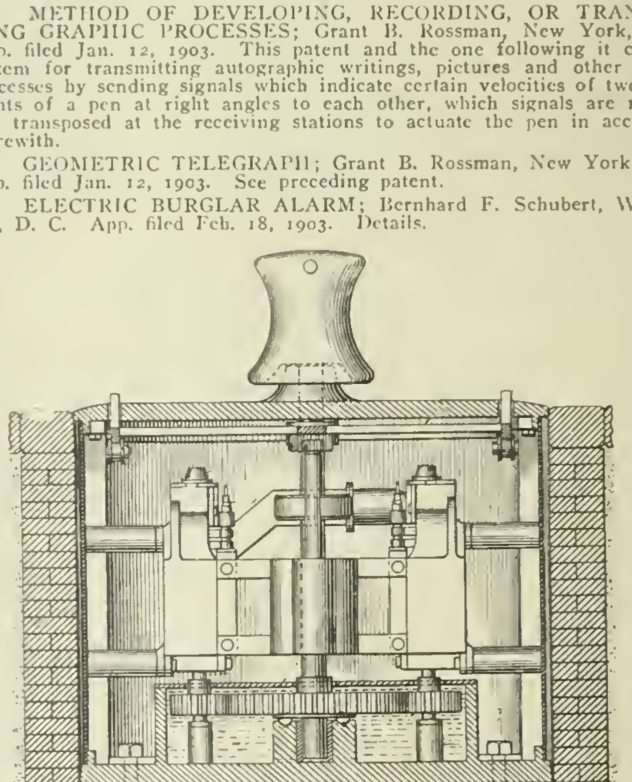
742,024. AUTOMATIC GAS LIGHTING APPARATUS; Barnett W. Harris, Waveland, Ind. App. filed Nov. 6, 1902. The gas is turned on and off and ignited at the burner by sending a puff of gas through the piping system, which actuates electrical contacts controlling the throw of the valve.

742,031. ELECTRICAL CONTROLLING APPARATUS; John D. Ihlder, Yonkers, N. Y. App. filed June 10, 1902. Details of construction of a switch designed especially for use with induction motors.

742,065. METHOD OF DEVELOPING, RECORDING, OR TRANSMITTING GRAPHIC PROCESSES; Grant B. Rossman, New York, N. Y. App. filed Jan. 12, 1903. This patent and the one following it covers a system for transmitting autographic writings, pictures and other graphic processes by sending signals which indicate certain velocities of two movements of a pen at right angles to each other, which signals are received and transposed at the receiving stations to actuate the pen in accordance therewith.

742,066. GEOMETRIC TELEGRAPH; Grant B. Rossman, New York, N. Y. App. filed Jan. 12, 1903. See preceding patent.

742,073. ELECTRIC BURGLAR ALARM; Bernhard F. Schubert, Washington, D. C. App. filed Feb. 18, 1903. Details.



741,995.—Electric Capstan.

742,098. INSULATING FIXTURE STUD; Alexander C. Proudfit, New York, N. Y. App. filed Sept. 19, 1903. Details.

742,125. UNLOADING APPARATUS; Charles P. Martin, Lemont Furnace, Pa. App. filed Sept. 24, 1901. A truck carrying a tilting track section can be run into line with the rails of other tracks, to receive from the latter a car to be carried to a dumping point.

742,127. PROCESS OF SUGAR-MAKING; Martin Hocker Miller, Wiarton, Canada. App. filed June 3, 1902. (See page 723.)

742,131. APPARATUS FOR ELECTROPLATING; Charles T. Pratt, Frankfort, N. Y. App. filed July 6, 1903. (See page 723.)

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ASPECTS OF FOREIGN TRADE.

The enormous magnitude of his home market has caused many an American manufacturer to be indifferent to the foreign market. At such times as these when production has at last overtaken the great domestic consumption, due to the purchasing power conferred on the people by a long period of expansion and prosperity, the foreign market comes into a position of more importance, and the true value of foreign trade is perceived by those who have been inclined to neglect and despise it. There are, moreover, many things we need abroad and shall always need, and such things will be more easily purchasable if we have been ready and willing to offer goods in exchange. It is only the rabid and impossible protectionist who either wants no foreign trade or else wants to do all the selling and none of the buying. Modern conditions of commerce and production do not permit of such sterile isolation, but aim rather at a steady large creation of goods that can suit all the markets most of the time. The true dividing lines are not frontiers or tariffs, but prices.

* * *

Secretary of the Treasury Shaw has just insisted in a speech at Boston that new opportunities of foreign trade should not cause us to be any less earnest in appreciation of the home market, but at the same moment he points out that we are now only securing 10 per cent. of the trade of South America, South Africa and the countries washed by the Pacific Ocean. This trade he sets at a figure of a thousand million dollars per annum. Other countries get the 90 per cent., but they are entitled to it on various scores, and for some of them, like Germany, the outlet has been a recent cause of great relief. The probability is that if our merchants and manufacturers went in for their proper share with the vim and acumen that distinguishes their drumming for the orders of Podunk and Skaneateles they would get it; and at the same time the total for foreign regions would be raised, so that all exporting countries would still benefit. One of the first and one of the lasting impressions of a visit to regions that must necessarily import manufactured goods and export raw products is the slight extent to which the possible interchange has been pushed. It is "neutral ground" in more senses than one. Mr. Shaw believes in subsidized ships, as an effective means of developing this oversea trade; but while a regenerated fleet of American mercantile ships is "a-borning" our manufacturers are not altogether destitute of ways and means for placing their goods at foreign thresholds, or for cultivating foreign knowledge as to what can be bought at advantage in the United States.

* * *

THE DUBLIN CENTRAL STATION.

We take pleasure this week in giving a description of the Dublin three-phase central station to which we have several times previously alluded. It possesses more than a passing interest, since Dublin is, if we mistake not, the largest city in which a pure three-phase distribution has been undertaken. Although the three-phase, four-wire system has been in use for some years in several American cities, like Sacramento and Salt Lake City, and with excellent results, these are small compared with Dublin, and do not, like Dublin, involve any material amount of underground distribution. The larger American cities were mostly equipped with Edison stations prior to the introduction of polyphase apparatus, and while this has been introduced to a very considerable extent, it has been quite uniformly for the purpose of transmitting energy to rotary converters feeding the old Edison networks. It is, therefore, particularly interesting to see an unmitigated polyphase system tried on a large scale under the severe requirements of modern urban distribution. The three-phase star with neutral wire is, perhaps, upon the whole, the most promising alternating system for use upon a large scale. It is not quite so simple as a two-phase, four-wire distribution, but saves a large amount of copper, almost as much as an ordinary three-wire continuous current system, even with the large neutral used in Dublin. Broadly, all distributing systems which save copper by combining circuits involve in one form or another the question of balancing the load to insure uniformity of voltage. In the early days of the three-phase system great importance was attached to this matter, and it was an objection often strenuously urged. As experience has been acquired, the fear of unbalancing has sunk to its proper plane, and it has been found that with reasonable care there was little to fear.

On a distribution fully laid out for three-phase circuits, this load wandering can be deprived of its injurious tendencies; but where, as in part of the Dublin system, three old single-phase circuits are put in three-phase connection without any material change, there is a considerable possibility of trouble. This sort of thing can be successfully done in cases where it is a very small part of the total load, or where, as in wiring large buildings, the secondary drop is rather small; but it must be rather carefully watched, and should be worked over to a pure three-phase form when opportunity offers. The connections are a trifle more complicated in a three-phase system than in an ordinary three-wire system, but the difference is practically inconsequential, and, with due care, as good service can be given from one as from the other. Certainly, the new Dublin system will be a vast improvement over the old one, and we doubt not that the results will be highly satisfactory. We are interested to observe that the frequency is dropped in the new plant to 50 periods, which seems to be becoming rather the standard practice abroad. Here there is a double standard, 60 periods for general service and 25 periods for work with rotaries. Where many motors are to be used or where much of the distribution is to be underground there is a material advantage in dropping the frequency below 50 periods; but where lighting is to be done by the alternating current 25 periods is too low. Perhaps there is no single standard frequency that can be settled upon in general practice in view of the complicated requirements, but it would certainly be an advantage if the bulk of the work could be done at a medium frequency which would enable the bulk of the machinery to be available for all purposes. As it now stands, an enormous variety of machines are built to furnish a fairly complete line at each frequency in use, and without wishing the art to become hidebound through standardization, it would be a good thing if there were greater uniformity in the matter of frequency.

An Extraordinary Telephone Situation.

On several occasions our news columns have contained references to an extraordinary telephone situation in which Mr. Milo G. Kellogg and the Bell Telephone interests are principals, and we print elsewhere in this issue an abstract of a long statement just issued by Mr. Kellogg dealing with the matter. This statement is frankly *ex parte*, and final judgment as to the actual merits of the case must naturally await the presentation of the other side. According to the information now at hand, it appears that during an illness which totally incapacitated Mr. Kellogg, his controlling interest in the Kellogg Switchboard & Manufacturing Company, which company had been the principal competitor of the American Bell, was disposed of to a representative of the latter interest in virtue of a power of attorney which Mr. Kellogg, when he found that recovery of health required entire abstention from business affairs for a long and indefinite period, had given to an officer of his company. It was not until some months later that Mr. Kellogg, then somewhat recovered in health, learned of this transaction, and immediately took steps to regain control of the company, or come to an arrangement whereby he would be constituted a large minority stockholder and the balance of power placed with a party or parties satisfactory to both sides, the company then to engage only in the manufacturing business along strictly commercial lines. As an inducement to resell to him his former stock, Mr. Kellogg made an offer to purchase it at an advanced figure, involving a profit of about $100,000 to the present holders. These negotiations having resulted in entire failure, several months ago suit was instituted to obtain an order declaring that the sale of the Kellogg stock was an unlawful injury to the minority stockholders and in restraint of trade, and consequently illegal and void.

This strange case has been accompanied by a number of incidental complications. Some months ago an arraignment of the transaction which deprived Mr. Kellogg of his control was published over the signatures of some of the leading members of the staff of the Kellogg organization, who yet remain in the employ of the company under its new control. Though guarantees given by the Kellogg Company to all of its customers are in existence, whereby in the case of action for infringement that company or its successors shall defend the suit, actions have been instituted by the Bell Company against such customers since it has acquired the control of the Kellogg Company. As the two former contending interests appear now to be legally identical so far as such suits are concerned, it is interesting to know what view will be taken by the courts of the legal situation thus presented in case the suits are brought to trial. Still another feature is that since the Bell Company has been in control, contracts for switchboards have been taken from independent companies in competition with Bell licensees, and instruments sold outright to competitors of such licensees at a rate very considerably less than the annual rental paid by Bell licensees for similar instruments. Altogether, the suit which Mr. Kellogg presents is a most remarkable one as affecting himself, some of the present staff of his former company, the Bell licensees and the Bell Company as bound by guarantees given by the Kellogg Company.

Concerning "Cold Light."

A paper by Lenard in the current number of the *Annalen der Physik* gives an immensely interesting account of experiments on phosphorescence induced by cathode rays. The research in apparatus and methods is too intricate for full description here, but some of the results cannot fail to be of high importance to electrical engineers in calculating the possibilities of electric lighting. Lenard experimented with various phosphorescent materials subjected to a cathode ray bombardment. He estimated by very ingenious means the energy required for excitation, and measured photometrically the intensity of the light produced. It has been well understood that in such cases light is produced at a very high efficiency, but Lenard's result of *ten Hefner units per watt* is decidedly higher than anything heretofore reached. Five Hefner units per watt was claimed in some of the experiments on very high temperature electric arcs, and Tumlirz and Knute Angström, respectively, derived 5.3 and 8.6 units per watt as the mechanical equivalent of light based on the Hefner lamp. On general principles there is not the least reason to doubt the correctness of Lenard's figures, since the efficiency of the electric arc has been pushed into the same neighborhood at least; and the spectrum of such an arc certainly contains a very large amount of non-luminous radiation, while the spectrum of low phosphorescence, like that of the fire-fly, is very rich in luminous rays. It is, however, a very long step from demonstrations like that made by Lenard to the practical production of light at any similar efficiency. Lenard's tube was small, the actual luminosity was small and all such methods as yet suggested require dealing with uncomfortably high voltages. The real surface brilliancy of the phosphorescent screens was so small that an impracticably large surface would be required to give a practically useful result, and all the work hitherto done tends to show that forcing the intrinsic brilliancy is likely largely to reduce the efficiency. The fire-fly still retains possession of his secret, and chemist and physicist alike have thus far failed to extract it from him.

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THE ENERGY OF RADIATION OF THE HEFNER LAMP.

The last number of the *Physical Review* contains an interesting paper by Angström on the radiant power of the Hefner standard amyl-acetate lamp. The Hefner lamp is much used in the photometry of incandescent lamps, and has the advantage of consuming a hydrocarbon fuel of definite and readily obtainable density and constitution. It is also very nearly constant and reproducible. Its main disadvantage is its red color and low temperature by comparison with the ordinary incandescent lamp. The paper commences with an important generalization not generally realized; namely, that the spectra of hydrocarbon flames are all very similar, and consist of the continuous spectrum of incandescent carbon with the discontinuous spectra of gaseous combustion products superposed. The spectrum of incandescent solid carbon is always essentially the same for a given temperature, and is a continuous spectrum running from the ultra-violet to the far ultra-red. The spectrum of a gas is always essentially a discontinuous, or banded, spectrum. Some gases have spectra consisting of a few lines only. In a hydrocarbon flame, such as a candle flame, there is an inner core of heating gas, surrounded by a sheath of highly heated and incandescent carbon particles, emitting continuous spectra, which are again surrounded by a sheath of highly heated carbonic dioxide gas and hot water vapor. These incandescent vapors superimpose banded spectra on the continuous carbon spectrum. In the case of the incandescent lamp, the incandescent filament emits a continuous spectrum; while the cooler vapor of carbon or other substances which may envelop the glowing filament have negative band-spectra or tend to absorb the energy of the carbon spectrum, selectively, and at the bands of their own spectra.

According to this doctrine, if it were not for the mantle of glowing gaseous combustion products, which add, here and there, energy to the carbon flame-spectrum, and to the sheath of cooler vapors which deduct, here and there, energy from the carbon filament-spectrum, the spectrum of a flame would be the same as the spectrum of an incandescent lamp, provided that the incandescent lamp were adjusted by its current strength to have the same temperature as the flame. The paper then goes on to show that the spectrum of a certain standard Hefner lamp was found to be very nearly the same as the spectrum of a certain incandescent lamp, when the latter was operated at a somewhat low pressure, or operated at reddish color instead of bright white. In the spectrum of the Hefner, drawn with ordinates as radiant intensities, to abscissæ of wave lengths, there were certain superposed lumps at or near three particular wave lengths; while the incandescent lamp spectrum showed indentations or hollows, at these wave lengths. Otherwise the two curves seemed to agree very closely. The unindented curve of either luminous source appears to follow Wien's law. This law may be verbally expressed by saying that the immissivity, or reciprocal of the power emitted at any wave length, varies as the fifth power of that wave length, and also as the anti-logarithm of a quantity which is the reciprocal of the wave length multiplied by the absolute temperature of the source. From this law it follows by integration that the total power of radiation, for all wave lengths taken together, varies with the fourth power of the absolute temperature—the proposition known as Stefan's law. It also follows that the radiant power commences at zero for wave length zero, and increases as the wave length increases up to a certain critical wave length, at which the radiant power is a maximum, and then dwindles to zero as the wave length becomes indefinitely increased. The critical wave length becomes shorter as the temperature of the source increases; so that the more highly heated a body becomes, the more its heat is radiated in short waves. This is in accordance with the observed phenomena of luminescence. Wien's law is strictly applicable to perfectly black bodies only, or to bodies that have no selective color radiation; but the law is assumed to apply either to a Hefner flame or to an incandescing lamp filament without sensible error.

Angström found that the total intensity of radiation (both visible and invisible), in the horizontal plane, of his Hefner lamp, was 900 ergs per second at a distance of one metre from the flame centre. If the Hefner were regarded as a luminous point source distributing radiant energy equally in all directions, the total power would, therefore, be 11.3 watts of heat energy, or chemical energy of combustion, and with a mean intensity of 0.88 British candle, the value ordinarily assigned, to a Hefner lamp, the power absorbed would be 12.8 watts per candle. The thermochemical value of the amyl-acetate burned per unit of time is not stated, but would constitute a check upon this estimate. The luminous efficiency of the Hefner was measured and found to be 0.0096, or nearly one per cent. Consequently, the measured intensity of luminous radiation of the Hefner was very nearly 9 ergs per second per normal square centimetre at a distance of a metre; i. e., 90,000 ergs per second per steradian or unit solid angle. If the Hefner may be regarded as a luminous point source, emitting light uniformly in all directions, the total luminous radiant power was 0.11 watt. The incandescent lamp tested had a straight filament, and absorbed, at normal candle-power, 0.25 ampere at 16 volts, or 6.4 watts. Unfortunately, its luminous intensity under these conditions, in terms of the Hefner, is not stated. The total luminous intensity of radiation was found to be 20.9 ergs per second per normal square centimetre, at a horizontal distance of a metre, which corresponds to 209,000 ergs per second per horizontal steradian. With a total luminous radiation including all directions of 2,063,000 ergs, or 0.2063 watt, the luminous efficiency of the lamp would have been 3.22 per cent. The temperature of the Hefner flame was computed to be approximately 1830° C. absolute, or 1557° C. above melting ice zero. The temperature of the incandescent lamp filament at normal candle-power is stated to have been 2000° C. absolute, or 1727° C. above melting ice zero. If these values are reliable the extra 170° C. of the incandescent lamp is a sufficient elevation of temperature to change the color of the light from the reddish tint of the Hefner, to the incandescent whiteness of the ordinary glow lamp.

The chief value of the paper lies in providing a mathematical clue to the operations of an incandescent lamp. If the formula is reliable, it should be possible to compute the color, absolute efficiency, and temperature, of an incandescent filament, when its consumption in watts per candle is given. It is important that such measurements should be repeated on an incandescent lamp, together with the photometric values of the lamp in luminous distribution and mean spherical Hefners. Meanwhile, it is interesting to remember that a Hefner-lux, or Hefner-metre, is an illumination by a Hefner at a horizontal distance of a metre, and corresponds to an incidence of luminous radiation at the rate of nine ergs per second per normal square centimetre; or, since the watt is the practical unit of power and the absolute unit, or absolute watt, is one erg per second, the Hefner-metre is nine absolute watts per square centimetre.

Telegraph Tournament.

A telegraph tournament was held in Philadelphia on October 30 and 31, under the auspices of the American Telegraphers' Tournament Association, and it was unquestionably the most successful affair of the kind ever held. It was organized on a large scale and was liberally supported. The tournament was held in the auditorium of the National Exposition Buildings, and the large hall was crowded almost to suffocation on Friday and Saturday evenings. There were so many entries to the later events that the work was not finished until 5 o'clock Sunday morning.

Mr. J. C. Barclay, assistant general manager of the Western Union Telegraph Company, opened the tournament with a few appropriate remarks.

Following is a summary of the events and the names of the successful contestants:

Railroad operators' sending and receiving contest; sending and receiving 20 ordinary railroad messages; first and second prizes in each class, $50 and $25, respectively. Sending—First prize won by L. G. Bartley; second, G. A. Cone. Receiving—First, J. H. Harrison; second, G. Hodgson.

Ladies' contest; sending 20 commercial messages and receiving 20 commercial messages on typewriter. Sending—First prize, $50, won by Miss K. N. Stetson, of New York; second prize, $25, won by Mrs. B. V. Gillespie, of Philadelphia. Receiving—First prize, $50, won by Mrs. F. Feldman, of New York; second, $25, Miss L. McKenna, of New York.

Old Timers' contest, sending and receiving 10 messages and 300 words of press matter, won by I. D. Maize, of Philadelphia; E. P. Porter, of New York, second. The first and second prizes of this contest were $50 and $25, respectively.

Best all-around operator contest. Sending and receiving 25 messages and 500 words of press matter. First prize $300 and the Carnegie medal; second prize, $150. Won by W. M. Gibson, of New York; second, E. E. Bruckner, of Chicago. This concluded Friday's events.

On Saturday the first event was the Phillips' Code contest; sending and receiving 1,000 words. First prize in each class, $75. Sending, won by G. W. Conkling; receiving, F. M. McClintic, first; W. C. Murray, second.

Broker operators' contest; sending and receiving 10 minutes; first prize, $100; won by Harvey Williams.

Yetman transmitter special contest; sending and receiving press for 15 minutes; first prize, $50 and one Yetman transmitter in each class. Sending, won by C. P. West, of New York; receiving, J. P. Gallagher, of New York.

Championship of America contest; sending 500 words; first prize, $300; second, $150; won by Harvey Williams, of Philadelphia; G. W. Conkling, of New York, second.

Receiving commercial messages on typewriter for 30 minutes; automatic transmission; first prize, $200 and a Fay-Sholes typewriter; second prize, $100; won by J. P. Gallagher, of New York; second, H. V. Emanuel, of Philadelphia. The winner received 53 messages in half an hour.

There was an extra contest for a silver cup offered by the New York Consolidated Stock Exchange. The cup was won by G. W. Conkling, of New York.

The De Forest Wireless Telegraph Company gave a demonstration of the practical operation of its system. Signals were transmitted and received across the hall, a distance of about 100 ft. The various typewriter companies made large and tastefully arranged exhibits of their machines and distributed souvenirs and literature of special interest to telegraphers.

Among the judges of the various contests were: J. P. Altberger, superintendent Western Union Telegraph Company, Philadelphia; L. Lemon, superintendent Postal Telegraph Company, Philadelphia; J. F. Skirrow, electrical engineer, Postal Telegraph Company, New York; Fred Catlin, New York; C. P. Bruch, assistant general manager Postal Telegraph Company, New York; George H. Usher, superintendent Postal Telegraph Company, New York, and T. R. Taltavall, ELECTRICAL WORLD AND ENGINEER.

The Carnegie medal, which was won by W. M. Gibson, was held by F. M. McClintic, of Dallas, Texas. According to the terms of its donation it must be competed for annually. It is a handsome example of the jewelers' art.

Colorado Electric Railway, Light and Power Association.

The Colorado Electric Railway, Light & Power Association held its first meeting October 28 and 29 in the demonstration hall of the Denver Gas & Electric Company in Denver.

J. F. Vail, general manager of the Pueblo & Suburban Traction & Light Company, was in the chair as president of the Association. At the opening session over one-fifth of the membership was in attendance at the meeting.

The address of President Vail took up a portion of the time of Wednesday afternoon. It recited among other things the fact that the organization of the Association was made August 12 of this year, and that this was the initial meeting. There was no reading of papers in the forenoon, that part of the programme being passed over in order to take up general business and the reports of the several committees who were appointed to get the new association under way.

Among the 22 active State corporations with representatives at the meeting were: Durango Light & Power Company, Larimer Light & Power Company, of Fort Collins; Las Animas Electric Light Company, of Las Animas; Colorado Springs Electric Company, Leadville Gas & Electric Company, Boulder Electric Light & Power Company, Pueblo & Suburban Traction & Light Company, Las Animas Light, Power & Manufacturing Company, of Trinidad; Arkansas Valley Electric Company, of Florence; Gilpin County Light, Heat & Power Company, of Black Hawk; Denver Gas & Electric Company, Denver City Tramway Company, La Junta Electric Company, Greeley Electric Light Company, Crested Butte Water & Power Company, Roaring Fork Electric Light & Power Company, of Aspen; Loveland Light, Heat & Power Company; Lamar Electric Company, La Bella Mill, Water & Power Company, of Goldfield; Colorado Electric Power Company, of Canon City; Colorado Springs & Interurban Railway Company, and Pagosa Springs Electric Light & Power Company.

Among the eighteen associate members represented were: Albert Sechrist Company, Denver; E. C. Means, agent Adams Bagnall Company, Denver; Phelps Company, Detroit; Western Electric Supply Company, of St. Louis; National Carbon Company, Cleveland; Mutual Oil Tank Line, Omaha; W. A. Layman, of the Wagner Electric Company, St. Louis; Westinghouse Electric Manufacturing Company, of Pittsburg; and these of Denver: Gilbert W. Kes & Co., R. J. Cory, of the Allis-Chalmers Company; Thomas H. Smith, American Steel & Wire Company, and B. K. Sweeney, B. F. Vreeland, W. L. Otis and George A. Woolet.

In the afternoon Mr. L. C. Stockton addressed the meeting, his topic being "A Few Advertising Hints," and was followed by Mr. C. W. Humphrey, whose subject was "Meters." A question box was opened and much information imparted to those who wanted enlightenment from experts.

When the association met for the second day's session, Mr. W. A. Layman, of the Wagner Electric Manufacturing Company, of St. Louis, read a paper on "Single-Phase Motors as a Means of Increasing Central Station Earnings," after which Mr. L. L. Summers, one of the engineers of the Denver Gas & Electric Company, read a paper on "Steam Economics." The delegates then went into executive session to elect officers.

Mr. J. F. Vail, of Pueblo, was re-elected president, which office he has held since the organization of the Association last August. Mr. William Mayhu, of Greeley, was re-elected vice-president, and Mr. George B. Tripp, of Colorado Springs, was made secretary and treasurer to succeed himself. The members of the finance committee chosen were Messrs. F. F. Webber, Charles Beeley and L. J. Kelin. The membership committee consists of Messrs. C. W. Badgley, C. E. Doolittle and C. H. Peters, and Messrs. J. E. Lundstrum and J. A. Beeler were added to the executive committee. In the afternoon the members went on a trolley ride to the coal mines of the Denver & Northwestern at Leyden, in the private car of General Manager J. A. Beeler, of the Tramway Company.

Life of Radium.

Prof. Robert A. Millikan, of the University of Chicago, has recently formed a careful mathematical estimate of how long a particle of radium can last, and how long a time must elapse before a loss of weight can be noted. Thirty thousand years is found to be the maximum limit before the radium is completely disintegrated. A possible minimum of 300 years has also been calculated, but this is not regarded as probable.

Transmission of Hudson River Power.—III.

(*Concluded.*)

WITHOUT following out in detail the arrangement of switches and lines at the Saratoga and the Alplaus switch houses, it may be said in general that in each place either transmission line from a generating station may be connected to either line running to a sub-station.

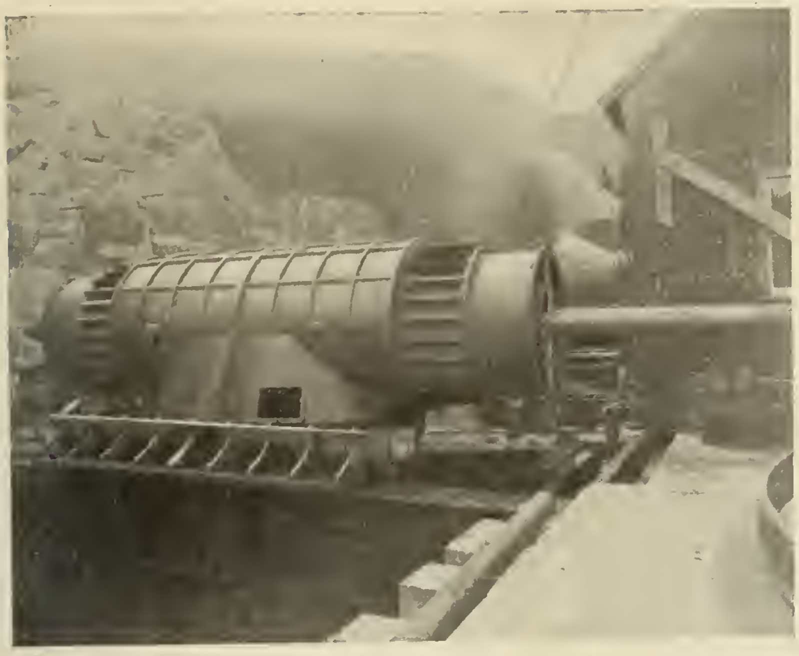


FIG. 13.—ONE OF THE WATER WHEELS.

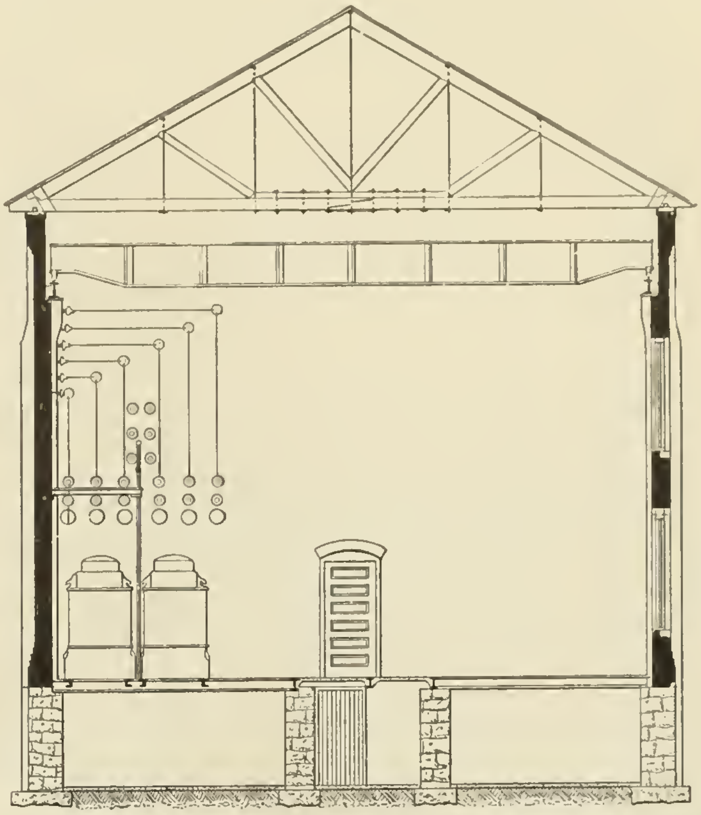


FIG. 15.—CROSS-SECTION OF SARATOGA SUB-STATION.

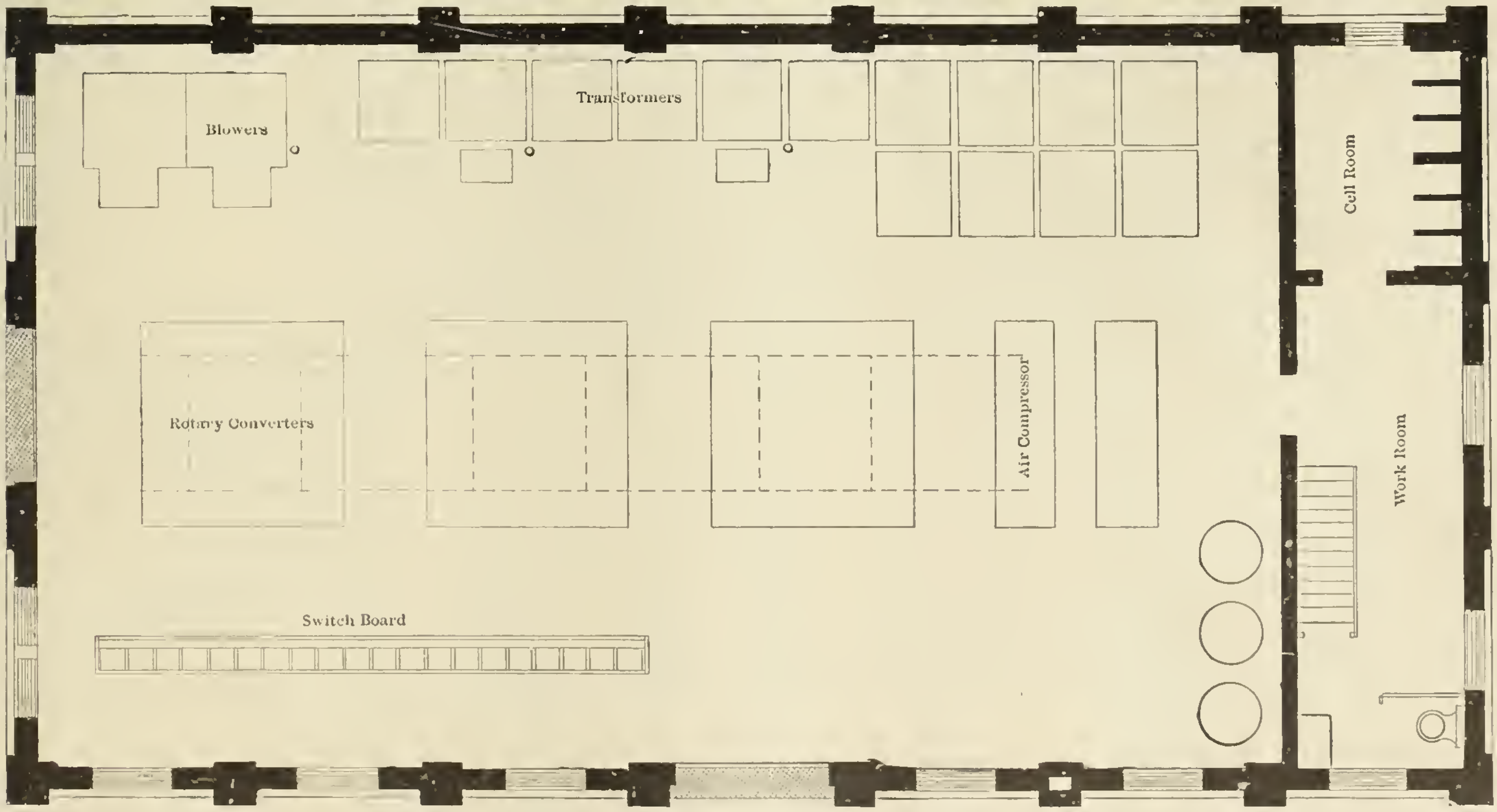


Fig. 14.—First Floor Plan Saratoga Sub-Station.

The flexibility of the connections between the generating and sub-stations is further illustrated by the sub-station at Watervliet, where lines operating at 26,500 volts from Spier Falls and lines with a pressure of 10,800 volts from Mechanicsville converge. All of the other sub-stations for railway and lighting work in the vicinity of Albany and Troy are fed through the Watervliet sub-station at about 10,800 volts pressure. In addition to provision for a local service at 2,300 volts, the Watervliet sub-station must, therefore, provide for supply to either of these connected sub-stations from either of the lines from the Spier Falls and Mechanicville generating plants. To accomplish this result a single pair of bus-bars is provided at Watervliet, and each bus-bar of the pair is divided by knife switches into as many sections as there are individual wires in the several transmission lines that enter this sub-station from the water power plants. Each wire of the 10,800-volt circuits from Mechanicville, after passing through an oil switch, may be connected to a section of either one of the two bus-bars by means of a double-blade knife switch. Each wire of the 26,500-volt circuits from Spier Falls, after passing through an oil switch, may be connected by a knife switch with the primary winding of a transformer designed to reduce the pressure from 26,500 to 10,800 volts. The secondary coil of each of these transformers may be connected to a section of either one of the two bus-bars by a double-blade knife switch. A similar switch connects each section of either bus-bar with an oil switch that is in turn connected to one of the wires of a 10,800-volt circuit that runs to one of the other sub-stations at Albany or Troy. Another set of knife switches can be used to connect any wire from Spier Falls with either of two transformers that normally have their primary coils connected to other wires. Besides the switches already mentioned for cutting the two 10,800 volt bus bars into sections, these bars are further cut into two groups of sections by a double pole oil switch with a knife switch on each side of each pole. To one of these two groups come all the wires from Spier Falls, and to the other group come all the wires from the Mechanicville plant. By means of these two sectionalized bus-bars and the various switches mentioned, any single wire from either of the two water power plants may be connected to any wire running from the Watervliet sub-station to either of the sub-stations which it supplies, either directly or through one of the step-down transformers.

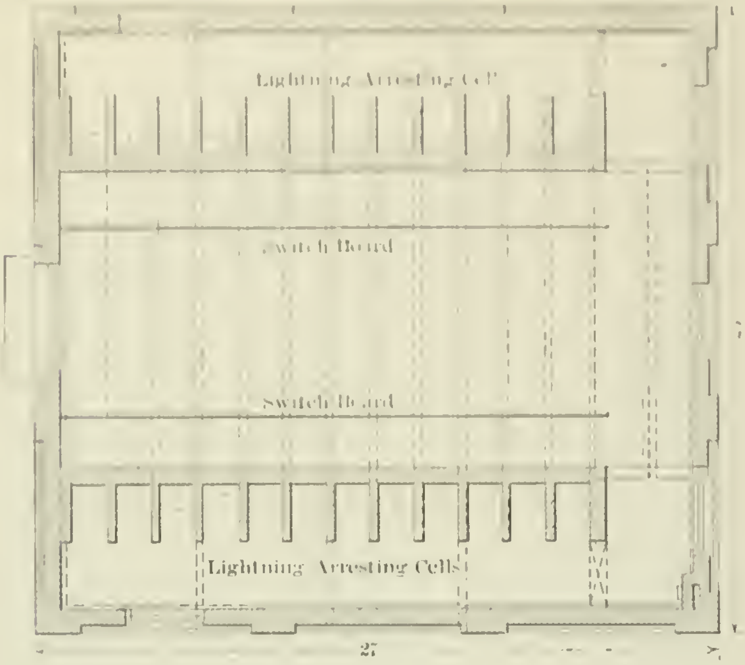


FIG. 16.—GROUND FLOOR PLAN OF SWITCH HOUSE.

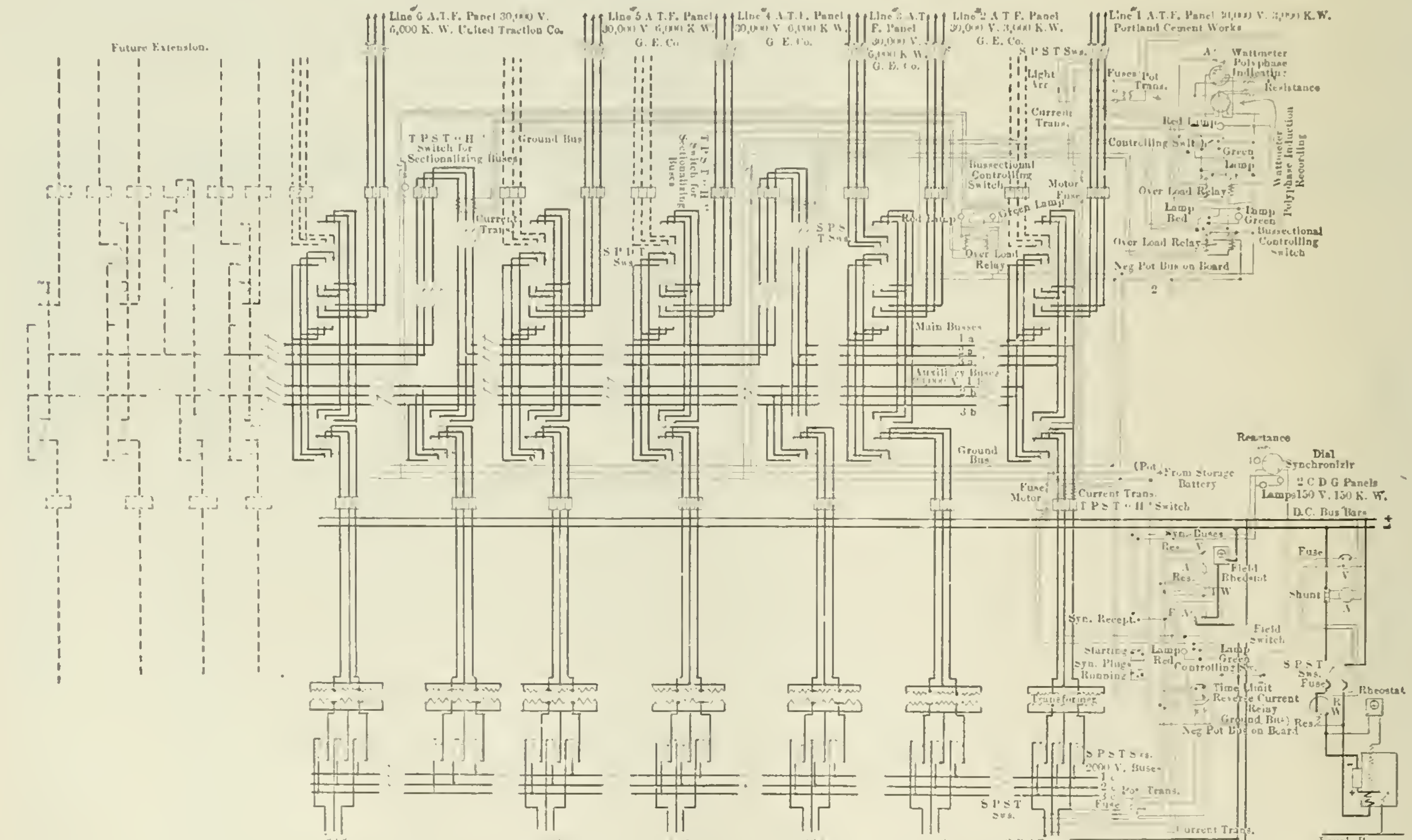


FIG. 17.—SWITCHBOARD CONNECTIONS SPIER FALLS.

At the Albany sub-station, whence the motor generators and transformers of the Albany Electric Illuminating Company are fed, the arrangement of knife switches, oil switches and bus bars permits either of the three 10,800 volt, three phase circuits from the Watervliet sub-station to supply either of three 10,800 volt circuits for synchronous motors, through either of two automatic voltage regulators. Furthermore, either of the 10,800-volt incoming power circuits may be connected to the primary coils of transformers that reduce the pressure to 2,300 volts for distribution feeders.

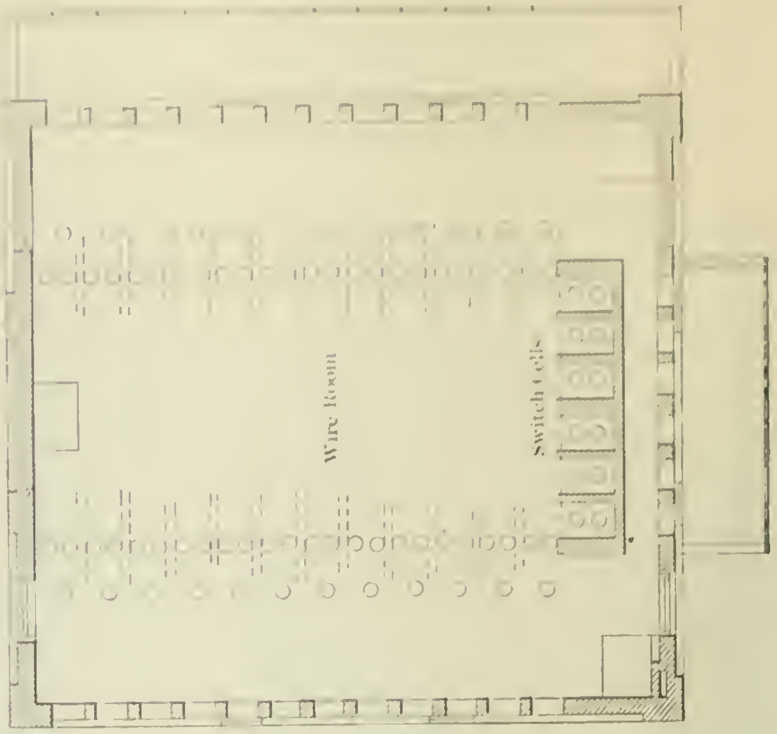


FIG. 18.—SECOND FLOOR PLAN OF SWITCH HOUSE.

The details of connections between the 26,500-volt transmission circuits and the 2,300-volt distribution circuits at the several sub-stations are illustrated by those at Glens Falls. At that sub-station the three wires of a transmission circuit, after entering double-blade knife switches that connect them at once with lightning arresters and oil switches, terminate in the three 26,500-volt bus-bars. To these bus-bars are connected the current and potential transformers that supply the ammeter, voltmeter and recording wattmeter with its overload relay and tripping coil.

The primary coils of each of three transformers may be connected with these 26,500-volt bus-bars through single-pole, double-throw knife switches. The secondary coils of these same transformers may be connected through similar switches to the 2,300-volt bus-bars that supply the distribution circuits. A fourth transformer has its primary coil connected to one terminal of each of the six double-throw switches that are normally used to join the 26,500-volt bus-bars with the primary coils of the three transformers just named. In a similar way the secondary coil of this fourth transformer is permanently connected to one terminal of each of the six double-throw switches normally used to join the secondary coils of the three transformers with the 2,300-volt bus-bars. These several connections make it possible by throwing four of the single-pole switches to completely disconnect either of the three transformers first named from the 26,500-volt and the 2,300-volt bus-bars, and to connect the fourth transformer in the place of the one thus disconnected.

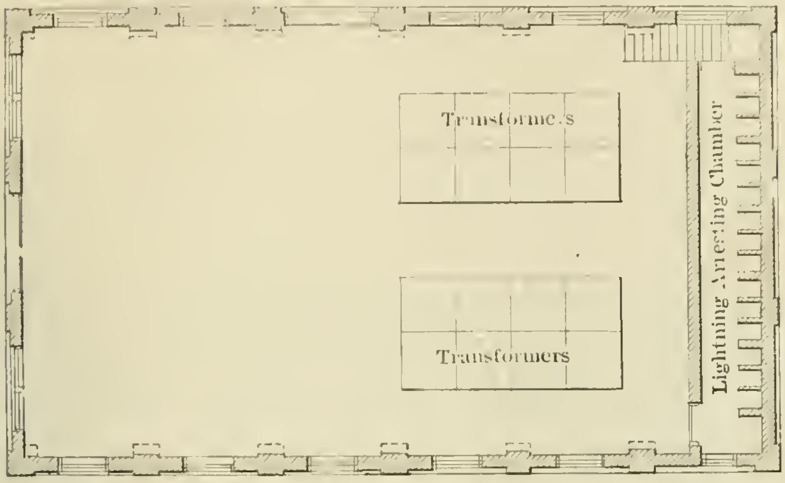


FIG. 19.—FLOOR PLAN OF SUB-STATION.

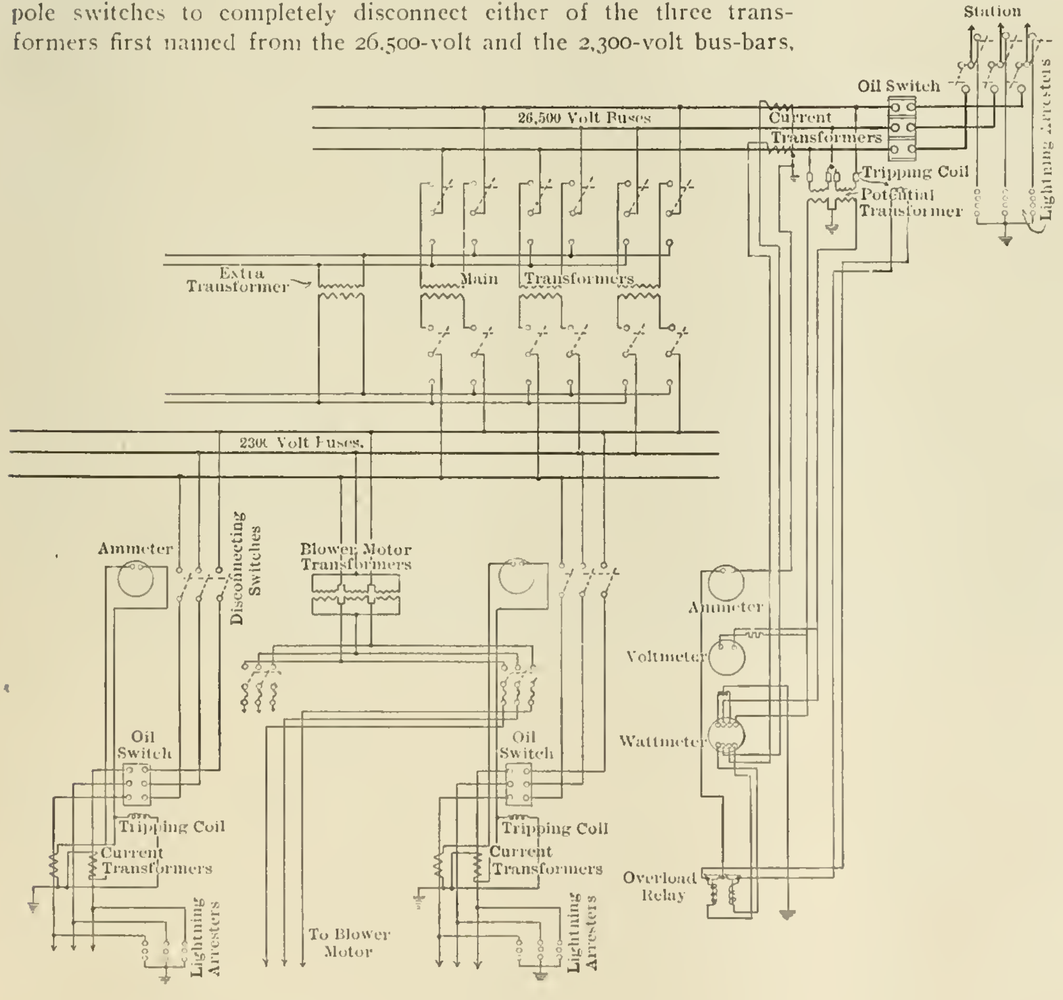


FIG. 20.—SWITCHBOARD WIRING GLENS FALLS SUB-STATION.

The switch houses at Saratoga, Alplaus and Schenectady correspond in general features of construction, though differing as to size and the number of connected circuits. In each case the walls of the switch houses are brick, the main floor concrete without a basement underneath, and the second floor is made up of concrete and expanded metal resting on steel I beams. Above the second story of each house comes the slate roof supported by planks secured to timber trusses.

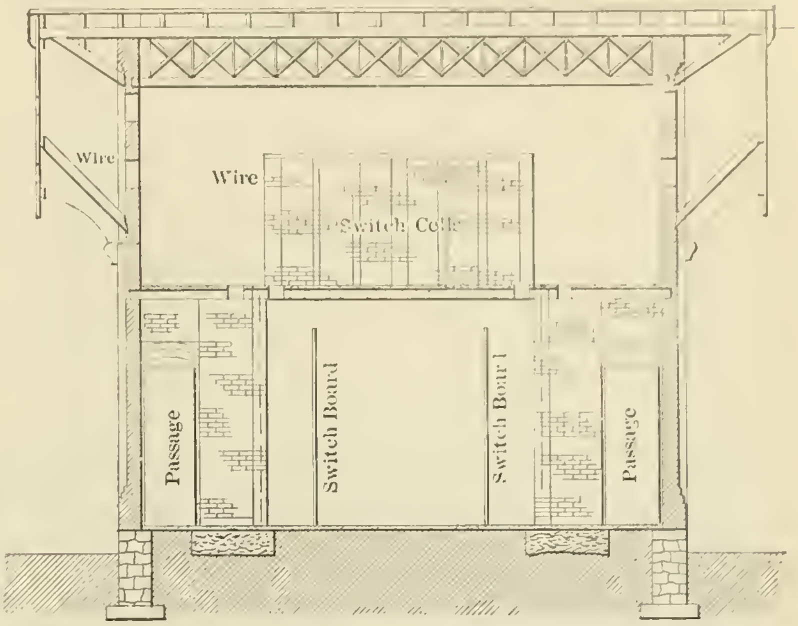


FIG. 21.—CROSS-SECTION OF SWITCH HOUSE.

The sub-stations built by the company at Glens Falls, Fort Edward, Saratoga, Ballston Spa and Watervliet, though differing in details, follow the same general type of construction, of which the Saratoga sub-station may be taken as an example. This last-named sub-station has an outside ground area of 72 ft. 10 in. x 39 ft. 2 in., and is two stories high, with a distance of 30 ft. from the ground line to the eaves of the slanting roof, and 42 ft. to the ridge. The walls of the sub-station are brick and the roof is slate laid on 2-in. matched spruce planks supported by timber trusses. Underneath the entire building is a basement with a cement floor 6.5 ft. below the first or main floor. From first floor to the lower chords of the roof trusses measures 28 ft. Stone foundation walls of the sub-station are 2 ft. thick, and extend all around the outside to a distance of 18 in. above the ground level. There are also three interior foundation walls each 20 in. thick. Starting from the top of the foundation the outside brick walls of the station shrink to a thickness of 1 ft. after a rise of a few inches. On the longer sides of the station and spaced at intervals of 8 ft. are piers in the brick wall that increase its thickness to 25 in. At a distance of 22 ft. 7 in. above

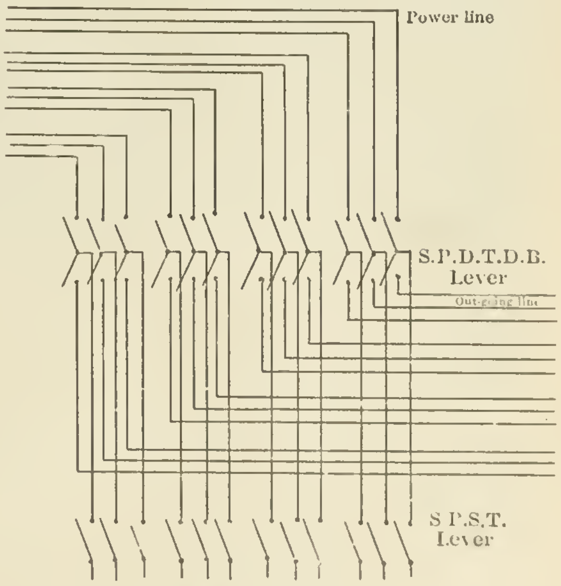


FIG. 22.—SUB-STATION TRANSFER SWITCHES.

the main floor seven of the piers on each of the two longer walls are reduced in thickness so as to form ledges on which rests an I beam for the traveling crane. By means of the interior foundation walls and double doors connecting them a large part of the basement is formed into a compressed air chamber. Into this chamber air is forced by motor driven blowers on the first floor, and over openings in the floor the air blast transformers are set. This first floor is of concrete with expanded metal supported in part on 6-in. and in part on 9 in. I beams, according to the weight to be carried. An 8-in. brick partition divides the first floor of the sub-station into a greater and a lesser part, the former being 35 ft. x 61 ft. 1 in. Another 8 in. brick partition cuts the lesser portion of the first floor into two parts, one of which is used as a work room, and the other, measuring 8 x 11 ft., forms the cell room for the knife and oil switches and lightning arresters on the 20,500-volt lines. This cell room extends up through two stories, has a second floor and the high-voltage lines enter its upper part. Along that side of the main floor of the sub-station which is next to the cell room a row of transformers is placed, and the 26,500-volt lines, after leaving the cell room, pass to these transformers over porcelain insulators mounted on the surface of the wall above them. To give ready access to the knife switches that connect these lines with the primary coils of the transformers a gallery 48 ft. 6 in. long and 5 ft. 5 in. wide is erected on the side wall where they are located, and at a distance of 11 ft. 4 in. above the first floor. On the opposite side of the main room of the sub-station from that where the transformers are located is the switchboard with its back 4 ft. 7 in. from the wall. In the center of this main room are spaces for three rotary converters and two air compressors. The two motor-driven blowers occupy a position in line with the row of transformers.

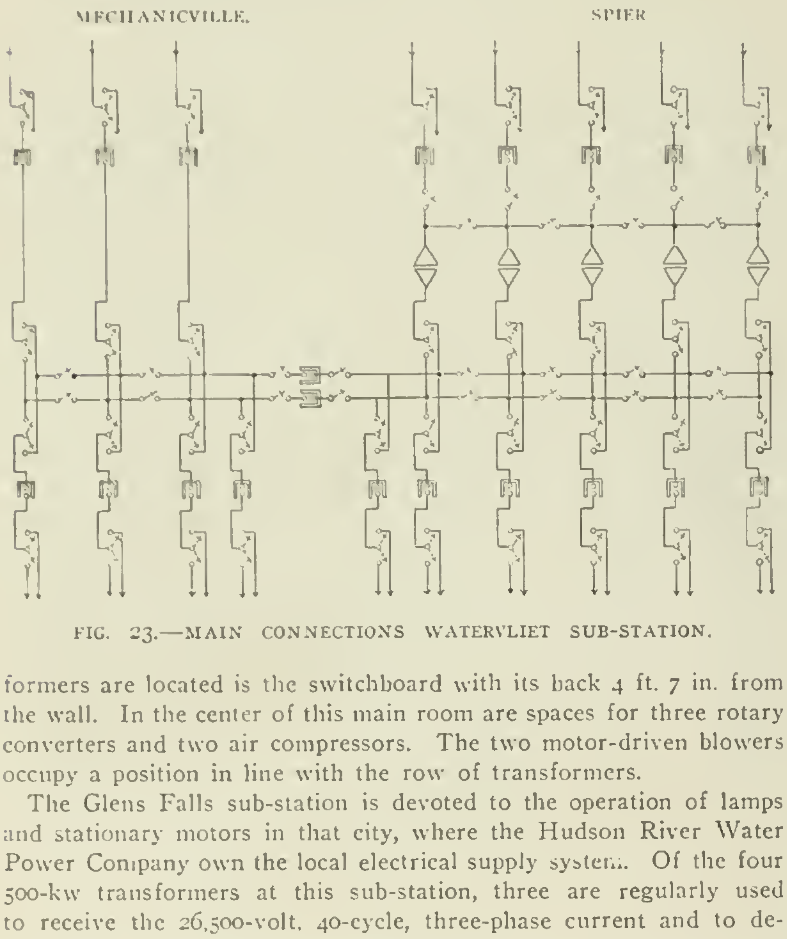


FIG. 23.—MAIN CONNECTIONS WATERVLIET SUB-STATION.

The Glens Falls sub-station is devoted to the operation of lamps and stationary motors in that city, where the Hudson River Water Power Company own the local electrical supply system. Of the four 500-kw transformers at this sub-station, three are regularly used to receive the 26,500-volt, 40-cycle, three-phase current and to deliver it to the 2,300-volt bus-bars. The fourth transformer of like capacity with the others is a spare. The 2,300-volt current is distributed for arc and incandescent lighting and induction motors. Enclosed 500-watt arc lamps for interior use have been operated during some months with the 40-cycle alternating current, and have given good results. At the works of the Glens Falls Portland Cement Company induction motors with a total capacity of 1,000 hp are to be supplied from this sub-station. The load of smaller motors scattered about the city amounts to about 300 hp.

At Saratoga, where the local electrical supply system is also in the hands of the water power company, the sub-station contains four of the 500-kw transformers like those at Glens Falls. Here again 2,300-volt, 40-cycle, three-phase current is supplied for arc and incandescent lighting and induction motors. The series arc street lamps at Saratoga will be operated with constant-current transformers. Included in the load of 350 hp of induction motors operated from the sub-station at Saratoga are three of 20 hp each on vertical shafts in the new sewerage pumping station of that city. Each of these motors is rated to pump 1,150 gallons of sewerage per minute, and all three are controlled by automatic regulators, so that they start and stop according to the requirements of the sewer system.

In Ballston Spa, where the local electrical supply system is also in the hands of the water power company, the sub-station, when completed, will contain three transformers like those at Glens Falls and Saratoga. This Ballston sub-station will be occupied in part by the transformers and converters of the Schenectady Street Railway, which uses some of the power sold to the General Electric Company.

Much the largest sub-station of the water power company is that at Watervliet, which will contain nine transformers of 1,000 kw capacity each. Here the 26,500-volt current from Spier Falls will be reduced in pressure to 10,800 volts and then transmitted, along with the 10,800-volt current from the Mechanicsville plant, to sub-stations of the local electrical supply systems in Lansingburg, Troy and Albany, also to sub-stations of the United Traction Company. The Watervliet sub-station is partly erected, some of its apparatus is already in regular operation, and it is supplying power to the sub-stations of the traction company. By the first of the coming year it is expected that the local electrical supply systems in Troy and Albany will be drawing energy from the same source.

All of the electrical apparatus at the stations and sub-stations of the above transmission system was built by the General Electric Company.

Description of this notable application of water power to electrical supply has been obtained through the kind co-operation of Mr. C. E. Parsons, chief engineer of the work at Spier Falls, and of Mr. J. D. Hilliard, Jr., manager of the electrical construction department of the system.

Meeting of American Society of Municipal Improvements.

The tenth annual convention of the American Society of Municipal Improvements was held in Indianapolis, Ind., October 20, 21 and 22. There were 59 delegates from all parts of the country. Mr. Charles H. Rust, of Toronto, Canada, president of the association, presided at the various sessions. Among the social features was a banquet tendered to the members by the Commercial Club.

The object of the society is to deal with the more technical questions of engineering work connected with the maintenance of the modern city. The membership of the society represents more than 100 cities, besides including manufacturers, contractors, engineers and city officials.

In his address President Rust touched upon the subject of electric railways in and between cities. Owing largely to the methods of construction and the low cost of the right of way, he stated, interurban companies have been enabled to charge lower rates than those charged by steam railway companies, with the resultant effect of causing the steam roads to discontinue local trains in many instances. He referred to modern methods of railway construction, and pointed out the experiences resulting from electrolytic action on underground pipes by the return currents from railway circuits. He was of the opinion that all municipalities should now insist upon trolley and feed wires being placed underground. Mr. Rust thinks that every city should own and operate its water and lighting systems.

Among the papers read was one by Mr. Thomas B. McMath, chief engineer of the Indianapolis Traction & Terminal Company, which was largely a description of the plans of the new terminal station now being erected at a cost of $1,500,000.

Mr. A. F. Hatch, of Detroit, read a paper on the subject of electric lighting in Detroit. He described a card system designed to keep a record of all wires above and underground in Detroit. Mr. Hatch was of the opinion that every municipality would save a good deal of money if the same system were adopted.

A paper was read by Mr. E. A. Fisher, city engineer of Rochester, N. Y., an abstract of which was published in our last issue. Other subjects discussed at the meeting related to water supply, pavements, the smoke nuisance, taxation, etc.

The following-named officers were elected for the ensuing year: President, G. M. Ballard, of Newark, N. J.; vice-presidents, A. P. Allwell, of Easton, Pa., and C. A. Brown, of Indianapolis, Ind.; secretary, G. W. Tillson, of Brooklyn, N. Y., and treasurer, F. J. O'Brien, of Oswego, N. Y. The next convention will be held in St. Louis in 1904.

Dublin Three-Phase Central Station.

On several occasions, and editorially last week, we have referred to the Dublin electric lighting system, which went into operation in September, and which employs the four-wire, three-phase distributing system. This plant displaces a single-phase installation which was started by the municipality in 1892, and at the time of its displacement had connected the equivalent of 16,500 16-cp lamps. The old plant had a primary voltage of 2,000 with a secondary pressure of 100 volts, and operated with 83 cycles per second. In addition, some street lighting was provided by arc machines. The distribution has been underground from the beginning. The first cables that were laid decayed rapidly and in 1899 an entirely new system was laid, the secondary pressure changed from 100 to 200 volts, and instead of each house having its transformer, all transformers were grouped into five sub-stations. The system, as operated, never gained favor, and it was finally decided to put in an entirely new plant, though $400,000 had been expended on the old one.

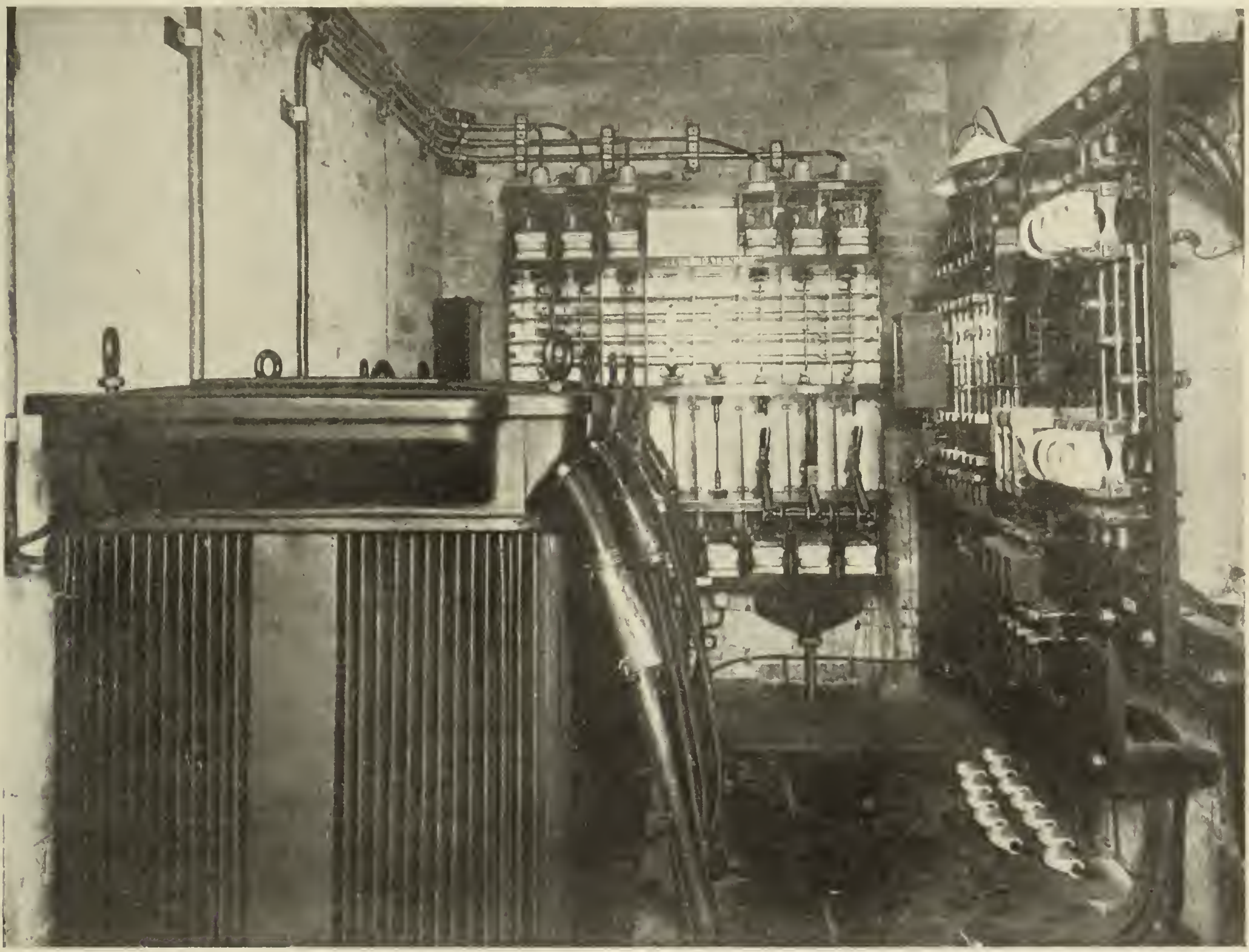


Fig. 1.—View of Interior of One of the Sub-Stations.

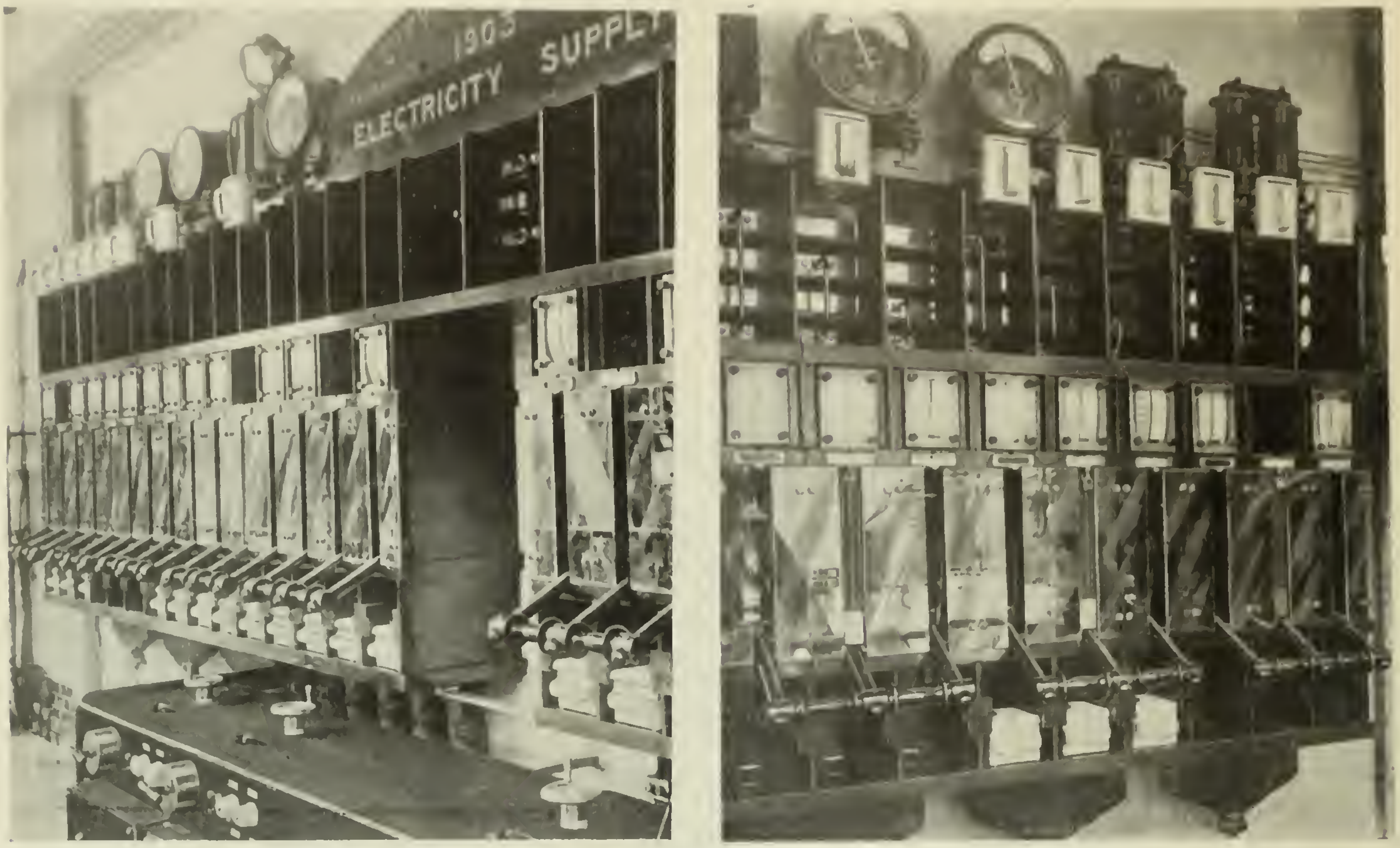
The cost of the new plant has been $1,222,000, the principal items being, in round figures, as follows: Buildings, $150,000; cables, $545,000; dynamos and engines, $165,000; boiler equipment, $89,000; arc lamps and pillars, $60,000; transformers and meters, $55,000; switchboards, $50,000.

As above stated, the system adopted is a four-wire, three-phase system. Primary current is generated at the entrance of Dublin Harbor and transmitted to a sub-station in the city. The secondaries of the sub-station transformers are star-connected, the old 2,000-volt mains being connected on separate phases between the outer points and center point. Twenty new sub-stations are being added, which will supply 200-volt networks, the lamps being connected between the outers of the star and the neutral common return to the center of the star. The arcs are supplied with direct current through motor-generators.

The generating works are equipped with all modern improvements, including coal-conveying apparatus, ash-handling plant, cranes, etc. The main generating sets are four in number, two of 1,000 kw and two of 500-kw capacity, and were supplied by the Oerlikon Works. One of the larger type is shown in Fig. 4, and one of the smaller type in Fig. 5. The magnet coils are wound with bare copper on edge, and the armature coils are accessible on removing two of the magnet coils. The armature casting is in four parts. The windings of the three phases are not connected on the machine itself, but are brought to the terminal box at the side of the frame, and thence three separate concentric cables run to the switchboard, the star connection of the machine being made at the switchboard, as will be explained further on. Current is generated directly at 5,000 volts, the frequency being 50 periods per second. Multipolar exciters, supplying a maximum current of 260 and 320 amp., respectively, at 100 volts, are driven by the main engine shaft, the armatures being overhung.

The normal speed of the smaller engines is 94 r.p.m., with a working steam pressure of 150 pounds per square inch and a vacuum of 26 inches, the indicated horse-power of each engine being 820. The larger engines run at 83.5 r.p.m., and under the same steam pressure and vacuum give an indicated horse-power of 1,620. The guaranteed steam consumption is 19 pounds per kw-hour for the larger sets and 21 pounds for the smaller sets. In addition to the main generating sets there is a 25-kw Kolben motor-generator, which charges a storage battery used for lighting the works. The motor is a squirrel-cage induction motor, which is usually started up from the direct-current side. The station is lighted at 100 volts, so that in the case of an accident to any exciter the alternators can be excited from the storage battery. At a normal six-hour discharge rate the capacity of the battery is 1,200 amp.-hours, and the maximum discharge rate is 650 amp.

The main switchboard (Figs. 2 and 3) is of the Ferranti cellular type, but there are some slight departures from usual practice in its arrangement. As has already been noted, three concentric cables are brought from each dynamo to the switchboard, these being connected to the three windings of the armature. Each outer of the concentric cables is connected to a bar at the bottom of the switchboard, and this connection is led to a small board upon the same platform as is the main board. Here this connection, which forms the center of the star connection of the dynamo, is earthed through a cut-out and an ammeter, the circuit to earth being broken by the cut-out if the current passing through it exceeds 7.5 amp. On this same board are three ammeters connected between the ends of the bound wires of the iron troughs containing the three feeder cables and earth. The ammeters are worked through transformers, and have each two scales with a different transformer for each. One scale reads from 0 to 3 amp., the other from 0 to 80, and there is a switch above each ammeter to connect up the transformer corre-



FIGS. 2 AND 3.—MAIN SWITCHBOARD.

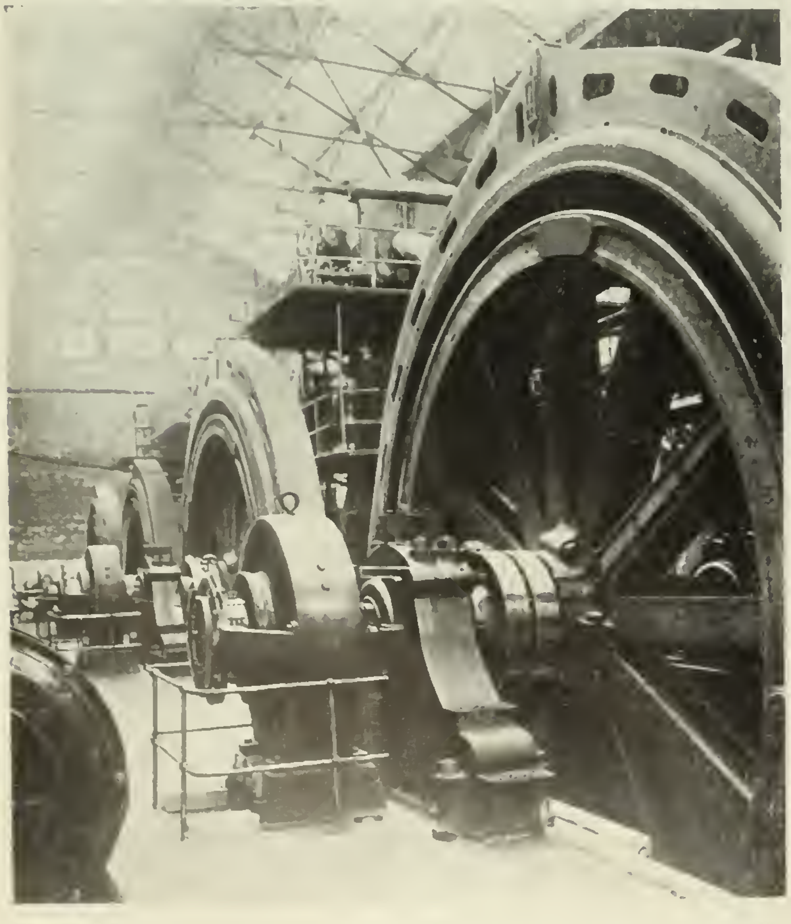


FIG. 4.—1,000-KW UNIT.

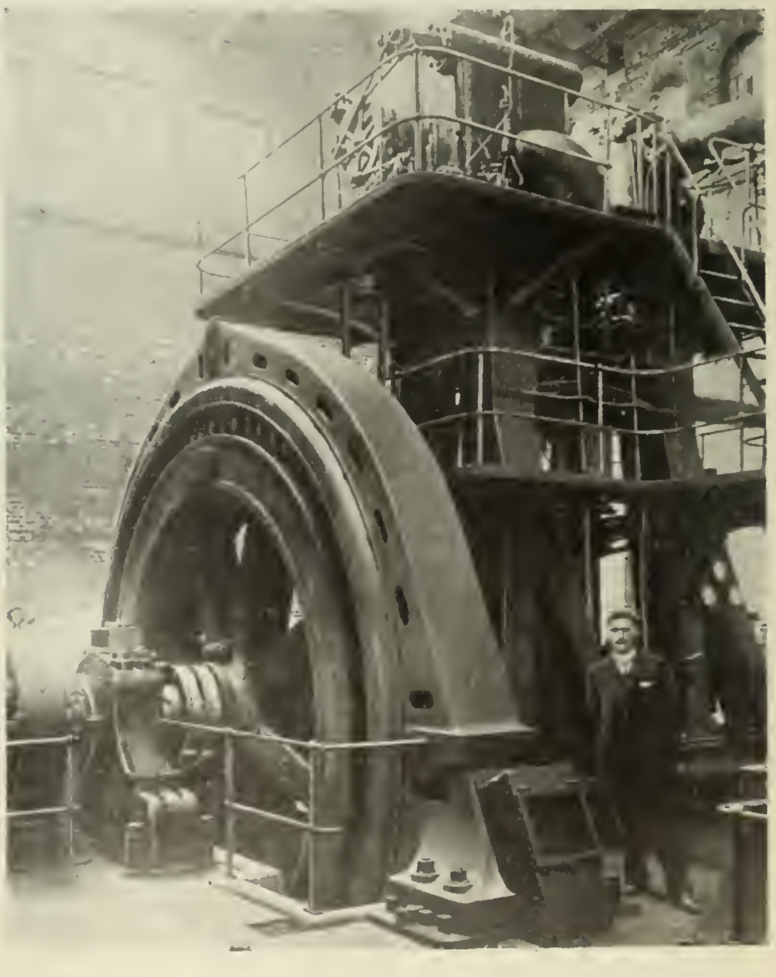
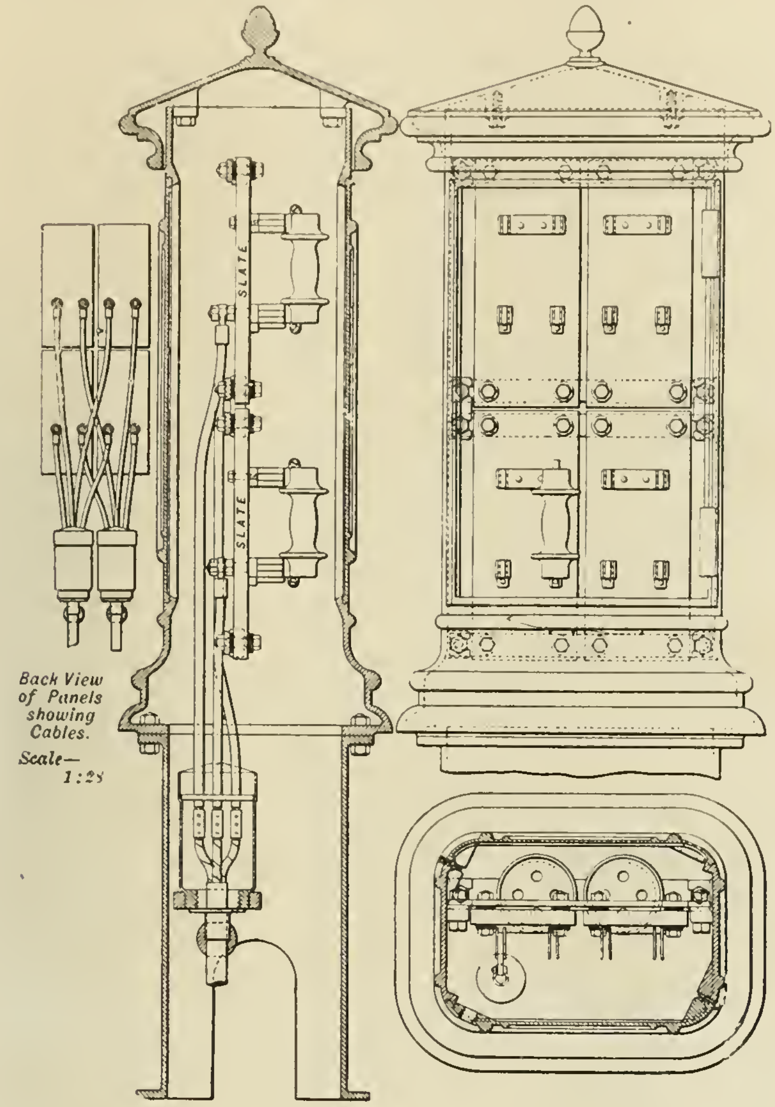
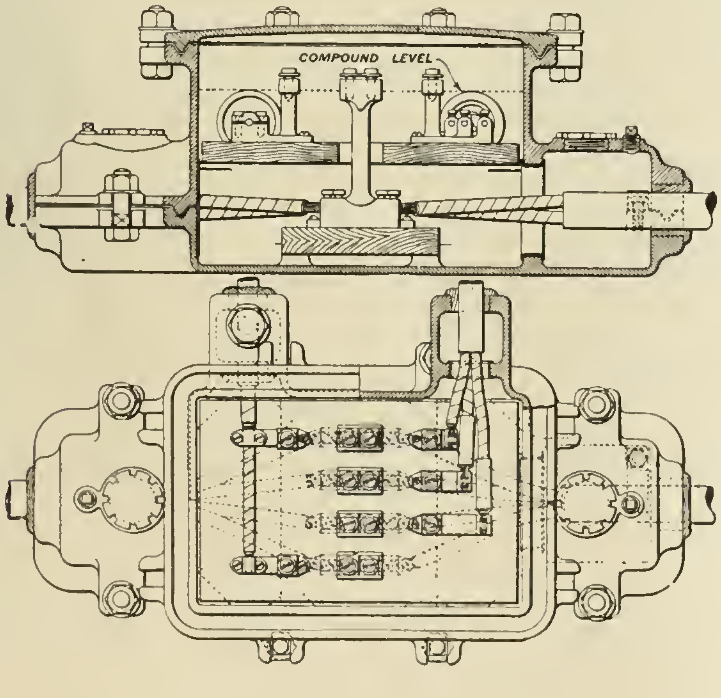


FIG. 5.—500-KW UNIT.

sponding to the range desired. Four integrating wattmeters for the four generators are also placed on this smaller board.



FIGS. 6, 7 AND 8.—SECTIONAL ELEVATIONS AND PLAN OF DISTRIBUTION PILLAR.

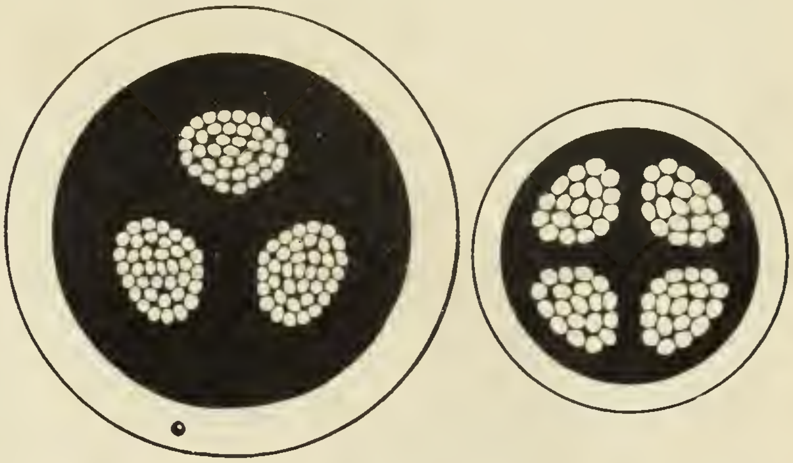


FIGS. 9 AND 10.—ELEVATION AND PLAN OF HOUSE SERVICE BOX.

On the main board the switches are of the oil-break type, shown in Figs. 13 and 14, which give a front view and a section through the working parts of the switch. There are the usual two contacts, the main one at *A*, and the final break at *B* under oil. The contact piece of the latter is a U-shaped steel forging, and the quick release is attained by a spring and trip device, as seen in the drawing, from which also the general construction and relative position of the parts is apparent. The levers of the switches for the three phases, in the case of the generator and of the feeder panels, are coupled together, and the working parts are protected by sheets of glass, as seen in the views of the board. There are three feeders from the generating station to Dublin, two of which are in constant use and one is held as spare. The panels for these are arranged similarly to the generator panels, with the difference, however, that the spare feeder panels are duplicated, one being placed on either half of the board. There is no device either for charging or discharging the cables before switching on or off, and no spark arresters have been fitted to take any possible momentary excess of pressure; the feeders are switched directly on and off the bus-bars. The synchronizing and also the field regulating arrangements are the usual ones, extra switches on the exciter regulating desk being for working signals to the engineman for increasing or decreasing speed.

In addition to the main board and the earthing board already mentioned, there is a small board at one end of the switch platform for the works lighting circuits, the motor-generator and cells, already mentioned. The motors for the coal conveyor and economizer are three-phase, being supplied through 5,000:100-volt step-down transformers.

Fig. 11 is a full-size section of the main high-tension feeders. Each core of these has a sectional area of 0.15 sq. in., and a capacity of 0.3 microfarad per mile when measured with the other two cores connected to the lead sheathing and earthed. As the feeders are 3.13 miles in length, it is seen that the capacity approaches to 1 microfarad. There being a potential difference of 5,000 volts between the phases, the potential of each of the cores with regard to earth is 2,886 volts. The cables are laid in cast-iron troughing ⅜ in. thick, the troughing being filled up "solid" with pitch in the usual manner. Part of the cable line is under the footway and part under the roadway, and in the latter case an extra protection of concrete is provided. Particular care is taken to have the troughing electrically continuous. There are bosses cast on to the sections of the troughing, and these are faced and thoroughly cleaned immediately before laying the troughs being bolted together as soon as in position. In addition to this, a bare copper wire is run inside the troughing and clamped to each section of it, this wire being also connected to the lead of the cable every 200 yards.



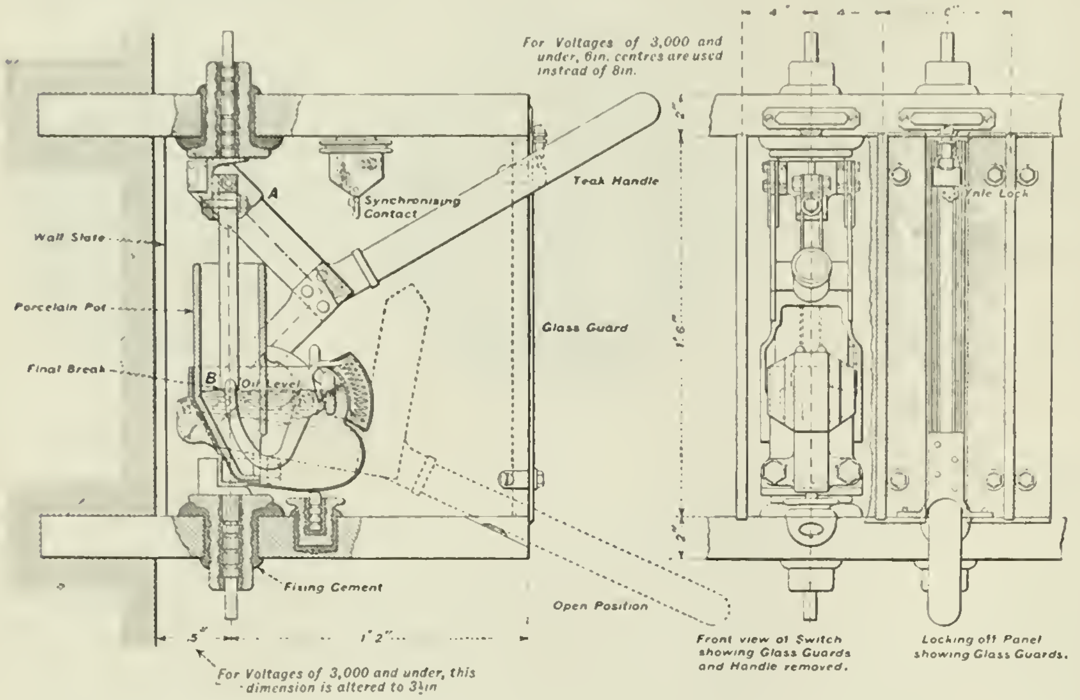
FIGS. 11 AND 12.—SECTIONS OF HIGH-PRESSURE 3-CORE AND LOW-PRESSURE 4-CORE CABLES.

These three cables terminate at the old Fleet Street station, which now forms a sub-station and switching center as well as a depot for testing the regulating mechanism for the arc lamps. On the way they have to cross a canal through a tunnel beneath the bed of the canal. At Fleet Street a large Ferranti board has been erected in two halves back to back. One of the feeders is brought to each side of this board, and the spare feeder has a panel on each board, as is the case at the generating station. At the front of the board are also similar panels for the arc lighting motor-generators, which are erected at the Fleet Street works; the primaries of the step-down transformers have panels at the back of the board, and the extra high-tension feeders to the new sub-stations are divided between the front and back. As the transformers are at the back, and the motor-generators at the front, this is the most convenient arrangement.

The Kolben motor-generators are three in number and are identical, each consisting of an induction motor driving two continuous-current generators. The motor stands in the middle of the bedplate, with a generator coupled on either side of it, and is directly connected to the 5,000-volt mains through the switchboard just mentioned, no transformers being used. It is fitted with slip rings and the standard type of starter, there being a device attached for short circuiting the rings and lifting off the brushes when the machine has run up to speed. The full-load speed is 488 r.p.m., the machine having 12 poles, and working off the 50-cycle circuit. The generators are employed for arc lighting only, each of these being capable of giving an output of 125 amp. at 550 volts; the set is, therefore, rated at 140 kw. The complete sets have been designed to have a guaranteed efficiency of 84 per cent. at full load. The two direct-current machines of each set are connected in series, the idea being to earth the middle point.

The switchboard for the direct-current side is separate, and is arranged to deal with the three double dynamos and with feeders for the arc circuits. In working, the circuits are divided into two groups, which are fed by separate dynamos, and the third set is held in reserve as a spare. There is also a switchboard at which the actual arc lamp circuits can be subdivided. In all there will be 23 10-amp. circuits with from 19 to 22 lamps on each.

The old lighting system was single phase, current being supplied at 2,000 volts from the Fleet Street sub-station to five sub-stations, from which low-tension, single-phase networks were fed at 200 volts. These sub-stations and networks are retained, and are, in fact, still fed from the old switchboard at Fleet Street, the step-down transformers already referred to being employed to change the pressure from 5,000 to 2,000 volts between the two switchboards. For this purpose three 250-kw, single-phase Westinghouse transformers have been provided, with a fourth one as spare, and also four 50-kw transformers (one being spare) for the light-load periods of the day. The primaries of the transformers are delta-connected, and the secondaries star-connected, the middle of the star being earthed. The secondary terminals of the transformers are directly connected to the old high-tension board, so that each group of three takes three independent circuits. Any motors on these circuits must be single-phase, but few are connected at present, and the new motors which come on will doubtless all be connected to the new three-phase secondary networks.


For Voltages of 3,000 and under, 6in. centres are used instead of 8in.
A
Synchronising Contact
Teak Handle
Wall Slate
Porcelain Pot
Glass Guard
Final Break
B
Oil Level
Fixing Cement
Open Position
2"
1'6"
2"
5"
1'2"
For Voltages of 3,000 and under, this dimension is altered to 3½in
4"
4"
6"
Yale Lock
Front view of Switch showing Glass Guards and Handle removed.
Locking off Panel showing Glass Guards.

FIGS. 13 AND 14.—SECTION AND ELEVATION OF OIL-BREAK SWITCH.

The new three-phase circuits are fed from 20 overground sub-stations, one of which is shown in Fig. 1. Here the current is transformed down to 200 volts, the primaries of the transformers being mesh-connected and the secondaries star-connected, 200 volts being the pressure between the outers of the star and the center point. The secondary networks are all distinct and not interconnected, and four-core cables of various sections are employed for distribution. One of these is shown in section in Fig. 12. The lamps are placed between one of the conductors connected to the outer of the star and the fourth conductor, which acts as a common return for the three phases, and is joined to the center of the star and earthed. Theoretically, of course, if the three circuits were perfectly balanced, no current would flow back through this conductor, but in practice it appears that the circuits will be far out of balance, that the four cores have been given equal section. The motors are, of course, to be connected across the phases without the neutral wire being employed. That the main reason for the adoption of this system is that it allows of a higher pressure between the three conductors corresponding to the three phases than if the lamps were simply connected on the three phases in the ordinary way. Two hundred volts has to be supplied at the lamp terminals, and by this four-wire connection the pressure between the three main conductors is $200\sqrt{3} = 346$ volts. Thus, even with four conductors of equal section, the total weight of copper employed is diminished. On the other hand, each conductor has to be better insulated, and, what is more important, the method of connection introduces more complications in the junction boxes and increases their size. Fig. 6 shows a four-core distribution pillar and Figs. 9 and 10 a plan and sectional elevation of one of the house service boxes, these being typical of the designs employed. The box in Fig. 10 shows an ordinary lighting and a motor connection taken off from a four-core distributor. The low-tension cable is laid in the same manner as the high tension cable, except that when the troughing is under the footways its thickness is reduced to ¼ in. Before handing over, all cables, both high and low-tension, were tested at double the working pressure, and in the total quantity of cable laid (150 miles) only four faults were discovered, two of which were due to mechanical injury.

To encourage new consumers a reduction has been made in the tariffs for electric light and power. Hitherto the charge has been a flat rate of 12 cents per kw-hour, but now the Wright system has been adopted. The charges for lighting are 14 cents for the first hour and 5 cents after, and for power 14 cents for the first hour and 2 cents after. There is now under consideration as an alternative a flat rate of 12 cents for lighting and 6 cents for power, and special flat rates of 9 and 8 cents, respectively, for lighting places of worship and theatres, music halls, etc. Meter rents are charged, the charge being from 67 cents to $1.87 per quarter, according to size.

The Electrical Industries of Germany.

Mr. Simon W. Manauer, Deputy United States Consul-General at Frankfort, reports as follows on the state of electrical development in Germany. The electrical industries of Germany form the subject of a brochure published by Dr. Bürner, the syndic of the Association for Guarding the Interests of German Electrotechnics. This expert says that in the year 1900 about 2,500,000,000 marks ($595,000,000) was invested in that branch of German industry. The severe crisis which it has undergone, and from which it still suffers, is in the main due to the following causes:

1. The electrical companies, instead of confining their activity to manufacturing, engaged in promoting ventures and obtaining concessions, and carried on the building of electric roads, lighting plants, etc., in the towns and rural districts, instead of leaving those enterprises to the municipalities, financial promoters, and private companies.

2. A great mistake was committed in erecting and conducting branch electrical factories in foreign countries, which caused numerous competitors to spring up in those countries and led other German companies to enter the foreign business, thereby producing a sharp struggle to obtain profitable orders.

As a third error, Dr. Bürner names the practice inaugurated by the electrical companies of establishing installation shops in all the cities and large towns of Germany, instead of leaving that part of the business to the resident plumbers and installation concerns.

Dr. Bürner does not favor the plan of uniting the German electrical companies in one common concern. He urges the formation of syndicates to regulate and protect prices and limit production where such is unprofitable. His main recommendation is to extend and increase the export trade.

The Electrical Drive for Machine Tools.

By Robert Lozier.

The writer has read with a great deal of interest on page 473 in the September 19th issue of Electrical World and Engineer, the article written by Mr. C. H. Hines on the electrical drive as applied to machine tools with special reference to railroad shops. Mr. Hines truly indicates that the rapid developments in air hardening steels have been largely responsible for shopmen investigating the methods that are available for increasing the driving speeds of the tools so as to get all the advantages out of these rapidly cutting steels.

Now, in seeking these advantages, the shopman desires to increase, first, the total range of the machine tool speed, and, second, the number of changes that can be made in that larger range.

To apply these new conditions the operator should study the tool or tools and see how far these changed conditions can be applied, and then seek the system that best accomplishes these results, rather than to first select a particular system and then endeavor to make the tools fit its possibilities or limitations. Judging from Mr. Hines' article there is no lack in the number of systems available to select from.

In studying the methods of driving tools Mr. Hines makes two general classifications: First, the new machine shop with a complete outfit of new tools on which the work to be done is of a varied character; and, second, those shops consisting largely of old tools in which the work to be done is practically of the same nature year in and year out.

He states that in his mind there is "no doubt of the superiority of the individual motor with varying speeds," for the first classification he makes, and I agree, in general with him, on that particular point. As regards the second classification—the shop with the old tools—he states it becomes a question of whether it would pay to attach individual motors to old machines (but too serviceable to be scrapped), most of them unfitted for high speed steels, and the inference is that he considers it best to group these old tools and drive them from a common line shaft "providing such speed changes that might be necessary by mechanical means." I would suggest that he should have considered these old tools in which the speed is not to be varied separately from the old tools in which the speed is to be varied. If we consider the old tools in which the speed is to be varied, then we should be careful to determine how far we can benefit by applying the individual motor with its variable speeds to these old tools before we consign them to group driving; for it must be remembered that such an old tool requires just as much expenditure for wages as if it were new, and it is with a view to making the wage produce a greater output, from the tool, that forms the principal reason for adopting the individual motor drive with its wide and flexible speed range.

The reason for Mr. Hines' preference for grouping old tools seems to be found in the latter part of his statement, that "it becomes a question of whether it would pay to attach individual motors to old machines *most of them unfitted for modern high-speed tools.*" (The italics are the writer's.) I gather from this that he has in mind the fact that the old tools are not able to stand the strain of displacing metal at the high cutting speeds that the new air-hardening steels are capable of. Herein lies the meat of the argument, and I desire to particularly point out that the increased output of a tool does not by any means always depend upon displacing all the metal the cutting tool is able to stand, but upon doing any particular piece of work at the most economical speed. If we have but five steps to our cone pulleys with the usual ratio of speed, it is not uncommon to find that we cannot get within twenty per cent. of the speed we desire. With a twelve-step variable speed motor properly proportioned, we can get within seven and one-half per cent. of the desired speed, and these variations are not only more readily obtained but can be made while the tool is cutting by simply moving the controller handle, instead of shifting the belt. Thus the individual variable-speed motor has a material advantage in that it has many more increments of speed, any one of which may be attained with greater ease than with the belt-driven tool. This applies equally to an old tool as to a new, and is quite apart from the further advantage that the range which represents the sum of these increments of the variable-speed motor is greater than the old cone variations, and enables the tool to be run at a higher speed than before, which applies only to such tools as can stand the racket, whether old or new.

I will take Mr. Hines' example of the wheel lathe to illustrate the point I have just endeavored to make. He states it as follows: "Now it would be folly to attach to such a tool a variable-speed motor with its high initial cost simply to provide for an occasional 'hard spot' or an unusual hard pair of tires, for cone pulleys would take care of such rare cases."

If this wheel lathe were equipped with an individual variable speed motor, a tire could be turned at the rate of twenty-six feet per minute if it has no "hard spots." If it had "hard spots"—and they are not infrequent in wheel tires—at each revolution the operator, by means of a multiple-voltage controller, slows the same down to a speed of four feet per minute while passing over a "hard spot," turning at least ninety per cent. of the tire at twenty-six feet per minute and ten per cent. of the tire at four feet per minute. With a belt-driven lathe, it would be necessary to adjust the speed for the entire process to four feet per minute (or for one hundred per cent. of the time) to accommodate the "hard spot." Mr. Hines, under such conditions, will only get out of the belt-driven lathe twenty per cent. of the work that is got out of a motor-driven lathe. This applies equally well to boring mills. The writer has even seen this thing carried out to a very much greater refinement in the case of finishing the outside of a spider in which a motor is speeded up at the space between the spider arms and slowed down just as the tool enters the face of the spider arm.

If we are to retain these old tools we must use every possible method for increasing their output to keep pace with the new, and as we cannot in some cases run as high in speed, we *can* facilitate the work by quickly changing the various speeds. In order to illustrate this statement by what has long ago been done in machine-shop practice, I would point to the engine lathe and turret lathe. The turret lathe was introduced not because it removes metal more rapidly than the engine lathe, but because it can be changed from one operation to another more quickly.

Now, however, if the tools are to be grouped, then it becomes necessary to select the best form of power distribution and type of motor. In making this selection Mr. Hines gives the preference to the induction motor and gives as his only reason for doing so the absence of the commutator; but again it is advisable to consider all the points involved in the systems available, so that in the one selected the advantages outweigh the disadvantages to the greatest extent.

For example, it may be of some slight advantage to have motors without commutators for the constant-speed work, but does this offset the consequent disadvantage of having two complete systems of power circuits and corresponding kinds of motors in the shop—one the alternating polyphase current for the induction motors which have no commutators and which cannot vary the speed, and the other, the direct-current multivoltage system for the variable speed motors? Concerning the latter Mr. Hines says, "It will be necessary perhaps to have a small amount of direct current for cranes and these will be perhaps a few large tools that it may pay to equip with individual variable speed motors." As it is, therefore, necessary to have the direct-current system in order to have variable-speed motors, not only for the cranes and big tools, but also for the new tools for doing work of a varied nature that will be introduced from time to time, why not select the direct-current system solely? It can successfully perform all the classes of shop service—that is, variable speed for tools and cranes, constant speed for tools, group driving and electric lighting. Why complicate this simple plan by adding to it the polyphase alternating-current system for accomplishing a purpose that can be well performed by the direct-current system which must be installed if individual motors are used to drive tools and cranes? Concerning this very alternating-current system, Mr. Hines says in his article, "In deciding upon the size of motors to be provided for the different tools, care must be taken in the case of the induction motor that the question of power factor is considered, as if the motors are much too large for the work they are to do, the station will have a large factor of wattless current to deal with."

Why have these wattless currents and other complications when the manufacturers of direct-current motors are guaranteeing their commutators to have sparkless operation for fifty per cent. overload, and the friction cannot be counted against them because their total efficiency is as high and generally higher than that of the induction motor?

In summing up the very interesting proposition involved in Mr. Hines' article, may I venture to suggest as my view of the case that it is best first to carefully consider all of the conditions to be met, not only as concerns the tools themselves, but their relation to each other, the disposition of overhead space with reference to crane service, light and heat, character of building with reference to supporting mechanical power transmission, or a lighter construction permissible with individually driven tools, and then having finally determined all those questions individually and collectively, to select that one system of power transmission which possesses the greatest common good.

We are glad that Mr. Hines will at some future date give us a detailed description of the plant with tests, and are sure that the ideas he sets forth are of value not only as being an expression of his opinion but as opening the way to a full discussion of this most interesting and comprehensive study.

Electrically Operated Mine Pumping Engine in the Gneisenau Mines, Germany.

Last year the management of the Gneisenau mine, near Dortmund, Germany, decided to replace their small lighting plant by a large electric central power station, which was to furnish current for lights and a large number of motors situated in the various shops. At the same time a new mine engine was to be installed which was to be operated by a 665-hp electric motor. As this motor consumed about one-third of the total output of the station, the three-phase current was selected, at a pressure of 2,500 volts and 25 periods per second. In this manner the advantages of the asynchronous induction motors, versus direct-current motors, were utilized. For light and power purposes during the daytime the voltage is transformed to 500 volts, while the pump motor is operated at 2,500 volts. The installation includes the following apparatus: Two direct-connected dynamos, furnishing three-phase current, each of 625-kw capacity; two transformer sets for excitation and lighting, furnishing direct current, one of 38 and the other of 50-kw capacity; one direct-current, direct-connected generator of 38-kw capacity, for the starting excitation of the primary generator; one asynchronous pump motor of 665 hp for operation of the subterranean mine engine. The entire plant was installed by the Helios Elektrizitäts-Aktien Gesellschaft, of Cologne.

The engines were built by the Sächsische Machinenfabrik of Chemnitz. They are of the horizontal compound type, having a rating of 680 hp at 83 r.p.m. The dynamos are of the internal pole type; that is, the poles are attached to the fly-wheel which forms the rotor, as shown in Fig. 1. The data are as follows: Diameter of magnet frame, 4,760 mm.; axial width, 330 mm.; number of poles, 36; e.m.f., 2,500 volts; number of slots, 423; bars per slot, 3. The cast-iron frame is light but solid, and so constructed that even while the machine is in operation all parts can be inspected and repairs be made with ease. The two generators are excited by two transformer sets, each consisting of a three-phase motor coupled to a direct-current egenerator. For the excitation of the generators after the plant has been shut down, a 38-kw, direct-current dynamo, driven by a steam engine by means of a belt, is used. This method obviates the necessity of a storage battery.

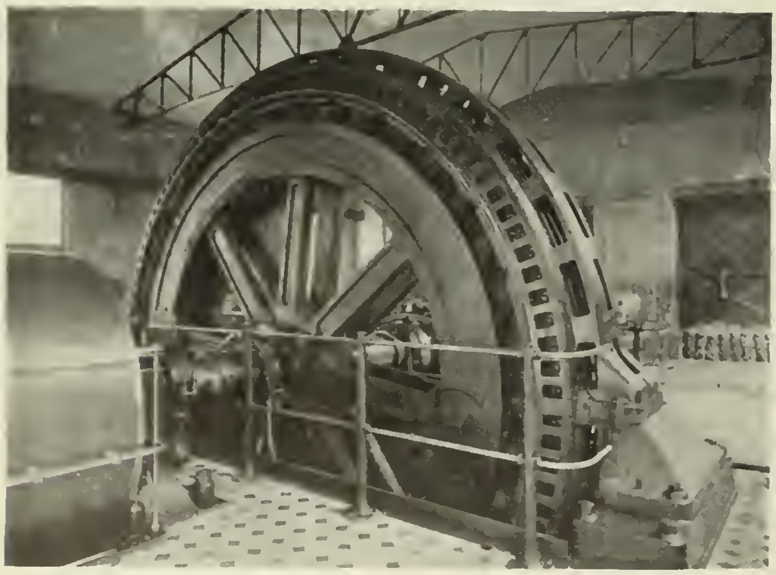


FIG. 1.—ONE OF THE DYNAMOS.

The subterranean mine engine was built by Ehrhardt & Sehmer, of Schleifmuhle, near Saarbrucken. It consists of two double-acting plunger pumps with common crank shaft, the cranks being set at 90° apart, and is driven by a direct-connected, three-phase motor. The two pumps have two air suction cylinders, four air pressure cylinders and a common air pressure cylinder for the discharge. The plunger is 216 mm. in diameter and the stroke 600 mm. The pump is located 380 metres below the surface and the suction height is from 3 to 4.5 metres. The duty of the pump at a speed of 61 r.p.m. is 5.3 cu. metres.

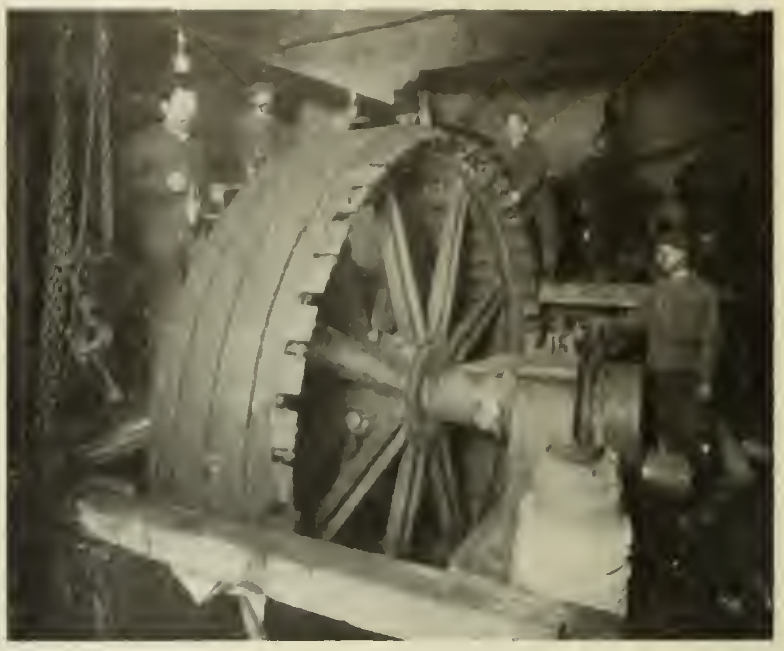


FIG. 2.—CONSTRUCTING MOTOR IN PUMP CHAMBER.

The data of the three-phase asynchronous motor direct-connected to the pump are as follows: External rotor diameter, 3,600 mm.; axial width, 610 mm.; r.p.m., 61; number of slots on rotor, 576; bars per slot, 2; number of slots on stator, 432; wires per slot, 16. The motor may be started by the dynamo direct or from the bus-bars.

Many difficulties were encountered in the installation on account of the small cross-section of the shaft, namely, 1,800 x 800 mm. It was necessary to build the stator in four parts, bolt the feet on separately and wind the stator in the mine. The two-part rotor also had to be wound after it had arrived at the mine. Special care had to be taken in transporting the material through the wet shaft, as well as the winding in the damp pump chamber, shown in Fig. 2.

The armature body and pressure plates, which also support the winding are provided with numerous holes, so that the air can circulate freely and the sheets and winding be kept cool. The stator consists of a four-part cast-iron frame, to which the plates are fastened by means of bolts. On the other end of the armature are the collector rings of phosphor-bronze with a short-circuiting device constructed as follows: On the outside of the collector rings is a flat plate with contacts which are alternately connected to the collector rings. By means of a lever a ring can be brought in touch with these contacts, thus short-circuiting the collector rings. A second lever lifts all the brushes. These levers are interlocking. The two movements can only be executed in succession and in the right order.

The pump motor may be started in either of two ways: Firstly, the short-circuited motor may be connected to one of the two dynamos, which is at rest. As soon as the dynamo begins to turn, the motor also turns and reaches its full speed simultaneously with the dynamo. This is the simpler and more convenient method. It requires no collector rings on the motor, but it is necessary when starting the same to first stop a dynamo. On this account there must be two separate three-phase circuits provided at the switchboard; one for the ordinary light and power service, and the other for starting the pump motor. As it was found desirable, however, to be able also to start the motor directly from the circuit, an oil-cooled starting box was installed, by means of which resistance was inserted into the rotor circuit at starting.

This starting box has stationary brushes through which the current is led, while the contacts from which the current is supplied may be moved by means of a vertical shaft. These contacts are built up like a collector with air insulation. Nickeline strips are used as resistance, and are imbedded in oil. As the brushes are stationary and the resistance moves in oil, a good circulation of the oil is effected. To further cool the oil, a coil of pipe is contained in the box, through which mine water circulates. As the motor is always started without a load, the starting box did not require to be very large. Furthermore, the starter is not used frequently, for the motor, if once started, frequently operates for one or two days or longer without being stopped.

Electrical Supply in Fitchburg, Mass.

Since the article published under the above heading in Electrical World and Engineer of October 3, 1903, was prepared, the details of the new plant at Fitchburg have been pushed to completion, save that the old boilers are still in use.

Outside of the station the circuits have been arranged so that the series enclosed arc street lamps may be operated from the tub transformers. The old 500-volt, direct-current power circuit has been discontinued over much of its length, and a new 550-volt, three-phase circuit for induction motors has been erected. This power circuit is fed by transformers at the station and one other point, and as these transformers take current at 2,300 volts the plan results in a saving of copper.

The new chimney mentioned in the preceding article has a height of 138 ft. As the new station is located on the bank of the Nashua River, the water of this stream is used for condensing purposes. This water is not sufficiently pure for use in the boilers, however, owing to elements introduced by factories further up the stream, and feed water for the boilers is, therefore, drawn from the public supply pipes. Sheets of ground and pressed cork each 9 x 36 in. in area and ½ in. thick are cemented to the concrete filling over the steel beams to form the cork floor of the generator and engine room. On the traveling crane that sweeps over the entire generator room are two hoists, one being of 20 tons and the other of 5 tons capacity. Both of these hoists are hand-operated. The Reading Crane & Hoist Company are the builders of this crane. In the wire tower named above racks for the lightning arresters are located and the 550-volt, the 2,300-volt, and the 4,000-volt lines pass from the switchboard down to the basement ceiling, then along to and up over these racks to porcelain tubes bedded in one brick wall of the tower. These tubes have a downward slant toward the outside of the wall, and the wires after passing through them are secured to nearby insulators. In this way between 40 and 50 wires leave the wire tower for a nearby pole. Onto each of these wires a lightning arrester is connected, and the other side of each arrester is joined to the grounded copper bar that is located along the under side of its rack. To each wire of the three-phase, 550-volt power circuit a lightning arrester with one carbon resistance rod and one air-gap between brass cylinders is attached. To each wire of a 2,300-volt circuit for commercial arc and incandescent lighting an arrester is connected that has one carbon resistance rod, and two air-gaps between brass cylinders. On the 4,000-volt lines for series arc lighting an arrester with two carbon rods and four air-gaps between the brass cylinders is connected to each wire. Besides the foregoing lines and lightning arresters there are two pressure wires for each 2,300-volt circuit, and to each of these pressure wires an arrester with one carbon resistance rod and one air-gap between brass cylinders is connected.

The switchboard is equipped with one set of 2,300-volt, three-phase bus-bars to which the generators feed and from which all of the lighting and power service in the system is derived. Energy for the series arc lighting is supplied from these 2,300-volt bars through the 4,000-volt tub transformers. For the 550-volt, three-phase power circuit that carries the load of induction motors two transformers are in use, each rated at 75 kw. and reducing the pressure from 2,300 to 550 volts, three-phase, 60 cycles. One of these transformers is located in the basement of the generating station, and the other like transformer is about one mile from the station. With the 550-volt, three-phase motor circuit is connected an induction motor at the power station that drives by belt a 45-kw. 500-volt direct-current generator for the few remaining motors of that type. Each main generator is connected to the three-phase bus-bars through an oil switch, and this is also true for the circuit that supplies the eight tub transformers, the circuit of the power transformers, and the three circuits for general commercial lighting. All of these oil switches are operated by magnets and for each oil switch a small knife switch is carried on the face of the switchboard. By closing one of these small knife switches the magnet winding of its oil switch is charged with direct current from one of the 125-volt exciters, and the resulting pull opens or closes the contacts. All of these oil switches were supplied by S. B. Conduit, Jr., & Co., of Boston. All of the generators, transformers and motors above named were built by the General Electric Company, as were also the volt, ampere and the indicating and recording wattmeters found on the switchboard.

General commercial arc and incandescent lighting in Fitchburg is provided for by three three-phase, 2,300-volt, 60-cycle circuits. Each of these circuits is fed by two sets of three-phase feeders having six wires in all, and from each of these three circuits a pair of pressure wires is run back to the power station. Just at present the only means of pressure regulation employed at the generating station is to vary the voltage on the main bus-bars by changes in the exciting current of the generator magnets. Three automatic regulators for the three commercial lighting circuits are an order, however, and their use will make it possible to supply different voltages to the station ends of the feeders for these three circuits.

The present number of enclosed arc street lamps connected to the tub transformers of the Fitchburg system is 306. The number of commercial enclosed arcs operated from the constant pressure lines is about 86. For incandescent lamps of all sizes the total connected load numbers 12,000 nearly.

For the 48 motors connected to the electrical supply system the total rated horse-power amounts to 302. The greater number and capacity of these motors is on the 550-volt, three-phase, 60-cycle power lines. With the highly efficient generating equipment now installed at the Fitchburg station a large and rapid increase of its motor load is to be expected, as the demand for power there is large.

Electricity in the American Navy.

The annual report of Rear Admiral Bowles, chief of the Bureau of Construction and Repair, has been presented to the Secretary of the Navy. Among other matters in the way of standardization, it is stated that the Bureau has issued general specifications for electrical appliances on navy ships and for electrical conductors in navy yards. During the last few years the ventilation of naval vessels has been obtained largely by electric fans. These have many advantages in practical operation over steam-driven fans. There was great lack of information, however, as to the real efficiency and delivery of the fans hitherto installed. Using apparatus especially designed for this purpose, the Bureau has caused comprehensive experiments to be made at the Washington Navy Yard during the last year upon the efficiency of fans of various commercial makes, and has supplemented these by special experiments upon ventilation systems installed upon the *Missouri*.

On all of the recent men-of-war of importance a number of water-tight doors and hatches, some or all of which are left open under ordinary conditions, but must, for the safety of the ship, be closed promptly in case of accident, have been fitted with mechanical appliances for controlling them and closing them from a distance as well as on the spot. Pneumatic appliances have been fitted upon nearly all doors in the service, but the bureau has been anxious for some time to extend the use of electricity to these fittings, provided reliable electrical apparatus could be developed. With this end in view, it had tests made during the year at the Washington Navy Yard of several types of electrically-operated water-tight doors with distant control, the doors and operating devices being tested for endurance as well as water-tightness. Types of electrically-operated horizontal sliding doors and hatches have not yet been approved, but experiments are still in progress, and it is expected that satisfactory fittings will be determined upon in the near future.

The Bureau has investigated existing types of electrical steering gear with a view to its use upon naval vessels, and has designed and purchased the material necessary for the installation of electrical steering apparatus on the monitor *Nevada*. The results of the trials of this steering gear when completed will, it is hoped, furnish ground for its further extension in the service. The importance of the absolute reliability of the steering gear of vessels renders it necessary, in the opinion of the Bureau, to proceed in this matter with extreme caution.

Factory Turbo-Generator and Electric Power Distributing Plant.

One of the first large manufacturing concerns in the country to recognize the great advantages of electric power distribution in factories was the B. F. Goodrich Company, rubber manufacturers, of Akron, Ohio. Their plant consists of a large number of buildings, and when it was operated by steam power it was necessary to have a number of steam engines located at different points, owing to the limitations of the steam drive. When it was decided to adopt electric power, a central generating station was erected near the center of the electrical load, direct connected generating units were installed and the electric motor drive substituted for the former steam and belting system. Two 500-kw generators and one of 150 kw were installed in the central station and space reserved for another 500-kw generator. The plant, however, soon proved inadequate, owing to unforeseen factory extensions, and in order to install a sufficient additional capacity of direct-connected units of the same type as those in use, an addition to the power house would have been required. It was found, however, that in the space reserved two turbo-generators could easily be installed, one of 750 kw and another one of 400 kw. Should further increase of power be necessary the 150-kw engine-driven machine may be replaced by two 400-kw turbo-units. It will thus be seen that a power house originally laid out for an ultimate capacity of three 500-kw and one 150-kw machines may, with turbine machinery, be arranged to accommodate 2,950 kw, or an increase of 80 per cent., and still retain the two original 500-kw engine units.

As stated above, the steam turbine addition to the plant consists of two units of 400-kw and 750-kw capacity, respectively. Both are of the Westinghouse parallel flow type, the smaller turbine being a single-cylinder and the larger a double-cylinder machine. Both turbines are direct-connected through semi-flexible mechanical couplings to two-phase, 220-volt, 60-cycle dynamos, arranged at the switchboard to operate in parallel with the three engine type generators. The smaller machine operates at 3,600 r.p.m. and the larger at 1,800 r.p.m. An overload capacity of 50 per cent. is provided by by-pass valves at the side of the turbine. These also enable the machines to carry full load continuously should the condensing system break down.

It is interesting to note that in the case of the 400-kw unit, no foundation was constructed, the turbine being supported partly upon a brick wall which had been part of the former building foundation, and partly upon I-beams spanning the condenser pit. This unit rests directly upon the power house floor. The 750-kw unit rests at the four corners upon four brick and concrete piers, 12 ft. in height, tapered from a width of 2¾ ft. at the top to 4 ft. at the bottom. An 8-ft. passageway between the piers provides access to the receiver and piping. The condenser pit is spanned by two 12-in. I-beams, one under each side of the bedplate, which is continuous, and provided with longitudinal and transverse ribs giving great strength and rigidity. Approximately 12 per cent. of the area of the bedplate constitutes the area of support of the piers, the remainder that of the steel beams, which, to prevent flexure, are reinforced by struts at the center.

Both turbines operate condensing in conformity with the remainder of the plant, and are connected to a single condenser located immediately beneath, in a concrete lined pit in the basement. Two vertical outlets communicate directly with the exhaust outlets of the turbines through gate valves and corrugated copper expansion joints, the latter being required to prevent distortion of the turbine shell by longitudinal expansion and contraction of the vertical exhaust piping. The directness of the exhaust line avoids the serious losses of vacuum incident to long lines of exhaust piping with many turns. It is in all respects equivalent to locating the condenser at the turbine outlet, as in the practice lately introduced in the case of large vertical engine type units.

A feature of the condensing system is an arrangement for cooling and abstracting saturated air. For this purpose a tubular vapor cooler is located in the lower part of the condenser head directly in the path of cold circulating water entering the condenser. A rotative air pump located beside the turbine foundation is piped through this vapor cooler to the condenser shell, thus serving to remove the vapor collecting in the top of the shell. In passing through the cooler the moisture condenses and the dry air is drawn off by the air pump. With this separation of the functions of dry and wet pump, each may be better adapted to their respective duties, resulting in more effective performance and higher vacuum.

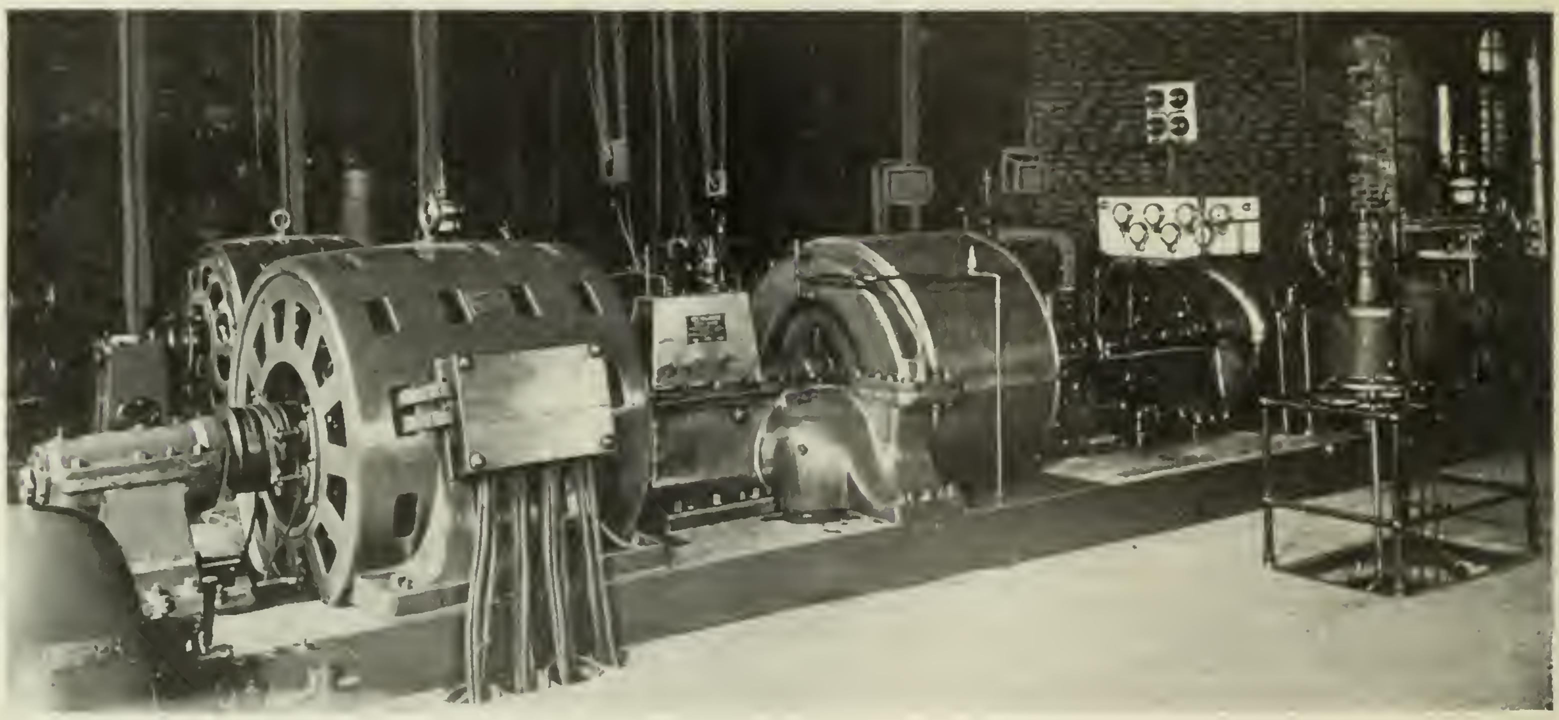


Fig. 1.—View of Turbo-Generator from Generator End.

The aggregate electrical plant now installed comprises 2,300 kw in generating machinery and about 4,000 hp in motors, divided in the approximate ratio of 3 to 7 between direct-current, variable-speed, and alternating-current, constant-speed induction motors, respectively. The entire generating plant is 220-volt, two-phase, 60-cycle, furnishing current to one switchboard, from which part is delivered directly to an alternating-current distribution system and part converted into 320-volt, direct-current by two 200-kw rotary converters, these in turn supplying a direct-current, three-wire distribution system.

An important feature of the electrical plant is the application of the three-wire balancing coil system to direct-current, variable-speed work. The advantages of the three-wire distribution were in the present instance of prime importance, both on account of the reduction of distribution losses and particularly the range of voltage necessary for variable-speed motor work. The balancing coil system permits the use of one generator or rotary converter instead of two as would be required in the ordinary three-wire system. It was thus possible to install larger machines with the attendant advantages of less sensitiveness to, and greater capacity for, sudden loads. A diagram of the system is shown in Fig. 4, giving the switchboard and rotary connections. It will be observed that no special apparatus is required for the three-wire system outside of the two balance coils, which are simply single-coil transformers mounted in standard transformer cases in any convenient location. In this case they are suspended from the basement ceiling. The rotaries are standard machines in every particular.

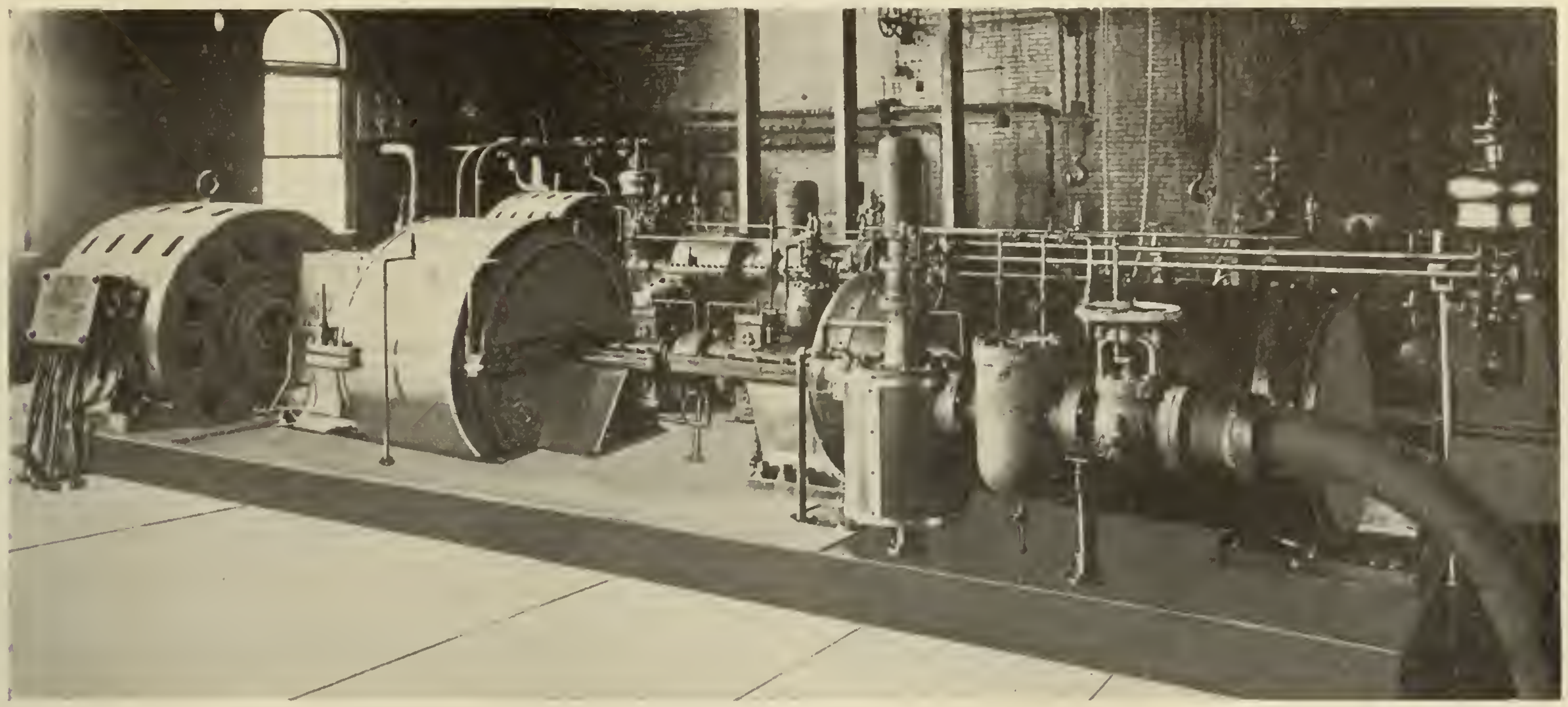


Fig. 2.—View of Turbo-Generator from Turbine End.

Throughout both alternating and direct-current distribution systems secondary buses have been installed in buildings where considerable power is required. The buildings are usually divided into five independent sections, each served by a secondary bus. These are fed by heavy cables carried from the power house bus through a system of tunnels used in common with the factory distribution systems for water, air, steam, signals, etc. In cases of especially concentrated loads such as occasioned by the 200 and 300-hp motors, special feeders are run from the power house in order to secure better voltage regulation upon the remainder of the motor and the lighting systems.

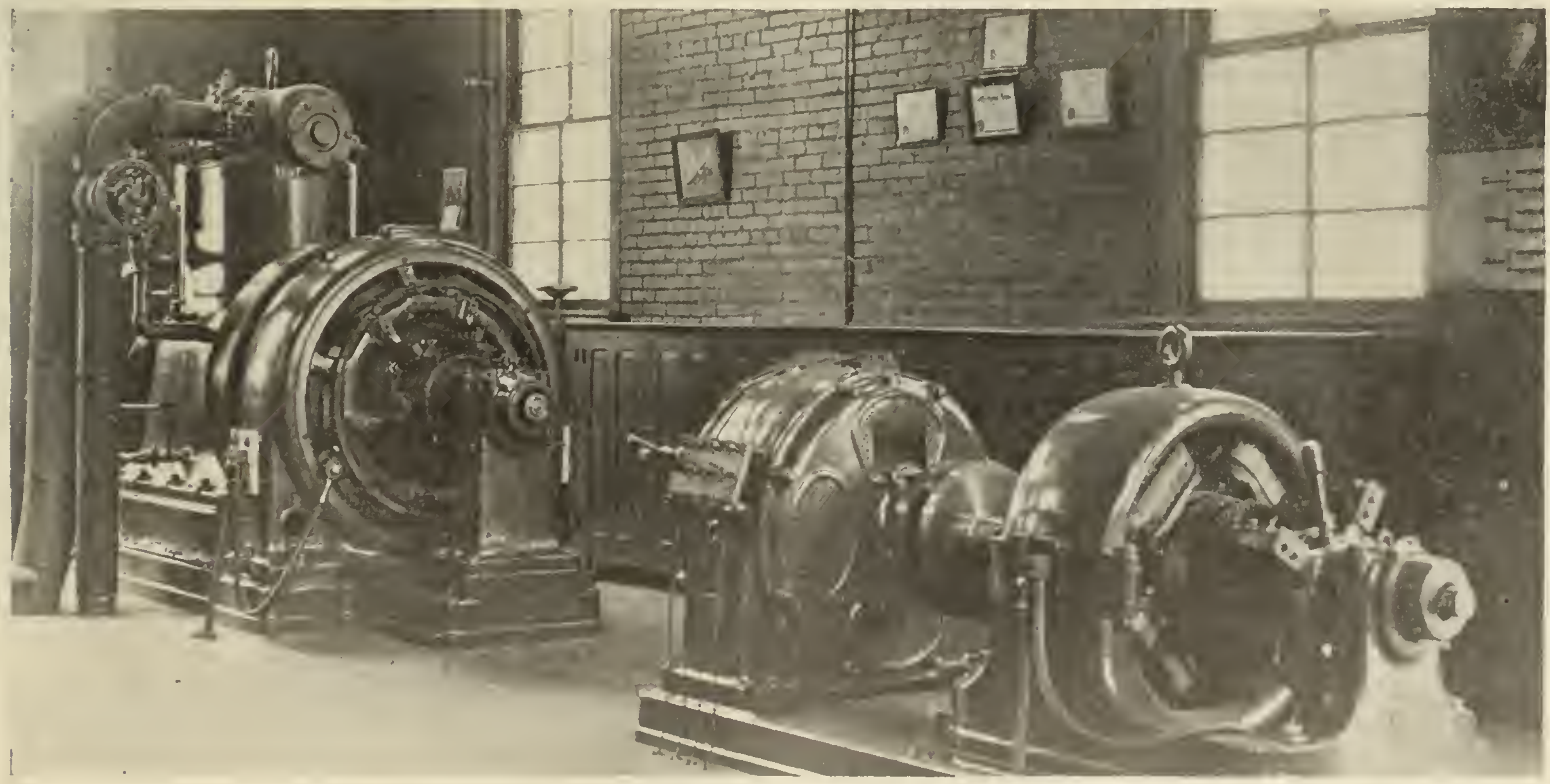


Fig. 3.—Exciter Units.

With the exception of two large engine drives located in buildings close to the power house, the motor drive is used for every class of work from the heaviest rolls and calenders down to machines requiring a fraction of a horse-power. The complete list of connected motors comprises about 112 hp induction motor machines, five of which are of 300 hp each; 13 direct-current, variable-speed machines, five of 100 hp each, and several motors arranged with automatic control for operating freight elevators. A large number of the motors are used for driving special machinery, but in the majority of cases the drives are of the simplest character. For group driving, the motors are generally bolted to the ceiling and belted directly or through countershaft, if necessary, to sectional line shafts. This applies to machinery adapted to belt driving from above. A similar arrangement is employed in the machine and wood-working shops for driving shop tools.

There is, however, a considerable amount of special machinery which it is necessary to drive from beneath in order to preserve clear head room above the operating tables. In these cases the motors are either mounted on the floor beneath the tables or attached to the ceiling below, and some form of transmission gear employed. In cases where plenty of room is available, rubber belting is used, but in restricted locations, such as floor drives, Morse or Renolds silent chain gear is employed, these being partially or entirely enclosed in sheet iron cases, according to their liability to become clogged with dust or grit. The ceiling drives with chain gear above mentioned are perhaps the most unusual. The chain is kept lubricated by oil and graphite and protected by sheet iron cases. Rotation is imparted to the vertical shaft through steel and rawhide bevel gearing, a similar arrangement being employed upon the floor above for driving a horizontal line shaft.

In a few instances variable speed with inverse torque is obtained by means of an adjustable pulley. Thus an expressing machine is served by a 10 hp induction motor running at 840 r.p.m. and mounted upon the floor level. It is geared through a Renolds silent chain to a Reeves variable speed pulley. The chain gear effects a speed reduction of 1:4 and a speed ratio of 12:40 is secured by the Reeves pulley, with a maximum torque at the commencement of the expressing process.

Large induction motors of 150 to 300 hp are geared with a ratio of 1:5 directly to massive crude rubber rolls, one motor being usually located between two rolls which it drives. A standard starting box is used with the smaller motors. To prevent sudden overloading of the power station due to the simultaneous starting of a number of the larger motors, a simple signal system has been put into use with the object of reducing the amount of reserve machinery otherwise necessary. The system consists of whistle alarms located near the 300-hp motors supplied from a compressed air system and operated by a magnet controlled by a push button upon the switchboard. A similar device controlled by the motor attendant is used to warn the power house of an increase of motor load. By this system the switchboard attendant is able to notify the motor attendant when the load upon the power house is so heavy as to necessitate the placing in operation of an additional generator to carry the increase.

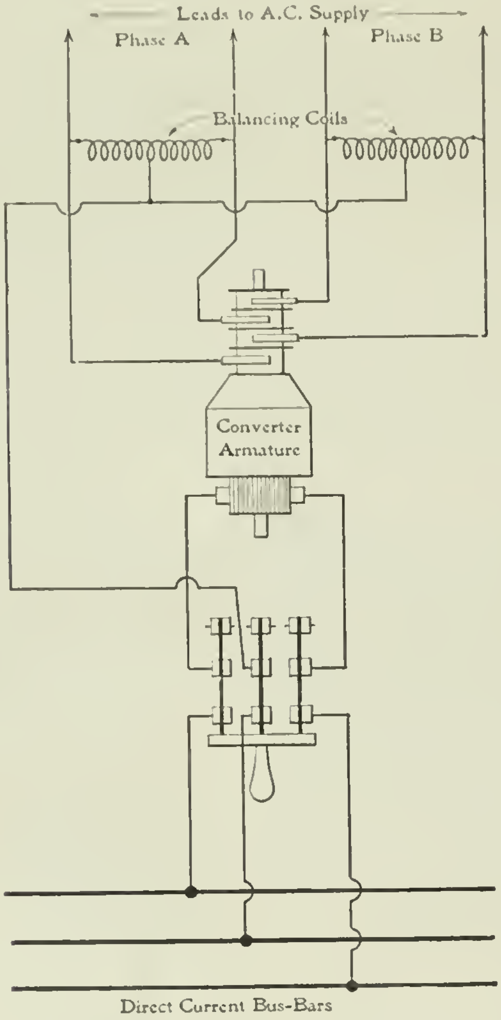


FIG. 4.—BALANCING COILS FOR DIRECT-CURRENT DISTRIBUTION.

The large direct-current motor drives are of interest by reason of the variable-speed feature. The motors are installed in a concrete pit and geared to the rolls through a heavy Morse "silent chain" reduction gear. Further speed reduction is accomplished by massive toothed gearing. The motors are of 100-hp capacity and each is provided with a standard controller located in front of a motor panel containing switches, circuit breaker and instruments. The controlling outfit is located close to the rolls operated, so that absolute and constant control of the process is possible. The controller has nine points giving 18 different speeds, with the two voltages available upon the three-wire system, namely, 160-320. Resistance in both armature and shunt winding are employed to effect the proper gradation of speeds which range from 100 to 500 r.p.m.

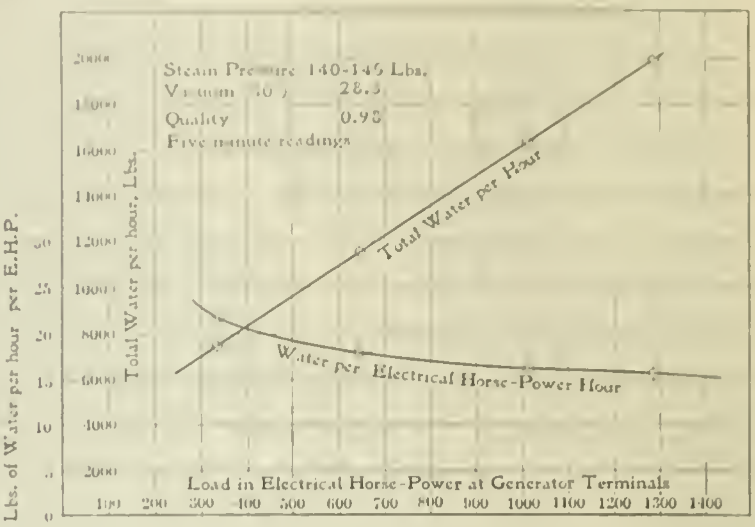


FIG. 5.—CURVE SHOWING PERFORMANCE OF TURBO-GENERATOR.

Current for lighting the entire works is obtained from a two-phase distribution system supplied directly from the power station bus in order to render the illumination independent of the local fluctuations due to motor load. In all cases 110-volt lamps are used upon each 220-volt lead, a neutral being introduced to equalize the unbalanced current. This neutral is connected to the central point of an auto-transformer or balancing coil, which serves to preserve, within reasonable limits, equal voltage upon the two sides. During Sundays and holidays, when the main plant is shut down a small 125-volt, direct-current generator is connected to the lighting mains.

The accompanying table and the curves of Fig. 5 give the result of a shop test of the 750-kw Goodrich turbo-generator, made February 28, 1903. The readings were taken at intervals of five minutes, and an allowance made of 352 pounds of water per hour for condenser leakage.

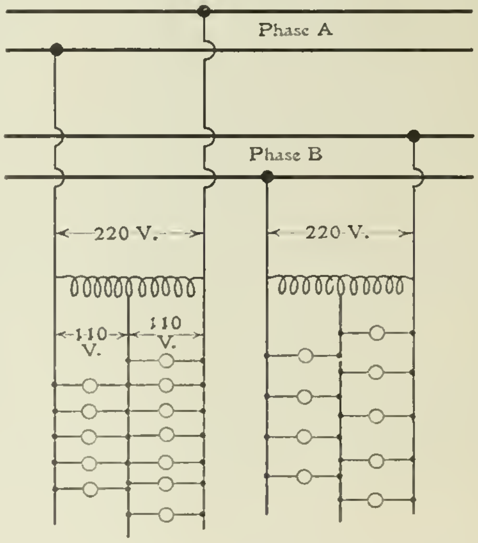


FIG. 6.—BALANCING COILS FOR ALTERNATING-CURRENT DISTRIBUTION.

Test No.	1	2	3	4
Steam pressure	140.20	140.30	145.00	145.00
Quality steam	.977	.98	.984	.982
Vacuum (actual)	27.06	27.03	27.00	27.18
Vacuum (30" bar.)	28.36	28.33	28.30	28.48
Load, K.W.	961.00	756.00	481.00	250.00
Load, E. H. P.	1288.00	1015.00	645.00	335.50
Water per hour	19899.00	16265.00	11551.60	7304.00
Water per E. H. P.-hour	15.43	16.01	17.90	21.75
Duration of test, hours .	2	1	1	1.

A most striking feature of the plant as a whole is the harmonious operation of two radically different types of prime-movers in parallel, and the ease and accuracy with which a definite subdivision of load may be predetermined. The turbine machinery, being last installed, was necessarily obliged to conform in all respects to the conditions already obtaining in the engine plant. It is, therefore, the more noteworthy that satisfactory operation in parallel has been secured. The turbine governors were designed for a definite sensitiveness. This proved to be somewhat greater than that of the engine governors, with the result that the burden of a sudden load would fall upon the turbines and cause an instantaneous checking in speed. This action induced a more or less severe surging effect between the two parts of the plant. This effect was easily remedied by cutting out of service a number of coils of the governor spring by means of a special nut mounted upon the governor sleeve. The adjustment of this nut determines the sensitiveness of the governor to sudden loads, and has been adjusted upon the two turbines, so that the turbine plant assumes somewhat more than its share of load during fluctuations, which is permissible on account of the high inertia of and the absolute uniformity of speed of the rotating parts. The effect is further distributed between the two turbines in inverse ratio to their respective capacities.

The adjusment for steady loads is, however, quite distinct from that for fluctuating loads. The former is a question of spring tension and the latter of spring stiffness. The tension adjustment may be made while the machine is running, as the entire spring mount is attached to a sleeve surrounding the governor spindle and working between ball bearings. This tension adjustment enables any divisions of load to be secured as indicated by the switchboard meters. It is also used for synchronizing. In practice, however, this is accomplished by a simple method, as follows:

The speed of the turbine is brought a little above that of the engines already running, so that a slow blinking of the synchronizing lamps is observed. By resting the finger lightly upon some part of the governor mechanism the speed may be brought down sufficiently to produce absolute synchronism for as long a period as desirable, even as long as one minute if the load happens to be steady. By this means the tension adjustment need never be changed, as the slight excess speed necessary to synchronize is not appreciable when the machine is under load. In this instance the large turbine is usually given more than its share of load owing to the controlling influence exerted upon the engine plant. Sudden loads which would perceptibly check the engines prove imperceptible in the case of the turbines, a beneficial result which is felt throughout the entire motive power system. No synchronous motors are employed, but rotaries and induction motors are more or less sensitive to fluctuations induced by sudden loads.

It thus occurs that the turbine plant, in addition to furnishing a substantial margin of capacity for both sudden and steady loads, also performs the duty of frequency or speed regulator by reason of inertia effects. During the twelve months of its operation no troubles have developed pointing to faulty design or construction, and the satisfaction derived from daily operation affords the surest indication of the fulfilment of expectations. It is a noteworthy fact that the 400-kw unit sustained at one time for a period of seven successive hours a load of 700 ehp or an overload of 30 per cent. without difficulty or injury. Striking proof of the low friction losses in the steam turbine is offered by the fact that if the vacuum is maintained at the closing of the turbine throttle, these machines will continue to revolve for thirty to forty minutes. Although this phenomenon is partly due to the high inertia of the rotating parts, it is, however, significant of high mechanical efficiency. By admitting air through a small valve the motion may, however, be greatly retarded—an expedient used when a quick stop is desired.

The cost of the turbine generating plant is stated by the owners to be about the same as a high-grade engine-generating plant. The increase in the cost of condensing machinery suitable for high vacuum is offset by the low cost of foundations, so that the choice of engine or turbine finally resolves itself into a question of floor space, efficiency, all-day economy, overload capacity, and regulation of alternating systems; and it is claimed that in all of these points the turbine plant has proven superior.

The above information regarding the Goodrich plant has been obtained through the courtesy of the B. F. Goodrich Company, the Westinghouse Machine Company, builders of the turbines, and the Westinghouse Electric & Manufacturing Company, which installed the entire electrical plant.

The Beznau Hydro-Electric Plant, Switzerland.

Probably one of the most interesting electric plants in Switzerland is that at Beznau. It is owned and operated by the Beznau Electricity Works, near Waldshut, and has a capacity of 10,000 hp. This installation is equipped with vertical generators directly driven by vertical shaft turbines. Each unit has a capacity of 1,000 hp and operates at a speed of 66⅔ r.p.m. The generators are of the three-phase revolving field type, with stationary external armatures. These machines can be seen in Fig. 1, the view of which was taken from the switchboard gallery. The alternators generate current of a frequency of 50 cycles per second and a potential of 8,000 volts. This plant was installed by the Actiengesellschaft Brown, Boveri & Co., of Baden, Switzerland.

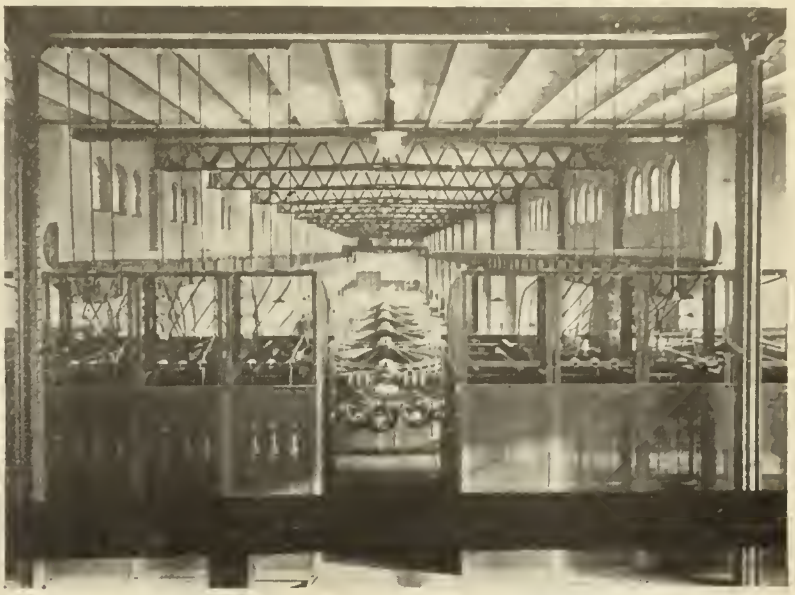


FIG. 1.—GENERAL VIEW OF GENERATOR ROOM.

The generator switchtable and feeder panels may be noted in Fig. 2, while the ingenious method of protecting the attendants from the high-tension wires is illustrated in both views, at the switchboard gallery. The transmission line is supplied with current from a number of step-up transformers, each of which has a capacity of 910 kw. The pressure used on the long-distance transmission line is 26,000 volts and at the various sub-stations the current is lowered in pressure for distribution for local lighting and power purposes.

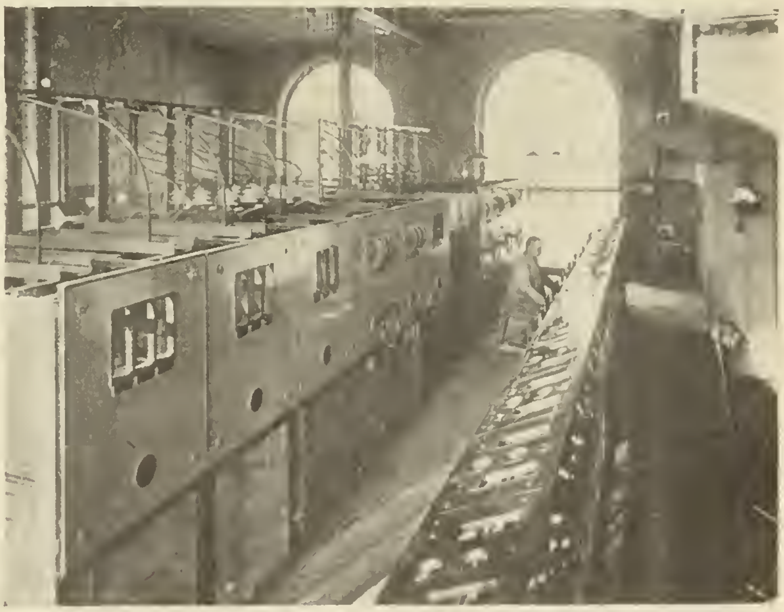


FIG. 2.—GENERATOR SWITCHTABLE AND FEEDER PANELS.

Southern Indiana Telephone Association.

The fourth annual convention of the Independent Telephone Association, of Southern Indiana, will be held at Evansville on November 10 and 11. An interesting programme will be provided. An invitation is extended to manufacturers to exhibit their goods. Mr. E. W. Pickhardt, Huntingburg, Ind., is the secretary of the association.

Convention of the Southwestern Electrical Association.

As noted in our issue of last week, the first meeting of the Southwestern Electrical Association was held at Oklahoma City, October 9, 1903. The Association starts with 35 active and 11 associate members, the former representing the several electric light, railway and telephone companies of Oklahoma, as well as several plants in Arkansas, Texas and Kansas. The list of officers elected was given in our last issue, and we present herewith portraits of Mr. John W Shartel, the president, and Mr. John Lowry Ellis, the secretary

Mr. Shartel, who is a native of the State of Pennsylvania and a railroad corporation lawyer by training and profession, is secretary and counsel of the Metropolitan Railway Company, of Oklahoma City, and president of the Oklahoma Traction Company, which latter is constructing a line of interurban railway between Oklahoma City and Guthrie and a street railway system at the latter place. Mr. Shartel, in 1901, resigned as solicitor for Oklahoma Territory of the Choctaw, Oklahoma & Gulf Railroad Company, to enable himself to devote a greater portion of his time to the development of electric railway enterprises. He organized the Metropolitan Railway Company, of Oklahoma City, in January, 1902, and directed its construction. In the early part of the present year he organized the Oklahoma Traction Company, which enterprise he has placed on a working footing. Mr. Shartel has lived in Oklahoma Territory for the past eleven years and has been largely identified with both its political and material development.

Mr J. L. Ellis, the secretary and treasurer of the Association, was born in Kansas and brought up in Tennessee. His first electrical experience was running at the age of 15 a 30-light Jenny arc machine in Shelbyville, Tenn., located in a mill. During the greater portion of the season the generator of the machine was driven by water power, but when the water was too high or too low the mill engine was coupled on. Mr. Elllis resided in Indianapolis about ten years and was identified with the then Varney & McQuat Company, as wireman, foreman of construction and traveling salesman. Mr. Ellis traveled out of Chicago for several years, after severing his connection with the above company. He came to Oklahoma in March of this year and is engaged in selling heavy machinery, water works materials and supplies, as manufacturers' agent. While Mr. Ellis has had no technical education, he has a thorough practical training in the electrical business.

President John W. Shartel.

Secretary John L. Ellis.

For the government of the Association, the constitution of the Ohio Electric Light Association was adopted with a few minor modifications. In addition to the officers elected mentioned in our previous issue, the following executive committee was named: T. K. Jackson, Enid, Okla.; W. K. Berry, Ardmore, I. Ty.; S. P. Render, Oklahoma City, and W. E. Robinson, Oklahoma City.

Mr. John W. Shartel, in a paper, discussed the possibilities of electric railways in Oklahoma and Indian Territories. He stated that there are several communities in the two territories located in sufficient proximity to make an inviting field for the construction of interurban lines, and future development bids fair to bring others into similar relations. He emphasized the fact that many electric railways have been laid down without sufficient consideration of their future profitability, and urged that the traffic problem should be very thoroughly investigated before the construction of a street railway is undertaken. While an interurban population of at least 10,000 is usually required to make a street railway profitable, yet experience has shown that no fixed rule of the kind can be imposed, and it is now recognized that 10,000 people located in a favorable condition for street car patronage involve a better condition than a community of 25,000 people in a local environment such that they may or may not ride as they feel disposed. The most favorable conditions are when the greater portion of the population is located some distance from the business center, or when a city is spread out over a narrow belt. If a street railway system can be united with interurban service, the proposition becomes much more favorable, for the difference in the cost of maintenance of a power house for 4 miles and for 15 miles of railway is measured chiefly by the fuel bill. Many a street railway system in this country which has been dragging a miserable existence, has been saved by interurban connections, and many a town or village which would be wholly inadequate to support a street railway system has enjoyed the benefit of that facility from interurban railways passing through them.

Mr. Shartel strongly urged that when an electric railway is put down it should be built in the most substantial manner; one mile of track constructed for 40 or 50-pound rails will require more attention and care than five miles constructed of 60-pound rails, and this is merely an illustration of the burden of maintenance between a poor and good construction. He recommended that wherever possible an electric railway plant should be operated in connection with an electric light plant. Such a plant divides the power house expense in two, and it affords an opportunity which could not otherwise be obtained for selling electricity 24 hours in the day.

In a paper entitled "The Accounting as Kept By a Central Station Man," Mr. U. S. Hart, of Shawnee, Okla., dwelt upon the economies that may be obtained by a proper system of central station accounting. He recommended that all coal should be weighed, each watch turning in the number of pounds consumed during its tour and also the minimum and maximum pressure carried on the boilers. By making such reports firemen soon learn to practice economy, as they lead to rivalry between the different watches as to which shall keep the coal consumption per kilowatt-hour output lower than the other. The engineer should keep a full log. For keeping track of the line poles and transformers, Mr. Hart uses, in addition to a map, pole cards on which are indicated the position of the wires, transformers, etc. When a change is made new cards are issued covering the changes. Each transformer has a card issued giving all its data with spaces to fill in the service numbers or the names of the consumers and number of lights to each service. By this means one can tell in an instant the number of lights on a transformer. A consumer's record is kept very similar to a depositor's record in a bank, each page holding the year's business crosswise, instead of up and down, all accounts being arranged alphabetically. This record is ruled for name, street, number, service number, date cut in, date cut out, rate, amount, discounts in deduction, cash book page, and for several other entries. By this means the business of each month and the amount of collection agrees with the cash book, thus furnishing a positive check. The total of deductions, amount paid and delinquencies, balance the total change as indicated in the total column. One is also thus enabled to compare the discounts each month and the delinquencies forwarded each month, with the previous months, and the months of the previous year, etc. Mr. Hart strongly urged that the standard system of accounts prepared by the National Electric Light Association be adopted by central stations.

Mr. Theo. K. Jackson, of Enid, Okla., read a paper entitled "Benefits Derived from Heating from Central Stations," which subject was discussed under the heads of heating with steam and heating with hot water. He considered that steam heating has an advantage where there are great variations in altitude and where tall office buildings, etc., are to be supplied. It is impractical to pump water to great elevations not only because of the additional cost of pumping, but also because special radiators are necessary to stand the high pressure required. Mr. Jackson's experience is that 40 pounds is the highest pressure that is safe to put on the average radiator after it has been in service some time, even though the radiators were originally manufactured to stand a pressure of 100 pounds. The disadvantages of steam heating are that owing to the higher temperature, the loss in radiation is greater and the system has no elasticity with respect to the regulation of the temperature.

He considered that where it is applicable heating with hot water is preferable to heating with steam, for the reason that the temperature can be controlled and therefore the loss of heat in transmission from point to point is greatly reduced. For example, hot water heating can be carried on at a temperature of 140°. The single-pole system for hot water heating cannot be used when a central station supplies more than 40,000 or 50,000 sq. ft. of radiation, as the water delivered in the last radiator would be much colder than that delivered in the first radiator. The double-pipe system is, therefore, preferable except in special cases. Several systems of central station hot water heating are described, and Schott "balanced column system" is spoken of favorably. In this system the water is not pumped into an expansion tank, but returns direct to the circulating pumps, the leakage loss being supplied by an additional pump called the "balance column pump," and the expansion cared for by a safety valve. The circulation pumps obtain the benefit of all return pressure, and only supply an amount of energy corresponding to the friction of the water passing through the system; on the other hand, with the expansion tank system the circulating pumps have to supply energy equal to the full head pumped against. It is stated that the column system saves about one-half of the cost of pumping water.

As to rates of charge for heating, a proper basis is stated to be a charge based upon a calculation of the heat required for a given space; such a calculation may be made by means of Carpenter's rule, which takes into consideration the cubic contents, square feet of glass surface and square feet of exposed wall. A cheap and efficient method of insulating the pipes is to lay them in boxes made of three or four layers of wood with air spaces between the layers, the outside of the box being covered with pitch or some other water-proof material. All openings which would allow of the circulation of air, such as manholes, expansion joints, etc., are calked with oakum. The use of thermostats in consumers' houses is recommended, and all exposed pipes should be lagged. It is stated that to make heating from central stations a success, there should be sufficient exhaust steam to take care of the connected radiation during about two-thirds of the heating season. It is not profitable to operate with live steam, and those not having sufficient exhaust steam available should keep out of the heating business. The conclusions of Mr. Jackson are that from the consumer's standpoint central station heating is a great success; and that from the manager's standpoint it is a financial success when there is cheap steam fuel and the cost of anthracite coal is high, where there is a well-balanced load, where there is proper construction both in the consumer's residence and in the central station, and where the rates of charge are fixed on a proper basis.

Local Sections of the American Electrochemical Society.

Following are the regulations adopted by the American Electrochemical Society governing the formation and conduct of local sections:

A local section may be authorized by the Board of Directors, at the written request of three members. Only one section shall be authorized in any one locality.

Any member of the Society, in good standing, may enroll as a member of any local section, provided he complies with the regulations of the said section. Only members of this Society are eligible to membership in its local sections.

The regulations of local sections are subject to the approval of the Board of Directors.

The expenses of each local section shall be borne by the members enrolled in said section. The Society shall not be responsible for any debts contracted by a local section or the officers thereof.

The Society will print copies of papers offered to local sections, in order to facilitate full discussion thereon, provided that said papers are approved for such advance publication by the chairman of the local section and by the publication committee of the Society.

Papers read before local sections, and discussions thereon, if reported, are to be considered as the property of the Society and published in the *Transactions* if approved by it. Reading of a paper before a local section does not, however, carry with it the right of publication in the *Transactions*.

Papers read before local sections may be offered for reading at General Meetings of the Society, and will be given equal standing with other papers on the programme of said meeting when approved by the committee on papers.

The Board of Directors reserves the right to abrogate, amend or add to the above regulations, or to pass upon questions concerning the welfare of local sections not covered by the regulations.

Permission has been granted for the organization of a local section at Madison, Wis., and at New York City.

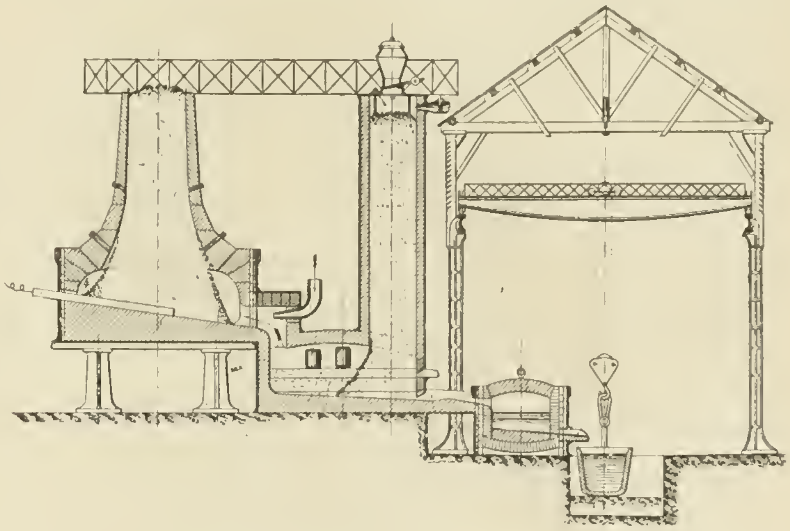
Recent Electrochemical Developments.

ELECTROMETALLURGY OF IRON AND STEEL.

Three patents were granted on October 27 to Mr. Henri Harmet, of St. Etienne, France, who is well known as the inventor of an electric iron and steel process in which the iron ores are converted into iron and steel by a series of three operations, the ore being first reduced, then fused and finally refined. The inventor has now modified his process by reversing the order of the two first operations, the ores being first fused and the oxides then reduced prior to their treatment in the refining oven. These three operations are conducted in three distinct furnaces, which are connected together in such a way that the fused materials leave the hearth of the fusion chamber shown at the left of the accompanying illustration, to enter directly the crucible of the reduction chamber shown in the middle part of the illustration, and then running into the refining oven shown at the right. For this purpose the sole of each crucible is an inclined plane, as shown in the illustration.

The hot gases developed in the reduction chamber shown in the middle part of the illustration are used for heating the ores and fluxes charged into the top of the fusion chamber at the left. These gases are mainly composed of carbonic acid, and before entering the fusion chamber they are mixed with air under pressure forced through tuyeres indicated in the illustration by an arrow. Since the heat of these gases may not be sufficient to fuse the material, additional heat is produced electrically by means of the electrodes placed at the bottom of the fusion chamber.

Inasmuch as in the reduction chamber the reduction of oxides absorbs more heat than is produced by the transformation of the carbon or coke-reducing agent into carbonic oxide, the crucible is heated by an electric current. This current is admitted through vertical electrodes, which enter the crucible to a depth so as to reach but not penetrate the slag of the crucible. The reduction takes place as follows: After working for some time a first layer of metal collects upon the sole of the crucible and is overlaid by a layer of incompletely reduced oxides, more or less mixed with a third layer of slag. The main column of coke, introduced through the vertical charging chamber, rests at its base upon the sole of the crucible, but fragments of the coke are lifted by the metal and slag and flow upon the liquid mass, spreading everywhere until they fill the entire lower portion of the crucible. The liquid mass then circulates in the spaces left between the fragments of coke as in ordinary blast furnaces. The melted oxides discharged from the fusion crucible at the left fall upon a mixture of coke and slag and are then reduced under the influence of the high temperature produced by the electric current. The reduced metal sinks to the sole of the crucible and there collects, the slag flowing on it. Before the reduced metal or the slag can be tapped through two tap holes at the right hand of the reduction chamber, they must both pass through the column of reducing carbon, which at the point where the metal and slag pass through it is in an incandescent state, thus completing the reduction.



HARMET ELECTRIC FURNACE.

The reduced metal then flows into the refining oven shown at the right hand. The refining operation in the regulator crucible is conducted in a manner analogous to that of the Martin refining oven. In many cases it is advantageous to have for each reducing chamber two regulators or refining ovens in which the crude metal flows regularly as soon as produced. In this instance one of the regulators receives and becomes charged with the metal, while the other is bringing the refined metal to the point of hardness and composition required.

Two of the patents granted to Mr. Harmet refer to the processes just described and the apparatus used in this process. The third patent refers to an arrangement of a reducing furnace in a former patent with a view to facilitating provision of a large number of pairs of electrodes and of preventing the passage of the current through the liquid metal, its passage through the same being useless because the heat developed there is unable to pass to the solid matters through the layer of slag.

PRODUCTION OF CHLORIDES OF CARBON IN THE ELECTRIC FURNACE.

A patent was granted on October 27 to Dr. F. J. Machalske, of Brooklyn, for producing chlorides of carbon in the electric furnace by bringing a porous mass of broken carbon, heated to incandescence, in contact with chlorine. A mixture of sodium chloride and silica sand is charged into the lower part of an electric furnace and broken coke is charged upon the mixture. The mixture and the coke are heated simultaneously to a high temperature by means of electric currents, various sets of electrodes above each other being provided for this purpose. The sodium chloride melts and the silica dissolves in the molten chloride, liberating chlorine, which arises through the incandescent coke and combines with it to produce the carbon chlorides, which are then carried to a condensing chamber. The charge should be free from water and a non-oxidizing atmosphere should be maintained in the furnace. Various chlorides of carbon may be produced by varying the proportions of the ingredients of the charge or by varying the number of electric arcs in the furnace chamber above the charge.

ELECTRODEPOSITION OF METALS.

In the electrodeposition of metals electropositive to hydrogen (like nickel), a certain quantity of hydrogen depending upon the current density used, is liberated at the cathode simultaneously with the deposition of the metal. This hydrogen is partly occluded by the deposit, partly adheres thereto, and is partly dissolved in the electrolyte. It exerts an injurious effect upon the tenacity, density and other characteristics of the deposited metal. In the electrodeposition of metals electronegative to hydrogen (like copper) an evolution of gas may also occur at the cathode, especially when a certain limit of current density is exceeded. Such metals also are injuriously affected by the gas.

Two patents were granted on October 27 to Mr. Woolsey McA. Johnson, electrometallurgist of the Lanyon Zinc Company, for overcoming these disadvantages. The inventor has found that if the electrolyte is freed from gases before the metal is deposited therefrom, and especially if it be maintained free from gases during the plating operation, the quality of the separated metal is greatly improved, as indicated by its increased density, hardness and toughness, by its smooth surface, and by its freedom from microscopic cavities. As a means for maintaining the electrolyte in this gas-free condition, Mr. Johnson makes use of a partial vacuum over the electrolyte. To this end he exhausts the air from an elevated receiving tank which preferably contains a filter, and which is suitably connected with the electrolytic cell. Portions of the electrolyte are thereby transferred from the electrolytic tank to the filtering vessel and may then be permitted to flow again to the electrolytic tank. By providing several filtering tanks and using them alternately, the flow of the electrolyte is made continuous.

MISCELLANEOUS.

A patent has been granted to Messrs. M. Moest, H. Hertlein and E. Oppermann, of Hoechst, Germany, on the electrolytic reduction of organic compounds by means of titanium compounds. It has long been known that organic substances are most energetically reduced by titano salts. Thus titano chloride reduces nitro compounds to amins, unsaturated acids to the corresponding saturated acids, etc. The present inventors have devised a process permitting industrial application of titano compounds for reducing purposes, by conducting the reduction in an electrolytic bath. Very small portions only of the titanium compound are required in the electrolyte, so that in fact the former is merely a carrier of the electrolytic hydrogen. The electrolyte may be used again in many cases. In a great number of cases the reduction may be made also without a diaphragm.

A patent granted to Messrs. J. Miller and F. M. Ashley, of New York, relates to an ozonizer which has the essential features, structurally at least, of an ordinary Leyden jar, ozone being produced by silent discharges. It consists of a dielectric body in form of a tube closed at one end and with electrodes, one of which covers the extremity of the closed end of the tube while the other covers the inside surface of the tube and is turned back at the mouth of the tube so as to embrace externally a part of the mouth portion of the tube. At this point it is in such spaced relation to the electrode at the closed end of the tubes as to prevent the formation of the undesirable spark discharge.

Three patents for primary batteries have recently been granted to Messrs. W. Strickland, C. W. Roberts and J. A. Pedrazzi, respectively. Mr. Strickland provides the excitant in a dry granular or powdered form, so that the cell is set in action when water is poured into it. The purpose is to enable one to keep the cell in an inactive state without deterioration until it is to be used.

Mr. Roberts patents a battery which he says may be worn on the finger, and which is capable of being put into action by the moisture derived from the evaporation of the finger. It is claimed to be useful for certain physical experiments. It consists of a metal strip provided with dented edges holding a strip of cloth on which is a strip of zinc. The cloth folds over the edges of the zinc and the dentals fold over the edges of the cloth and zinc.

The battery of Mr. Pedrazzi comprises an outer casing and an inner porous cup, a solution of concentrated lye being arranged between the cup and casing. A vertically corrugated shell of zinc is arranged within the lye, while the porous cup contains a solution of copper sulphate in which are placed parallel plates of copper and alternating layers of copper wire binding the copper plates together.

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Riding on a Zossen Car.

A special cable message from Berlin reports that Dr. H. S. Pritchett, president of the Massachusetts Institute of Technology, has the distinction of being the first foreigner to ride on the motor cars used in the high-speed electrical experiments on the Marienfelde-Zossen military railroad.

After riding in both the Siemens-Halske and Allgemeine cars last week, President Pritchett described his experiences and observations to the Associated Press. Both cars reached the speed of a hundred miles an hour. The chief of the government's military railroads, who was on board, would not permit a higher speed because of the fog which prevailed.

Dr. Pritchett was surprised at the steadiness of the cars, which did not create, so far as unevenness of movement was concerned, the impression of so great a speed as American trains running at 60 miles an hour, and the engineer assured him that the impression was the same when going at the rate of 130 miles. The groups of observers standing near the track presented a blurred image as the car dashed past. President Pritchett was afforded every facility for studying the experiments. He rode at the front and in the rear of the cars and noticed the enormous air suction at the rear platform.

From the observations which he made and from the figures submitted by the engineers, Dr. Pritchett does not doubt the commercial success of the motors up to a speed of 100 miles. He thinks that on roads between cities like New York and Washington, with low grades, few curves and heavily ballasted, a cheap system of electric traction would undoubtedly prove commercially profitable. Dr. Pritchett regards a speed above a hundred miles as being perhaps unprofitable, owing to the great expense of each additional mile. At any rate, Dr. Pritchett says, it is a great mistake to regard the Marienfelde-Zossen experiments as a mere scientific curiosity. Practical results of an important character will certainly follow.

The engineers indicated the hope that American capitalists would take the matter up and put it to practical use. They argue that the great boldness of American capitalists and the intense economic life in the Eastern States offer exceptional prospects for building the first successful high-speeding roads. Germany is too poor and too little developed to take the matter up at present. One of Emperor William's ideas is an electric road between Berlin and Hamburg. His Majesty has shown the deepest interest in the Marienfelde-Zossen experiments throughout.

Before going on board the cars Dr. Pritchett had to sign an agreement fully exempting the company from any claims for damages in case of accident.

New Telephone Patents.

COMMON BATTERY SWITCHBOARD CIRCUIT.

It is probably safe to say that the switchboard connecting cord is the most vulnerable part of the switchboard equipment, receiving necessarily a maximum amount of wear and tear from the very nature of the functions it must perform. Most maintenance men consider that the cord caused its full share of trouble and expense when, as in the magneto system, it consisted of two conducting strands. With the advent of the common battery system wherein until recently three conducting-strand cords have been universally required, and the requirements for satisfactory working greatly increased over those of magneto working, cord trouble became an even greater item. Improvements in cords have been made to largely meet the increased demands upon them, but nevertheless many gladly hail the recent adoption by some manufacturers of central energy systems wherein but two strand cords are required. Of course, one must not infer that the difficulties with three-strand cords played an important part in determining the adoption of the so-called two-wire systems, for they most probably did not. However, the use by these systems of a two-wire cord is most surely an incidental point well in their favor.

Quite a number of these two-wire systems have now been developed, the latest being the subject of a patent granted to Kempster B. Miller, of Chicago, and assigned by him to the Kellogg Switchboard & Supply Company. This system is quite different from the earlier Kellogg systems, being arranged with a repeating coil cord circuit. In Fig. 1 are shown the circuits in principle and detail. From the two batteries, *r r'*, circuits may be traced through the wires, 3, to the subscribers' stations, *A* and *B*, these circuits passing through the back contacts of the relays, *b b*, and being normally open at the subscribers' switch hooks only. The line relays, *C C*, being included in these circuits, of course respond to any closure of the circuit at their respective stations to indicate in the usual manner the arrival of a call. The operator responds with her plug, *p*, through the spring jack, *d*, elevating slightly with the plug tip the corresponding jack spring. Now, moving with this spring, but insulated therefrom, is the spring, d^3, which brings up against contact, d^4. This closes the circuit of relay, *b*, which operation transfers the line wire springs from the battery to the jack contacts. In addition, the contact, a^4, grounds the test rings, d^5, of all the jacks of line *A* to provide a busy test. Referring now to the cord circuit, it is found divided into two sections by the repeating coil, *w*. Across either section is a double-wound relay, between the windings of which is connected the corresponding central battery. Now, the plug, *p*, being in jack *d*, battery *r* sends current to subscriber *A* through relay *h*. This relay, *h*, does not respond, however, because of the differential relations of its windings. Battery *r* also sends current through another circuit. This, too, involves relay *h*, passing therefrom through repeating coil winding, *w'*, and contact, m^2. Now, when the operator completes the connection to subscriber, *B*, exactly similar conditions pertain except that the relay, k^7, operates until the currents in its two windings are equalized by the removal of the bell ground by the response of *B*.

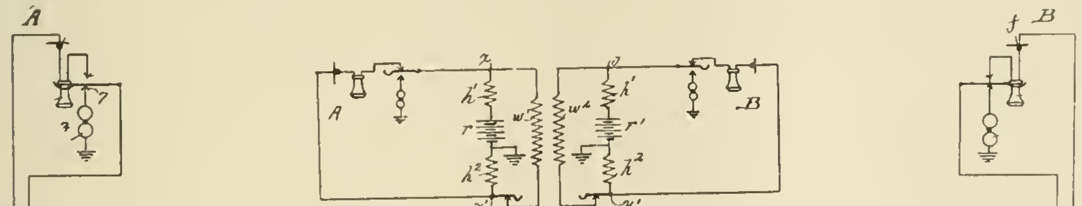


FIG. 1.—MILLER CENTRAL ENERGY SYSTEM.

It was noted that a circuit was made from each battery through the corresponding part of the repeating coil and differential relay, and consideration of this circuit shows that the control of it lies solely in contacts m^2 or v^2. These are plug socket switches, and are opened by the return of the connecting plugs to their seats to prevent the waste of current through this coil circuit when no call exists. These plug socket switches are a most objectionable feature undoubtedly, but they are necessary to the system and must be used irrespective of the fact that their disadvantages probably outweigh any advantage which may have been introduced over other two-wire systems.

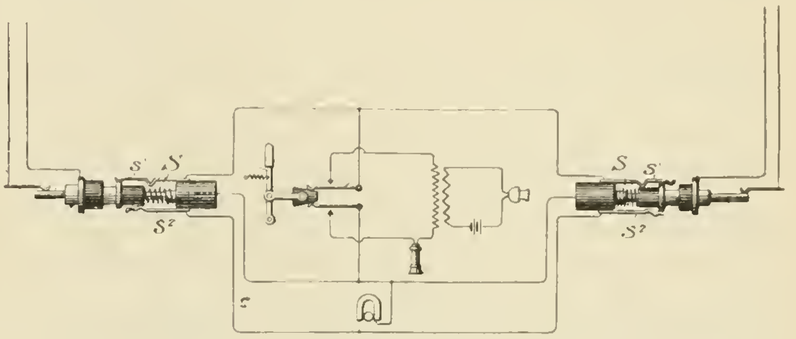


FIG. 2.—PRENTISS SWITCHBOARD.

SIGNALLING PLUGS.

Another recent patent is that of S. B. Prentiss, of Washington, D. C., which describes a design of plug and arrangement of circuit such that separate ringing keys are dispensed with. Earlier systems have been arranged to cause a signal to be sent out on a line by an excessive pressure upon the base of a plug inserted in the line jack, but in these systems at least a portion of the ringing circuit and device was associated with the jack. Mr. Spenser thinks it better to include the whole device within the plug, basing his judgment upon the ease of replacement and repair of this part of the equipment.

Fig. 2 shows the arrangement of this invention, the plug at the left being in the normal and that at the right in the ringing position. Little explanation seems necessary, the figure clearly showing how when the base of the plug is depressed against the pressure of the spiral spring, *S*, the spring, *S'*, clears the sleeve of the plug while the ringing spring, S^2, contacts therewith.

PREVENTING CHATTERING OF RELAYS.

With certain central energy systems wherein a relay is required to maintain the continuity of a subscriber's line during connection between his station and the line jacks, trouble has been experienced when an attempt has been made to signal by pulsating currents in party-line work, because of the chattering of the controlling relay during the application of the pulsating current.

Mr. David F. Stokes considers that this chattering is due to the discharge of the subscriber's station condenser in the interval between impulses of current, this discharge taking place to earth through the controlling relay, and being of an opposite sign from the normal current it releases the armature. He has found a remedy for this effect in the shunting of the relay by a high-resistance, non-inductive shunt, which, while not affecting the normal operation of the relay, carries the condenser kick around it.

A NEW WALL SET.

A fourth patent of the issue under consideration is that granted to H. F. Farwell, of Chicago, for a design of wall set in which none of the circuits are carried through hinges. In fact, Mr. Farwell dispenses with hinges altogether, mounting all his apparatus within a box, the bottom of which forms the backboard. The base of the transmitter is provided with a collar at the plane of the box cover, this collar being of slightly larger diameter than the transmitter and accurately fitting a corresponding hole in the box front. Thus the box cover can be removed over the transmitter and yet no unsightly openings are left, when it is returned to place.

The Kellogg-American Bell Complication.

Mr. Milo G. Kellogg has issued under date of November 2, 1903, a statement to the customers of the Kellogg Switchboard Manufacturing Company concerning the sale of the control of that company during his illness to the Bell Telephone interests. The statement gives an account of all the various stages of the complication that arose through the sale, and of the action that had been taken to reinstall Mr. Kellogg in the former position of ownership and control of the Kellogg Company.

The sale of the Kellogg Company took place in January, 1902, while Mr. Kellogg was absent in California sick and incapable of attending to his affairs or of being consulted about them. In August, 1901, previous to going to California, Mr. Kellogg had given to Mr. De Wolf, vice president of the Kellogg Company, power of attorney to transact any and all business connected with his personal property. During the following December it became apparent that the Everett-Moore syndicate would not be able to care for paper to the amount of $222,000 which the Kellogg Company had accepted and discounted, and which would be due during the next two months. To meet this situation Mr. De Wolf thought it best to make a sale of Mr. Kellogg's stock, by which the funds needed by the company could be secured and at the same time his estate relieved of the care and responsibility connected with the controlling interest in so large a business.

The sale was made to Mr. Barton, of the Western Electric Company, on January 4, 1901, and Mr. Kellogg states that he was not aware of the transaction until July 4, 1902. A correspondence was at once opened with his attorneys, and on October 1, 1902, Mr. Kellogg returned to Chicago and entered actively into negotiations with the American Bell interest with a view to regaining control of his company. He suggested a readjustment by which there would be divided ownership of the stock with the Bell interest in the minority, or a return to Mr. Kellogg of all his stock which had been sold, at a price which would afford $100,000 profit on the transaction to the purchasers from Mr. De Wolf.

In the correspondence on the subject Mr. Kellogg charged that there was a plan which apparently originated at the time of the purchase and which was carried out by the management of the company and by the representatives of the Bell interest, to conceal the sale of the Kellogg stock from the customers of the company and thereby obtain for the company much valuable business which could not otherwise have been obtained; and that under these misleading appearances business for the company during the last year, amounting to over $1,500,000, had been obtained. His own name having been used in the transaction without his knowledge or consent, he claimed the right to be placed in the position of ownership which has been assigned to him with the public during the last year on fair, reasonable and equitable terms, and he offered to repurchase his stock with an allowance of a profit as above stated.

Another line of argument put forth by Mr. Kellogg is that the greater portion of the product of the Kellogg Company consists of apparatus which is claimed by the Bell Company to infringe its patents, and that the Kellogg Company had given guarantee to all of its customers that in case of suit that company would protect the user, bearing all the expense of litigation. With the Bell Company practically directing the management of the company and participating in the profits from the sales, the purchaser obtains practically a license from the Bell Company to use the apparatus. But the Bell Company has previously given to others than these customers of the Kellogg Company the exclusive right to use its patents in certain territories, and to grant to the customers of the Kellogg Company the right to use apparatus claimed to be covered by Bell patents would put the Bell Company in the position of acting in comprevention to its exclusive rights previously given to its licensees. Moreover, in the sales of the Kellogg Company the transmitters are on the basis of $1.75 and the receivers on the basis of $1.35 or thereabouts, while the Bell Company leases the same instruments to its regular licensees at an annual rental which is greater than the above prices at which the Kellogg Company has been selling them during the last year under conditions which really amount to a license under the Bell patent. Consequently, the regular licensees of the Bell Company would be entitled to object to the rentals they pay on the ground that they are exorbitant.

Another difficulty which Mr. Kellogg says would arise if the facts were known is that the Bell Company would practically show to the world that it places very little value on its patents, and capital which may at the present time possibly be deterred from entering into the competition with the Bell interests on account of the patents will no longer have any fear of them. Still another complication pointed out is that the Kellogg Company, its successors and assigns have guaranteed that its apparatus does not infringe any patents granted and in force and valid, and that should this statement be challenged by suit, the Kellogg Company will, at its own cost and expense, defend such suit and pay any damages which may be assessed by reason of any such alleged infringement, or by loss or damage to a customer's business caused thereby. The Bell Company, after acquiring the Kellogg Company, began several suits against the users of the apparatus of that company, and as the former is now practically the owner of the Kellogg Company, which company had guaranteed to make good all damages which may be assessed against the telephone company for infringement, there can be no real controversy between the Bell Company and a telephone company in respect to the suits, since the two parties to the suit would be in essence identical.

Mr. Kellogg states that he brought up the matters above mentioned among others as reasons why the Bell interest should make a return of the stock to him, and, therefore, relieve itself of the manifest difficulties of the ownership of the stock. Early in the year Mr. Kellogg states that he was informed by counsel that the minority stockholders have a remedy if they invoke the aid of the State in proceedings to prevent the formation of unlawful agreements. He then began to consider the form in which he should make announcement of the transaction publicly, but his attention was called by an officer of the company to the fact that a disclosure at that juncture would jeopardize the whole investments of two of the largest customers of the company, which had been made since the Bell interest had obtained control of the company, as this plan had not been fully completed. Negotiations were then again taken up with the view to return of the Kellogg stock, and again failed. Thereupon, Mr. Kellogg confided to some of the minority stockholders the true condition of affairs and a bill of equity was filed June 1 by some of them, asking for a decree of court which should declare the sale of the Kellogg stock to the Bell interest was an unlawful injury to the rights of the minority stockholders and in restraint of trade, and, therefore, illegal and void. In this suit Mr. Kellogg was made a technical defendant, but later he filed a cross bill to this case and he expresses himself as confident that the final determination will be to reinstate him in his former position of ownership and control of the Kellogg Company. In the cross bill Mr. Kellogg places himself in complete accord with the attitude of the minority stockholders and also sets up new reasons why he should be allowed to repurchase the stock. The attorneys for Mr. Kellogg are John O. Miller and Pliny S. Smith, both of Chicago, those of the minority stockholders being Henry S. Robbins and John O. Miller, the latter acting as advisory counsel.

A World-Wide Magnetic Storm.

A remarkable display of the Aurora Borealis was witnessed in this country during the early hours of October 31, with resultant magnetic disturbances of great intensity. Reports have since been received of corresponding manifestations about the same time in various parts of the world. In New York and Chicago, the interruption of telegraphic service on land was complete, and messages were accepted subject to delay by both the Western Union and the Postal Companies. The telephone systems in some cities also suffered, but as far as can be ascertained, wireless telegraphy was not affected in the least. Submarine cables were, however, much affected. In general nothing like it had been felt since 1888, particularly in Central Europe, including Russia. In Switzerland the effects were marked, and at Geneva even the trolley cars had to stop.

Louis A. Bauer, chief of the terrestrial magnetism division of the Coast and Geodetic Survey, says on the subject: "These magnetic disturbances are indicative of the approach of the period of maximum sun spots. This period in the past has come about every eleven and one-third years. The last period was in 1894. Astronomers have recently discovered sun spots more fully developed than are expected at this time, and the prevalence of magnetic storms, it seems, would indicate that the period of maximum sun spots is coming sooner than usual or will be more than normal in character. The last magnetic storm noted by our laboratory, situated sixteen miles from Washington and in a region unaffected by electrical currents from street cars or machinery, occurred October 11. It was severe enough to deflect the compass needle nearly an entire degree. The reports of the present magnetic storm indicate that it is much more serious in character, inasmuch as we have never before heard of serious interference with cable and telegraph lines. I would judge that the compass needles on ships at sea have been affected to a much greater degree. We have laboratories in Maryland, Kansas, Alaska, the Hawaiian Islands and Puerto Rico, and their observations of these recent magnetic disturbances show that those points are affected simultaneously. As a rule, the disturbance affects the entire surface of the earth. The Aurora Borealis was observed in the New England States two weeks ago.

In England the Meteorological Office reported a magnetic storm, accompanied by Aurora Borealis, in several parts of Ireland and Scotland. The telegraphic disturbance was one of the most extraordinary on record. Before it had been settled where the disturbances originated, although Siberia was strongly suspected, slight seismic disturbances were reported from the Riviera. Sir Oliver Lodge and Sir Norman Lockyer were interviewed on the matter and agreed in attributing the cause to sun spots and an increase in solar activity, which would also account for the unusual wet season now being experienced.

In Paris the almost complete paralysis of the telegraph system is attracting the attention of numerous scientists, including Camille Flammarion, the astronomer, who attributes it to magnetic disturbances caused by huge sun spots which crossed the center meridian of the sun on October 31. Eugene Antoinadi, formerly a co-worker with M. Flammarion, says the disturbance was due to a magnetic storm caused by a group of sun spots 125,442 miles in length. The largest sun spot according to M. Antoinadi, was 37,260 miles long.

Sir Oliver Lodge, the distinguished electrician, president of the University of Birmingham, said in an interview that there are evident signs of great eruptions going on in the sun. There are very large sun spots now, and surrounding each there are indications that masses of gas, calcium and hydrogen and other vapors have been thrown up and have spread over an area compared with which Europe is a mere speck. This area is several thousand times the size of the spots, although each spot is as big as the earth.

One effect is the emission of electrified particles such as are known in the laboratory as cathode rays, the same kind of rays being among those emitted by radium. These electrical particles, shot out from the sun and traveling at enormous speed, constitute an electric current of considerable strength. If they pass near the earth they are quite likely to induce telegraphic, magnetic and other disturbances. Where they penetrate the earth's atmosphere they give rise to the Aurora Borealis.

CURRENT NEWS AND NOTES.

METRIC SYSTEM.—The New Zealand Parliament has passed a bill empowering the Governor to introduce after January, 1906, the metric system, which is then to become the only system of weights and measures for the country.

TRIP TO NIAGARA.—The Central Railway Club, of New York, proposes to hold its next meeting at the auditorium of the Natural Food Company, Niagara Falls, Friday, November 13, when it will visit various plants in the vicinity. Papers will be read.

NEW GERMAN ATLANTIC CABLE.—The new cable of the German Atlantic Cable Company between Emden and Fayal, Azores, has just been completed. This is the first section of the second cable between Germany and New York City. The section between Fayal and New York will be laid early in 1904. This is virtually a part of the Commercial cable system. The route was shown in these pages when the first cable was laid down.

ITALO-ARGENTINE WIRELESS TELEGRAPHY.—It is announced from Rome that Mr. Marconi will arrive there this week to surpervise the work of erecting an ultra powerful wireless telegraphy station for the purpose of establishing communication between Italy and the Argentine Republic.

TELEPHONE RINGS NOT PREFERRED.—President Wheeler, of the Chicago Telephone Company, has accused Cupid of making trouble for the Chicago telephone service. The only complaint he can make against the girls in the employ of the company, is that they are too good, and as soon as they become good operators they go off and get married. He says that the best operators are Irish-American, as they combine quickness and alertness of hand and mind, which are requisites for a superior "hello girl."

A TELEPHONE EXCHANGE CAPTURED.—Some days ago an intoxicated individual took possession of the telephone exchange at Stafford, Neb., during the absence of the manager, who had left it in charge of a young son. For about two hours and a half things were made interesting over the lines between Stafford and Norfolk, as the man is said to have called for connections with several hundred telephones in the latter place, running up a bill against himself of $22.50 before he could be gotten off the wire.

ANOTHER QUICK AUTO RUN.—Mr. C. L. Edgar's automobile, which made such a quick run, with an Edison storage battery equipment, last week, from Boston to New York, has made the return trip in even better time, the total elapsed time being 48 hours, 30 minutes and the actual running time 22 hours 52 minutes, or a speed of 10.8 miles per hour over a distance of 249½ miles. Messrs. W. G. Bee and H. M. Wilson handled the vehicle on the trip. The vehicle had a Columbia motor outfit, solid tires and 68 cells of battery.

UNDERWRITERS' MEETING.—Mr. C. M. Goddard, secretary of the Underwriters' National Electric Association, advises us that the annual meeting of the electrical committee of this association will be held at the rooms of the New York Board of Fire Underwriters, 32 Nassau Street, beginning at 10 A. M., Wednesday, December 2. All parties interested in the National Code will be welcome at these meetings as in the past. Any suggestions for changes in the code should reach Mr. Goddard not later than November 16.

AUTOMOBILE CLUB OF AMERICA.—The annual meeting of the Automobile Club of America will be held at the club house, 753 Fifth Avenue, on Monday, November 16, at 4.30 P. M. The governors, pursuant to the by-laws, have nominated the following ticket to fill the vacancies named: For president, Winthrop E. Scarritt; for first vice-president, Henry Rogers Winthrop; for second vice-president, Harry Payne Whitney; for third vice-president, William K. Vanderbilt, Jr.; for treasurer, Jefferson Seligman. For three governors to serve three years (class of 1906)—Dave H. Morris, Sidney Dillon Ripley, Albert R. Shattuck. For two governors to serve one year (class of 1904)—Harlan W. Whipple, Arthur Iselin. Mr. Shattuck positively declined renomination as president, and is entitled by long, arduous service to be "let out." Mr. Scarritt has been a very active and efficient member of the club for some years.

ELECTRICITY ON THE CANALS.—That interest is not lost in canals is shown by the fact that a very heavy majority has carried the proposal at this week's election to make the Erie Canal big enough for 1,000-ton barges. The present limit is about 250 tons. The total cost is put at about $100,000,000. Such a movement gives renewed importance to the application of electricity to canals, and to such tests as that made at Schenectady last week, when the Wood system was tried on about 2,700 ft. of the Erie Canal opposite the General Electric works, which furnished the current. It is a duplex monorail system on low poles, the motor taking current by trolley pole from a wire above and traveling along the rail, or girder, while a wheel grip, pulling upward, steadies it from the lower side of the rail. By carrying a motor at each side of the cross arms, two motors can pass in opposite directions, and are slightly above the other. The towing device has two motors of 40-hp each, and is said to expend about 60 hp in towing four loaded barges of 250 tons each at 4 miles an hour. The experiments made in the presence of Governor Odell are said to have been quite successful, but detailed data is not obtainable from the promoters of the system. Other experiments on the Erie have been made by Mr. Frank W. Hawley, with motors on the boats and trolley connection to parallel wires on the bank; and by Mr. R. Lamb, whose motor traveled on an aerial flexible cableway.

LIGHTING THE ST. LAWRENCE.—On October 29, for the first time, the ship channel between Montreal and Sorel was illuminated by electricity, making it as navigable as during the day. In the past ships have been compelled to lay to in the river during the night. Early next season the river will be lighted as far as Quebec.

TROLLEY IN PARIS.—It is stated that extensions of the overhead trolley in Paris promise to increase. The demand by the omnibus company for almost a general franchise has been answered by a special committee of the City Council, which in principle draws the line against trolleys entering the center of the city, but concedes permission to come well within the city limits. The Council itself, however, may veto all. One overhead trolley is already in operation in the Rue du Quatre Septembre, near the Opera. A temporary franchise was obtained, but, as usual in such cases, it will probably remain indefinitely.

ARM AND PIN CONVENTION.—Mr. J. B. Magers, secretary, informs us that the manufacturers of arms, pins and brackets will hold a convention on November 10 at Chattanooga, Tenn. The American Boiler Manufacturers' Association has also arranged to hold its meeting at the same time, for mutual benefit and convenience, and it is requested that in securing transportation the members of the former association will, in buying tickets for the latter, report to its secretary, who will sign all the certificates. Upon receipt of the fee of $1, members will receive blue prints of the shapes and dimensions, etc., adopted by the association for the standard arm, pin and bracket.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The nominations for officers of this Society for the coming year, made by the Nominating Committee, are as follows: For president, Mr. Ambrose Swasey, of Cleveland, Ohio. For vice-presidents—Prof. D. S. Jacobus, of Hoboken, N. J.; Mr. M. L. Holman, of St. Louis, Mo.; Mr. William J. Keep, of Detroit, Mich. For managers—Mr. George I. Rockwood, of Worcester, Mass.; Mr. John W. Lieb, Jr., of New York City; Mr. Asa M. Mattice, of Pittsburg, Pa. For treasurer, Mr. William H. Wiley, of New York City. At the December meeting, the headquarters of the Society will be, as usual, at the Society House, 12 West Thirty-first Street, where the opening session will occur on Tuesday evening, December 1, at 9 P. M. The president, Mr. James M. Dodge, will deliver the annual address, the subject being "The Value of an Engineering Education to a Young Man." The second session will occur on Wednesday morning, at the hall of the Mendelssohn Glee Club, 113 West Fortieth Street. This will be the business session of the convention and professional papers will also be presented. Following this luncheon will be served at the Society House, and the afternoon will be spent in making excursions to various power stations and points of interest. The evening of this day has been left free for the members to make their own engagements. The third session will take place in the Carnegie Laboratory of Stevens Institute on Thursday morning at 10 o'clock. Luncheon will be served at the Institute, and will be followed by visits to various points of interest in and about the grounds. The usual reception for guests and friends will be at Sherry's on Thursday evening, at 9 o'clock, and will be followed by dancing and supper. The closing session will be at the Society House on Friday morning, December 4, at 10 o'clock.

WIRELESS TELEGRAPH PATENTS.—The interest in wireless telegraphy among inventors is indicated by the flood of patents on that subject issuing from the Patent Office. Among the latest of these are two issued to Prof. R. A. Fessenden, one of which is an extension of a previously patented system by the same inventor involving the use of one or more reactance circuits between the antennæ and the receiving and sending circuits, the object of which is to obtain sharp tuning and selectivity. This method will be recognized as similar to that of Stone, recently described in these columns. The second patent relates to means for neutralizing in a wireless telegraph receiving circuit disturbing impulses or waves of a frequency different from that it is desired to receive. This consists in the use of two receiving conductors which are tuned to different periodicities by suitable means. When an electric impulse is received by the two conductors, the first few oscillations of the series of waves will generate nearly the same potential at the ends of the coherer or translating device in series therewith, but if the oscillations persist and their periodicity agrees with that to which either of the receiving conductors is tuned, the potential at one end of the coherer will rise higher than that of the other and the receiver will be actuated. If, however, the periodicity of the impulse does not agree with that to which either receiving conductor is tuned, there will be no cumulative rise in the potential at one end of the receiving device, and if the periodicity of the impulse be sufficiently different from the periodicities to which the receiving conductors are tuned there will be no appreciable rise at one end above that of the opposite end. Another recent patent relates to a new form of detector, the patentees being L. H. Walter and Prof. J. A. Ewing, of Cambridge, England. This is of the hysteresis type, and consists of hard steel, fine, insulated wire on a vertical bobbin carried on pivots and controlled by a torsion spring, the whole being contained in a vessel containing petroleum or other insulating fluid for damping the vibrations. The winding of the bobbin is in the receiving circuit. A prolongation of the axis of the bobbin carries an indicator, which may be a mirror or a siphon recorder. Surrounding this arrangement is a magnetic field construction which is caused to revolve by an electric motor. When the magnet is set to revolve, the bobbin tends to follow it in consequence of the energy expended in reversing the magnetism of the iron or steel winding which it carries, and this tendency is met by applying a suitable restoring moment by means of the spring torsion. Then when electric oscillations pass through the wire on the bobbin the deflection of the bobbin is increased, which effect is shown by a sudden deflection in the direction in which the magnet revolves. The deflection persists while the electric oscillations continue, and the bobbin returns when the oscillations cease. Thus long and short periods of oscillation are exhibited by long and short periods of augmented deflection. Still another patent on detectors relates to mechanical details of the ordinary filings coherer, including a mounting whereby a coherer may be quickly replaced without disconnecting circuit wires, the patentee of this improvement being Thomas E. Clark.

LETTERS TO THE EDITORS.

Three-Phase Measurements.

To the Editors of Electrical World and Engineer:

SIRS:—Since from my own experience I believe any one having to do with unbalanced three-phase circuits appreciates all information he can get on the subject, I may call the attention of such of your readers as are interested in the matter presented in Mr. Jeannin's article on "Three-Phase Measurements" in your issue of October 10, to the application which I contributed to your columns on January 10, 1903, of a similar method to the calculation of the apparent kilowatts in any three-phase circuit, balanced or unbalanced, inductive or non-inductive. I would also call attention to an accurate geometric method of construction and trigonometrical method of calculation as given by me on page 449 of your issue of March 14, 1903.

SAO PAULO, BRAZIL. L. L. PERRY.

To the Editors of Electrical World and Engineer:

SIRS:—The elaborate method for the determination of the relative phase positions of the several currents in a three-phase circuit operating on an unbalanced load by Mr. F. Hardie Jeannin, as set forth in your issue of October 10, furnishes a ready means for ascertaining from the readings of the three values of amperes and three of volts the apparent power in the circuit, and also the real watts transmitted when the load is strictly non-inductive. It is well, however, to note the fact that, for commercial loads, the method gives no indication of the true power. In the expression for power in a three-phase circuit,

$$W = \sqrt{3} EI \cos \phi,$$

the quantity $\cos \phi$ has been omitted. The inability of an ammeter-voltmeter method for determining the true power will be appreciated if one considers that with equal e.m.f.'s per delta of E, and equal currents per lead of I, the real power may have any value from *nil* to $\sqrt{3} EI$.

It is well also to call attention to the fact that in three-phase problems only currents of the circuit frequency can be represented in a single plane, as are the line currents to form the sides of a triangle by their values and relative phase positions. Any current at a different frequency must be represented by a vector in quadrature, with any vector representing any quantity at the fundamental frequency. To fulfill this condition, its location must be at right-angles to the plane containing the fundamental triangle. A superposed asynchronous current has no effect upon the watts transmitted, but it increases the value of the circuit current and leaves in doubt the value to be assigned to the apparent power. The true power, however, is properly recorded by two wattmeters as ordinarily introduced into the circuit.

The existence of current at a frequency different from the fundamental of the circuit becomes of considerable importance with any live load, as, for example, with asynchronous, and especially with synchronous motors and converters. Any variation of the e.m.f. wave form of the motor from that of the circuit causes to flow current at an harmonic frequency, and with motors running light, this quadrature, space component of current is frequently of a value sufficient to overshadow all other currents in the circuit.

Ithaca, N. Y. A. S. McAllister.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Compounding of Alternating-Current Generators.—Meyer.—The author discusses the compensation and compounding of alternating-current generators, in order to arrive at some conclusion in regard to their commercial superiority over the standard revolving field type. He bases his remarks on an article by Heyland, noted in the Digest of October 24. He considers the first cost, the cost of operation, the cost of maintenance and the cost of reserves of both types of machines. As far as first cost is concerned, and especially the claim that a Heyland synchronous generator ought to be cheaper, since a larger armature reaction is permissible than with a normal type generator of close regulation, the author contends that the diameter in both types must be the same, as that is determined chiefly by the number of poles. A saving can, therefore, be obtained only in the width of the machine; but "while the cost of an alternating-current generator is reduced approximately as the square of the reduction in diameter, it will only be reduced at about one-half the reduction in width," and, therefore, the gain in this direction cannot be very great. A copper strip winding which in most cases can be put on a standard machine, is also more economical and cheaper than a multiple wire winding with its number of connections to the commutator. As regards the cost of the cross-connected commutator as against the standard exciter, he concludes that for ordinary high-speed machines there will not be much difference, as the material is a much less important item than the labor, especially as the exciter is mostly a modified standard machine, while the self-exciting commutator has to be made up specially adapted to each kind of generator. For slow-speed machines the conditions will be much more unfavorable to the Heyland type, as the commutator, owing to the number of poles, will take enormous dimensions. As according to Heyland 6 or even 12 segments are preferable per pole, a 64-pole machine would have to have 384 or 768 segments respectively. For generators with more than 20 poles, the cost of the commutator and its connections should be considerably higher than that of a corresponding standard exciter. The question of efficiency is discussed under the heading of the cost of operation, and with the assumption that a gain in efficiency is possible, due to the smaller amount of iron in the stator, and the reduced copper section required for excitation. This ought, however, to be more than set off by the larger brush contact and the friction losses in the commutator, and by the losses incurred through compounding and in the accessories. The cost of maintenance should be about the same in both cases, though in large, slow-speed machines, the advantage is decidedly on the side of the standard machine, owing to the wear of the large commutator. The cost of reserves is considered by the author to be a most important item, which turns the scales altogether in favor of the standard generator. The commutator and all the accessories form an inherent part of the Heyland machine and in case of a break-down anywhere the whole generator has to be shut down. Therefore, a plant with these generators would seem to require in all cases a reserve generating set with all accessories, where a spare or amply proportioned exciter would do in the case of the standard machines. In conclusion, the author states that the above statements are based on the data at present available and may be somewhat modified if further particulars obtained in actual operation of Heyland machines are given; but as the main objections are not affected thereby, their usefulness will always remain limited.—Lond. *Elec.*, October 16.

Iron Loss in Dynamos.—Press.—The author investigates mathematically the iron loss in dynamos, in order to find an explanation for the fact that such loss is about two and a half times as much as it is in transformers, for the same maximum density. In the case of direct-current machines, he comes to the conclusion that the great difference between these losses can be explained in major part by taking into account the slope of the flux distribution wave, the ratio of transformer to dynamo losses being actually 1 : 2.5. By the method of slopes the losses become 1 : 1.9, leaving 0.6 out of 2.5 to be accounted for by rotating hysteresis, end casting effect, iron loss effect of teeth under pole shoe (which for a narrow air-gap is comparatively large for a great number of teeth), by circulating current and by losses unaccounted for and due to commutation. He concludes further that the so-called full-load increment in iron loss can be in a measure accounted for by the skewing of flux due to cross magnetization. For the same volume of flux, skewing may increase the eddy loss to almost any value, and an eddy loss increase from three to four times may be looked for. He also concludes that the ideal distribution curve is a parabola degenerating into a flat top, with parabolic sides for a minimum total iron loss, and that for a given pole pitch there should be less and less flat top the greater the periodicity, i. e., the revolutions. In the second part of the article he considers the case of alternators, and comes to the conclusion that with machines of low frequency, where the coefficient of hysteresis is more important than the eddy current coefficient, a flat top wave should be aimed at. A formula is given for the flux distribution curve. He also calls attention to the fact that the pole pitch factor is smaller in alternators than in direct-current machines, and the flux density is also smaller; hence, the incremental iron loss when the machine takes on load should be less, since the skewing plays a less important rôle. This would explain the fact that whatever additional loss is observed in alternators, is usually quite small. —Lond. *Elec.*, October 16.

Alternators in Parallel.—Rosenberg.—He discusses at considerable length the influence of the damping with alternators working in parallel. He uses the word "Reaktionsverhaetniss," or reaction-relation, to define the ratio between the synchronizing moment and the initial pendulum moment, which gives an insight into the reaction of the alternator on the prime-mover. The expression, reaction-relation = 1, signifies, then, complete equality between the forced and the free oscillations, i. e., complete resonance. The author concludes from his investigations that there is a wide field for the application of the damping, the limits of which are sharply defined by the reaction-relation. If the latter is between 0 and ½, the damping has a harmful effect, whereas when it exceeds the value of ½, the damping is beneficial. It has the greatest value for a reaction-relation, which comes near to unity. To be on the safe side, a machine should be equipped with such large fly-wheel masses that the calculated oscillations are within allowable limits, and the factor of increment is small for all oscillations which come into consideration, and in that case damping can be dispensed with. In cases, however, where other considerations demand as low as possible fly-wheel weight, or where, in machines already built, the reaction-relation is large, due to the non-consideration of these calculations, the damping is an effective means for relief or even cure.—*Elek. Zeit.*, October 15

Variable-Speed Motors.—Couffinhal.—A paper read before the International Society of Electricians in Paris. The author gives the results of some recent experiments with a Couffinhal motor, the speed of which is varied by changing the air-gap. The mechanism by which the change of the air gap is effected is briefly mentioned. The motor with which the experiments were carried out was a bipolar machine of 28 amp. at 220 volts. The measurements were made with half the normal current, or 14.5 amp., and the full normal current of 25 amp. The air-gap was varied between 3 and 48 mm., with speeds ranging between 405 and 1,800 revolutions, respectively. The efficiency for half current was 83 per cent. for the slow speed and 79 per cent. for the high-speed. With full normal current and nearly the same speeds the efficiency was 85.5 per cent. for the low and 80 per cent. for the high-speed. A table is also given for the hysteresis and the eddy current losses for the various speeds.—*L'Eclairage Electrique*, October 10.

REFERENCE.

Armature Reaction of Alternators.—Guilbert.—A mathematical article in which the author calculates the direct and the transverse magnetomotive force for ordinary alternating and polyphase currents.—*La Revue Technique*, September 25, October 10.

Lights and Lighting.

Intense Arc Light and Mercury Vapor Light.—Hospitalier.—A paper read before the International Society of Electricians in Paris. The author discusses briefly the "intense" (Bremer) arc light lamps, stating that in experiments made by Janet at the Laboratoire Central d'Electricité, an ordinary arc light without a globe was found to give 16.8 lumens per watt, while a Bremer lamp gave 32.6 lumens per watt. He refers briefly to some unpublished work of Blondel with tri-zone carbons, which, according to him, have made it possible to obtain arcs of only 3 amp., which produced a luminous flux of 45 lumens per watt, and arcs of 9 amp., which produced 77 lumens per watt, or more than four times the amount of an ordinary arc absorbing the same power. He then discussed the Cooper Hewitt lamp. (A lumen is the flux of light of one [hefner] candle through a solid angle. One spherical [English] candle equals 14.28 lumens. —*Comp.*)—*L'Eclairage Electrique*, October 10.

REFERENCE.

Electric Lighthouses.—König.—A review of the advantages of the electric lighting of lighthouses, as compared with oil and acetylene.—*Elek. Anz.*, September 20.

Power.

Electric Pumping Plant.—An illustrated description of a recent installation for the electrical operation of a large mine drainage pump. The generating station comprises a large 840-hp steam engine, driving a three-phase fly-wheel magnet alternator with 30 poles, which generates 22.5 cycles current at 2,000 volts. The exciter is driven by a separate vertical steam engine. A smaller 150-hp engine drives by belt a three-phase generator. The pump is designed to raise 5 cu. m. of water to a height of 400 metres. The motor, which is coupled directly to it, is of the three-phase induction type, and has a normal output of 570 hp at 78 r.p.m., and a starting torque 20 per cent. greater than the normal torque, with full load current. The diameter of the rotor is 3 metres and the air-gap measures 2 mm. The winding of the stator consists of 162 coils embedded in 324 grooves and insulated with micanite tubes. The weight of the whole machine is 28 metric tons, of which 9 are sheet iron and 1.4 copper. At normal load the motor absorbs about 170 amp. in each phase, with a power factor of 82 per cent. and an efficiency of 92 per cent., the slip being 2.7 per cent. The maximum torque is twice the normal torque.—Lond. *Elec. Rev.*, October 16.

French Aluminum Manufacturing Power Plant.—Perkins.—An illustrated description of the plant of the Société Electrometallurgique Française at La Pras, Savoie. In the generator room of the power house, there are more than 30 electrical machines of a capacity of nearly 15,000 hp. The first generators installed were of the vertical type, directly coupled to vertical turbines. The latter machines are of the horizontal type, direct-connected to horizontal turbines. An alternator is also illustrated, which is stated to serve for the production of steel in the electric furnace. It is a monophase 500-hp machine, running at 110 volts and 33 periods, and supplies a current of 3,750 amp. at 250 r.p.m. The field poles revolve within the armature, which is stationary. The field has 16 poles, the winding of each pole consisting of a conductor of a cross-section of 6.5 × 6.6 mm. The armature winding consists of 16 parallel circuits connected to two metallic rings, the conductors consisting of copper bars 2.2 mm. thick and 42 mm. wide. The machine delivers a current of either 120 or 65 volts, as desired.—*Electricity*, October 14

Small Electric Station Driven by Wind Power.—Lacour.—An abstract of a paper read before the Technical Congress in Copenhagen. A description is given of a small plant in Askov, Denmark, where a wind motor is used for furnishing current. The greatest difficulty was encountered in getting a suitable speed regulation for the dynamo, as it could not be coupled directly to the wind motor on account of the variations of speed of the latter. This has been overcome by adopting two different regulations, one by a mechanical arrangement, which acts when the speed of the wind motor is too great, and another by an electrical arrangement, if the speed is too low. The arrangement is briefly and diagrammatically illustrated. The current is used for the charging of a storage battery. The station furnishes light and power to the inhabitants of several rural communities. The normal current is 50 amp., and the voltage of the circuit 2 × 110. It is stated that the station has worked very satisfactorily and has made good profits.—*Elek. Anz.*, October 15; from *Teknik Tidskrift*, Stockholm.

REFERENCES.

Motor-Driven Vertical Milling Machine.—An illustrated description of a recent construction.—*Am. Machinist*, October 22.

Air Compressors Driven by Electricity.—The conclusion of the article previously noted in the Digest. A number of constructions are described and illustrated.—*Glueckauf*, October 10.

Traction.

Multiple-Unit Train Control.—An illustrated description of the Siemens-Schuckert multiple-unit train control, which has recently been employed on the Overhead and Underground Railway of Berlin. The actual working of the controllers is accomplished by a pneumatic system, the air valves being electrically operated by a low-voltage current. There are two separate drum pattern controllers, viz., a reversing controller and a speed controller, both built on standard lines. The last-named controller has two chief stops, one for the series position of the motors and the other for the parallel position; but the arrangement is such that the drum may be made to stop in any intermediate position. To insure the prompt working of the switching-off arrangement in the case of a train breaking in two, the current which operates the valve mechanism is left continuously flowing during the time the train is running. If this control current circuit is broken for any reason, the motors are switched off. The system is explained at some length.—Lond. *Elec.*, October 16.

REFERENCE.

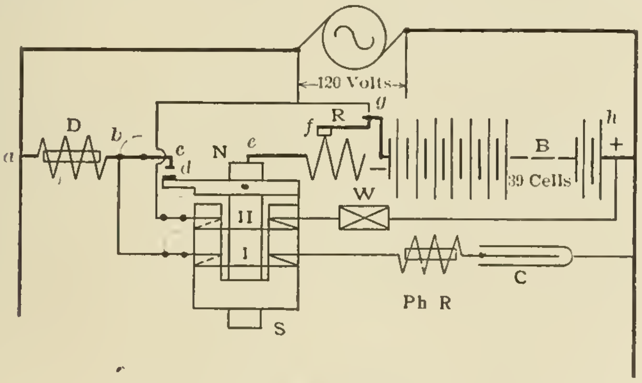
Magnetic Method for the Study of Railway Axles.—Sandaran.—An abstract of a paper in which the author outlines a method for the study of the changes in molecular conditions, which the axles of locomotives and railroad cars undergo when in service, on account of the continuous vibrations to which they are exposed. The method is based upon measuring the magnetic permeability and recording the gradual changes of the latter. The arrangement which the author uses is illustrated and his method of conducting the experiment is described in detail.—*L'Eclairage Electrique*, October 17; from *La Energia Electrica*, Madrid, July, 1903.

Installations, Systems and Appliances.

Three-Phase Switch Gear.—Eborall.—The continuation of his illustrated serial, previously mentioned in the Digest. In this issue he deals at length with light-pressure oil switches and their auxiliary attachments. In place of the employment of quick-acting fuses on the machine and feeder panels of the power station and sub-station switchboards, he recommends the following arrangement of the protective devices for standard cases: 1. Automatic non-overload switches with reverse-current attachments on the generator panels; they will take care of the system should an alternator fail through losing its excitation or through a coil giving out, or should a faulty synchronizing or measuring transformer fail to be protected by its fuses. There will be no interruption in the supply.

the remaining generators sharing the extra load until a spare unit can be got in. 2. Automatic overload switches with time attachments on the feeder panels, which will cut out any faulty feeder (or one with a persistent abnormal overload) at the station end. 3. Automatic non-overload switches with reverse-current and time attachments on the feeder panels of the sub-station board, these switches being inserted between the feeders and the high-pressure bus-bars. Their object is, in the first place, to prevent the fault in a defective feeder (disconnected at the station end by arrangement 2) being supplied through the healthy feeders from the power station or with back current from the synchronous machinery in the sub-station and also to prevent, in the second place, a fault which might occur in the power station being supplied with current from motored synchronous machinery in the sub-station, back through the feeders. 4. Automatic overload switches with time attachments on the machine panels of the sub-station switchboards; that is to say, in circuit with the synchronous motors or transformers (supplying the rotaries), as the case may be. These circuit-breakers take care of the individual converting units. The overload time circuit-breakers referred to in 4 should be set for quicker operation than those in 2, and the reverse-current time circuit-breakers in 3 for quicker operation than the overload time circuit-breakers in 2. For the case in which feeders from the distant power station pass through a nearer sub-station on their way to others more remote, the above arrangement must be extended by providing overload time circuit-breakers on the outgoing feeder panels in the sub-station. The author then discusses the objections against such an arrangement involving much complicated additional apparatus at considerable additional expenditure and gives his reasons for thinking that the additional expense is not so large as it might seem at first sight. He then discusses the question of what would happen if one of the reverse-current circuit-breakers on the generator panels of the power station switchboard should take fire. He comes to the conclusion that such a contingency is very remote indeed, and on account of the smallness of the risk he would not provide for it as a general rule. For exceptional cases he would prefer to make these panel section switches in the form of hand-operated oil switches.—Lond. *Eng'ing*, October 9.

Direct Current from Alternating-Current Circuits.—Sterzel.—The author gives the results of investigations conducted with a rectifier constructed according to Koch's system, which was described in the Digest of November 9, 1901. The apparatus was used for about a year and a half to charge a battery of storage cells of 20 amp. charging current, from a three-phase, 50-cycle current at 120 volts. The apparatus is illustrated diagrammatically in the adjoining figure. The main circuit consists of an oscillating relay armature, a choking coil, *D*, of moderate reactance, an ordinary regulating rheostat, *R*, and the storage cells, *B*. The shunt circuit, *I*, consists of two field coils, a condenser, *C*, for obtaining a lead of the current, and a variable self-induction coil, *Ph R*, for the exact regulation of the current phase. The oscillating armature closes the contact with the utmost precision at times, when no power is transmitted; that is, at the moment where the charging current and the battery voltage have the same value. A second shunt circuit, *II*, consisting of a second winding on the field coils and a rheostat, regulates automatically the time of contact, as in the charging of the cells the time for which an excess of the alternating voltage over the alternating voltage obtains, gradually becomes shorter. If a counter e.m.f. (storage battery) is not present in the circuit, the apparatus takes complete alternation and circuit *II* and the reactance coil, *D*, can be dispensed with. The author determined the completeness of the utilization of one alternator, which he finds to be within 3 per cent. of the theoretical when the battery was replaced by an ohmic resistance. Experiments were also conducted with various amperages for charging the battery, from which he calculates the factor of completeness of current utilization. The electrolytic direct-current equivalent was also determined. In conclusion he calculates an example for a rectifying arrangement, in order to determine the necessary resistances which have to be introduced into the circuit.—*Elek. Zeit.*, October 8.



DIRECT CURRENT FROM ALTERNATING CIRCUITS.

REFERENCES.

Coventry (England) Electricity Works.—An illustrated description of recent extensions, consisting of two 600-kw alternators. They are of the standard revolving field type, running at 2,000 volts, 50 cycles, and are direct-coupled to triple-expansion engines of 125 r.p.m. The revolving field is carried on a cast-steel spider. The exciter is a shunt-wound dynamo mounted directly on an extension of the alternator shaft. The construction of the machines is briefly described.—Lond. *Elec. Rev.*, October 16.

Synchronizing Devices.—Davies.—An article, illustrated by diagrams, giving a review of the development of the methods of synchronization and a description of those in use.—Lond. *Elec. Eng.*, October 2.

Electrical Station Practice.—Radcliffe.—The continuation of his long illustrated serial, previously mentioned in the Digest. The plan of the building is discussed and the interior arrangement of a station dealt with at length. The installation of machines and apparatus is then taken up.—*Electricity*, September 30, October 7, 14, 21.

Wires, Wiring and Conduits.

REFERENCE.

Calculation of Networks of Conductors.—Busset-Schiller.—An article illustrated by several diagrams in which the author gives an improvement of his graphical method for finding the most favorable position of the junction points for mains and feeders, which was referred to in the Digest of October 3.—*L'Ind. Electrique*, September 25.

Electro-Physics and Magnetism.

Discharging Power of Ultra-Violet Light.—Ladenburg.—An abstract of an article in which the author draws attention to a notable difference between the photoelectric effects observed by Elster and Geitel, and that observed by Lenard in an absolute vacuum. The former, working with ordinary light, found a decisive influence on the direction of the plane of polarization. The latter found that the effect depends solely on the amount of light, and not upon its direction of vibration. The author suggests that this may be due to the fact that the ultra-violet light penetrates below the surface, whereas the ordinary light does not. Experiment shows that this supposition is correct. Mirrors of burnt-in platinum were used, upon which nickel mirrors of various thicknesses were deposited electrolytically. He found that the so-called fatigue of the mirrors is due to some change in the condition of the surface produced by the light. The maximum current is obtained with the brightest polish. The series of metals arranged in order of current strength begins with platinum and ends with nickel, but shows no connection with other physical properties. The current depends simply upon the amount of incident ultra-violet light, and not upon its angle of incidence or polarization. In the case of nickel, the distance to which light penetrates into the metal is about 8 wave lengths.—Lond. *Elec.*, October 9.

Influence of the Field upon the Magnetic Susceptibility of Solutions.—Heydweiller.—A short abstract, giving the results of his investigation of the above subject. He finds that within small variations of field intensity the change in the susceptibility of solutions of iron and manganese salts is inappreciable, but that when the fields range from 0.1 to 40,000 C.G.S. units, variations are distinctly traceable. In ferric chloride they are slight, in ferrous and manganous chloride they are somewhat greater, and in the sulphates the variations attain as much as 30 or 40 per cent. As regards the theory of molecular magnets, it must be concluded that complex molecules are formed in these salts.—Lond. *Elec.*, October 9: abstracted from *Annal. der Phys.*, No. 11, 1903.

REFERENCES.

Magnetism.—Maurain.—A very long article, illustrated by diagrams, containing a review of recent progress in the study of magnetism. The author discusses the general magnetic properties of nearly pure iron, steel, cast iron, etc., the magnetization curves and the influence of other substances than iron and carbon. He also deals at length with the influence of the speed of variation of the magnetic fields and the results obtained by a number of investigators. The third part of the article is devoted to the discussion of the variation of the magnetic properties with the temperature.—*l'Eclairage Electrique*, October 3, 10.

Magnetic Properties of Iron Containing Carbon.—MAURAIN.—The author discusses the relation between the constitution of the varieties of iron which contains carbon, and their magnetic properties.—*l'Eclairage Electrique*, October 17.

ELECTRO-CHEMISTRY AND BATTERIES.

Generation of Acetylene.—MOREHEAD.—An article in which the chemical questions involved in the generation of acetylene from calcium carbide and water are discussed, with special reference to the methods by which the possible sources of danger are eliminated in modern acetylene generators. So far as the toxic properties of the gas are concerned there is practically no danger. The three important points are danger from overheating, from excessive after-generation, and from an explosion of a mixture of the gas and air. Overheating is due to the heat developed in the reaction between calcium carbide and water; the production of this heat cannot be avoided in any way, so that the first consideration in the design of the generator must be to get rid of this heat. This may be done in two different ways: first, by dissipation into the surrounding air, and second, by absorption in water; dry machines used for bicycle or automobile lamps, etc., depend upon the first principle; wet machines, upon the second. All charged machines belong to the latter class. To counteract the danger from an excessive pressure due to after-generation, the present generators retain their gas by means of water seals, which would "blow" at a few pounds and relieve the pressure. The author considers that a true explosion like that of gunpowder or of glycerine is a dissociation, and that the explosion of a mixture of acetylene and air is really a very rapid and very violent combustion, burning; that is, a combination of carbon with oxygen. The maximum explosive effect is obtained by mixing acetylene gas with 12.5 times its volume of air; the explosion requires that the mixture be ignited. Through gross ignorance or carelessness an acetylene generator can be made to fill a basement with gas just as it can by only ordinary care be made to supply a system of burners. A basement full of air and gas, water gas, coal gas, natural gas, or acetylene gas, is harmless unless ignited.—*Electrochem. Ind.*, October.

Precipitation of Gold from Cyanide Solutions.—CALDECOTT AND JOHNSON.—A paper in which the authors discuss the reactions involved in the precipitation of gold from cyanide solutions, either by means of zinc shavings or by the electric current. They agree that the view based on the ionic theory, according to which potassium ions are primarily precipitated and afterwards react with the double salt in solution with the result of a secondary deposition of gold, may be the more correct one; but they think that as a working hypothesis, it is better to assume that the precipitation of gold is due to nascent hydrogen. The precipitating efficiency of chemically pure zinc is practically zero, as the action is that of a zinc couple; the function of the less positive metal in the couple is thought to afford innumerable points of the rough surface for the liberation of hydrogen. The great barrier to continuously effective precipitation is the lack of contact between the precipitating surface and the solution, and, owing to the readiness with which the surface becomes coated in various ways, it is necessary to employ enormous areas to insure good results. A most efficient aid to zinc precipitation would be the discovery of some solvent for zinc hydrate which will not interfere with the cyanide.—*Electrochem. Ind.*, October, 1903.

Electrolytic Formation of Perchlorates.—OECHSLI.—A very long article, in which the author gives the results of his studies on the above subject. In order to determine the conditions for the formation of perchlorate, he conducted electrolyses of the chlorate in neutral acid and alkaline solution, with variable current densities, and with smooth and platinized anodes. His conclusion is that his results agree with the idea that the electrolytic formation of perchlorate is brought about by the spontaneous decomposition of discharged ClO_3 ions into ClO_4 and ClO_2, while the chlorous acid, which appears in this connection, is oxidized by the current to chloric acid.—*Zeit. f. Electrochem.*, October 8.

REFERENCE.

International Congress for Applied Chemistry.—DANNEEL AND CLEMENT.—A continuation of their congress report, with abstracts of the following papers: Lebeau, on the composition of electro-metallurgic products containing silicon; Coehn, on the specific action of metals in electrolytic reduction and oxidation; Solvay, on the application of a formula of gravitation to the process of diffusion; Goldschmidt, on the kinetics of the reaction of the reduction of metals; Elbs, on the electrochemical methods for the preparation of organic chemicals; Buchner, on the electrochemical methods in technical organic chemistry.—*Electrochem. Ind.*, October, 1903.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Transformers for Measuring Instruments.—PUNGA.—An article in which the author considers the various points to be taken into consideration of transformers to be used in connection with measuring instruments for measuring large currents, especially when the transformer is to be used for more than one frequency and in connection with more than one instrument. The construction of a transformer intended for one primary turn only is illustrated. It is stated that secondary currents of 1 to 5 amp. will be found most useful, the number of ampere-turns depending entirely upon the purpose the transformer has to serve. If standard transformers have to be designed, the author suggests the adoption of three different sizes, viz.: a cheap one for use in connection with switchboard instruments, up to about 500 amp., and two larger ones with 1,500 and 4,000 amp., respectively, on the secondary winding, to be used for wattmeters, power factor indicators, integrating meters, etc. The author then investigates mathematically whether the ratio between the primary and secondary currents is constant at varying loads, and if not, how much it varies. He deduces a formula, from which he calculates a table for the ratio at different loads. He finds that between 20 per cent. full load and 30 per cent. overload the ratio does not vary more than 3.5 per cent., which he considers sufficiently accurate for most practical purposes. He then considers the above ratio for different frequencies with the help of a diagram, from which he deduces the following means for reducing the influence of the frequency on the ratio, viz.: 1. By using iron of high permeability; 2, by making the magnetic path through the air as well as through the iron as short as possible; 3, by making the total resistance of the secondary circuit as small as possible, and 4, by making the self-induction of the secondary circuit as high as possible. The fourth means, however, he considers doubtful, because the magnetizing ampere-turns are increased nearly in the same ratio, thus altering the ratio between the primary and secondary currents in relation to different loads. In conclusion, he gives some data of a transformer employed with a Thompson recording wattmeter, with 125 amp. in the primary and 25 amp. in the secondary.—Lond. *Elec.*, October 9.

Ballistic Galvanometers.—POWELL.—A paper read before the British Association on some points in the design and working of ballistic galvanometers. The author first calculates a formula for the damping effect, and in order that the motion of the coil may be effectively stopped by short-circuiting, its resistance must not be greater than the value obtained by the equation. When a deflection is being read, however, in order to render the damping term inappreciable, the total resistance of the circuit must be considerably greater than this value. In a special case, a galvanometer was calculated and constructed, and was found to have a much higher period and much lower sensibility, than it had been designed for. The cause was found to be that the copper wire used for the construction of the coil was magnetic, and that this magnetic control was very large in comparison with the feeble control of the strip. To overcome the difficulty, it was tried to obtain non-magnetic wires, but the best results were obtained by depositing electrolytic copper on a very fine wire. This was, however, brittle and an attempt at rolling and annealing it resulted in making it magnetic. The method finally adopted consisted in using a very narrow coil and making the field of the permanent magnet as uniform as possible by means of pole-pieces. In order to increase the moment of inertia of the system a light copper disc was attached rigidly to the coil by a light bone rod. This arrangement gave satisfaction as regards sensibility and periodic time, but did not damp well when short-circuited. This difficulty was overcome by placing below the copper disc a small electromagnet, which, when excited, quickly brought the disc to rest by reason of the eddy currents induced in it. In conclusion the method of calibrating the instrument is briefly outlined.—Lond. *Elec.*, October 9.

REFERENCE.

Measurement of Power in Alternating-Current Circuits.—Ballard.—A didactic article, reviewing the methods for carrying out the measurements.—*Engineer*, October 1.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraph Apparatus.—An illustrated article describing the application of the Lodge-Muirhead system of telegraphy to a portable apparatus for military purposes. The aerial system is only 40 ft. in height, and is constructed on the "roof" principle, in the shape of an upright pyramid. The lower capacity area is not formed by an ordinary earth, but by a copper netting and several copper plates. The sending and receiving circuits are diagrammatically illustrated. An open circuit is employed, the aerial on the one side and the capacity, adjustable inductance and wire netting on the other, being connected directly to the spark knobs of the secondary of the induction coil in the case of the transmitting circuit. For receiving, the aerial is connected to the primary of the "jigger," whose other terminal goes straight to the wire netting, etc., and in this case an adjustment is possible by changing the "jigger." The secondary circuit of the receiving station consists of a Lodge revolving disc coherer and a syphon recorder, current being supplied from two storage cells through a potentiometer. The system recorder is bridged by an adjustable condenser.—Lond. *Elec.*, October 16.

Electric Switch and Signal System.—An illustrated description of the system adopted by the North Eastern (England) Railway Company in a recent installation. With the exception of the mechanical interlocking of the switches and signals, all operations are performed by electric power. The levers in the signal cabin are used only to operate the electric switches controlling the motor and signal apparatus, the physical labor on the part of the operator is, therefore, much less than with the ordinary arrangement. The motors for operating the switches are of 2½ hp. Current is supplied at 200 volts from the railroad company's power station.—Lond. *Elec. Eng.*, October 16.

REFERENCES.

The Present State of Wireless Telegraphy.—Tissot.—A long historical review of the development of wireless telegraphy and its present condition.—*Rev. gen. des Sciences*, October 15.

Automatic Signal System.—An article giving an illustrated description of the Harrison electric signal system for electric roads.—Lond. *Elec. Eng.*, October 16.

Telephone Exchange.—An illustrated description of the large automatic exchange of the Home Telephone Company, of Dayton, Ohio.—*Elec. Rev.*, October 24.

MISCELLANEOUS.

Production and Consumption of the Most Important Metals.—An abstract of statistics collected by the Metallgesellschaft and the Metallurgical Gesellschaft, of Frankfort-on-the-Main, Germany, for 1902 and the seven first months of the current year.—*Glueckauf*, October 10.

Electric Welding Apparatus.—Reyval.—An illustrated description of several types of electric welders constructed by the Société Française Thomson-Houston and an enumeration of the applications of the electric method to the welding of various shapes.—*L'Eclairage Electrique*, October 17.

New Books.

Induktionsmotoren. Ein Kompendium für Studirende und Ingenieure. By B. A. Behrend. Translated by Dr. Paul Berkitz, with notes by Prof. W. Kubler-Dresden. Berlin: M. Krayn. 182 pages, 107 illustrations and 10 plates. Price, 11.50 marks.

The German translation of Behrend's book on the induction motor has been enlarged by several plates, giving drawings of the mechanical design of modern alternating-current motors and, in this respect, the German work is more complete than the American original. The plates illustrate among other things a 375-hp induction motor and a three-phase railway motor for 400 hp., 900 r.p.m., 45 cycles and 1,150 volts, built by Siemens and Halske. Also a 10,000-volt motor built by the same firm for railway purposes is well illustrated in several plates. We cannot help admiring the care and skill employed by the Germans in the illustrations of their scientific and engineering publications, and such plates as the ones appended to this work are much to the credit of the publishers.

There is also a sin of omission in Behrend's book which should be made good in a future edition. There is a widespread idea that with the same magnetic circuit a squirrel cage induction motor has a higher power factor and overload margin than a motor with a Y-connected winding for the insertion of resistance, the erroneous argument being that a rotor winding with many phases, as a squirrel cage winding, is superior to the three-phase winding of the Y-connected rotor. Experimental evidence to the contrary would have been a welcome addition, especially as it would have had considerable weight coming from an engineer of such large experience.

BOOKS RECEIVED.

Elementare Vorlesungen über Telegraphie und Telephonie. By Dr. Richard Heilbrun. Berlin: Georg Siemens. 63 pages, illustrated.

Der Drehstrommotor. By Julius Heubach. Berlin: Julius Springer. 356 pages, 163 illustrations. Price, 10 marks.

The Practical Testing of Dynamos and Motors. By Charles F. Smith. Manchester: Scientific Publishing Company. 231 pages, 80 illustrations. Price, 5 shillings.

Theoretische Grundlagen der Starkstrom-Technik. By Charles Proteus Steinmetz. Braunschweig: Friedrich Vieweg & Son. 331 pages, 143 illustrations. Price, 10 marks.

Die Gleichstrommaschine. By E. Arnold. Berlin: Julius Springer. 665 pages, 484 illustrations. Price, 18 marks.

Die Montage Elektrischer Licht und Kraftanlagen. By H. Pohl. Hannover: Gebruder Janecke. 272 pages, 328 illustrations. Price, 4.40 marks.

Messungen an Elektrischen Maschinen. By Rudolf Krause. Berlin: Julius Springer. 158 pages, 166 illustrations. Price, 5 marks.

Elements of Electromagnetic Theory. By S. J. Barnett, Ph.D. New York: Macmillan Company. 473 pages, 145 illustrations. Price, $3.00.

A Text-Book of Electrical Machinery. By Harris J. Ryan, M.E., Henry H. Norris, M.E., and George L. Hoxie, M.M.E., Ph.D. New York: John Wiley & Sons. 258 pages, 134 illustrations. Price, $2.50.

The Gas Engine. By Frederick Remsen Hutton, E.M., Ph.D. New York: John Wiley & Sons. 483 pages, 243 illustrations. Price, $5.00.

Electric Railway Economics and Preliminary Engineering. By W. C. Gotshall. New York: McGraw Publishing Company. 243 pages. Price, $2.00.

Der Elektrische Lichtbogen. Bei Gleichstrom und Wechelstrom. By Berthold Monasch. Berlin: Julius Springer. 266 pages, 141 illustrations. Price, 9 marks.

Engineering Preliminaries for an Interurban Electric Railway. By Ernest Gonzenbach. New York: McGraw Publishing Company. 71 pages, 5 illustrations. Price, $1.00.

The Dynamo. By C. C. Hawkins and F. Wallis. London: Whittaker & Company. 925 pages, 413 illustrations. Price, $4.00.

A New Corporation to Extend the Tunnel System in Chicago.

With a capital stock of $30,000,000, the Illinois Tunnel Company has been incorporated at Springfield, Ill., to succeed the Illinois Telephone & Telegraph Company. The new corporation will take over the property and grants of the old one and will expend the additional capital in completing the 50 miles of tunnels required by its franchise, in the next ten years. Telephony will be merely a side issue with the new company. There is space in the tunnels for the telephone wires and that is said to be the reason the automatic service is being promoted. The real object is the transportation of freight.

The object of the new company, according to the articles which have been filed are: "To furnish, transmit, convey and deliver signals, sounds, intelligence, packages, mail matter and general merchandise, power, heat and light by steam, water, air, electricity and otherwise, and, to acquire, construct, dispose of, hold, maintain, operate and lease to or to rent from others all tunnels, instruments and appliances and other property, real or personal, in carrying out such objects."

Under its ordinance, the Illinois Tunnel Company is required to construct at least 50 miles of tunnel within ten years. Twenty miles of tunnel, 6 x 7 ft. in bore, have been constructed and heavy rails have been laid for the carrying of freight by motor car. The various railroad yards and depots have been connected with this tunnel in the down town section and plans are ready for the extension of the tunnels to the stock yards and outlying districts. No freight is yet being transported through the tunnel, but it is said by the company officials that this part of the business will begin on or before July 1 next.

The new concern which succeeds to all the rights and privileges of the old company has a capital of $30,000,000, as compared with the $5,000,000 capital of the Illinois Telephone & Telegraph Company, which was organized and licensed June 23, 1898. The incorporators of the new company are Charles C. Wheeler, Henry A. Wilkening and Thomas A. Moran, Jr.

◆

A Small Town Automatic Telephone Exchange at Hope Valley, R. I.

The accompanying diagrams and cuts illustrate the principal features of the Clark Automatic Telephone Switchboard system installed at Hope Valley, R. I., a town of about 900 population, and situated 40 miles southwest of Providence, R. I. The main leads in the line construction consist of 30 and 35-ft. chestnut poles, equipped with standard 10-pin cross arms, locust pins and pony glass insulators, while in the country line construction 25-ft. chestnut poles, equipped with 6-pin cross arms, are used. All iron cross arm braces, bolts, washers, guy wire and anchors are of the best galvanized material. No. 12 B. B. galvanized iron wire is used for the talking circuit and a common return wire of No. 12 B. B. with weather-proof insulation completes the switching circuit. The object in insulating the common return is to prevent any likelihood of a cross with one of the talking wires, which is also used for switching purposes, as this would short-circuit the central switching battery and throw the system out of service. The wiring of the plant is such that the common return wire is used only for switching and might be replaced by a ground connection. It is obvious from the diagrams that it is possible to cut in transpositions on the line wherever necessary to balance up the circuits.

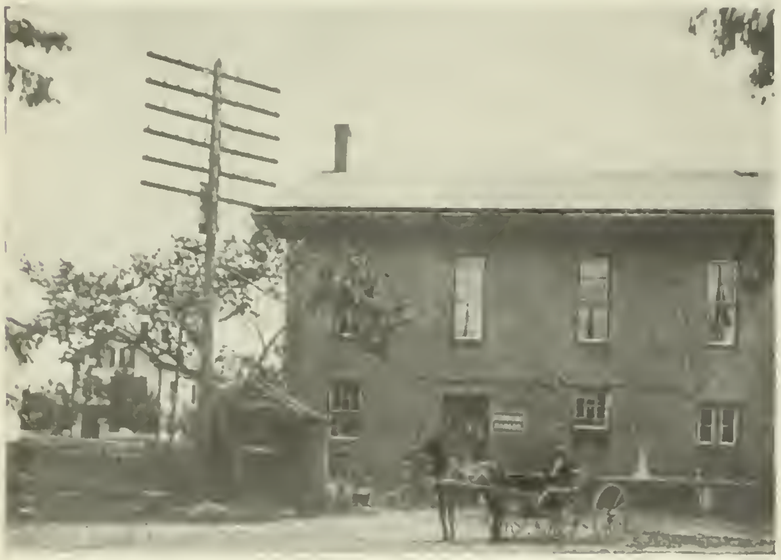


FIG. 1.—HOPE VALLEY TELEPHONE EXCHANGE AND CABLE POLE.

The system is operated by means of a central switching battery consisting of eleven American Battery Company's cells charged by means of a bank of 33 cells of gravity battery. This method of charging the storage battery is employed as the town has no light or power facilities from which charging current might be obtained.

A 75-pair weather-proof cable, made up of twisted pair, No. 19 copper conductors with rubber insulation, connects the line wires at the cable pole with the lightning arresters located in the switchboard room. From the lightning arresters the lines pass through a small panel of jacks, mounted near the toll operator's telephone, to the automatic switchboard. The automatic switchboard has a full complement of 72 switches, each subscriber requiring a separate switch, which is operated by a dial located at the subscriber's telephone. The telephones used in this exchange are of the Clark bridging type with adjustable arms and equipped with Clark automatic dial, Holtzer-Cabot three-bar, automatic clutch shunt generator, 1,000-ohm ringers and American Bell transmitters and receivers.

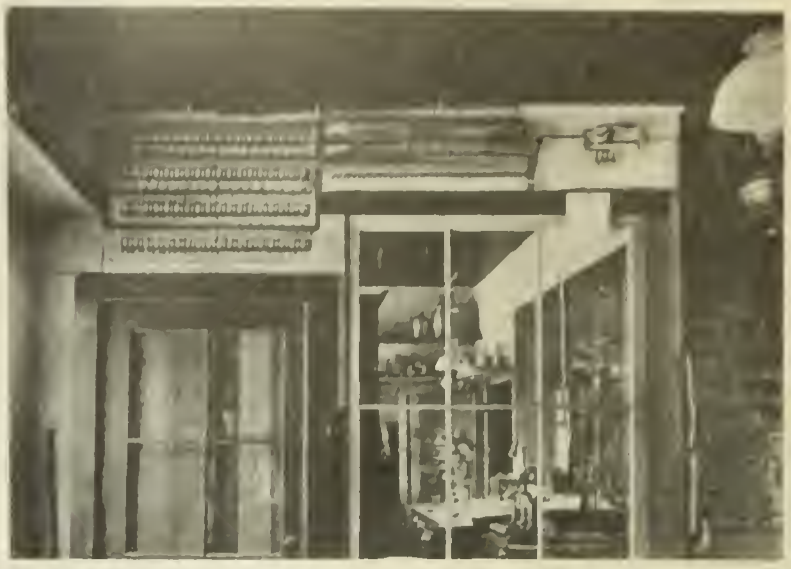


FIG. 2.—LIGHTNING ARRESTERS.

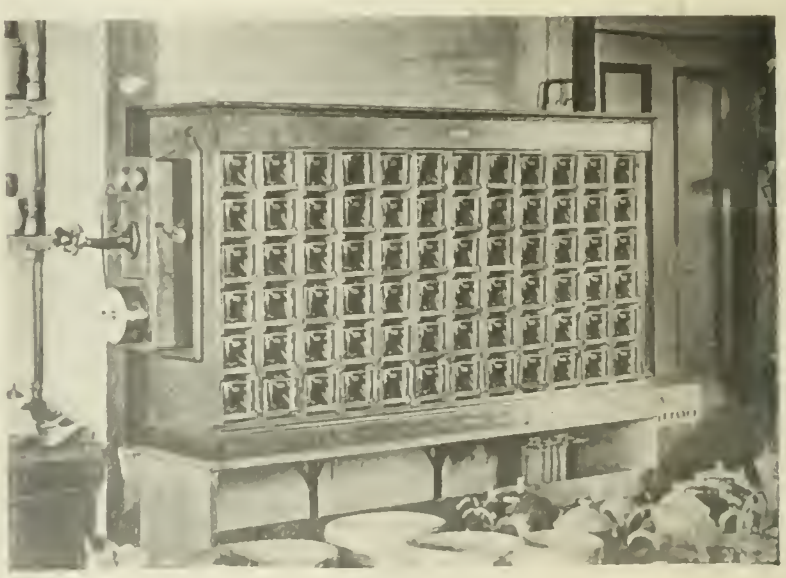


FIG. 3.—SWITCHBOARD FOR 72 SUBSCRIBERS.

A rural line four miles long is connected with the automatic switchboard, and by means of a special circuit the subscribers on this line are enabled to call local subscribers automatically. This is accomplished by the insertion of a relay on the line, the automatic

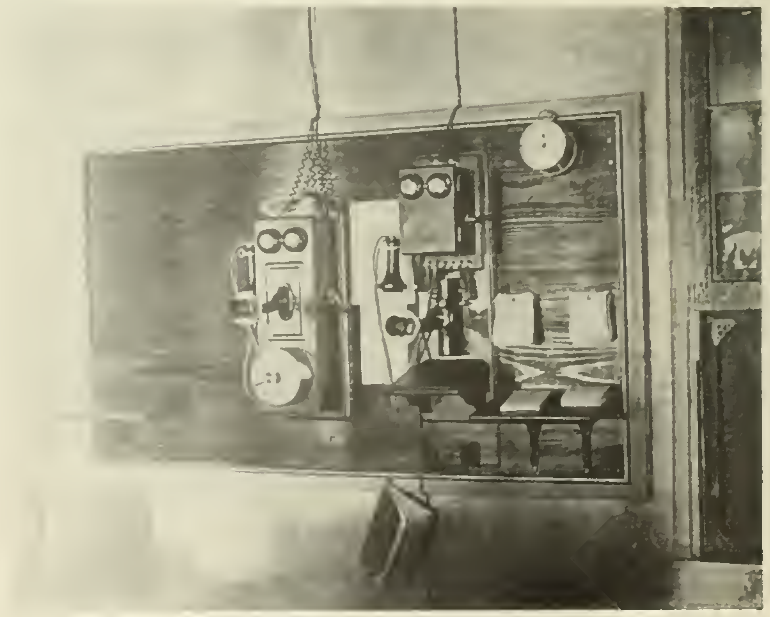


FIG. 4.—METHOD OF GIVING TOLL CONNECTION.

switch operating off the local contacts of the relay, as shown in the diagram. By this method no increase in the voltage of the central switching battery is required. Subscribers in this exchange may call any long-distance point from their telephones as follows: The local toll operator is also a subscriber to the automatic system. When a subscriber desires a long-distance connection he first calls the toll operator, on the automatic telephone, and gives him the name of the party desired. When the toll operator obtains the long-distance connection, he simply trunks it through the jack panel to the local subscriber by means of a pair of cords, at the same time ringing the local party. On an incoming call the toll operator, on receiving the number wanted, trunks the long-distance call through the jack panel, at the same time ringing the local subscriber. The insertion of the jack panel referred to has a double value: First, in testing the lines, and secondly in making it possible to connect the automatic subscribers to the toll lines direct, thereby cutting them off the automatic system entirely and insuring an all-metallic connection independent of the local system.

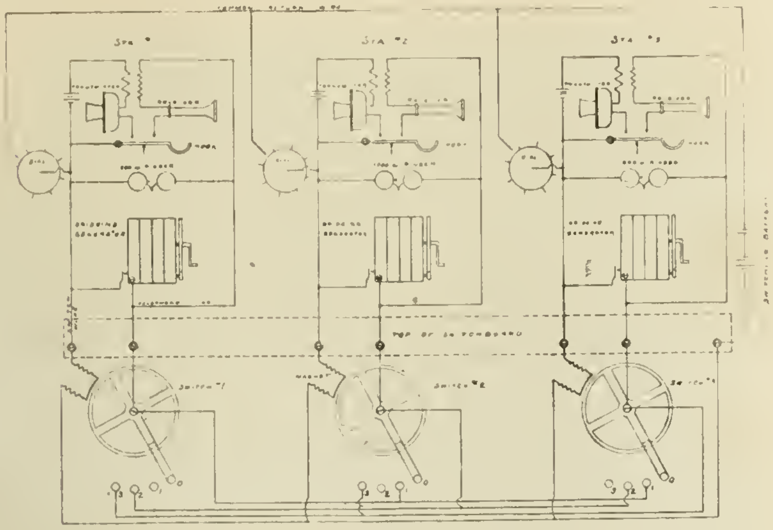


FIG. 5.—DIAGRAM OF WIRING OF BRIDGING SYSTEM USING COMMON RETURN FOR SWITCHING ONLY.

When the construction of this plant was begun in May of the present year it was on the basis of 30 signed contracts. The plant began operation in the middle of July with an increase of 50 per cent. in the number of subscribers. There has been, since that time, a further increase of 20 per cent., the total number of subscribers at the present writing being 54. The rentals obtained are $20 per year for residences and $24 per year for business houses.

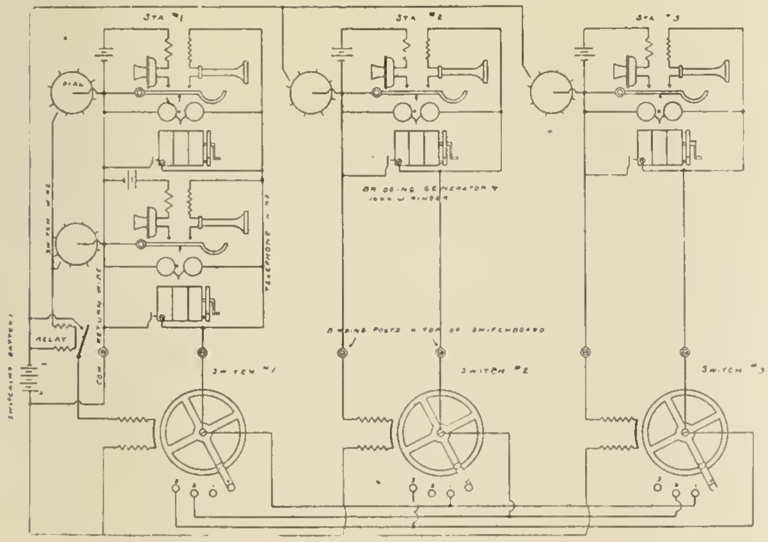


FIG. 6.—DIAGRAM OF WIRING FOR BRIDGING SYSTEM WITH RELAY ON LONG LINES.

Schuler-Ferranti Single-Phase Alternating-Current Motor.

The accompanying illustration shows a single-phase motor of the self-starting type, manufactured by Ferranti (Limited), Hollinwood, Lancashire, England. The core of the stator is built up of sheet-iron stampings, paper insulation being placed between the stampings. The stampings are clamped hard together by the frame, so as to minimize undue noise arising from the vibration of the stampings, and ample space is allowed all around the stampings for a free passage of air. The winding is in slots punched into the stampings, and consists of form-wound coils carefully insulated. The rotor is built up of iron stampings in the same way as the stator. The winding consists of rectangular bars. The rotor is provided with a commutator on one side and three slip rings on the other. The brushes bearing on the commutator are short-circuited by means of a copper ring and the brushes bearing on the slip rings are connected to the starting resistance.

The framework consists of a solid iron casting, circular in shape, with ventilating holes in the volute to allow free circulation of air around the stator stampings. The bearings are supported on heavy cast-iron brackets, securely bolted at each side of the main framework; the bearings are of gun metal. An oil well is supplied to each bearing, cast in one piece with the bearing bracket. The lubrication is automatic, by the use of continuous oil ring lubricators; special oil throwers are provided to prevent the creepage of oil along the shaft.

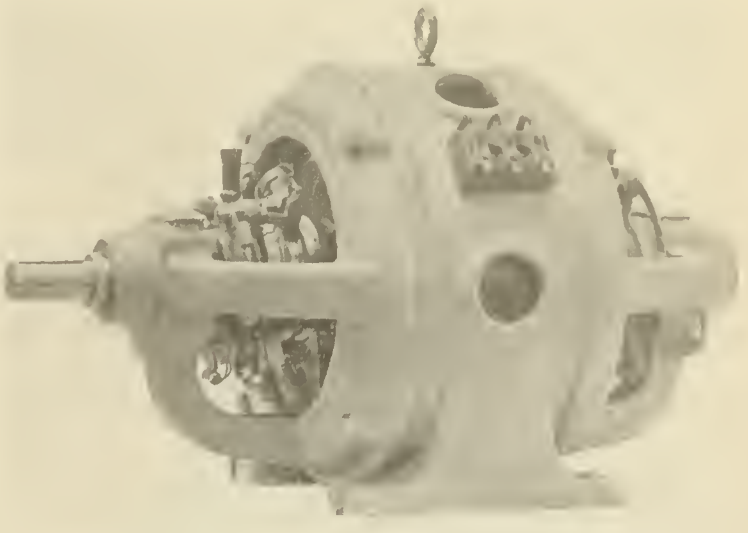


FIG. 1.—SINGLE-PHASE ALTERNATING-CURRENT MOTOR.

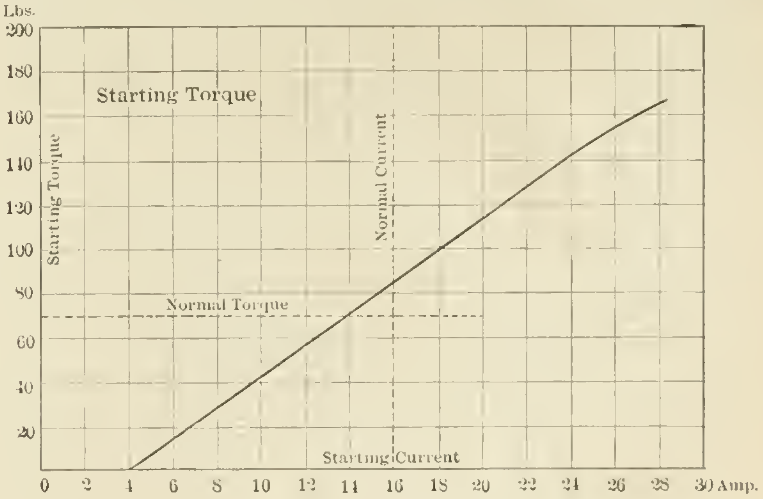


FIG. 2.—TORQUE CURVE.

When the current is switched on the motor starts up, the starting resistance is gradually cut out, thus causing the motor to attain full speed. The motor, it is stated, runs absolutely without sparking. Under ordinary running conditions the commutator carries no current and the motor will start against full load and give 1¼ times full load torque without increase of full load current. It can also be arranged to give twice full load torque at starting with only 50 per cent. increase of full load current. When starting against no load it will run up to speed, taking only about one-third of full load current. The direction of rotation can be reversed by a simple throw-over switch controlled, if necessary, from a distant point. The motor is particularly suitable for lift, crane or other power purposes requiring high starting torque, and hitherto outside the scope of the ordinary single-phase motor. The motor has a high efficiency and power factor, and is made for low and medium speeds. It is guaranteed to stand an overload of 50 per cent. for five minutes, and to start with any load up to 2½ times its normal full-load torque. After working at full load for six hours, the temperature rise is guaranteed not to exceed 70° F. above the atmosphere. The starting current is guaranteed not to exceed the following figures:

At a starting torque of 2½ times the normal, current not to exceed 100 per cent. above the normal; at double the normal torque, current not to exceed 50 per cent. above the normal; at 50 per cent.

torque above the normal current not to exceed 20 per cent above the normal; at 25 per cent torque above the normal, normal current; at one-half of the normal torque one-half of the normal current.

◆

New Form of Incandescent Lamp Filament.

The Downward Light Electric Company, of New York, is placing on the market an incandescent lamp with a new form of filament designed to throw downward the greatest possible portion of the candle-power of the lamp. As will be seen, all but a small percentage of the length of the filament lies in nearly a horizontal plane when the lamp is placed vertically. The accompanying curves showing the distribution of light from this and other forms of filament have been plotted from tests made by the Lamp Testing Bureau, of New York. Curve 1 is from a double-filament lamp; curve 2 from an oval anchored filament; curve 3 from a double round filament; curve 4 from a flattened double lamp, and curve 5 from the "Downward" lamp. In every case the lamps tested were 16-cp incandescent lamps. The lamp is manufactured with a tipless bulb, thus still further facilitating the downward flux of light.

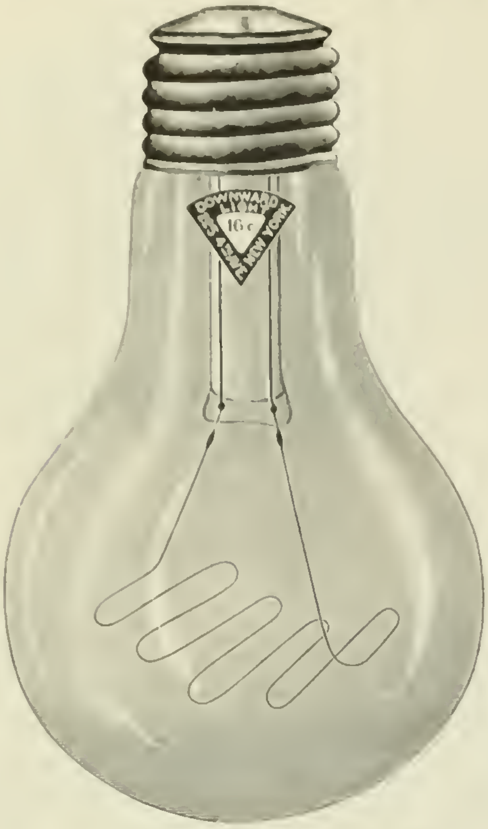


FIG. 1.—DOWNWARD LIGHT INCANDESCENT LAMP.

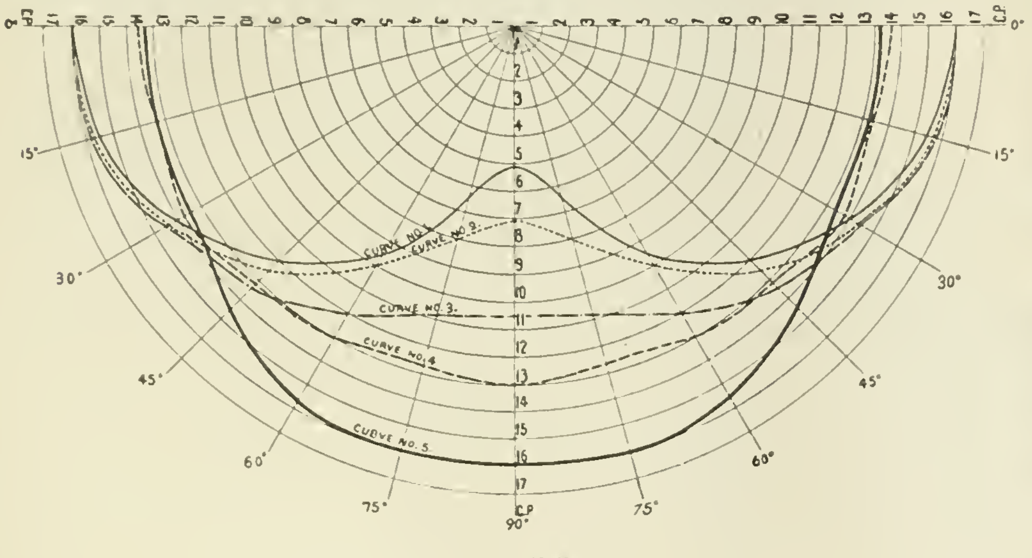


FIG. 2.—LIGHT DISTRIBUTION CURVES.

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A Portable Line Meter.

The Denver Gas & Electric Company has been using lately a little instrument which is called by its manufacturers, the Portable Electric Instrument Company, of Denver, Colo., a portable line meter. The local company have employed it principally for balancing loads on their transformers and in locating transformers at the most advantageous points on the three-wire network. In many instances they have found transformers badly overloaded or unbalanced, which might otherwise have gone unnoticed until a burn-out occurred.

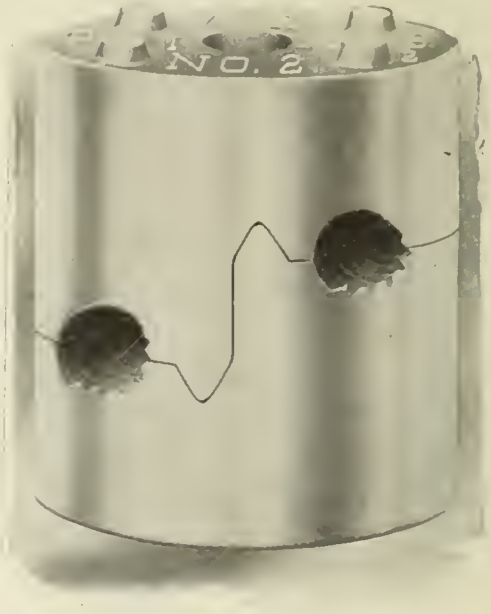
The meter, which is shown in use in the accompanying cut, takes the amperage anywhere on the line. It consists of a small series transformer with a ring-shaped core, one section of the ring being hinged to permit it being opened to place it over the wire carrying the current. This little transformer is connected to a portable ammeter by means of 40 or 50 ft. of flexible duplex cable. The standard instrument will measure with a high degree of accuracy, it is said, loads of from 20 to 400 amp. In Denver two men in a single evening have covered a large down-town district and tested a large proportion of the transformers there.

PORTABLE LINE METER.

◆

A New Split Porcelain Insulator.

A new type of porcelain insulator, known as the "W. E." split porcelain insulator, has been put upon the market by the Western Electric Company. The accompanying illustration gives a good idea of the general construction and appearance of this device. It is manufactured of highest grade porcelain, cylindrical in shape, and symmetrical with respect to the dividing line. The two parts are perfectly interchangeable. It is not intended to carry two conductors, as might at first glance be thought, one hole being too near the supporting surface to admit of this being done. The No. 1 knob takes wires from No. 10 to No. 14; the No. 2, from No. 6 to No. 8. The insulator is readily installed, the two pieces being fastened with one nail or screw. It is approved by the Board of Underwriters.



PORCELAIN INSULATOR

Switchboard Designed for Export.

Owing to the demand of its switchboards for export, Ferranti (Limited), Hollinwood, England, have designed a special type for the purpose, which is shown in the accompanying illustrations. The makers, in considering the design, appear to have fully recognized the difficulty in procuring skilled labor for erecting in many places and have produced a type of their well-known designs which can be very readily placed in position and connected up without requiring expert erection.

Fig. 1 is reproduced from a photograph taken of a board just before packing for shipment to Pietormaritzburg, and Figs. 2 and 3 illustrate clearly the method of packing, which is all-important for such work. It will be seen that the switch gear is made in complete self-contained sections, which are finished off in every detail at the maker's works. The sections are first surrounded by strong wooden battens clamped together by iron bolts, and then the whole is let down into an external packing case, the space intervening between the two sets of packing cases being filled in with material of a springy nature. On arrival at their destination, it is only necessary to lift the section with the internal packing from the case and rest it upon the trestles or brick piers. Then only is the switch gear proper disclosed, and by the simple means of joining up the bus-bars with links provided for the purpose, the entire apparatus is made ready for service.

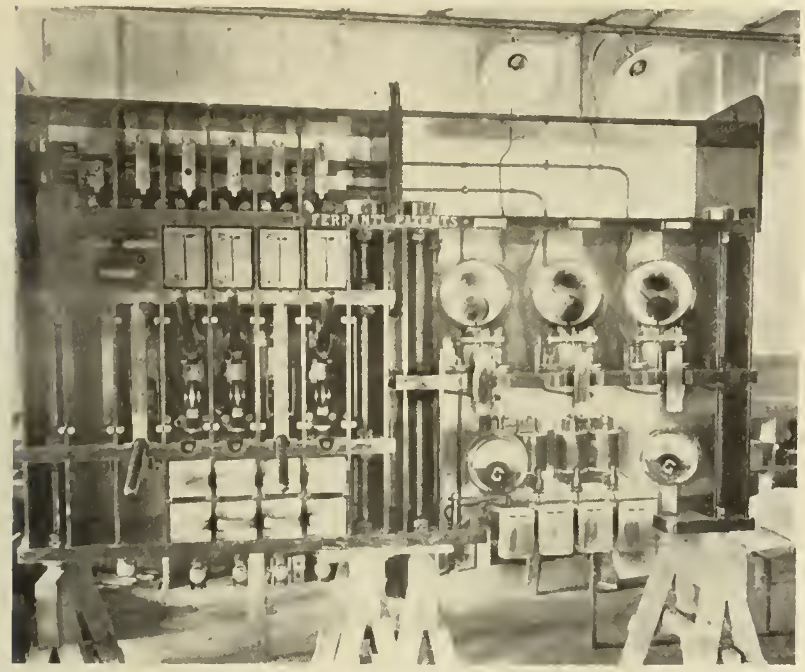


FIG. 1.—GENERAL ARRANGEMENT OF SWITCH GEAR.

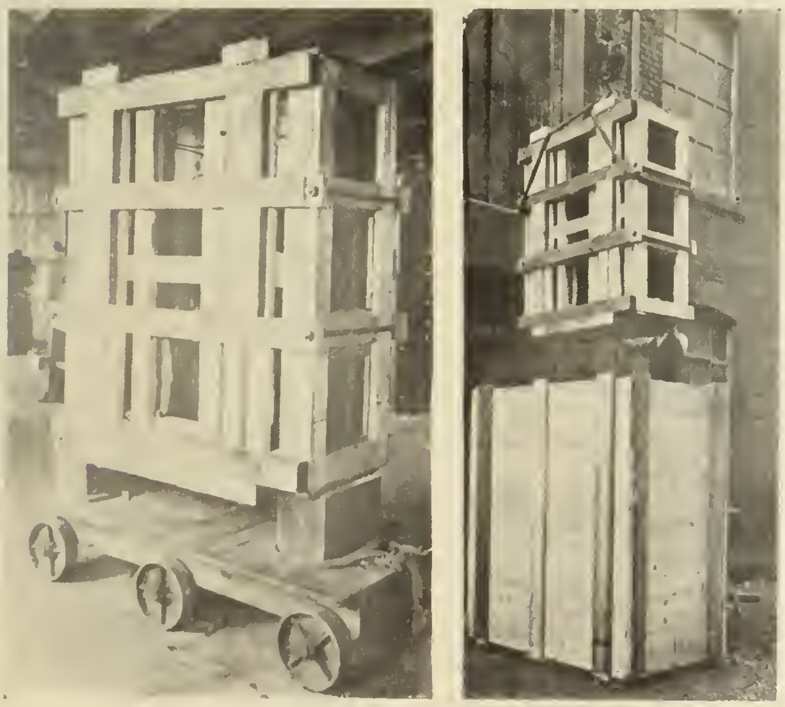


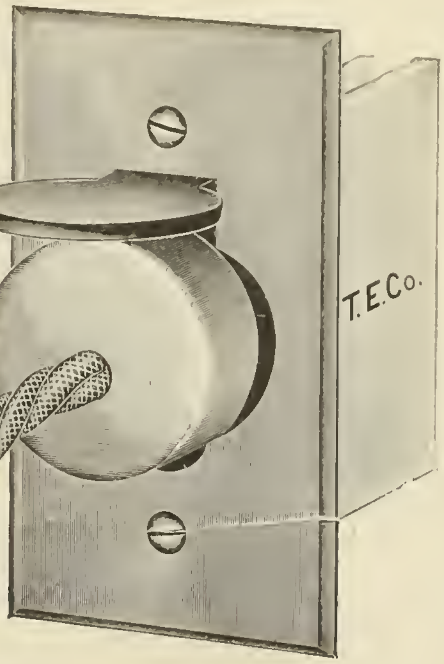
FIG. 2.—COMPLETE SECTION AND INTERNAL PACKING.

Great security is afforded by these designs, for which the makers make the following claims: Cellular type, minimizing fire and life risks; simplicity in construction, reducing possibilities of errors in manipulation; economy in floor and wall space occupied, designs self-contained and portable, uniform and symmetrical arrangements, no expert erection required outside the maker's works.

◆

Flush Receptacle.

The main features of the flush receptacle shown in the accompanying illustration, made by the Trumbull Electric Manufacturing Company, Plainville, Conn., are that it fits into any standard switchbox without the use of a special plug. It is made to take the ordinary Edison base attaching plug, such as is used for tapping into an incandescent lamp fixture for a fan motor or a desk lamp. In this respect the receptacle is claimed to be unique.



FLUSH RECEPTACLE.

Any person using an Edison plug will find this device a convenience, and with a great number of such attaching plugs in use and their immediate availability wherever any electrical supplies are sold, it is thought that contractors will find it desirable to install this type of receptacle. It is fitted with a nickel-plated cover.

◆

Equipment for Queensland Railway Shops.

The most complete electrical equipment for operating machine tools, etc., hitherto installed in the Antipodes, has just been completed at the Ipswich shops of the Queensland government railways. The electrical machinery is all of American manufacture. The complete contract was undertaken by the engineering and contracting firm of Noyes Brothers, of Sydney and Melbourne, who represent the Westinghouse interests in Australasia.

There are three Westinghouse vertical compound condensing 250 r.p.m. engines of 300-hp capacity each. These engines are direct-connected to 200 kw, 60-cycle, two-phase, alternating-current generators of Westinghouse build operating at 220 volts. Exciter current is furnished from an independent 17½-kw direct-current exciter. The condensing plant consists of a Worthington combined air and circulating pump and a cooling tower. The latter is a cylindrical tower 15 ft. in diameter and 32 ft. high, built up of steel plates and packed with 12,000 interlocked tubes, giving a total cooling surface of 80,000 sq. ft.

Within each shop the electric current is distributed to the motors—161 in number—ranging from 1 hp to 75 hp, and having a total capacity of 1,200 hp, by means of overhead rubber insulated cables carried on the roof by glass insulators. The motors are of two-phase induction type, completely enclosed and self-lubricating. Many are suspended from the ceiling or placed on vertical walls.

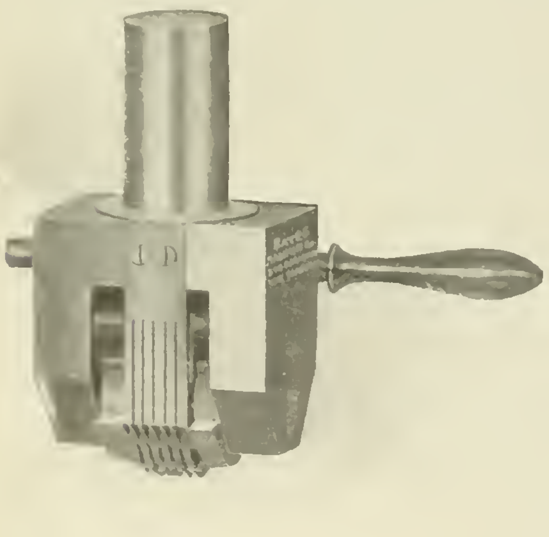
Babcock & Wilcox secured the contract for the boiler plant, which consists of four units of 350 hp each. The C. W. Hunt Company, of Staten Island, was awarded the contract for the coal and ash-handling machinery.

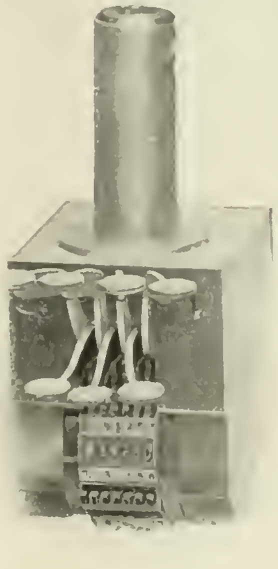
Machine Numbering in Metals.

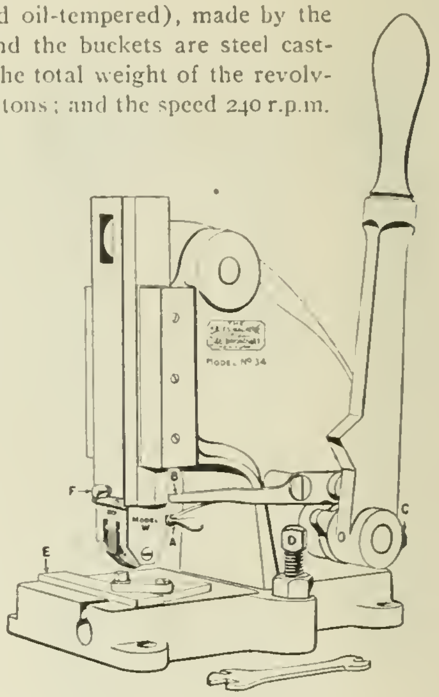
The operation of numbering name plates and metal parts has until recently remained a most unsatisfactory one, and the old method of employing individual figure stamps and hammer was not only crude, slow and expensive, but errors and irregularities constantly occurred and the appearance of the work was far from attractive. The machines here described are designed with a view of meeting the requirements, eliminating the many difficulties which have heretofore existed, and performing in an hour what was before considered a good day's work, in an infinitely superior manner enhancing, rather than destroying the appearance of the parts upon which a number is to be placed. By their use consecutive numbering is accomplished with absolute accuracy, and any numbers which skip backward or forward, such as type and voltage numbers, may be impressed on the parts themselves or upon plates or tags to be attached to them. These machines are already in use to such an extent that their practicability has been fully tested, while it has been demonstrated that they are important factors in the saving of labor.

One form shown in Fig. 1 is designed for consecutively numbering gold, silver, steel, brass, copper, iron, tin, hard rubber, fibre, leather-covered and wooden instruments, or parts of any kind, size or shape, such as name plates for electric, gas and water meter tags, brass checks, steel keys, locks, watch cases, watch movements, steel bars and plates, etc. It may be operated in any punch, screw or lever press. The shank is made straight or to any taper and length desired. It is set up in the same manner as an ordinary punch, but the stroke of the press must be limited and carefully adjusted to the depth of the impression required. As the discs revolve, the figures are brought into correct alignment, are equally spaced apart and are sunk precisely the same depth, thus insuring perfect uniformity. The lever bar may be attached to any stationary part of the press, and the number will then advance automatically in consecutive order with each stroke. The figures and letters are made to any size desired and are cut upon "tool steel" wheels, carefully hardened and tempered.

Fig. 2 shows a style which is designed for stamping the style, size, grade, type, ampere, voltage and power numbers upon name plates, tags or parts of motors, dynamos, electric meters, etc. Any combination of letters and figures may be set instantly—skipping backward or forward as is required for numbers which do not progress consecutively. Each numbering disc or wheel is provided with a lever which operates it independently of the others. The ends of the levers form a small keyboard. Remarkable speed is invariably attained as soon as the operator becomes practised. This experience is very easily acquired by an ordinary machine hand. The figures or letters which are in stamping position are always shown by the indicators on the front of the wheels just below the keyboard.







Figs. 1, 2 and 3.—Numbering Machine.

The hand lever bench press shown in Fig. 3 is designed to facilitate the operation of Figs. 1 and 2, but as before stated, any punch, screw or lever press may be utilized. Adjustable gauges are usually provided to which the pieces or parts to be numbered are fed. A toggle joint insures maximum power with comparatively slight pressure upon the lever. A consecutive numbering machine is shown in the cut. These machines are made by the Bates Machine Company, 346 Broadway, New York.

Bearings for Dynamos and Motors.

The Hobart Electric Manufacturing Company, Troy, Ohio, is using new bearings for its dynamos and motors, which have some features of merit. With its self aligning, self-oiling bearings a hot box seems quite impossible. Superior machine work secures accurate alignment, but as an additional precaution the company provides for the self-adjustment of the bearing sleeve so as to secure exact and automatic conformity with the shaft. The sleeves are of the best anti-friction metal and are readily removable and interchangeable. The oil chambers are large. This reduces the attention to a minimum. The thrust collars provided for centering the shaft magnetically deserve especial consideration. These thrust collars provide against too great end play and secure the proper amount of end play, at the same time preventing the armature from being drawn against one bearing. Correct end play further facilitates lubrication and prevents the brushes from wearing grooves in the commutator.

Nimshew, Cal., Power House.

At the Nimshew power house of the Valley Counties Power Company, a sub-company of the California Gas & Electric Corporation, the first two machines have begun operation, feeding into the transmission line of the Bay Counties Power Company. The power house is located in the Butte Creek Canyon, 24 miles from Chico. The available total head of water is 1,531 ft., taken down in one pipe line 6,200 ft. long, and tapering in three sections, from 30 to 28½ in. diameter. Within the power house the pipe terminates in a Y, each branch of the Y supplying a 3,700-hp water wheel, the largest ones, it is stated, operated by one single jet of water.

The generators are of the Stanley Electric Company's make, the rotary element mounted on one single shaft with the water wheel. The entire hydroelectric unit runs in two bearings, the rotary element of the generator between the bearings, and the water wheel overhung. Shaft and wheel disc are nickel-steel forgings (the shaft being hollow, forged and oil-tempered), made by the Bethlehem Steel Company; and the buckets are steel castings of the ellipsoidal type. The total weight of the revolving part of each unit is over 40 tons; and the speed 240 r.p.m.

Each Doble wheel is provided with a Doble needle regulating deflecting nozzle and hydraulically operated piston gate, and a Lombard governor with electric speed controller taking care of the sudden fluctuations of the load by deflecting the nozzle; whereas the regulating needle is operated by hand and set according to the average load of the respective hours of the day. The hydraulic machinery, including shaft, bearings and gates, was designed and built by the Abner Doble Company, of San Francisco.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Speculation was dull and professional, and industrial stocks were unfavorably regarded on poor earnings showings and adverse indications as to iron and steel industrials. The traction stocks received support from local political sources, based on speculation attending the municipal contest in New York City. Despite the conflicting rumors in regard to the position of Amalgamated Copper, that stock held firm, although it was much less active than during the week previous. On Friday the market was dull in spite of its heaviness and the further indications of very poor bank averages for the week. Brooklyn Rap. Tran. closed at 35¼, a net gain of 1¾, the sales aggregating 57,150 shares. Met. St. Ry. fluctuated between 107⅛ and 111½, closing at 109¾ a gain of 2¾. Man. Elev. made a gain of 2 points; closing at 135¼. The electrics were firmer and showed an advancing tendency. General Electric reached 153¼, but closed at the week's lowest figure—148½. This, however, is a gain of ½ point. Westinghouse common made a net gain of 6 points, closing at 137. Western Union gained ¾ point net, closing at 82¾. Following are the closing quotations of November 4:

NEW YORK.

	Oct. 27	Nov. 4		Oct. 27	Nov. 4
American Tel. & Cable	78	78	General Electric	150	150
American Tel. & Tel	123	129	Hudson River Tel	..	.
American Dist. Tel	24	24	Metropolitan St. Ry	110	110¼
Brooklyn Rapid Transit	34⅞	35⅛	N. E. Elec. Veh. Trns	..	..
Commercial Cable	..	..	N. Y. & N. J. Tel	..	..
Electric Boat	17	20	Marconi Tel	..	..
Electric Boat pfd	41	44	Western Union Tel	82⅝	83
Electric Lead Reduction	*1⅛	*1⅛	Westinghouse com	137½	136
Electric Vehicle	5	5½	Westinghouse pfd	165	165
Electric Vehicle pfd	8	8			

BOSTON.

	Oct. 27	Nov. 4		Oct. 27	Nov. 4
American Tel. & Tel	123¾	127½	Western Tel. & Tel. pfd	..	75
Cumberland Telephone	*115	..	Mexican Telephone	*1¾	1⅛
Edison Elec. Illum	231	244	New England Telephone	123	*123½
General Electric	149	150	Mass. Elec. Ry	19	18½
Western Tel. & Tel	*10	8½	Mass. Elec. Ry. pfd	77½	77½

PHILADELPHIA.

	Oct. 27	Nov. 4		Oct. 27	Nov. 4
American Railways	42½	43	Phila. Traction	94	95¼
Elec. Storage Battery	*50	47	Phila. Electric	5⅞	6⅛
Elec. Storage Battery pfd.	*50	47	Phila. Rapid Trans	12⅛	12
Elec. Co. of America	7⅜	7⅜			

CHICAGO.

	Oct. 27	Nov. 4		Oct. 27	Nov. 4
Central Union Tel.	..	..	National Carbon pfd	85	..
Chicago Edison	..	140	Metropolitan Elev. com	17	17
Chicago City Ry	169	167	Union Traction	7¼	6
Chicago Tel. Co	..	115	Union Traction pfd	32	30
National Carbon	15	17¼			

*Asked

CHICAGO RAILWAYS COMPANY.—Application has been made for articles of incorporation of the Chicago Railways Company, which, it is said, will be the financial factor in the solution of the problems confronting the Union Traction Company and its underlying corporations. The commissioners making the application are Nathan C. Johnson, W. E. Cooper and Archibald G. Thiselton. Mr. Alfred Skitt is said to be the prospective president, as well as a director of the company, and Harry B. Hollis, now a director of the Union Traction Company, has tendered his resignation of that office, and will be associated with Mr. Skitt in the directory of the new corporation. While the capitalization of the new concern is placed nominally at $10,000, it is said to be the purpose of its promoters to increase it, as soon as the organization is complete, to $5,000,000, and later to a figure that will cover the amount required for the rehabilitation of the North and West Side systems. The new company is declared to be not organized for any purpose unfriendly to the receivership of the Union Traction Company, and any leases which may be made by it will be subject to the termination of the receivership.

CINCINNATI GAS & ELECTRIC.—The Cincinnati Gas & Electric Company reports that during the past three months 43,000 new gas services have been established and 27,000 new gas ranges have been disposed of. Within the same period the gas consumption has been 60,000,000 ft. greater than during the same period last year. In the three months 22,000 electric lights have been installed. The daily consumption of gas is increasing at the rate of 600,000 to 900,000 ft. over last year at this time. The electric output has increased over 20 per cent.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company reports for Sept., 1903, its output of instruments to be 79,406, which, after deducting returns of 33,438, there is left net output for the month of 48,968, against 31,677 in the corresponding month last year. The increase is 14,391. From Jan. 1 to Sept. 30, there is a decrease of 8,247 instruments, compared with the corresponding period last year. The output thus far in 1903 is 453,398. Outstanding instruments, total 3,603,718.

MONTREAL TROLLEY EARNINGS.—The Montreal Street Railway reports as follows for the year ended Sept. 30, 1903:

	1903.	1902.	Changes.
Gross	$2,222,000	$2,046,000	Inc. $176,000
Expenses	1,317,000	1,135,000	Inc. 182,000
Net	$905,000	$911,000	Dec. $6,000
Earned on capital stock	11.41%	11.68%	Dec. .27%
Passengers carried	54,500,000	49,900,000	Inc. 4,600,000

The decrease in net earnings was due to two strikes, one in February and another in May. Computing the loss of car earnings together with expenses of these strikes, brings the net earnings down some $200,000. The dividends paid during the year amounted to $600,000. During the year $1,000,000 new stock was issued for extensions.

AMERICAN LIGHT & TRACTION makes the subjoined annual report for the year ended June 30, 1903:

	1903.	1902.	Changes.
Dividends received	$1,006,593	$769,093	Inc. $237,500
Other income	85,470	24,240	Inc. 61,230
Total income	$1,092,063	$793,333	Inc. $298,730
Expenses	25,078	20,071	Inc. 5,007
Balance	$1,066,985	$773,262	Inc. $293,723
Preferred dividend	528,337	457,015	Inc. 71,322
Surplus	$538,648	$316,247	Inc. $222,401

DIVIDENDS.—Directors of New England Telephone & Telegraph have declared a regular quarterly dividend of 1½ per cent., payable November 14. The directors of the Consolidated Gas Company, of New York, have declared the regular quarterly dividend of 2 per cent., payable December 15. The Nassau Electric Railroad Company has declared a dividend of 4 per cent. on its preferred stock, payable November 14.

TWO-CENT TROLLEY FARES.—A proposition to build and equip four street railways to be operated at a straight two-cent fare has been received by the City Clerk of Cleveland. The proposition was made by William Christy through his attorney, C. W. Collister. Mr. Christy has for years been actively interested in the street railroad business in Cleveland and other cities.

TROLLEY ROAD LIEN.—The Vandergrift Construction Company, of Philadelphia, has filed a lien for $112,944.82 against the Hampton Roads Railway & Electric Company, which recently went into the hands of a receiver. The sum claimed is balance due on construction work for the railway line, which was built by the Vandergrift Company.

Commercial Intelligence.

THE WEEK IN TRADE.—Cooler weather has stimulated retail trade generally throughout the country, and this is reflected in the increasing demand for seasonable goods. The movement of the crops in the northwest, west and south has been freer, and interior collections have improved. While buying is classed as conservative, eastern jobbers note a more cheerful tone in trade. The tendency to scale down the gains hitherto reported is still shown in reports of railway earnings. Up to the end of October the gain of all roads reporting is close to 7 per cent. The labor situation is rather unsettled, and it is openly stated that the suspensions of industries of late and the retrenchment policies of the leading railroads have been partly inspired to curb foolish tendencies on the part of labor organizations. Agricultural producers show a tendency to refuse to accept lower prices for their surplus and there is an immense demand from millers. Cotton also exhibits the same tendency, producers showing no inclination to part freely with their product, though prices are 1½ cents higher than a year ago. In lumber there is a better tone, and other building material is steady. In iron and steel few changes are noted, the trade being weak. Finished products were strong, notwithstanding the cuts in crude material. Hardware is reported active. The shut down of the Amalgamatel Copper mines has had a strengthening effect on that metal. The output of those mines is placed at 20,000,000 pounds monthly. The market was rather excited on the report of the closing down of the Amalgamated mines and consumers rushed in to buy for early as well as later delivery. Prices advanced rapidly, and closed strong at the following quotations: Lake 13½ to 13¾c; electrolytic, 13¼ to 13½c; cathodes 13 to 13¼c; casting stock 13⅛ to 13⅜c. The business failures for the week ending Oct. 29 as compiled by *Bradstreet's*, aggregated 217, as compared with 216 the week previous and 191 the corresponding week last year.

FOREIGN TRADE.—The classified trade report for September makes some interesting comparisons. The decrease of imports was chiefly composed of "animals and food," mostly sugar. Activity of manufactures is indicated both in the increase of crude materials by $3,278,912, and the decrease of "partly manufactured" by $3,963,273. The changing aspect of international trade is well shown in the decrease of imports of luxuries by $411,451, against an increase for the nine months of $9,036,553. The import of pig iron was over a million less than in the previous September, and the total decrease of iron and steel products was over two millions. The decrease of agricultural exports was larger than the total decrease of exports, there being an increase of exports of several classes, the largest being $1,473,360 for manufactures. This is more than a million over the increase for nine months, indicating that some lost ground is being regained. The exports of electrical machinery for the last nine months amounted to $3,875,003 as compared with $4,390,151 for the nine months last year, due to the springing up of large American factories abroad, for heavy material; but the demand for electrical specialties is very large.

CANADIAN NICKEL.—By the recent purchase of a controlling interest in the Bruce Nickel Mines of Sudbury, Ont., Chas. M. Schwab and his associates in the International Nickel Company become dominant factors in the Canadian Nickel ore field and ultimately will be in position to control the world's output. Through the subsidiary Canadian Copper Company the International Nickel Company acquired for $600,000 the famous Bruce mines on the north shore of Georgian Bay. The mines were bought in 1847 by an English corporation for $200,000. About $10,000,000 worth of ore has been taken out. Since 1870 they have been worked only occasionally. The International Nickel Company will utilize the ore for a flux for its new smelting plants at Sudbury where $1,000,000 is being spent in reduction works. Mr. Edison is understood to be heavily interested in Canadian nickel. He uses large quantities of nickel in his new storage battery.

ANOTHER EL ORO POWER PROJECT.—Another group of American capitalists contemplate the construction of power transmission lines into the El Oro mining district. As mentioned in our last issue, the Mexican Light & Power Company, Limited, propose to generate current at its huge Necaxa plant for transmission to El Oro, some 100 miles distant. It has since been learned that the Guanajuato Power & Light Company, Limited, which has just completed the construction of a transmission line between the Douro River and the Guanajuato mining region, more than 100 miles long, will immediately begin work on a large hydraulic plant in the State of Michoacan, which will generate current to be carried 45 miles to the El Oro and Tlalpujahua camps. Contracts have already been secured for several thousand horse power. Mr. H. Hine, formerly of the Stanley interests, is president of the Guanajuato Company.

HIGH PRICE OF SHELLAC.—One of the articles of large consumption in more than one electrical art is shellac, of which there now appears to be a short supply. In January, 1900, S. A. S. shellac, which is one of the standard medium grades, sold at 16⅞ cents a pound. To-day the same quality commands 52 cents a pound in the wholesale market. The advance began in 1901, when the price went to 22 cents, then to 20 cents, and early in 1902 it was quoted at 32½ cents. Since then it has been steadily rising. T. N., the lowest grade of shellac, is now selling at 48 cents. During the period from January to September 53,241 cases, each containing about 240 pounds of shellac, have been imported. During the same period last year 44,222 cases were imported, and in 1901, 51,000 cases. The new crop comes to market in January and February, but no decrease in price is looked for then.

GRASS VALLEY MINING PLANT.—The New York Grass Valley Gold Mining Company's big plant, Grass Valley, Cal., is in operation and more stamps are being installed to increase the output. No new building will be erected for the electric light plant, as it will be installed in a building that has already been put up for that purpose. The plant will be of about 100 lights, which will light the mine throughout, underground, in the various levels, shafts, etc., as well as the tunnel and the entire mine and plant. The electric plant as well as the mill, stamps, concentrators, compressor, hoist, pumps, etc., are all run with free water power owned by the company. This big mine and plant will within one year be the largest in the district.

TELPHERAGE FOR JACKSONVILLE, ILL.—The Jacksonville Gas, Light & Coke Company has just installed a coal-hoisting and handling system purchased from the United Telpherage Company, of 20 Broad Street, New York City, which has of late developed quite a large business with gas and electric light plants for moving their coal and ashes. At Jacksonville the coal is delivered to a large hopper, from which the telpher hoist loads and transports it to various points in the coal shed, holding about 1,500 tons. The hoist handles 1,200 pounds at a time. The plant was installed by Mr. F. G. Roberts, of the Telpherage Company.

SEWER CONTRACT FOR G. M. GEST.—At a special meeting of the West Orange Town Council last week for the purpose of passing on the application of the Harrison Construction Company, which desired to transfer its contract for building section 1 of the outlet sewer to Guy M. Gest, the electrical subway contractor of New York, the sewer committee reported favorably on the matter and the transfer was made, the work to be done for the same amount and under the same terms as those assumed by the Harrison company. Mr. Gest gave bonds for $10,000 to insure the faithful performance of the contract.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, of Chicago, reports a long list of exchanges which it has recently equipped with apparatus, either the regular express switchboard or the Bell express type of central office equipment. The following is a partial list of the most recent shipments: Wilmont, S. D., 100-line Bell express; Effingham, Kan., 200-line Bell express; Topeka, Kan., 25-line Bell express; Troy, N. C., 100-line Bell express; Frankfort, Kan., 100-line express; Hale, Mo., 200-line express; Fort Riley, Kan., 50-line Bell express; Kingman, Ariz., 150-line express; Trenton, Mo., 100-line express; Chillicothe, Tex., 25-line express.

AJAX MOTOR VEHICLE COMPANY.—The Ajax Motor Vehicle Company, of 220 West Thirty-sixth Street, New York City, has made an assignment to Charles G. Cornell. The company was incorporated in July, 1901, with a capital stock of $10,000, with Alfred L. Simpson as president. In January last the company's statement showed assets of $54,000 and liabilities of $20,500. The company manufactured electric automobile runabouts, motors, etc. The assignment is attributed to dull business. The business does not appear to have gone beyond the experimental stage.

ST. LOUIS EXPOSITION.—Although the St. Louis Exposition is built partly upon a side hill, it will be necessary to raise some of the drainage and sewerage by pumping, in order to effect its disposal. For this purpose the authorities have purchased from Henry R. Worthington four 12-in. vertical centrifugal sewerage pumps, each having a capacity of 3,000 gallons per minute and capable of operating against a head of 60 ft. These pumps will be driven by Westinghouse vertical-shaft induction motors.

GENERAL ELECTRIC EQUIPMENT FOR MEXICAN MINES.—The Guanajuato Consolidated Mining & Milling Company, which operates one of the more important properties in the Guanajuato mining district, Mexico, has placed a contract with the General Electric Company for considerable electrical equipment to displace steam power hitherto utilized by the company. Several further contracts for motors, etc., are expected to be let shortly for use in other mines in the same vicinity.

STROMBERG-CARLSON TELEPHONE MFG. COMPANY, of Rochester, N. Y., reports that its underground cable department located there is running full blast. A recent shipment of 60,000 ft. of underground cable was made to the Keystone Telephone Company of Pennsylvania. They are so situated as to be able to make the cable according to any specifications submitted.

A LARGE TELEPHONE ORDER.—The Kellogg Switchboard & Supply Company, Chicago, has lately received an order from the Cuyahoga Telephone Company of Cleveland for 8050 telephones, 5000 wall sets, 2500 desk sets and 550 pay station sets. The Kellogg Company is building for the same telephone company an 18,000 line board.

LUNKENHEIMER FRENCH OFFICE.—The Lunkenheimer Company of Cincinnati has experienced a growing demand for its valves and specialties in France, and has opened a branch office at 24 Boulevard Voltaire, Paris, where it will carry a complete stock of goods.

ORDER FOR TELEPHONE RECEIVERS.—The Lambert Schmidt Telephone Mfg. Company, of Hoboken, N. J., has just received a contract from the Eastern Telephone Company of Philadelphia for 5000 high grade double pole receivers. The award was not made on price, as there was severe competition.

FAILURE OF JANSSENS.—The Société Anonyme des Etablissements Janssens, of Paris, which concern was the largest handler of American machine tools and other machinery in France, and one of the biggest in Europe, has gone into bankruptcy. The Société had been laboring under financial difficulties for a considerable time past. There are several American creditors. The Société was organized in 1901 for the purpose of taking over the extensive business of Adolphe Janssens. Previous to that date British machinery exclusively was imported. Since the formation of the Société fully $4,000,000 worth of Yankee labor-saving devices went through the books. Branch establishments were opened in Belgium and in anticipation of an extensive trade during the Paris Exposition huge contracts were placed in the States for machine tools of all descriptions. The looked-for business did not all materialize. Mr. Janssens shortly after the exposition closed relinquished the active management of the concern. He was succeeded by his son, who had had but little experience in the business. The failure is attributed to too heavy expenses and mismanagement. Machinery in many cases was sold for little or no profit. For instance, one lot costing $10,000 was sold delivered in Spain for only $10,075. The Société was mulcted in large penalties for non-delivery on time on large quantities of machine tools for the French arsenals. Among the American creditors are the Watson-Stillman Company, 204 East Forty-third Street, New York; the Union Manufacturing Company, of New Britain, Conn.; Manning, Maxwell & Moore, 85 Liberty Street, New York; the Standard Tool Company, of Cleveland, Ohio; Warner & Swasey, of Cleveland, Ohio; the New Haven (Conn.) Manufacturing Company, the Springfield Machine Tool Company, of Muskegon Heights, Mich.; the J. A. Fay & Egan Company, of Cincinnati, Ohio. The German house of Schuchardt & Schutte, who are the largest handlers of American machinery on the other side, represent the interests of several American creditors. They have just opened branch stock rooms in the French capital. The New York offices of the concern are in the Beard Building. The American creditors' claims foot up a total of some $50,000. It is expected from the information so far in hand at this end that the Société will be able to pay at least 20 cents on the dollar.

ELECTRIC POWER PAPER MILL.—The extensive improvements at the mills of the George H. Friend Paper & Tablet Company, Dayton, Ohio, have made it one of the most up-to-date plants in the country. A complete electrical equipment displaces the long lines of shafting, steam piping and auxiliary engines and permits the operation of the several departments from one central station. The generating plant consists of a 450-kw Thresher multipolar generator directly connected to a Harrisburg tandem compound engine, running at 150 r.p.m. Thirty-two motors ranging in size from 1 to 200 hp, also manufactured by the Thresher company, are located throughout the plant, operating individual machines or groups of machines according to the character of the work to be performed. The installation of motors for driving the supercalenders deserves special mention, as it is the first time these machines have been thus equipped, and is a marked advance in economy of operation. The problem is a difficult one, as the machine requires a large amount of power and wide variation of speed. Each machine has an independent motor, controlled from one panel located so as to be under the hand of the operator.

FLATS AND ELECTRIC ELEVATORS.—Mr. H. H. Neil, a real estate expert, says in the *New York Mail and Express:* "The introduction of the electric elevator to the west end, five years ago, was one of the most important developments in the history of uptown real estate, and it was freely predicted at the time that no more flats of the older type would be built west of Central Park. This prediction has not been found false as yet, but there seems to be a possibility, in the enormously increased demand of late for old-fashioned flats, that early expectations in this matter may have to be somewhat modified. The facts is that the new building law, while it was at first expected to make the builder of five-story buildings most unhappy, has proven just as severe, and perhaps more severe, upon the builder of seven-story apartment houses. The latter, in fact, can no longer be produced with any hope of economical profits. Nor can the five-story flat of the old kind." The general introduction of electric elevators in dwellings is a distinct feature of New York life.

GENERAL ELECTRIC ITALIAN CONTRACT.—The Mediterranean Thomson-Houston Company, which is largely controlled by General Electric interests, has secured a contract for the construction of a large hydraulic power plant to generate current for transmission to Turin, Italy. The plant is to be built at the foot of Mont Cenis. Its initial capacity will be 4200-kw. The equipment will consist of three twelve-pole turbine-driven three-phase alternators of 1400-kw capacity each. The generating pressure will be 3000 volts. The line pressure is to be 30,000 volts. The length of the transmission line will be about 40 miles.

GERMANY IN CHILI.—A joint stock company, with a capital of 5,000,000 marks ($1,190,000), has been organized at Valparaiso for the purpose of securing control of water power, erecting an electric light and power plant, and taking over the horse car lines. The largest stockholders in this company are German firms, viz.: Siemens-Schuckertwerke, Allgemeine Elektrizitätsgesellschaft, Die Union Elektrizitätsgesellschaft, and a group of banking houses, to which the Berliner Handelsgesellschaft, the Deutsche Bank and the Diskontogesellschaft belong.

EQUIPMENT FOR SYDNEY TRACTION SYSTEM.—The Allis-Chalmers Company has secured the contract for the engines to be installed in the additional sub-stations now under construction for the Sydney, N. S. W., City and Suburban electric traction system. The rotary converters—900-kw—with necessary transformers are to be General Electric. This plant is to be considerably enlarged very shortly and the additional power may be generated by means of steam turbines.

LIGHTING EQUIPMENT FOR YOKOHAMA.—The Yokohama (Japan) Union Electric Light Company is about to let contracts for an extension to its plant. There will be a 600-kw, 2400 volt, two phase, 60 cycle, 120-rpm field type alternating current generator direct connected to a cross compound side crank condensing engine of 900-hp capacity, or else a turbo-generator. It has not been decided yet as to whether rotaries or induction motors will be ordered.

RAILWAYS IN ITALY.—The Mediterranean Railroad of Italy, in conjunction with a number of foreign firms—for the most part German—is contemplating building an electric railroad from Rome to Naples. For this purpose it proposes to ask the government, in the near future, for the necessary concession. This road will be about 130.5 miles in length, and the estimated cost thereof $19,300,000.

GEO. C. TOWLE MANUFACTURING COMPANY.—At a meeting of the directors of the George C. Towle Manufacturing Company, held on October 19, it was decided to increase the capital stock of the company to $50,000 and to change the name of the company to the Fidelity Electric Company. Due application is now to be made to the State to the above effect, for proper authorization.

LIGHTING AT VLADIVOSTOCK.—The growing city of Vladivostock, Siberia, needs an electric light plant. It has 40,000 inhabitants. An English firm made a favorable offer for the plant, which was for a time under consideration and is now before the municipal board. A Seattle firm had this same electric offer under consideration but could not see its way clear to accept it.

IRON CITY ENGINEERING COMPANY, Frick Building, Pittsburg, Pa., has secured contracts for two complete electric light plants to be installed at Ord and St. Paul, Neb. It is also installing the electrical equipment in the new shops of the Hockensmith Wheel & Mine Car Company, Penn Station, Pa.

5000-KW CURTIS' TURBINE IN SERVICE IN CHICAGO.—The first unit consisting of a 5000-kw Curtis' turbine is now running, it is reported, on regular commercial service at the Commonwealth Electric Company, of Chicago's new plant. Two more units of similar capacity are now being installed.

ELECTRICAL SUPPLIES FOR ABROAD.—The American General Trading Company, 136 Liberty Street, New York, of which concern Geo. E. Austin is manager, has some substantial contracts in hand for various electrical supplies for export to Mexico, Brazil and the Hawaiian Islands.

VARIOUS EQUIPMENT FOR JAPAN.—The Japanese house of Mitsui & Company is about to place some substantial contracts in this market for electrical equipment for the Far East. The firm is also figuring on big equipment for which orders are expected to be placed here.

GENERAL ELECTRIC MEXICAN CONTRACT FOR TRANSFORMERS.—The General Electric Company has been allotted the contract for the transformers, 45,000 hp all told, by the Mexican Light & Power Company for its Necaxa-Mexico City power system.

BALL ENGINE ORDER.—The Ball Engine Company, of Erie, Pa., will install three 450-hp engines direct connected to generators for the Milwaukee Coal & Coke Company, Milwaukee, Wis. These engines are to be used for by-product coke ovens.

LIGHTING IN PEKIN.—It is reported that a Hamburg firm has received an order to equip the Chinese Emperor's palace at Pekin with electricity. For this purpose dynamos, four steam engines and sixteen transformers will be required.

TELPHERAGE FOR JAPAN.—The Imperial Steel Works, of Japan, have just placed an order with the United Telpherage Company, of New York, for a telpher plant intended to handle coal, supplies, material, etc.

CUTTER CIRCUIT BREAKERS FOR ENGLAND.—The Cutter Company, of Philadelphia, has just received a large British contract which calls for some 100 circuit breakers of various sizes.

SUBMARINE BOATS.—The Holland submarine electric torpedo boats *Porpoise* and *Shark* have been accepted by the Secretary of the Navy.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Ave., Detroit, Mich.

American Street Railway Association. Secretary, T. C. Pennington, 2020 State Street, Chicago.

Association of Edison Illuminating Companies. Secretary, W. S. Barstow, New York City and Portland, Ore.

California Street Railway Association. Secretary, J. E. Morris, Oakland, Cal.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., 1904.

Chicago Electrical Association. Secretary, W. B. Hale, 242 South Jefferson Street, Chicago.

Colorado Electric Light, Power & Railway Association. Secretary, George B. Tripp, Colorado Springs, Col.

Connecticut State Street Railway Association. Secretary, A. E. Pond, New Haven, Conn.

Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

Illinois State Electric Association. Secretary, H. E. Chubbuck, LaSalle Ill.

Indiana Public Utilities Association. Secretary, A. M. Barron, Indianapolis, Ind.

Independent Telephone Association of the United States. Secretary, Frank G. Jones.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Pichardt, Huntingburg, Ind. Next meeting, Evansville, Ind., Nov. 11, 1903.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, Ill., December 8, 9 and 10, 1903.

Iowa Electrical Association. Secretary, W. S. Porter, Eldora, Ia.

Iowa Telephone Association. Secretary, C. C. Deering, Des Moines, Ia. Annual meeting, Des Moines, March 8, 1904.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ind.

Maine Street Railway Association. Secretary, E. A. Newman, 71 Congress Street, Portland, Me.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass.

Michigan Interurban and Street Railway Association. Secretary, Benjamin S. Hanchett, Jr., Grand Rapids, Mich.

National Arm, Pin & Bracket Association. Secretary J. B. Magers, Madison, Ind. Next meeting Chattanooga, Tenn., Nov. 10, 1903.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting St. Louis, Mo., September 14, 15 and 16, 1904.

New England Street Railway Club. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

National Electric Light Association. Secretary, Ernest H. Davis, Williamsport, Pa. Next meeting, Boston, Mass., May or June, 1904.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, Milwaukee, Wis., Jan. 20, 1904.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, Ohio.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Pennsylvania Street Railway Association. Secretary, Charles H. Smith, Lebanon, Pa.

Southwestern Electrical Association. Secretary, J. L. Ellis, Oklahoma City, Okla. Next meeting, Dallas, April or May, 1904.

Southwestern Gas, Electric & Street Railway Association. Secretary, Frank E. Scovill, Austin, Texas.

Street Railway Association of the State of New York. Secretary, W. W. Cole, Elmira, N. Y. Next meeting, Utica, N. Y., Oct. 11 and 12, 1904.

Tennessee Street Railway Association. President, C. C. Howell, Knoxville, Tenn.

United Electrical Contractors' Association of New York State. Secretary, William J. Davis, Ithaca, N. Y. Next meeting, New York City, January 19, 1904.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

Virginia Street Railway and Electric Association. President, R. P. Apperson, Lynchburg, Va. Next meeting, Norfolk, Va., May 15, 1904.

General News.

THE TELEPHONE.

VENTURA, CAL. The Home Telephone Company has voted $100,000 bonds for the construction of its system in this country. The company will also erect a three story office building in this city.

SAN BERNARDINO, CAL.—The Dale Telephone Company has been incorporated with a capital stock of $10,000 to build and operate a telephone line from Amboy to the Dale and other mining camps. The directors are H. H. Ames, F. A. Reed and J. J. Ellerman.

LOS ANGELES, CAL.—The Home Telephone Company has completed its long distance line from here to San Dimas. The Pomona Valley Co-operative Company has its line from Pomona to San Dimas almost completed. This company has over 500 subscribers and more want the service.

LOS ANGELES, CAL.—W. H. Holabird, claiming to be the lawful president of the Home Telephone & Telegraph Company, has begun suit against F. F. Graves, secretary; John M. C. Marble, president; George G. Metzger and James H. Adams, to restrain them from entering into a "pooling arrangement" that is alleged to affect the plaintiff.

DENVER, COL.—Work will soon be started on an 80 mile telephone line between Phoenix, Ariz., and Tonto, the plans for which have been prepared under the direction of the United States government hydrographic survey.

ATLANTA, GA.—The Southern Bell Telephone Company has just completed a line of six copper wires between Birmingham and Atlanta for the long distance service. Within the next six months it is said that nearly every town of any importance in Alabama will be connected with Birmingham. In Birmingham three new sections of multiple switchboard are being completed while thousands of dollars have been expended in the city for improvements.

DIXON, ILL.—The Lee County Telephone Company is contemplating rebuilding its exchange. It has 1,200 subscribers.

HOUSTON, ILL.—The Farmers' Mutual Progressive Telephone Company has increased its capital from $190 to $1500.

MARSEILLES, ILL.—The Marseilles Telephone Company has at present 250 subscribers, of which some 50 were added last year, and it is expected to increase the number to about 300 this year.

MACON, ILL.—Stromberg-Carlson apparatus is used in the exchange of the Macon Telephone Company which furnishes service to 230 subscribers at $15 a year. Mr. O. E. Daggett is manager.

CHICAGO, ILL.—The Illinois Tunnel Company has been incorporated, capital $50,000, for the transmission of sounds, signals, mail matter and merchandise. Incorporators: Chas. Wheeler, Henry A. Walkining and Thomas A. Moran, Jr. (See page 775 for further details.)

KANSAS, ILL.—Messrs. N. and C. D. Arterburn, owners of the Kansas Telephone Company, contemplate increasing their plant by about 150 telephones next year. They operate a 300-drop "American" switchboard and have 222 subscribers.

MARTINSVILLE, ILL.—With a population of 1,000 the Martinsville Telephone Company in this place is naturally proud of its record of 600 subscribers. In addition to furnishing service to the townspeople it has connections with 1,400 telephones. "American" apparatus is used. Mr. E. N. McNary is proprietor of this enterprising exchange.

ELBURN, ILL.—The Interstate Independent Telephone & Telegraph Company operates in Elburn and has branch exchanges at Kaneville and Virgil. It is now putting in a new cable of 150 pair, which gives it a capacity of 250 pairs of wires. It contemplates building a new toll line of about 25 miles to Aurora. The Elburn exchange has 204 subscribers, with prospects of an increase to 300. The rates are $12 and $24 per annum.

ORRVILLE, IND.—An independent telephone exchange has been established here by the Mt. Carmel, Ill., Independent Telephone Company.

COLUMBUS CITY, IND.—The recently incorporated Whitley County Telephone Company will extend its system over at least eight counties.

DECKER, IND.—The Home Telephone Company is building a line to connect this city with Redcloud. It is the intention to connect with the Vincennes lines.

EDWARDSPORT, IND.—The town board has granted a franchise to the Bicknell Independent Telephone Company which proposes to extend its line from Bruceville to this place. Joseph Barr is president of the company.

ALEXANDRIA, IND.—The Alexandria Telephone Company, of Madison County, has filed articles of incorporation with a capital stock of $8050. The company will build lines radiating from Alexandria throughout Madison County.

HAZLETON, IND.—Steps have been taken to organize a local telephone company at this place. The officials of the Princeton Telephone Company are encouraging the enterprise and promise the local company connections that will give it service in Princeton and as far north as Vincennes.

INDIANAPOLIS, IND.—Senator Fairbanks announces that he will take up the matter of delivery of "special delivery messages" by telephone immediately upon the convening of Congress.

FRANKLIN, IA.—The Northwestern Telephone Company has been granted a franchise for a telephone exchange in this place.

CLINTON, IA.—Articles of incorporation of the Klondike Telephone Company of Clinton township, Wayne County, have been filed. The capital is $500. D. B. Porter is president and W. A. Ockerman secretary.

ATCHISON, KAN.—The Atchison Telephone Company has petitioned the City Council for an amendment to its charter to enable the company to increase the price of its residence telephones from $1 to $1.50 per month. It is stated that the number of subscribers has exceeded the original estimate, hence the increased cost of maintenance.

NEW BEDFORD, MASS.—The Southern Massachusetts Telephone Company has decided to install a common battery switchboard to take the place of the present equipment in this city. The company estimates that the proposed changes will involve an expenditure of from $60,000 to $75,000.

POTTERSVILLE, MICH.—An exchange of 97 telephones have just been put in operation by the Citizens' Telephone Company and a large number of additional subscribers will be connected as soon as supplies arrive.

LANSING, MICH.—The South Dover Telephone Company, of South Dover, has been incorporated with a capital stock of $1,000, and the Traverse Bay Telephone Company of Central Lake has been incorporated with a capital stock of $4,000.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company has decided to advance its rates to the maximum limit allowed under the franchise. The present rate is $20 for a residence and $30 for business telephones. The new rate will take effect January 1 and will be $24 for residences and $36 for business telephones. The company will shortly begin the installation of its new automatic system, which it is intended to have ready for operation within a few weeks.

NORTHVILLE, MICH.—The Northville Telephone Company, of Northville, Mich., has elected the following named officers for the ensuing year: Dr. J. M. Burgess, president; F. S. Neal, vice-president; R. H. Porter, secretary; E. H. Lapham, treasurer; M. A. Porter, manager; A. K. Carpenter, Dr. J. M. Johnson, W. H. Yerkes, W. G. Yerkes. The company has about thirty miles of wire and 150 subscribers. The stockholders will get a 10 per cent dividend for the past year.

WANAMINGO, MINN.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $10,000.

BRICELYN, MINN.—The Mutual Telephone Company has been formed here to buy the local exchange. It will build a new system.

WINONA, MINN.—A 700-drop "Sterling" switchboard is operated by the Winona Telephone Company which has 750 subscribers. It contemplates building a number of rural lines. The rates are $18 and $30.

BLUE EARTH, MINN.—The Kossuth Telephone Company and the Twin City Company have agreed to extend their lines to meet at this point. This line will give access to all the principal cities and towns of northern Iowa and southern Minnesota.

PONTOTOC, MISS.—The Alabama, Mississippi & Tennessee Telephone Company contemplates the erection of cross arms and more wire from Pontotoc to New Albany, Miss., on the line to Memphis, Tenn. The company is improving its lines. At Pontotoc there are 70 subscribers, the subscription rate being $1.50 per month.

HELENA, MONT.—The Rocky Mountain Bell Telephone Company is seeking permission to build a conduit system in this city.

OSWEGO, N. Y.—The Empire State Telephone Company has let the contract for its new exchange building in this city, the price being about $15,000. The company intends to rebuild its entire system in this city.

LITTLE VALLEY, N. Y.—Six miles of farmers' lines are projected by the Little Valley Telephone Company. This company operates a Western Electric 50-drop switchboard and has 105 subscribers. The rates are $12 and $16.

DUNDEE, N. Y.—The Dundee & Tyrone Telephone Company has been incorporated. The officers are: President, G. A. Motham; vice-president, Eugene U. Bigelow; secretary, T. N. Howell, and treasurer, Philander S. La Fevre.

MALONE, N. Y.—The Franklin County Telephone Company has increased its business about one-third in the past eight months and is contemplating the building of 20 miles of toll line. There are 340 patrons of the service who pay $15 annually.

SCHENECTADY, N. Y.—A new telephone company has been organized here to construct a line from Schenectady to Princetown, thence to Delanson and Esprance. The line will be an independent one, but will have long-distance connections with the Hudson River Telephone Company's system.

NEW YORK, N. Y.—A new telephone system for the policemen on post was installed in the First Precinct of New York City last week. There are 26 telephone boxes at various points in the precinct connecting with the Old Slip Station. A bell attached to the boxes, which are placed against the buildings, may be rung from the station house and thus the officer on post may be called to the box to communicate with the sergeant or captain. Three men are detailed at the station to handle the telephone board. The precinct is divided into five sections, from which the policemen report in succeeding five-minute stretches, so that for half of each hour there is constant reporting from the men on post. Every report is entered and the sheet goes to headquarters each day. If a patrolman delays five minutes in reporting he is looked up by the roundsman and has charges preferred against him. Each policeman has a key fitting the telephone boxes. Superintendent of Telegraph Brennan established the service, and it will be spread to other precincts in the city. For several years there has been a box service for the policemen in Brooklyn, but it is not so highly developed as the one being installed in Manhattan. The patrolman can talk to the sergeant in Brooklyn by wire, but the sergeant cannot respond to the patrolman.

MONROE, N. C.—J. A. Austin and others will establish a new telephone system in Monroe.

ROCKINGHAM, N. C.—The Rockingham telephone exchange was recently destroyed by fire.

HAMLET, N. C.—The Hamlet Telephone Company has been sold to the Southern Bell Telephone Company.

ASHEVILLE, N. C.—A big petition has been gotten up here protesting against the granting of the franchise to the Bell Telephone Company.

COVINGTON, OHIO.—The Covington Home Telephone Company has increased its capital stock from $20,000 to $30,000.

ST. PARIS, OHIO.—There are 200 subscribers to the service of the St. Paris Telephone Company, which has installed American telephones.

WEST JEFFERSON, OHIO.—The West Jefferson Telephone Company has installed Stromberg-Carlson telephones and gives service to 96 subscribers. The charges are $12 and $24 per annum.

TOLEDO, OHIO.—The City Council has ordered the solicitor to commence action to prevent the Home Telephone Company of this city from increasing its rates in alleged violation of its franchise.

CINCINNATI, OHIO.—The Cincinnati & Suburban Bell Telephone Company has closed a contract with the Owenton Telephone Company, of Owenton, Ky., which will give service from all points in Owen County, Ky., to this city.

WASHINGTON C. H., OHIO.—The Washington Home Telephone Company has American Electric apparatus and 900 subscribers. It has 100 miles of toll lines. From $12 to $24 per annum is charged, according to the class of service.

RICHWOOD, OHIO.—The addition of 12 miles more of farmers' lines is under consideration by the Richwood Telephone Company, which has at present 300 subscribers, operating North and Stromberg-Carlson instruments. The rates are from $1 to $2 per month.

XENIA, OHIO.—An exchange at Bowersville is projected by the Springfield-Xenia Telephone Company and also the building of a number of party lines. The Xenia exchange has 850 subscribers, to whom charges are made for business $2 and for residence $1 per month.

SIDNEY, OHIO.—Several country lines will be built by the Sidney Telephone Company, which now has 782 subscribers, 98 miles of toll line and uses "American" apparatus. It informs us that the outlook is very flattering for a most prosperous year, with many new subscribers to be added and this in spite of the increase made in the rates in January.

WESTON, OHIO.—Eighteen months ago the Weston Home Telephone Company began business and it now numbers 135 subscribers, with a looked-for increase to about 175. Connections can be had with Hamler, Malinta, Westhope, McClure, Grandiapida, Tontogany, Haskim, Holgate and Grelton, Ohio. The company plans to run a toll line to Milton Center and Custas, Ohio.

SANDUSKY, OHIO.—The Sandusky Telephone Company has a 2,400-drop North switchboard through which service is furnished its 1,200 subscribers. The system has grown at the rate of 150 telephones per annum. The charges are $18 and $30, "but it is evident we will soon be obliged to increase our rates and institute party lines and measured service," Manager Curtis states.

RAVENNA, OHIO.—The Portage County Telephone Company operates a 200-drop switchboard at Garrettsville, 140-drops at Mantua, 1,000 at Kent and 560 at Ravenna. North and Eureka apparatus are used. There are now 50 miles of toll lines and it contemplates adding 30 miles more. Mr. Allen Seiberling tells us that the telephone business is growing faster than cash can be obtained to take care of it.

TIFFIN, OHIO.—The Home Telephone Company reports that it has never been able to take care of the increase in the business and could have 1,500 telephones working (present number 975) if it could supply all the applicants. With the installation of a new switchboard of 2,000 drops individual residence service will be advanced to $18, giving a four-party line selective service at $12. The company expects to have 1200 telephones within the next six months.

OTTO, OKLA.—The Perry & Otto Telephone Company has been incorporated with a capital stock of $500. The incorporators are G. Reuple, T. J. Smith, J. H. Baird and others.

CARNEGIE, PA.—The Gayly Local Telephone Company has been incorporated with a capital stock of $5,000.

STEELTON, PA.—The United Telephone & Telegraph Company will soon start work on the erection of a new brick exchange building.

INDIANA, PA.—The Indiana Telephone Company has decided to spend an additional $5,000 in finishing the Saltsburg line and in general improvements to the company's system.

MT. AIRY, S. C.—The Bell Telephone Company will build a long distance line from Winston-Salem to Mt. Airy.

BOWDLE, S. D.—The Dakota Central Telephone Company has 49 subscribers, all of whom use North apparatus. A new metallic copper line from Bowdle to Aberdeen was recently completed.

FLANDREAU, S. D.—A 50-drop section board and some farmers' lines are proposed by the Flandreau Telephone Company, of which Mr. W. A. Simpson is manager. The company uses Standard Telephone & Electric Company's apparatus, and has 125 subscribers.

CHATTANOOGA, TENN.—The stockholders of the Hamilton Telephone & Power Company have elected the following named officers: President, Z. C. Patten; vice-president, C. D. Mitchell; secretary, E. Y. Chapin; treasurer, M. Llewellyn. Directors: Z. C. Patten, L. J. Sharp, H. S. Chamberlain, Charles Rice, C. D. Mitchell, J. N. Trigg, E. Y. Chapin.

AUSTIN, TEX.—The Fort Worth Telegraph Company has increased its capital stock from $304,000 to $450,000.

LOGAN, UTAH.—The Rocky Mountain Bell Telephone Company is arranging to construct a new building early next spring. The structure will be two stories high.

FARMVILLE, VA.—The council has granted permission to the South Side Telephone Company to establish an office in this city.

FAIRHAVEN, WASH.—An effort is being made to raise sufficient funds for the construction of a telephone system to San Juan island. The scheme is being promoted by the governing board of the commercial club of this city.

ELECTRIC LIGHT AND POWER.

YREKA, CAL.—The Siskiyou Electric Light & Power Company has purchased a site in this city on which to erect a transformer building for transmitting power in Yreka.

LOS ANGELES, CAL.—The franchise granted by the Board of Supervisors to Reuben Hart several months ago to construct and maintain wires and conduits for the transmission of electrical energy for light and power purposes along the streets of Santa Maria and adjacent territory, has been sold to the Machinery and Electrical Company, of Los Angeles. A four months' extension of time has been granted to the Los Angeles concern.

LOS ANGELES, CAL.—According to a recent statement of chief engineer, B. L. Davis, of the Kern River Power Company, formerly the Edison Light & Power Company, the company will build a transmission line from Kern River to this city, a distance of 160 miles. It is stated that this will be the heaviest transmission line in the world. The line will be supported upon iron towers 60 feet high and 700 feet apart. The towers are designed to carry cables, wires and wire conduits, and 1300 of them will be required. Power will be transmitted at 100,000 volts and will be available at different points for lateral connections. The transmission system will cover Southern California.

DENVER, COL.—The Routt County Electric Light Company has been incorporated with a capital stock of $125,000. Mr. J. B. Waterbury is one of the directors.

COEUR D'ALENE, IDA.—The Town Trustees have granted the Consumers' Company a franchise for water works and a lighting system.

BLACKFOOT, IDA.—This city is now lighted by electricity, transmitted a distance of 50 miles from the plant at American Falls, by way of Pocatello.

BOISE, IDA.—Parties representing Senator W. A. Clark, of Butte, Mont., have laid before the state engineer plans for the diversion of water from the falls at Shoshone and the construction of an immense power plant at a cost of about $5,000,000. If the necessary concessions are secured by the promoters the plant will be by far the largest in the western territory. Power, it is planned, will be distributed from this point as far south as Ogden and Salt Lake City, Utah. The company also contemplates the construction of an electric road from Boise to the Boise basin.

CARDIFF, ILL.—The Coal Company is said to be contemplating putting in an electric light plant, and furnishing light to the village.

VIOLA, ILL.—The Viola Electric Light Company has been incorporated; capital, $6000. Incorporators: T. F. Sexton, A. C. Bradford and L. J. Sexton.

KENTLAND, IND.—The electric light plant of this city, owned by George D. Rider, was totally destroyed by fire Oct. 23. The loss is $8000 with no insurance. The plant will be rebuilt at once. Mr. Rider wants bids for the construction of the new plant.

INDIANAPOLIS, IND.—James B. Nelson, who was city engineer during the last city administration, has been appointed manager of the Merchants' Lighting & Heating Company of this city.

INDIANAPOLIS, IND.—Dr. S. C. Dickey, manager of the Technical Institute, is preparing to ask for bids for the construction of a power house and an electric light plant on the institute grounds in this city.

CONNERSVILLE, IND.—The General Electric Light & Power Company, of this city, has gone into the hands of a receiver. J. C. Mount has qualified as receiver under bond of $100,000. The trouble arose over a suit to recover interest on twelve $500 bonds which had defaulted.

DAVENPORT, IA.—The Davenport Water Power Company, it is stated, intends to revive a plan for supplying water power from the Iowa side of the Mississippi River. This development has been proposed at intervals for ten years past, and it is now stated that the project has taken shape in the form of a bill which will be presented to Congress for the purpose of acquiring the necessary rights.

DAVENPORT, IA.—The Electric Construction & Machinery Company, of Moline, Ill., has secured the contract for the general electric equipment at the new shops of the Rock Island Railway Company. The contract calls for 146 arc lamps, 3500 incandescent lamps and 121 motors, to be furnished and placed in position; also wiring for connections with motors. The contract price is reported to be $32,000.

HARRODSBURG, KY.—Electric light bonds amounting to $18,000 have been sold.

HOLYOKE, MASS.—The Holyoke Water Power Company has transferred to the Whittmore Mfg. Company the plant, site and water power rights at the corner of Canal and Appleton Streets in this city. The price paid for the plant was in the neighborhood of $75,000.

BOSTON, MASS.—The Worcester South Electric Companies, of Boston, Mass., has been incorporated with a capital stock of $200,000. The incorporators are: President, Thomas Reed; treasurer, Henry F. Knight, and clerk, Arthur E. Newhall. The purpose of the corporation is to aid in the incorporation, organization and development of electric light, electric power, gas, water, water-power, railroad, railway, telephone, telegraph and manufacturing companies.

DETROIT, MICH.—Mr. George W. Winterhalter has secured the contract for laying 3250 feet of electric light conduits in this city.

TRAVERSE CITY, MICH.—The plant and franchises of the Traverse City Gas Company have been purchased by the owners of the Boardman River Electric Light & Power Company.

MONROE, MICH.—The 300-hp. compound engine in the municipal lighting plant in this city collapsed recently and was much damaged. It is stated that it will require a month's time and an expenditure of over $2,000 to repair the damage, and in the meantime the city will be without electric light. There is a second engine in the plant, but it is in such shape that it cannot be used.

SOUTH STILLWATER, MINN.—The citizens have voted to issue $15,000 bonds for an electric light plant and bids for the bonds will be received Nov. 21.

HANNIBAL, MO.—George A. Damon, of Chicago, is in Hannibal inspecting the municipal electric light and power plant to make recommendations for the board of public works for the perfection of the plant and to furnish an estimate of the cost of improvements. A plan for the rebuilding of the entire plant is being considered.

FLORENCE, NEB.—The City Council has granted a franchise to the Omaha Electric Light & Power Company for 25 years and has entered into a five-year contract for five arc lights on Main Street and twenty incandescents on the side streets. The company has already begun to extend its lines from Omaha and within a very short time the work will be completed. The series alternating arc lighting system will be used.

NEWARK, N. J.—The Block Light Company, of Nebraska and Kansas, to deal in electric lighting plants has been incorporated here, capital, $100,000. Incorporators: Charles A. Murphy, Frederick H. Porter, William W. Shaw, Gardner W. Kimball, James B. Richardson.

BATAVIA, N. Y.—The gas & electric plant of the Consolidated Gas & Electric Company has been turned over to the Consolidated Industries Company of New Jersey, which latter concern will operate the local plant in the future.

SYRACUSE, N. Y.—The following-named officers of the Syracuse Lighting Company were elected at the recent meeting: President, Ceylon H. Lewis; vice-president and treasurer, John J. Cummins; secretary, Louis L. Waters, all of Syracuse.

NEW YORK, N. Y.—The Improved Electric Light & Heat Company, of New York City, has been incorporated with a capital stock of $10,000. The directors are John Knobloch and G. K. Hartung, of New York City, and G. W. Wallance, of Mt. Vernon.

PORT JEFFERSON, N. Y.—The Central Long Island Electric Light Company, of Port Jefferson, has been incorporated; capital, $5000. Directors: Chas. R. Mitchell, of New York City; D. McN. Niven, of Montclair, N. J., and A. S. Niven, of Glen Ridge, N. J.

DEFIANCE, OHIO.—The Peoples' Gas & Electric Company, of Defiance, has increased its capital stock from $100,000 to $150,000.

PRAIRIE DEPOT, OHIO.—Owen King, owner of the electric lighting plant at this place has offered to sell the plant to the town for $5,000. Mr. King claims that he is now running the plant at a loss.

COLUMBUS, OHIO.—It is stated that the report of Mr. E. F. Brown, state examiner, who has just completed an investigation of the records of the City of Hamilton, will not be favorable to municipal ownership of the gas and electric light industries. The average annual cost for each arc light per annum to the Hamilton tax-payers, according to Mr. Brown's figures, has been $99.43 and of gas lamps $45.

GUTHRIE, OKLA.—The Shawnee Light & Power Company, of Denver, Col., has been granted a territorial charter with $200,000 capital. The incorporators are Edith Paulson, Otto Dappler, D. J. McCann and others, all of Denver, with C. E. Jackson, of Shawnee, Okla., as territorial agent.

MARYSVILLE, PA.—The Marysville Electric Light Company has been incorporated with a capital of $10,000.

PITTSBURG, PA.—The East McKeesport Light Company has been incorporated with a capital stock of $50,000.

HARRISBURG, PA.—Local press reports state that the Pennsylvania Railroad Company is to construct a plant to provide its yards with light and power.

SCRANTON, PA.—The contract for electrical equipment in the Almshouse at Hillside Home has been awarded to H. B. Coho & Company, New York, for material and labor, $11,375.

ERIE, PA.—Architect Engstrom, of Philadelphia, has completed plans for the new power house to be built south of Waterford by the Erie, Cambridge, Union & Corry Traction Company.

MILLER, S. D.—Stephen Pauly is interested in the construction of an electric light plant.

WESSINGTON SPRINGS, S. D.—J. B. Collins is stated to have secured a franchise for an electric light plant.

HOUSTON, TEX.—The Houston Light & Power Company will expend about $200,000 in improvements and extensions.

PITTSFORD, VT.—The Chittenden Power Company is preparing to erect a power house near East Pittsford, Vt. French & Bryant, of Brookline, Mass., are the engineers.

RICHMOND, VA.—E. E. Davis, Secretary of the Committee on Water, writes that new bids will be received on Nov. 16 for furnishing material and erecting an electric power plant, including steam, hydraulic and electric machinery of 200-hp capacity; also two electrially operated pumps of 1000 gallons capacity per minute each; also for erecting an annex to new pump house.

NEWPORT, WASH.—The Council has granted J. C. Odell and associates a franchise for an electric light plant.

OLYMPIA, WASH.—The City Council has passed an ordinance granting a franchise to Gordon Mackay and others to furnish electric light and power.

ROE, W. VA.—It is reported that the Hughes Creek Coal Company proposes to purchase an electric power plant. Mr. J. W. Moore is manager.

WITTENBERG, WIS.—The citizens have voted to issue $8000 bonds for a municipal electric light plant.

KILBOURN, WIS.—Steps are being taken to rebuild the dam to furnish electric power. P. L. Spooner is interested.

THE ELECTRIC RAILWAY.

EUFAULA, ALA.—A franchise has been granted to the Eufaula Railroad Company. The company is composed of J. P. Foy, B. B. McKenzie, R. A. Ballowe, C. A. Martin, H. C. Holleman and L. H. Brassell. It is proposed to construct a system of electric lines over the city and to extend it as far as Abbeville.

TORRINGTON, CONN.—At the annual meeting of the Hartford-Torrington Tramway Company the following officers were elected: President, M. C. Webster, of New Britain; vice-president, Walter Holcomb; treasurer, N. E. Pierce, of Bristol; secretary, D. B. Mansfield, of Harwinton.

MOUNT VERNON, ILL.—Isaac A. Smith, chief engineer for the Southern Illinois Electric Railway Company, has finished the drawings for the main power house of the road, which will be located at Irvington.

CHICAGO, ILL.—The Chicago Railways Company has been incorporated to operate street railways in the counties of Cook, Lake, McHenry, DuPage and Will; capital, $10,000. Incorporators: N. C. Johnson, Wm. E. Cooper and Archibald Thistleton.

ROCKFORD, ILL.—The Inter-State Electric Railway Company, which was incorporated some weeks ago for the purpose of building a line from Rockford to Madison via Brodhead, has been formally organized at Rockford. President, M. A. Beal, manager, Rockford Edison Company; vice-president, N. F. Thompson, vice-president Manufacturers' Bank.

FRANKFORT, IND.—The Indianapolis & Northwestern Traction Company has the road now completed between Lafayette and Dayton. Construction trains are now running back and forth. The connection between the interurban and the street car company's tracks will not be made for a few weeks.

LOGANSPORT, IND.—The Union Traction Company has announced that the line being built from Anderson to Newcastle paralleling the Pennsylvania Railroad system will be abandoned, although much of the grading has been done and the right of way for a distance purchased. The action was taken owing to the exorbitant prices set on land in the Sugar Creek bottoms south of Anderson.

INDIANAPOLIS, IND.—The Indianapolis, Shelbyville & Southeastern Traction Road has been sold by Fletcher Hines and Dr. R. C. Light to the traction interests headed by Charles L. Henry. The consideration was about $8,500,000. New officers were elected, George A. Ball, of Muncie being made president. It is announced that the extension from Shelbyville to Greensburg will be pushed through.

IOWA CITY, IA.—Articles of incorporation of the Iowa City, Davenport & Muscatine Railway Company were filed with the Secretary of State. The capital stock of the company is $1,500,000. The line will be about 60 miles in length. Motive power will be electricity, steam or compressed air. It is intimated that this line is to be a link in the Des Moines-Chicago electric line now projected. The company is empowered to manufacture and distribute and sell electricity for light, heat and power purposes. The incorporators are: Milton Remley, Stephen Bradley, H. R. Berry, E. J. Spencer, Thomas W. Crouch, L. S. Mitchell and L. B. Pierce. At a meeting of the stockholders in Iowa City, Oct. 16, the following officers were elected: H. R. Berry, of Iowa City, president; T. W. Crouch, of St. Louis, vice-president; Milton Remley, of Iowa City, secretary; L. S. Mitchell, of St. Louis, treasurer.

JUNCTION CITY, KAN.—The Junction City Electric Railroad, Light & Ice Company, of Junction City, has filed an amendment to its charter increasing its capital stock from $100,000 to $300,000. Numerous improvements are contemplated.

BALTIMORE, MD.—The city solicitor of Baltimore, Md., has been authorized to institute legal proceedings against the United Railways and Electric Company for the occupancy of the city conduits which the company has been utilizing for 18 months. It is said, however, that the company will make a further proposition to the city.

WESTFIELD, MASS.—The Woroneo Street Railway Company has enlarged its power house in order to provide for an additional generator.

WORCESTER, MASS.—The Worcester Consolidated Street Railway Company plans to build in the spring a new line between Worcester and Leominster.

GREENWOOD, MISS.—The City Council of Greenwood has granted a 50-year franchise to the Greenwood Electric Railway Company which contemplates building an electric railway system which eventually may be extended to a number of nearby towns.

SOUTH OMAHA, NEB.—It is announced that a new railway company, to be financed and operated by South Omaha men and to be known as the Omaha & Southern, will be incorporated within a few days. The road will run from South Omaha to Papillion. It is to be capitalized for $250,000. The incorporators are Messrs. B. E. Wilcox, Z. Cuddington, A. C. Tully, John J. Ryan, Lyman Waterman and Charles E. Miller.

SCHENECTADY, N. Y.—The Schenectady Railway Company has received authority from the State Railroad Commission to increase its capital stock from $600,000 to $7,000,000. The increased capital to be used for the absorption of the stock of the Mohawk Gas Company, of Schenectady.

ROME, N. Y.—At a meeting of the directors of the Rome City Street Railway Company, the following new officers and directors were elected: President, Horace E. Andrews; vice-president, John J. Stanley; treasurer, Charles B. Rogers; secretary, Walter N. Kernan. Directors: William E. Lewis, C. Loomis Allen, Nicholas L. Devereux.

NEW YORK, N. Y.—According to a special despatch from St. Paul, the United States Steel Corporation management is considering the feasibility of operating by electricity its ore-carrying railroads in Minnesota and the mines on the ranges; and an inspection of these properties has recently been made by a party of United States Steel officials and representatives of the General Electric Company and the Westinghouse Electric & Manufacturing Company.

UTICA, N. Y.—At the annual meeting of the Oneida Railway Company the following officers were elected: President, Horace E. Andrews, Cleveland; vice-president, John J. Stanley, Cleveland; secretary, Walter N. Kernan, Utica; treasurer, Charles B. Rogers, Utica; assistant secretary, A. L. Linn, Jr., Utica; general manager, C. Loomis Allen, Utica. Directors: Messrs. Andrews and Stanley, of Cleveland; Kernan and Rogers, Utica; A. M. Young, New York; R. E. Drake, Syracuse, and H. C. Stone and Hon. E. L. Hunt, Oneida.

ZANESVILLE, OHIO.—The Southeastern Ohio Railway, Light & Power Company has organized with the following officers: M. W. Hissey, president; Frank Ransbottom, vice-president; E. R. Meyer, secretary-treasurer and general manager. The company proposes to build an electric railway from Zanesville to Crooksville and ultimately to extend to New Lexington.

AKRON, OHIO.—The directors of the Northern Ohio Traction & Light Company have authorized the extension of the line from Akron to Massillon. This line was proposed over two years ago, and about $65,000 was spent in securing right of way and grading so that a portion of the route is ready for the rails. Work was stopped where the company secured control of the Canton-Akron Railway, which also touched Massillon. At the time of the Everett-Moore embarrassment the Canton-Akron Railway reverted to the former owners. Now that the Massillon line is to be completed the Northern Ohio Traction & Light Company will enter into competition with the Canton-Akron Railway.

PORTLAND, ORE.—The Portland Railway Company is to construct a new railway down the Peninsula.

JOHNSTOWN, PA.—There is a movement on foot for the building of an electric railway from Johnstown to New Florence.

PLYMOUTH, PA.—The Township Commissioners have granted a franchise to the Berwick & Nanticoke Street Railway Company.

JEANNETTE, PA.—Rights of way have been secured and surveys are being made for an electric railway from Jeannette to West Newton, which will ultimately be extended to Webster.

IRWIN, PA.—A charter has been issued to the Irwin & McKeesport Railway Company, capital $45,000, to build a line 7½ miles long from Irwin to Fawcett, Allegheny County. John George is president.

HAWTHORNE, PA.—The Bethlehem & Hawthorne Street Railway Company, $36,000 capital, has been chartered to build a 6-mile line from South Bethlehem to New Bethlehem and Hawthorne. W. S. Cox is president.

ALLENTOWN, PA.—Rights of way are being secured for an electric railway from Macungie to East Texas, which will connect with the Allentown-Reading line at Macungie. The Reading Traction Company is trying to extend its line along the East Pennsylvania Railroad.

LANCASTER, PA.—A charter has been granted the Lancaster & Southern Street Railway Company, capital $84,000, to build a 14-mile line from Martic Forge to Westhook station. The officers are James G. McSparran, president; William Wohlsen, vice-president; T. K. Worthington, secretary and treasurer.

ERIE, PA.—Capitalists of this section have formed a company for the purpose of going ahead with the preliminaries incident to the building of the Northeast, Findley Lake & Corry Electric Railway. These officers have been elected: G. W. Blaine, president; E. E. Chambers, president of executive committee; A. I. Loop, secretary.

MEMPHIS, TENN.—The Shelby County Traction Company is seeking right of way for a direct electric railway from Memphis to Colliersville. Judge T. J. Latham is among those interested. The new company proposes to furnish electric lights to farmers along the route. The new company is prepared to begin work in a few weeks provided all preliminaries are arranged satisfactorily.

HOUSTON, TEX.—It is stated that Stone & Webster, of Boston, Mass., who own the electric street railway system here contemplate extensive improvements. D. G. E. Tripp, of Boston, has been investigating the situation here.

TEMPLE, TEX.—The project of building the interurban electric railway between Belton and Temple has been revived and it is said that the prospects are now favorable for the early construction of the line. R. T. Crawford, of Temple, can give information.

SHERMAN, TEX.—It is reported that a syndicate of Boston capitalists, represented by William Netherhurt, a civil engineer, are investigating the situation with the view of building an interurban electric road between this city and Dallas by way of McKinney and also to build a line between this city and Fort Worth.

HOUSTON, TEX.—W. E. Scott, of the Houston-Galveston interurban electric railway, says that the work of constructing the line will commence in about three months. The articles of incorporation of the company will soon be filed for record in the Secretary of State's office at Austin. It is the purpose of the company to first construct the line between Houston and Galveston and thereafter build the branch line to La Porte.

SPOKANE, WASH.—Arrangements are being made in New York for the placing of the bonds of the company which will construct an electric railway between Huntington, in this state, and Lewiston, Ida. M. O. Reed, president of the company, writes from New York that the project has been favorably considered by eastern capitalists and that work will commence on the road early in the spring.

NEWPORT NEWS, VA.—The charter of the Hampton Roads Railway & Electric Company, of Newport News, has been extended for three years and the capital stock increased from $50,000 to $500,000.

MERIDA, MEX.—The legislature of this state has granted a concession to Fernando Cervera and G. Rojen for the construction and operation of a street railway line between Yaxcopoil and the town of Chocola.

NORFOLK, VA.—The control of the Chesapeake Transit Company, operating an electric road from Norfolk to nearby points, has passed into the hands of A. H. Flint, of New York, who was elected president of the road.

CHARLESTOWN, W. VA.—A charter has been issued to the Paden City, Middlebourne & Salem Railway Company, of Paden City, to construct and operate an interurban railway system through these cities, with a capital of $100,000. The incorporators are Thomas A. Watkins and George R. Wallace, of Pittsburg, Pa.; Robert Miller, of Paden City, W. Va.; George F. Work, of Sistersville, W. Va., and F. L. Robinson, of New Martinsville, W. Va.

NEW INDUSTRIAL COMPANIES.

THE JANDUS ELECTRIC COMPANY, of Cleveland, Ohio, has been incorporated; capital, $100,000; capital in Illinois, $2500.

THE ROBERTSON ELECTRIC COMPANY, of Buffalo, N. Y., has increased its capital stock from $20,000 to $50,000.

THE AMERICAN ENGINEERING & EQUIPMENT COMPANY, New York, has been incorporated; capital, $250,000. Directors: F. M. Ashley, A. H. Broza, and J. M. Birnbaum, New York.

THE FISH & HORTON COMPANY has been incorporated at Rochester, N. Y., to install electric lighting plants. The capital stock is $10,000, and the incorporators are Fredk. Fish, Minaz S. Horton, Emma F. Fish, of Rochester, N. Y.

THE RADIO HEAT & POWER COMPANY has been incorporated in the District of Columbia at Washington with a capital stock of $200,000. The names of the incorporators are L. A. White, R. K. Van Mater, W. C. Dashiell and Edwin Bradford.

THE EMPIRE CONSTRUCTION COMPANY has been incorporated at Santa Rosa, Cal. Senator W. A. Clark, of Montana, and ten others are the incorporators. The company is organized to construct railways, telephone lines, etc., with a capital stock of $1,000,000.

THE SCOTT SNELL LIGHTING COMPANY, of New York City, has been incorporated in New Jersey to manufacture lamps and lighting apparatus. The capital stock is $250,000, and the incorporators are S. B. Timmins, A. B. Filback, New York City, and Chas. Schegel, Jersey City.

THE ELECTRIC PROTECTION COMPANY has been incorporated at Trenton, N. J., with a capital stock of $3,000,000. The company proposes to manufacture electrical burglar-proof vaults. The incorporators are John R. Williams, W. W. Miller and Charles A. Sitler, Camden, N. J.

LEGAL.

INJURY FROM TELEPHONE WIRE. The Michigan Telephone Company, in stringing a wire around an angle in a street, erected a guy wire to stay the pole at one end of the elbow to prevent the pole being drawn over and the wire sagging. The guy wire was fastened near the top of the pole, and extended to another pole, between the sidewalk and the curb, fastened about ten feet from the ground, crossing above the pavement. A man was injured by his wagon coming in contact with the wire, the wire having then sagged to within a few feet of the ground. The telephone company contended on the trial of an action for damages brought by the injured man that the sagging was due to an exceptionally severe storm, which had been very destructive to poles and wires within the city, and that it had procured all the help possible in addition to its regular employees to repair the damage, and that it had no notice of the sagging of this particular wire. It was held by the Michigan Supreme Court that defendant's negligence and plaintiff's contributory negligence were questions for the jury.

JOINT LIABILITY FOR BROKEN WIRE.—In the appeal case of the Economy Light & Power Company, et al versus Hiller, the Supreme Court of Illinois held that where the wires of an electric light company charged with a powerful current crossed above the wires of a telephone company, not of themselves dangerous, but left uninsulated, and the poles and supports of the electric light wires were neglected, there was a joint liability for personal injuries received from a telephone wire charged by contact with a sagging electric light wire, and they might be joined in suit therefor. There was evidence tending to show that the Chicago Telephone Company would probably know when its wires were burned out or its system interfered with, and after the wire was burned out in the night time, and was hanging in a dangerous condition in a public street, nothing was done to repair the damage or remove the danger at 8:30 o'clock the next morning, when the accident occurred. It was held that the court could not say, as matter of law, that proper inspection and diligence on the part of the telephone company did not require it to discover the dangerous condition and remove the danger to those using the street before that time.

WATER POWER CONDEMNATION.—In upholding the judgment of the Circuit Court of Will County, in the Gaylord water power condemnation case, the Supreme Court of Illinois lays a doctrine regarding the statute of 1872 under which Gaylord sought to acquire the water power at Joliet, created by Sanitary District Canal. The following is an excerpt from the decision: "We are clearly of the opinion that in so far as the statute of 1872 attempts to authorize the condemnation of private property for the purposes of public mills or machinery other than public grist mills, it is violative of that provision of our constitution which declares that private property shall not be taken or damaged for public use, without just compensation, the meaning of which is that private property shall be taken for no other than a public use, and then only on the payment of just compensation, and that on these grounds alone, the Circuit Court would have been justified in sustaining motion to dismiss appellant's petition." The Gaylord syndicate has sued to seize the power under the plea that is was about to build a grist mill, as provided in the statute. By the Sanitary District it was contended that the property had already been put to public use in carrying off sewage of the City of Chicago, and was about to put it to still further use by constructing a water power of its own.

OBITUARY.

RODERICK H. WEINY, a well known telegraph engineer, of New York, was stricken with apoplexy on October 31 and died the next day. At the time of his death he was in the service of the American Telephone & Telegraph Company as telegraph expert and special agent to the general superintendent. Deceased was 45 years of age. The funeral took place on November 2 in Glen Ridge, N. J.

JOHN C. DANIELS.—We regret to record the death of Mr. John C. Daniels, of the Garton-Daniels Company, manufacturers of lightning arresters and other electrical specialties at Keokuk, Iowa. He died on October 25 at his former home in Eau Claire, Wis., whither he had gone in the hope of securing relief from his disease. He was formerly owner of a fleet of raft boats on the Mississippi, in the days when commercial navigation on the great river was more important than now; but since 1892 he had been connected with the company above named. Born in New York State in 1840, Mr. Daniels was therefore 63 years old. He was a man of sterling worth and character and deserved to be more widely known personally than he was in the electrical field, especially as the apparatus bearing his name has so long enjoyed a widespread reputation.

PERSONAL.

MR. JACOB WENDELL, JR., of Wendell & MacDuffie, Havemeyer Building, has returned from a trip to Europe.

MR. S. B. CONDIT, JR., of Boston, Mass., was in New York last week in the interests of S. B. Condit, Jr., & Company.

MR. W. B. BOURN, the president of the San Francisco Gas & Electric Company, is, it is reported, to receive a salary of $25,000 per year.

BROWN-MILLER.—The marriage is announced of Mr. Joseph Stanford Brown, well known in electrical circles, to Miss Frances Baldwin Miller, of New York City.

MR. J. A. MUIR, general manager of the Los Angeles Railway Company, has been elected to the directorate of the Pacific Light & Power Company, of Los Angeles, Cal.

MR. J. M. MARTIN has resigned his position as district sales agent at the Philadelphia office of the Nernst Lamp Company, and Mr. A. E. Baker has been appointed as his successor.

MR. B. MAGNUS, superintendent of the electrolytic refinery and silver mill of the Anaconda Copper Mining Company will shortly leave Montana, and expects to be located in the East.

MR. CHARLES T. BISHOP, formerly with Ladenburg, Thalman & Company, New York, and late paymaster U. S. Navy, has been appointed auditor of the H. W. Johns-Manville Company, of New York City.

DR. HANS GOLDSCHMIDT, the discoverer of thermit, will deliver a lecture at Columbia University, Friday, Nov. 13, during which he will demonstrate experimentally some of the remarkable properties of the new heat agent.

MR. MYRON T. HERRICK, the banker and street railway leader of Cleveland, has been elected Republican governor of Ohio by 100,000 majority. His opponent was Mr. "Tom" Johnson, also known once as a street railway manager of large fortune, but now prominent as an advocate of low fares.

COL. N. H. HEFT.—It is stated from New Haven, Conn., that the return of Col. Heft, general electrical manager of the New Haven Road and principal stockholder in the New York and Stamford Tramway Company, from Europe, has revived the rumor that the Consolidated is to take over the smaller property.

MR. CHARLES M. CLARK presented a paper on telpherage before the Institute of Electrical Engineers last year. This has now been reprinted with revisions by the author, by the Smithsonian Institution of Washington, D. C., in the Smithsonian Report for 1902 and more recently in separate pamphlet form.

MR. W. C. ESCHER, of the Swiss engineering firm of Escher, Wyss & Company, of Zurich, is now on a visit to this side. His firm, as noted in these columns at the time the contract was placed, are building large turbines for installation in the Necaxa plant of the Mexican Light & Power Company, Limited.

MISS EDITH AYRTON.—It is announced by cable that Miss Edith Ayrton, daughter of Prof. W. E. Ayrton, is to marry Mr. Israel Zangwill, the well-known English novelist and dramatist. Both of them have visited this country. Miss Ayrton has also marked literary ability and has been a contributor to "Lippincott's Magazine," the "Westminster Gazette," and other periodicals.

MR. GEORGE W. McELHINEY, of Guanajuato, who is largely interested in the Guanajuato Electric Light & Power Company and several mining properties in Mexico which are to be electrically operated, is now in New York at the Waldorf-Astoria, and at the offices of William P. Bonbright & Company, 15 Wall Street.

MR. JAMES F. CUMMINGS is now in St. Petersburg, Russia, superintending the laying of Yankee conduit for the municipal telephone and telegraph lines. He has employed over 2000 Russians to carry out the work. The conduit is being shipped from the plants along the Raritan River, N. J., of the American Vitrified Conduit Company.

MR. ALFRED SKITT, of the Manhattan Elevated, has been inspecting the traction systems in Chicago, with a view, it is rumored, to buying out all the Elkins-Whitney-Widener interests there on behalf of new capital. Mr. Skitt is himself an old street railway man, having been manager of the old Vanderbilt Fourth Avenue system. Details of this move are given in our Financial intelligence.

MR. J. M. SMAIL, C. E., engineer-in-chief of the Metropolitan Board of Water Supply and Sewage, Sydney, Australia, is visiting this country on his way home from England. Besides visiting water works and sewage plants while here, he has been looking into electrical matters, such as pumping, etc., and has visited some of the leading electrical factories. He will proceed over the Canadian Pacific to Vancouver.

MRS. T. A. EDISON gave a notable Hallowcen party at Llewellyn Park, Orange, last week, where electricity was enlisted by the "Wizard" himself for some new sensational effects appropriate to the occasion and worthy of imitation elsewhere. Mr. W. J. Hammer exhibited and discussed radium as one of the new sources of light by which a girl can see the face of her future husband and even read his mind if he has one.

PROF. W. E. AYRTON, F. R. S., who has been visiting this country as a member of the Mosely Educational Commission, sailed for home last Saturday. His stay was all too short for the work in hand, as well as for the friends who wished to see him and the things he wished to inspect in the field of electricity. Besides studying education in New York, Prof. Ayrton went to Washington and other cities. The calls for him from his professional engagements in England were too pressing, however, to be denied.

MR. ANDREW CARNEGIE and family returned home to New York last week on the White Star liner *Cedric*, in good health. He will spend the winter at his new Fifth Avenue home. Interviewed as to the financial outlook, he said: "It is a good thing to have some of the water squeezed out of some of the stocks which are now on the market. It will not hurt the standard securities, they are as good as ever. The recent turn of affairs in Wall Street will have as a result the salutary reduction of values, and everything will be brought to a healthy condition."

MR. HENRY S. SNOW.—We regret to note that Mr. Henry Sanger Snow has tendered his resignation as President of the Polytechnic Institute, Brooklyn. His action is based on a desire to be relieved of the administrative cares of the institute. He has been the head of the Polytechnic since July 1, 1899. He has been re-elected Chairman of the Board of Trustees of the institution. A special committee has been appointed to select his successor as president. Mr. Snow has a great many financial interests to look after, including those of the New York & New Jersey Telephone Company.

MR. F. S. PEARSON left for Mexico Oct. 31 in connection with the undertaking of the Mexican Light & Power Company, of which he is vice-president. Mr. F. O. Blackwell, formerly chief engineer of the power and mining departments of the General Electric Company, is chief engineer of the Mexican Company. He is now in the southern republic. Mr. J. M. Neilson, the managing director of the company, has left Montreal, where its head offices are, for Mexico. Mr. James Ross, of Montreal, the president of the company, is expected to make a visit to Mexico about the latter part of this month.

MR. JAMES STEWART, of the American contracting firm of James Stewart & Company, of Pittsburg, St. Louis and London, who as constructing manager of the British Westinghouse Electric & Manufacturing Company's plant at Trafford Park, near Manchester, worked such wonders, sailed for Europe Oct. 31, after a short visit to this side. Mr. Stewart is now primarily engaged in the supervision of the construction of the huge Chelsea plant which is to operate the Yerkes underground roads in London and vicinity. The British Westinghouse people have the contract for the construction and equipment of the plant.

MR. ARTHUR WILLIAMS, whose contribution to the programme of the Chicago meeting of the National Electric Light Association will be remembered as one of the most interesting items, has kindly consented to continue in charge of the department of sign and decorative lighting and to prepare another report on the subject, to be presented at the next convention, to be held in Boston in May or June. When so busy a man as Mr. Williams gives the time and thought necessary for making such elaborate reports two years in succession, it shows that he has the interests of the association very much at heart and all the members are under great obligations to him. Through the kind co-operation of the New York Edison Company, Mr. Williams' last report, handsomely printed with colored illustrations, was distributed without expense to the association, enough extra copies being furnished to bind the book of proceedings.

Trade Notes.

CROSS OIL FILTERS.—The Tennessee Coal, Iron & R. R. Co. has sent its fourth order for Cross oil filters to the Burt Mfg. Co., Akron, Ohio.

OHIO ELECTRIC WORKS, Cleveland, have just issued a new catalogue of electrical novelties which they are mailing to the trade. Copies will be sent on receipt of address

THE BALL ENGINE COMPANY, Erie, Pa., has received an order from the American Steel Foundries, of Indiana Harbor, Ind., for a 300-hp direct-connected Ball engine unit.

J. G. WHITE & COMPANY, engineers, etc., have removed their offices to the twenty-second floor of the Wall Street Exchange Building, 41 to 43 Wall Street, and 43 and 49 Exchange Place, New York.

THE SUMTER TELEPHONE MANUFACTURING COMPANY, of Sumter, S. C., has recently completed a large addition to its already prosperous plant. Several new types of instruments will shortly be turned out.

MR. W. ROCHE, the dry battery manufacturer, 42 Vesey Street, New York City, had a severe visitation from fire last week, when considerable damage was done to stock and building. Business will be carried along as usual.

THE ZENITH LAMP is made by the Packard factory and sold by the Electric Appliance Co., Chicago. It is strictly an incandescent lamp, yet may be named as a type of its own as an intermediate illuminant between the arc and incandescent. Booklets, illustrating this lamp, which is a most marked advance in lighting, will be mailed promptly for the asking.

CHASE-SHAWMUT COMPANY, of Boston, notes the removal of its factory to Newburyport, Mass., where it will have greatly increased facilities for manufacturing. A large stock of its standard product in electrical specialties will be carried by its agents, Stuart-Howland Company, Boston; W. S. Brown, New York; Thos. G. Grier Company, Chicago; John R. Cole, San Francisco.

ELECTRICITY VS. GAS.—The Wagner Electric Mfg. Company, St. Louis, has issued a very neat little pamphlet giving the true story of an electric light company which was "knocked out" by Welsbachs, but which turned the tables on its gas competitor by piling up a big power load in the daytime. The points are well made and are full of suggestion to those who have not yet developed a power business.

THE HEWITT MERCURY VAPOR LAMP is the subject of a very interesting illustrated pamphlet issued by the Cooper Hewitt Electric Company, of 220 West 29th St., New York City. A number of types and designs are shown, including the new tilting lamp illustrated lately in these pages. A number of testimonials are given as to the excellent results obtained by photographers and others. The current consumption is given as .4 and .3 watt per spherical candle.

ELECTRIC GAS LIGHTING COMPANY, 195 Devonshire Street, Boston, Mass., has recently entered the telephone field, to supply apparatus as well as its well-known batteries, and has issued a handsome catalogue on the subject, which illustrates and describes a large variety of "Samson" transmitters, receivers, bells, intercommunicating systems, etc. Full details of construction, prices, etc., are given.

PITTSBURG TRANSFORMER COMPANY, of Pittsburg, Pa., has issued a circular in which it gives a letter from Mr. H. W. Hamblin, general superintendent of the Nassau Light & Power Company, of Roslyn, L. I., to Mr. A. H. Mustard, sales agent in New York City, testifying as to the remarkable and splendid results obtained with these transformers, of which he has 300, ranging from 1-kw to 50-kw. The endorsement of a practical man could not be more emphatic.

HAZARD MFG. COMPANY, of Wilkesbarre, Pa., has just issued a new catalogue of its wire rope, a specialty by which it was known long before it entered the field of insulated wire manufacture. Wire rope was made as far back as 1848 in this country by men who afterwards formed the Hazard Company, and the product thus named has always enjoyed a high reputation. The new catalogue brings to notice also a variety of detail and auxiliary apparatus and material.

THE CENTRAL ELECTRIC COMPANY, Chicago, has just issued its November price-list and discount sheet, copy of which ELECTRICAL WORLD AND ENGINEER desires to acknowledge. It is an exceedingly attractive little book, designed to supplement its 1903 general catalogue. It has been revised to date and contains the very latest prices in force, hence cannot help but be of interest to every one in the electrical field. Every holder of a catalogue who has not received this price-list should write for one.

BUFFALO FORGE COMPANY, Buffalo, N. Y., have just issued a new catalogue on mechanical draft apparatus. It embodies a variety of interesting data and material, as well as some illustrations of outfits installed by the concern. The tables included give the capacities of fans for induced draft under average working conditions as well as the theoretical output with unrestricted inlet and discharge. The pamphlet, which can be had on application, illustrates also the Buffalo fan system of heating, ventilating and drying apparatus.

TRUMBULL ELECTRIC MFG. COMPANY, Plainville, Conn., has recently brought out a neat flush receptacle different from other receptacles in that it fits the standard switch boxes and takes any Edison base attachment plug. No special plug is necessary. Any Edison screw base that has ever been used for a desk lamp or a fan can be used in this receptacle. It has a nickel-plated cover. The Trumbull Company has also issued excellent bulletins as to its switches of various types, rosettes, sockets, cut-outs, connectors, etc., all well made, durable and low in price.

PEERLESS RUBBER MFG. COMPANY, 16 Warren Street, New York, has issued in Catalogue No. 60 a splendid summary of the state of the art in miscellaneous rubber goods for mechanical and industrial purposes. It is a book of 150 pages, handsomely printed in black, red and other colors not merely for ornament but to bring out the goods as they actually appear, as, for example, the packings and mattings or tilings. Some idea of the range covered by the pamphlet may be formed from the fact that no less than 47 trade marks controlled by the concern are enumerated, and many of these are familiar to everybody in the electric light and power field. The fullest information is given as to all the specialties and some of it is quite interesting as, for instance, that in regard to the origin of "Rainbow" packing. The goods are also beautifully illustrated.

STANDARD ELEC. MFG. COMPANY, of Niles, Ohio, the maker of the Star incandescent lamp, has issued a remarkably handsome catalogue devoted to its lamp specialties. The cover is most ingenious, showing a Star lamp hanging in the center, in high relief, to which around the borders of a large panel run wires represented by yellow silk threads held down by cleats. The effect is very novel and pleasing. The contents of the pamphlet are devoted to a discussion of the features of the lamp—vacuum, filament, voltage, etc., and varieties of standard, round, railway, white, miniature and other types are richly illustrated. A feature of this brochure, which is likely to be preserved by all who get it, consists in the beautiful illustrations of scenes and buildings in which the incandescent lamp figures decoratively, and many artistic fixtures are also depicted.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 27, 1903

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

742,195. HEAT ALARM; Howard Field Jones, Wilson, N. C. App. filed Feb. 3, 1903. Contacts are applied to a thermometric device to close an alarm circuit when the temperature rises or falls to a certain point.

742,280. ELECTRIC MOTOR; Joseph H. Blair, St. Louis, Mo. App. filed March 21, 1903. A centrifugal device for short-circuiting the armature coils when an alternating current, self starting, single-phase machine reaches full speed.

742,287. MASSAGE INSTRUMENT; Louis Casper, Chicago, Ill. App. filed June 4, 1901. A tubular belt containing liquid has a flexible wall which receives the strokes of a vibrating hammer, thus communicating the shocks through the liquid to all parts of the body embraced by the belt.

742,298. COHERER FOR WIRELESS TELEGRAPHIC SYSTEMS; Louis Dorman, Washington, D. C. The coherer comprises a globule of mercury having a coating of oil and a finely divided mineral substance.

742,305. BLAST CONTROLLING DEVICE FOR DENTAL OR OTHER USES; Nathan K. Garhart, Indianapolis, Ind. App. filed April 17, 1903. An electrical heater is inserted in a tube through which a blast of air is directed; the air can flow hot or cold, depending upon whether the circuit of the heater is opened or closed.

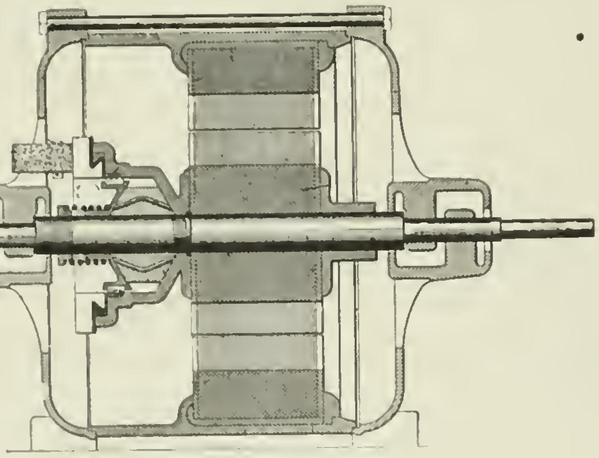
742,309. ELECTRICALLY ILLUMINATED SIGN; John H. Goehst, Chicago, Ill. App. filed May 12, 1902. A nut screws externally upon the receptacle and clamps the thin metal face of the sign in an opening in which the receptacle is located.

742,310. ELECTRIC CAR HEATER; Edward E. Gold, New York, N. Y. App. filed Feb. 26, 1903. A heat deflecting plate is arranged under the seat and a number of heaters are mounted common to a single plate.

742,311. TROLLEY FINDER; Fred A. Graham, Ferdinand F. Carmiencke and John R. Neely, Muncie, Ind. App. filed Jan. 30, 1903. A rotary spiral track each side of the trolley wheel conveys the displaced wire to the wheel.

742,331. CASING FOR TROLLEY WHEELS; Thomas Kelch, Newport, Ky. filed Feb. 2, 1903. A casing in which one side is hinged to allow the wheel to be removed and replaced.

742,348. ELECTRIC POCKET FOR LIGHTING PURPOSES; Alexis Olenin, New York, N. Y. App. filed March 28, 1902. A plug entering the pocket acts as a wedge upon the blades of a knife-switch and closes the same.



742,280.—Electric Motor.

742,374. CIRCUIT CONTROLLER FOR SURGICO DENTAL ENGINES; William W. Alexander, Kansas City, Mo. App. filed Dec. 24, 1902. Details.

742,378. TROLLEY CONTACT DEVICE; Wallace L. Baker, Painesville, Ohio. App. filed Dec. 29, 1902. Springs are arranged to hold the wheel in a normal position, but permit it to tilt when necessary.

742,398. HANGER FOR ELECTRIC LAMPS OR THE LIKE; Michael C. Donahue, Colorado Springs, Colo. App. filed May 1, 1902. Details of a take-up spool for flexible cord.

742,407. ELECTRIC ADVERTISING; George W. Enright, New York, N. Y. App. filed March 4, 1902. Receptacles are mounted in monogram form and a given letter is selected by placing a pattern sheet over the monogram containing openings that admit lamps at places to form only the desired letter.

742,408. ELECTRODYNAMIC EQUIPMENT FOR SCHOOLS; Horace J. Evans, Wausau, and Tracy B. Hatch, Menominie, Wis. App. filed Aug. 5, 1903. An assemblage of apparatus consisting of supports, pole shoes, magnets, commutators and other parts, arranged to be assembled as desired and knocked down at will for the purpose of teaching the principles of electricity and electro-dynamics.

742,426. ELECTRIC CARRYING APPARATUS; John J. Hill, Rose Mills, Va. App. filed June 22, 1903. Details of a parcel carrier system.

742,449. QUICK BREAK SWITCH; Hubert Krantz, Brooklyn, N. Y. App. filed June 4, 1903. A block of insulating material carrying a blade on each side hinged to one pair of terminals, has a handle pivoted to it and also connected by a spring which is put under tension when the handle is lifted to finally quickly remove the blades from the clips.

742,453. SPLIT ELECTRICAL CONDUIT; Edward N. Lake, Chicago, Ill. App. filed April 25, 1903. The conduit is split longitudinally, the parts being laid together as required.

742,487. ELECTRIC SIGNALING DEVICE FOR RAILWAYS; Hubert Pfirmann, Frankfort-on-the-Main, Germany. App. filed Dec. 7, 1901. Details.

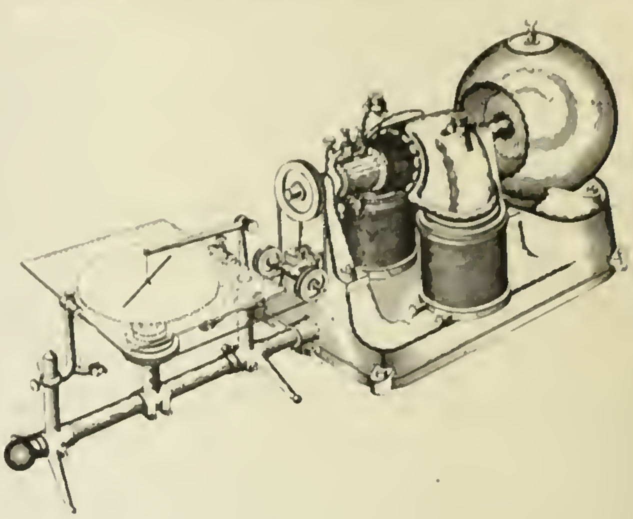
742,499. ELECTRIC FUSE SWITCH BOX; Joseph Sachs, Hartford, Conn. App. filed March 19, 1901. A casing having fixed terminals and a hinged cover having a clamp for an inclosed fuse; when the cover is closed, the fuse acts as a switch element to close the circuit across the fixed terminals.

742,508. PUSH BUTTON SWITCH; Alexander B. Simpson, New York, N. Y. App. filed July 9, 1903. Details.

742,547. ELECTRICAL SWITCHING SYSTEM; Golbert Wright and Francis V. Nicholls, Pittsfield, Mass. App. filed Feb. 16, 1903. The mechanism comprises a hand switch, the condition of which serves as an indicator of the integrity or defectiveness of the circuit.

742,548. TRANSFORMER; Golbert Wright, Pittsfield, Mass. App. filed Feb. 20, 1903. A transformer comprising a central core, I shaped radiating magnetic yoke sections arranged around the core and primary and secondary coils encircling the core and embraced between the arms of the yoke sections.

742,551. WIRE CORE MACHINE; Thomas A. Aiton, New York, N. Y. App. filed May 4, 1903. A machine adapted to wrap two or more telephone or other wires with strips of insulating material and at the same time twist the wrapped strands together to form a core.



742,408.—Electrodynamic Equipment for Schools.

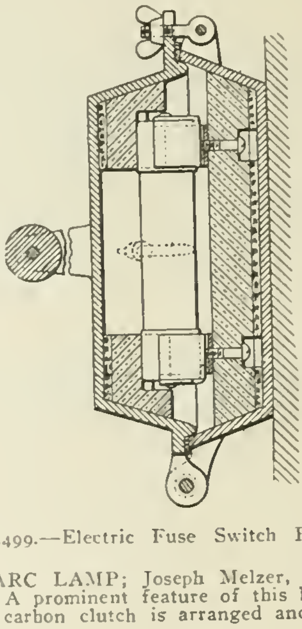
742,600. DYNAMO ELECTRIC MACHINE OR MOTOR; Edwin R. Cox, Jr., Birmingham, Ala. App. filed Aug. 21, 1903. A uniform-field dynamo or motor, comprising oppositely excited pole pieces electrically insulated from each other and rotary armature disks co-operating with the pole pieces and in electrical connection with each other and with the respective pole pieces whereby the armature currents are conducted to and from the machine through the metal body.

742,604. ELECTRIC ARC LAMP; George R. Davison, Pittsfield, Mass. App. filed Feb. 16, 1903. The wire connection between the movable carbon rod and the electro-magnet is prevented from becoming entangled by a guide through which it passes.

742,661. ELECTRIC LIGHTER; Conrad Hubert, New York, N. Y. App. filed May 8, 1902. For igniting a cigar-lighting torch, the electric terminals are placed in a tube having draft openings below and above and a port to admit the end of the torch to the terminal.

742,681. AUTOMATIC INDICATOR; Wesley E. Laird, Pittsfield, Mass. App. filed Jan. 13, 1902. Consists of apparatus adapted to measure the electrical condition at a given point in a circuit and to transmit to a distance definite signals corresponding with such measurements, together with means controlled from a distance for setting the apparatus in operation.

742,705. ELECTRIC ARC LAMP; Joseph Melzer, Cleveland, Ohio. App. filed April 10, 1901. Details.



742,499.—Electric Fuse Switch Box.

742,706. ELECTRIC ARC LAMP; Joseph Melzer, Cleveland, Ohio. App. filed Jan. 2, 1903. A prominent feature of this lamp is that the magnet which operates the carbon clutch is arranged and adapted to act as the choking coil.

742,725. ELECTRIC LAMP SOCKET; Mortimer Norden, New York, N. Y. App. filed Feb. 24, 1903. A cup member and a base member forming a receptacle, the two parts being held together by screws passing from one into the other and at the same time engaging with the metallic plates carried by each part, so that the circuit will be closed from the main conductors through the plates and screws to the lamp terminals.

742,743. COMMUTATOR; Christopher J. Roach, Hartford, Conn. App. filed June 27, 1903. The armature terminals are detachably connected with the commutator segment, so that the commutator can be removed without disturbing the armature coils.

742,814. SURGICAL APPLIANCE; Albert V. Todd, Denver, Colo. App. filed Aug. 3, 1903. Details.

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Municipal Ownership at Ashtabula.

It is fairly safe to assume that the State authorities of Ohio in investigating the accounts of the municipal lighting plant at Ashtabula, have done so without "prejudice." The State Auditor and his expert accountants ought to know what they are about, and hence we are inclined to accept without reserve the statement which we quote on another page as to the results obtained from their inquiry. It appears that the yearly cost to the taxpayers for ten years past has averaged $98.24 per arc light, and that not on an "all-night contract," but a moonlight schedule, subject without fines and rebates to the city's own construction of what moonlight may mean. There is not a central station company in the country in a city the size of Ashtabula that would not thank its stars for such a "cinch."

Electrical Conquest of the Canals.

It seems to us more than an ordinary coincidence that we are able this week to publish accounts of two separate and distinct efforts to apply electricity to canal traction in this country. One equipment is on the famous old and fairly dilapidated Erie Canal; the other is on the Miami Canal in Ohio. The former is a direct-current aerial monorail system; the latter is a polyphase locomotive and track system. Both seem quite independent of the type of current used, for it is easy to imagine a change about to alternating current on the telpher line and direct current on the regular trolley track. But aside from that, there is an essential and radical difference in the method. The aerial line, as we can testify from actual observation, imposes no additional "servitude" on the towpath in the sense of obstruction. Anything or anybody can pass easily in either direction along the bank. With the trolley system, however, the whole bank is virtually occupied by the trackage, and it is easy to imagine serious objections to that plan. On the other hand, the "monorail" system looks so heavy it would appear easier and cheaper to lay the track right on the ground instead, and probably save money. In doing so, of course, one would give up the advantage of a clear bank for mule tows, etc.

These two are not the only methods, and we are glad to know, as recorded in these pages, that other systems are in vogue or under trial in Europe. The main point for which we contend, if, indeed, argument is necessary, is that electricity is wholly adequate to replacing the mule or the steam propeller on canals. Any one of these systems is feasible and a little time will soon develop the relative economies and efficiencies. And this statement is true, so far as the Erie Canal is concerned, whether the present small barges or the proposed new 1,000-ton barges are hitched to an electric motor. The bigger barges avoid breaking bulk, and we have ourselves seen over 1,000 tons in one tow manipulated with the greatest smoothness and quietude at fully 4 miles an hour. It is high time the decadent canals were rescued and put on the profitable level of modern trolley roads once operated by animal power.

The Wireless Telegraph Conference.

We note in the November *North American Review* a statement from Mr. John L. Waterbury, United States delegate to the recent wireless telegraph conference in Berlin, as to what was discussed at that important gathering. It would seem inevitable from his statement that another conference must soon follow if any practical results are to be reached, and without general agreement it would seem that there must be trouble. When it is held, it is to be hoped that some respect will be shown for the rights of inventors and pioneers. Anybody who reads Mr. Waterbury's report can detect the tendency of the various governments to dispose of the whole subject as seemeth best to them, because of their alleged rights of eminent control over the telegraphs. It should surely be easy to put some restraint on rival systems without going to the other extreme and leaving them virtually stripped of reward or protection. All the great pioneer work of Marconi, for example, in oceanic wireless, is to go for nothing; and, unfortunately, according to, and possibly with the aid of, Mr. Waterbury, such a piece of high sea robbery is to have the United States as a party to it. The Marconi Company is nothing to us, and we consider that Mr. Marconi still has to make good some of his most vital claims; but to brush their work aside or insist that *nolens volens* they or others shall be made to turn their land plant over to universal use by Tom, Dick and Harry, without due compensation, strikes us very much like high handed confiscation. There is surely a more equitable way out of the difficulty than that.

For example, Mr. Fessenden might have a most expensive and elaborate tower system, while Dr. De Forest, without towers, might have signaling apparatus that everybody gave preference. If the Fessenden people, selling or leasing no apparatus, were compelled to receive all De Forest messages, as the present international scheme proposes, without right to secure some proper compensation, they might easily be bankrupted in six months, although on the use of their property the transmission depended. Other equally unfair combination of conditions under this ruling reported by Mr. Waterbury can readily be imagined. Even if a man is a common carrier, he has some common rights left.

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GRAPHIC RECORDING AMMETERS.

At the last meeting of the American Institute of Electrical Engineers a paper was read by Mr. A. H. Armstrong upon a new form of recording ammeter, suitable for use on an electric car. Recording ammeters have been in use for some time in central station work; but such instruments are stationary. Moreover, the fluctuations of the current passing through such an instrument are rarely very rapid or very intense. The problem becomes distinctly modified and complicated when the apparatus has to be placed on a rapidly moving car, subject to jars and vibrations, and where the fluctuations of the current may be both very sudden and very intense. The instrument described is an ink recorder, and the pen is attached to the movable coil of an electro-dynamometer. This dynamometer differs from the ordinary form in having an iron core, and also in having a steady current supplied to the movable inner coil from a local source, such as a small storage battery. By this local supply of magnetization to the movable coil, intensified by the stationary central iron core, the torque tends to vary as the current strength in the fixed outer coil, rather than as the square of that current. This not only provides for a nearly uniform scale, but also ensures a much more powerful torque for weak currents, than could otherwise be obtained with a given full load torque.

The use of an instrument of this character is rendered necessary for the study of the starting behavior of traction motors under the conditions of practice. The curves of current and pressure at starting appeal as strongly to the trained eye of the traction engineer as the indicator diagram of an engine to the observation of the steam engineer. Another great advantage which this type of instrument possesses is its maintaining an accurate record of the pressure and current on a car over a given schedule, without having to detail an observer or observers for the purpose. There are few duties more fatiguing than that of recording a long series of voltmeter observations on a car at, say, ten second intervals. The recording instrument, however, can register many changes within ten seconds should rapid fluctuations occur, and plot all the observations automatically.

An ideal car recording instrument would be capable of marking on one and the same moving paper ribbon the time, the speed, the distance, the grade, the volts, the amperes, and the kilowatt-hours. The mechanism for the synchronous recording of all these seven quantities would not be a very complicated. Four of the quantities may be derived from non-electrical mechanism, such as clocks and shaft-gearing. The remaining three electrical quantities should be more readily recorded on one and the same moving tape, than on three separate tapes. Such a mechanism might readily be transferred from one car to another, and would not require much time to connect on any car. Its record would give a complete history of a run over a road, and many practical problems might be satisfactorily solved by its use. Already recording machines are in use which combine several of these items. Machines of much greater complexity are already in use on steam railroads for recording the conditions of the track.

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DISTRIBUTION OF CURRENT IN THREE-PHASE SYSTEMS.

We print on page 797 of this issue a very practical article, by Mr. F. H. Jeannin, on the distribution of current in three-phase systems. The three-phase system of mixed delta and star connections is relatively a complex distributing system. For example, it is a much more complex system to follow quantitatively than the four-wire two-phase system. Nevertheless, the three-phase system possesses the inherent advantage of a saving in copper of twenty-five per cent by comparison with any direct current system, single-phase system, or association of single-phase systems, of the same effective voltage. For this reason the three-phase system has come into practically universal use for the long-distance transmission of power. Consequently all propositions concerning the important quantities in the three-phase system, such as questions connecting voltages, currents and powers are likely to become of practical value.

The article points out that a pair of current transformers for operating line ammeters in a switchboard, are sufficient for the operation of all three line ammeters in a three-phase system. This is a consequence of the well-known laws of a three-phase system that at any instant the vector sum of the three-line currents is zero, and that the vector sum of the steady effective line currents is steadily zero—the effective current being the square root of the mean square, or the average heating effect, or the current as indicated by a properly calibrated alternating-current ammeter. This proposition is correlated with the well-known law of a three-phase system, that two wattmeters can be connected to indicate jointly the total power on the three lines.

Attention is very properly called to the fact that if the connections between the two current-transformers and the three ammeters are improperly made, the third ammeter will give misleading and erroneous indications. Another interesting proposition set forth in the article is that if, in a three-phase system, the three voltages of the generator delta, assumed equal and equally dephased, be drawn, like isometric coordinates, passing through a common point and spaced sixty degrees apart, then the algebraic sums of the components of line currents resolved parallel to any three such adjacent lines will always be equal for equal generator output, no matter how much the apparent power, or volt-amperes may vary. The arithmetical sum of the three currents will, of course, tend to increase as the power factor diminishes, and as the volt-amperes increase, keeping the real power constant, but the resolved components of these currents on the coordinate axes will always maintain the same sum-total, when the sign of the components is taken into consideration. This proposition follows from the fact that the total power in the system is equal to the sum of the three voltages into the respective projections of the line currents upon them, and if this power is to remain constant, and the voltages are also constant, the sum of the three projections, or components, must also be constant.

From an observation of the line currents, and of the wattmeter readings, it becomes possible to determine the phase relations of the currents with the line voltages, and in this way to analyze the currents into working components on each line. This is on the assumption that the delta voltages are equal, but a slight modification of the proposition can be made to meet the case in which the delta voltages are unequal, corresponding to dissymmetrical terminal voltages.

ENGINEERING EDUCATION.

The recent visit of the British Commission investigating American methods of technical education brings to the front a very serious question as to the value of that which they have found. That technical instruction in England is in a highly unsatisfactory state admits of little doubt; it is quite certain also that the Commission discovered here some admirable institutions, but did they find a well-defined method of education which might fairly be said to be common to American technical schools? We think not, and on the contrary, if their investigations were at all as thorough as they were intended to be, they assuredly found that American institutions were on all sorts of planes of usefulness and representing all sorts of educational ideals. English technical instruction is essentially a development of the trade school idea, very useful in itself, but far from being all-inclusive in its functions. Here the trade school as such is almost an unknown quantity, and so far as it here exists is of comparatively recent growth. That it may be useful when intelligently managed the correspondence schools which have assumed some of its functions bear witness; but they cannot be regarded as a sequent part of our general educational system, which is based as regards technical instruction, on the small university using that term in its American signification of an institution in which all sorts of things are taught. The main work of technical instruction in this country is done by the "land-grant" colleges under State supervision and founded originally to provide instruction in "agriculture and the mechanic arts." In many instances the instruction in agriculture has been separated from that in the mechanic arts and the latter has been merged in the general work of a State University; but it is an impressive fact that technical study has been in every State of the Union backed up by a strong local appreciation of its necessity. It is in response to this sentiment that courses in engineering have been developed, and because of its representation of local necessities that they have taken the various forms in which they now appear.

In State institutions there is a direct pressure of popular feeling to which deference has to be paid, and that feeling to a considerable extent is governed by the nature and efficiency of the public schools. A group of endowed independent colleges and universities can and do exercise a very powerful influence on the public schools; but the State Universities must act by moral suasion, as they sometimes do with considerable effect. From such causes spring the curious anomalies which our British friends have certainly found. In electrical education the results are sometimes very singular, indeed. One finds, for example, two institutions in neighboring States, both with popular courses in electrical engineering, one of which contains perhaps as much as ten times more shopwork than the other. Now, evidently a student gets too much shopwork in one place or not enough in the other. Similarly one can find courses in which the students graduated in electrical engineering are merely mechanical engineers who have dabbled a few hours a week for a couple of years in an electrical laboratory without grasping fully a single fundamental electrical principle. Most courses in electrical engineering have been offshoots of a dominant mechanical engineering course, and these variations merely indicate the completeness or incompleteness of the gradual segregation which has been taking place. In fact, American electrical engineering reflects this origin. It has been mechanically clever, replete with the skill of the shrewd adapter and the tactful draughtsman. It has, too, been wonderfully successful up to a certain point along just these lines. The training has been vastly superior to that obtained in trade schools as such, but whether it is adequate for the future needs of the profession is a very different matter. A time has come in which the investigator must play in the principal rôle before the chorus of adapters appears upon the stage. And if one solemnly considers the really important electrical advances of the last quarter century or thereabouts it is somewhat startling to see how little of the great work has been done here or abroad by men whose training was wholly or chiefly in the direction of applied mechanics. The great work, both that which has been accomplished here and that which, arising abroad, has been subjected to benevolent assimilation, has, on the contrary, sprung from a very wide variety of sources. We hope, therefore, that our British friends will not go home bearing with them the idea that the American notion of electrical engineering is a concrete of machine design and strength of material with just enough dynamo testing to stick it together. We are very far from wishing to cast reflections on mechanical engineering, or in any wise to belittle its past and present usefulness to American industry, but in the present stage of electrical science it is far from being the whole thing. The electrical engineer of the twentieth century needs civil engineering, chemistry and general physics fully as much as he needs mechanical engineering, and more than any of these he needs some fundamental notions as to the methods and importance of research. The electrical industries are yearly getting more and more complex and making greater and greater demands upon general science; and engineering instruction must recognize this tendency and act upon it. In the past the main thing which confronted the student was the design, testing and operation of dynamos to which everything else in the ordinary electrical engineering course that smacked at all of electricity was subordinated. We are now in a different era. The problems which press for solution are of an entirely different order, and the men who are successfully to attack them must have a training wide and deep, as far from the old order of things as can well be. They have no time to waste on work that can be as effectively done in practice by a fifteen-dollar-a-week draughtsman, and no need for pottering over obsolescent fan motors. They have work to do for the progress of electrical science in the next generation, and what was useful or even essential twenty years ago may be a positive hindrance to-day. If American engineering is to take place as a world power in progress, it must originate instead of copy; and the power of origination, in whatever measure it may be influenced by training, needs a wider grasp upon fundamental principles than has ever before been required. Engineering education to be effective must be organized with almost prophetic instinct for the requirements of the years to come.

The St. Louis International Electrical Congress.

We are informed that the following appointments have been made by Prof. Elihu Thomson, president of the Committee of Organization of the congress, for the officers of the various sections:

Section		Subject	Chairman	Secretary
A		General Theory Mathematical Experimental	Prof. E. L. Nichols, Cornell Univ.	Prof. H. T. Barnes, McGill Univ.
B	Applications	General Applications	Dr. C. P. Steinmetz, Schenectady, N. Y.	Prof. Sam'l Sheldon, Poly. Inst., Brooklyn.
C		Electrochemistry	Prof. H. S. Carhart, Univ. of Mich.	Mr. Carl Hering, Philadelphia.
D		Electric Power Transmission	Mr. Chas. F. Scott, Pittsburg.	Dr. Louis Bell, Boston.
E		Electric Light and Distribution	Mr. J. W. Lieb, Jr., New York.	Mr. Gano S. Dunn, Ampere, N. J.
F		Electric Transportation	Dr. Louis Duncan, Mass. Inst. Tech.	Mr. A. H. Armstrong, Schenectady.
G		Electric Communication	Mr. F. W. Jones, New York.	Mr. B. Gherardi, Jr., New York.
H		Electrotherapeutics	Dr. W. J. Morton, New York.	Mr. W. J. Jenks, New York.

It is understood that all of these gentlemen, who are well known specialists in the departments they represent, have already accepted these appointments, with the exception of one who has been unable to do so owing to absence in Europe, but who is now returning.

The section officers will have charge of the proceedings of the congress at St. Louis in their respective sections.

The papers that are to be read at the congress will be communicated by invitation from well-known authors in this country and abroad. They are to be read and discussed at St. Louis during the congress week 12-17th September, 1904. They are then to be printed and published in book form.

Invitations to join the congress are steadily being issued to persons and parties interested in electricity. Over 6,000 such circular letters of invitation will be sent out in the United States, and a similar number to foreign countries. Most of the circulars are being directed to members of electrical industries, societies and scientific institutions. Joining the congress entitles the member to attend the various functions at St. Louis and also to receive a copy of the subsequent transactions. It is expected that many will join the congress who cannot expect to attend the sessions in St. Louis, merely to receive the subsequently printed transactions. The transactions are expected to form a very valuable addition to electrical literature, both theoretical and practical. Already about 350 Americans have joined the congress in response to circulars, and only part of the circular catalogue has been covered. There is, consequently, every reason to expect a large and representative membership in the congress, both from this country and abroad.

Communications concerning the congress should be addressed to the general secretary, Dr A. E. Kennelly, Cambridge, Mass.

Failure of Municipal Ownership at Ashtabula, O.

The examination of the accounts of the electric lighting plant owned by the city of Ashtabula by agents of the auditor of the State of Ohio has been finished. It shows that for the past ten years the city lights have cost, on the average, about $100 per year each, and this is for what is known as the moonlight, or short schedule, which gives at least 25 per cent. fewer hours' lighting than in Cleveland, where the contract price per light is $75 per year on an all-night, every-night schedule.

The original cost of the plant was $63,500.64 up to 1893 and from that year until August, 1898, $24,751.15 additional was expended for extensions and betterments. This brought the total construction cost up to $88,251.79. In 1898 a committee was appointed to fix the actual value of the plant, which was placed at $55,666.12, showing a depreciation below actual cost of $32,586.67, or over 7 per cent. per year.

The annual operating expense is $60 per light per year, which sum is paid by general taxation upon the taxable property of the city. No allowance is made for depreciation in this connection because the extensions and betterments made to the plant out of the revenues, without direct taxation on city property, approximate 7 per cent. per annum and practically provide for the depreciation as shown by the appraisement.

The sum of $19,525.36 has already been paid for interest charges on the bonded indebtedness and only $2,500 of this was derived from the revenues of the plant. This leaves $17,025.36 from the general taxation fund, or an annual cost of $40.54 per arc light. The cost of the plant to the city of Ashtabula for the years 1892 to 1898 is made up as follows: For operation, $60 per lamp; for interest on bonds, $40.54; for lost taxes, $9; total $109.54 per lamp per year. This does not include the loss in county and State taxes, approximating $4.05 per annum.

From 1898 to December 31, 1902, the cost was somewhat reduced. The operating expenses were $60 per annum, while interest charges were reduced to $31.45. The charge for lost taxes was $9.10 and, with loss in State and county taxes, $13.75, a total of $105.20.

The cost to the taxpayers for the six years ending 1898 is given as $685.14 per lamp; for the four years ending 1902, $292.28, a total for ten years of $982.42, or an average cost per annum of $98.24 per light, and that on the moonlight schedule.

Self-Starting Single-Phase Motor Patent Decision.

The United States Circuit Court of Appeals, sitting in New York City, has handed down an opinion sustaining a decision rendered by the Circuit Court of the same district, declaring that the Wagner single-phase motor does not infringe, as alleged, a patent granted June 17, 1890, to Elihu Thomson. The lower court held that the Thomson patent, which was claimed to cover broadly the use of "locally closed circuits" in the starting of motors, was a mere paper patent; that it does not appear that any motor had ever been made under the patent, while on the other hand, the defendants have developed the class of motors claimed to infringe the Thomson patent.

In its opinion the Court of Appeals states that it is entirely satisfied that the term "locally closed circuit" as used in the claim of the Thomson patent, means, as one of the experts has expressed it, that all the coils of the armature are closed upon a circuit which is local in that it is independent or disconnected from every other circuit but that established through the armature coil. The Thomson claims emphatically state that in the motor of the patent this condition of a locally-closed circuit in the armature-coils must be found when the motor is running at the predetermined speed. With equal emphasis they state that this "locally-closed circuit" is a *change* from the condition existing while the motor is being started; that is to say, the locally-closed circuit of the running motor is not to be found in the starting motor. In the starting condition and in the running condition alike the armature coils of the Wagner patent are on locally closed circuit, and however slight may be the difference between this motor and the motor of the patent, infringement cannot be predicated of claims phrased as are those in the Thomson patent.

Doctors on Roentgen Ray Effects.

The Society of Medical Jurisprudence, at a meeting held in the Academy of Medicine, New York City, this week, discussed the subject of the application and effect of the X-ray. Dr. Carl Beck read a paper on "The Medico-Legal Aspect of Accidents Caused by the X-Rays." "Undesirable results," he said, "frequently attended the use of the X-ray, even when it was applied by the most careful and expert operators. There was no person who would not be burned by the ray if he were exposed to it long enough. One way to avoid these distressing consequences was to study carefully the condition of the patient, and in this way determine, as nearly as possible, the proper duration of an exposure. Whereas some persons may be subjected without harm to long exposures at frequent intervals, in other cases it is imperative that the exposures should be short and given at long intervals."

Dr. Samuel Lloyd attacked the members of the legal fraternity for their ignorance of things medical. "The questions which are put to us in trials for damages resulting from the use of the X-ray," said he, "it is utterly impossible to answer, for the simple reason that the lawyers are unable themselves to understand the subject under discussion."

Dr. William J. Morton dwelt on the use of the ray in the treatment of cancer. "While it will cure cancers which are not deep set," said he, "as for example, those of the face, it cannot be relied on as of much real value in curing those which are located in less accessible parts of the body, as in the chest or the abdomen." He did not agree with Dr. Beck that everybody is liable to be burned by the treatment. "Why," said he, "I have a patient whom I've been trying to burn for a year, and he simply won't burn."

Electric Towing on the Erie Canal.

THE Erie Canal has been the scene of various attempts to haul barges by electricity, but although other canals in Europe and America have now been equipped with electric tractors of one kind or another, the famous old artificial waterway between Albany and Buffalo is still dependent upon mules and a few steam propellers for its motive power. It has thus been left in such hopeless competition with the railroads that the people of New York State have just voted to spend a sum of over $100,000,000 upon the Erie, Oswego and Champlain Canals in order to render them capable of floating 1,000-ton barges instead of those now employed with a capacity not exceeding 250 tons. The fact that electricity is not less applicable to the larger barges than the small ones gives special interest to the renewed demonstrations during the past fortnight upon the Erie of electrical methods differing in many respects from those already tried there.

The first electrical tests on the Erie Canal date back to 1893, when Mr. F. W. Hawley equipped with two Westinghouse electric motors an old steam propeller so as to drive the screw and took current by trolley from cross span wires on a pole line running along the bank, near Rochester. The test was at once successful, but the plan was open to the objection which applies to the propeller at any decent rate of speed, namely, the undue suction and wash caused, detrimental to the bank. Moreover, the lateral motion created various difficulties with the trolleys, two of which were employed. The next plan tried was that of Mr. Richard Lamb, C.E., who introduced an ingenious cableway supported along the towpath on short, substantial columns, with a telpher motor traveling along two cables, placed one above the other, the upper for bearing and the lower for traction. With this motor went a man to handle the mechanism and controller. This system was shown in operation at Tonawanda, N. Y., as well as on the Raritan Canal; but for various reasons was not developed further. Meantime on the Miami Canal a polyphase system has been introduced with a hauling trolley locomotive on a regular track; while in Europe practical systems are in use, as described already in these pages, employing automobile electric tractors running along the bank without tracks, but taking current from overhead trolley circuits.

The newest system is that of Mr. Stephen W. Wood, shown in operation on the Erie Canal opposite the General Electric factories at Schenectady, by the International Towing and Power Company, of New York. It is a monorail system resembling methods already advocated by Messrs. Sachs in America and Thwaite in England; but having been worked out with considerable novelty, care and attention to engineering details. The experimental track is about 2,700 ft. in length, with a sharp curve, and furnishing a good average section of the 7-ft. prism. Along the bank are erected every 25 ft. short posts set in concrete and supporting, on each side of the post, about 3 ft. apart, continuous plate 18-in. girder, the girder farthest away from the canal being raised above the inner one, as in a tier of seats. The girders are cross braced so as to stiffen the structure; and, indeed, the whole work is of a most substantial character—too heavy, it would even seem, for the work in hand. The edges of each girder are faced with light 3-in. rail for track. Over the two girder tracks extend a series of ordinary trolley brackets carried on poles set at the outer edge of the canal bank and carrying a trolley wire so placed as to be readily accessible to a trolley reaching up from either track. The construction of the track and the pole line, with relation to the canal, can be seen already from Figs. 1 and 2.

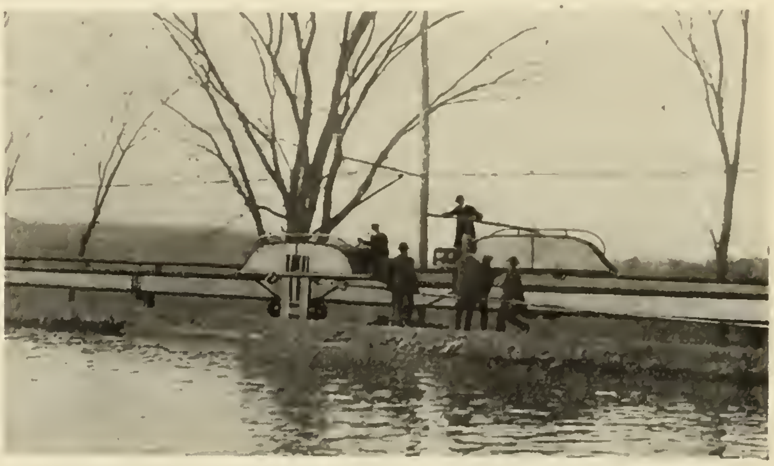


FIG. 2.—TOWING MOTORS PASSING EACH OTHER.

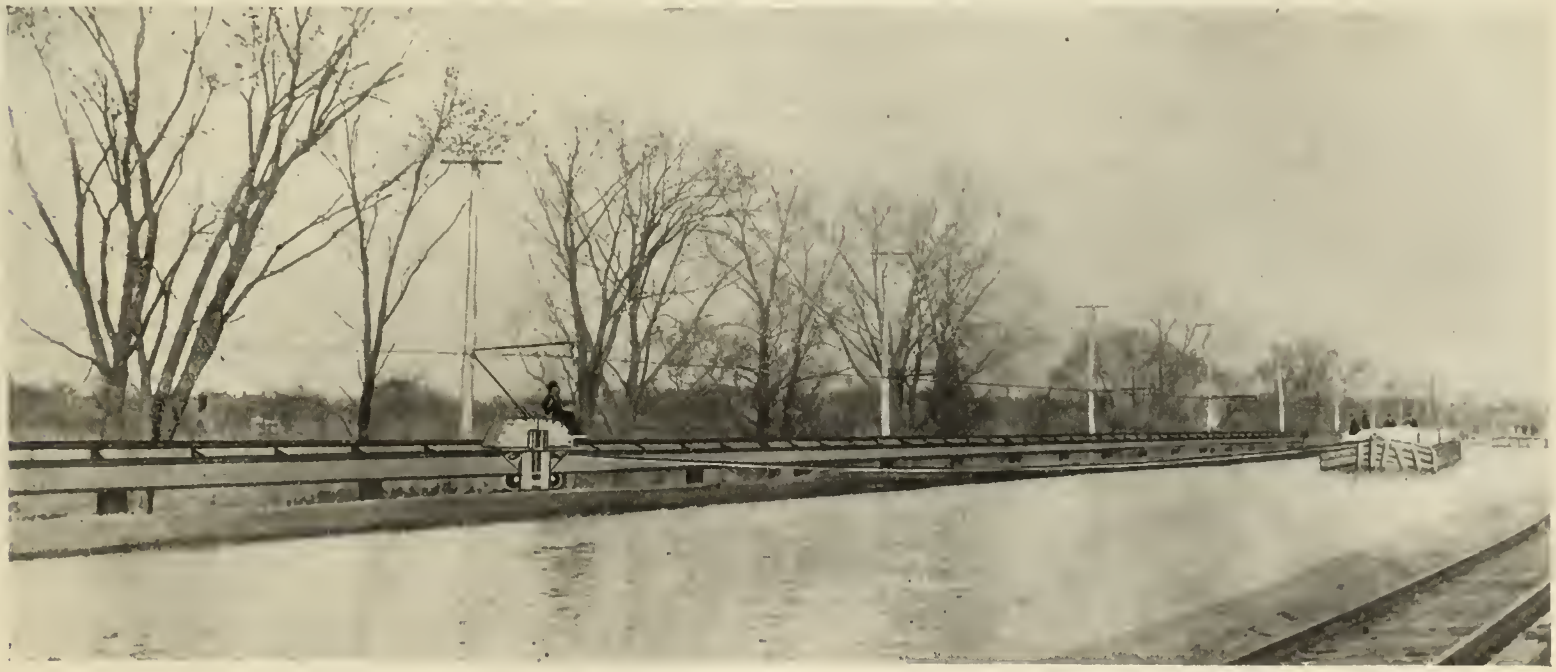


FIG. 1.—MONORAIL ELECTRIC TOWING ON THE ERIE CANAL. A TOW OF FOUR LOADED BARGES.

The "electric mule" is very clearly illustrated, complete and in detail, in Figs. 3 and 4, and will be easily understood, although we are not at liberty to reproduce structural drawings. The mule is a vehicle closely resembling a "hog-back" mine locomotive, and is 10 ft. long by 2 ft. wide, and 3 ft. high from the rail. It is ironclad for better protection from the weather, but, as the photographs indicate, all the mail is quickly removable and all the parts are accessible. At each end is a 40-hp motor of street car, narrow-gauge type; but, owing to the low speed required, geared down by double reduction in the ratio of about 40 to 1. Both sets of gear are shown in one of the views, on the exposed side, the first reduction from the motor armature axle to the first gear being seen in front, while the second reduction set of the rear motor are seen at the rear. Each motor thus drives a grooved wheel about 22 in. diameter, which travels upon the upper rail; and, by reversing, the motor runs promptly backward and forward. At the rear end is a street car, or series-parallel controller, with few steps, and a resistance box serving as a seat for the driver, who would doubtless appreciate its warmth in such weather as accompanied some of the recent tests. The "mule" has two large hooks for the towropes and has also a running board and guard hand rail, seen in Fig. 2, so that the driver can go around the machine without dismounting. Reaching upward from the center of the top shell of the motor is a stout, short mine trolley, which can be pulled down so as to let another "mule" go by on the upper or lower track. The method of doing this simple operation is shown in Fig. 2. Obviously, two wires, one for each track, could be strung if desired.

From the body of the motor mule extends downward a heavy arm, which carries springs pulling upwards two grooved wheels so as to exert a gripping effect on the under rail. This tension spring can be loosened or tightened at will, and the arrangement serves to keep the tractor steady, besides affording additional adhesion, to such an extent that the traction effect due to the weight of the motor —over five tons— is virtually doubled, the "draw-bar pull" reaching, it is said, over 30,000 pounds. The amount of power or current consumed varies, of course, with the speed, the weight hauled, the depth of the prism, the condition of the track and other factors. In this connection it may be stated that a number of readings have been taken under all conditions, from which, later, a variety of interesting conclusions may be deduced. The current is direct, furnished from the General Electric plant to the motors at 475-500 volts. It would be fair to assume that in practice, if necessary, instead of rectifying the current, single-phase or polyphase motors could be used, after stepping down the supply from such points as Niagara, Spier Falls, Mechanicville, etc.

As to the tests themselves, they have been made in the presence of Governor Odell, State Engineer Bond, the Canal Commissioners, the Superintendent of Public Works, and others, and have naturally attracted public attention. As seen by one of the editors of Electrical World and Engineer, they included the hauling of two boats each loaded with over 200 tons, at a speed up to 4¼ miles an hour, as recorded by tachometer in the observation car keeping abreast over the run. These two boats would represent a total weight of probably 600 tons. Other tests included the haulage of four loaded barges at various speeds up to the same figure. In every instance the slight wave motion in the canal, or absence of wash, was most noticeable, the disturbance dying out in a mere ripple as it reached either bank. This would appear due to the steadiness of the breast pull and the abolition of the churning action consequent upon the use of a screw propeller. Some of the tests seen by the writer were conducted in a heavy snowstorm, but little, if any, difference was observed in the results, while part of the monorail track was at times sanded by the driver to improve the tractive effect after some of the squalls. During the tests one or two mule tows passed in the opposite direction, making barely a mile an hour on the wet towpath. The contrast between the two systems was most striking, while it was not to be forgotten that both the old and the new methods were operating at the same time without interference.

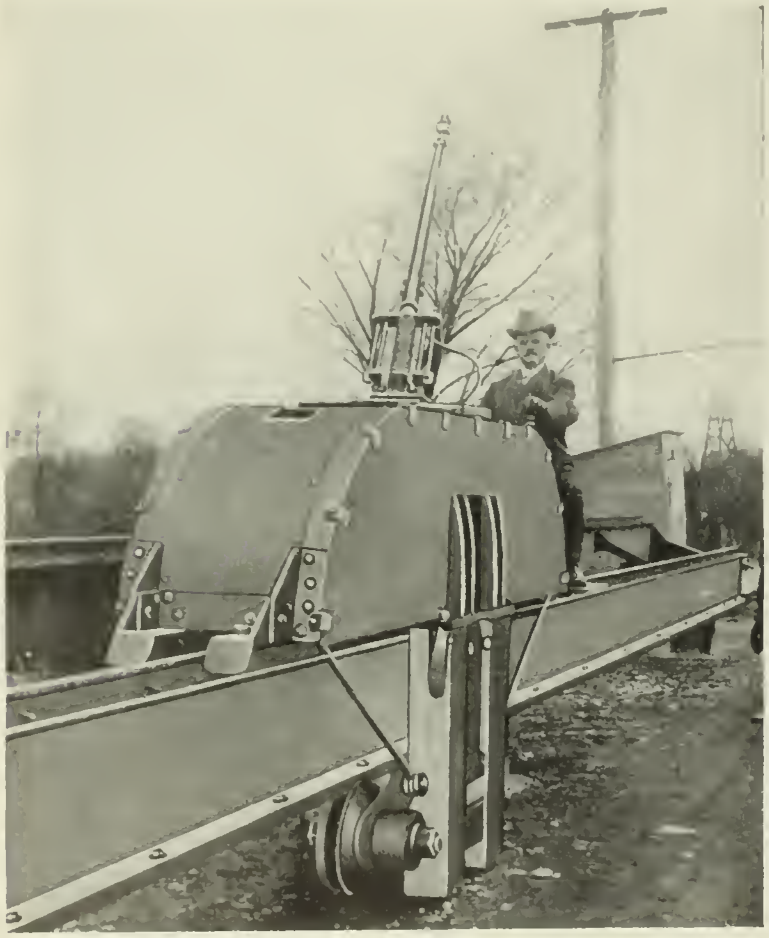


FIG. 3.—TOWING MOTOR SEEN END ON.

Aside from the engineering superiority of an electric motor on a track over a mule on a yielding towpath, the main question is that of economic efficiency. It would be a fair inference that, as on the trolley roads, mechanical power applied electrically has all the advantages. Awaiting further data, it may be well to cite, without approving, the claims of the company undertaking these tests. The cost of equipping the Erie Canal, 352 miles, with the Wood system, is estimated to be:

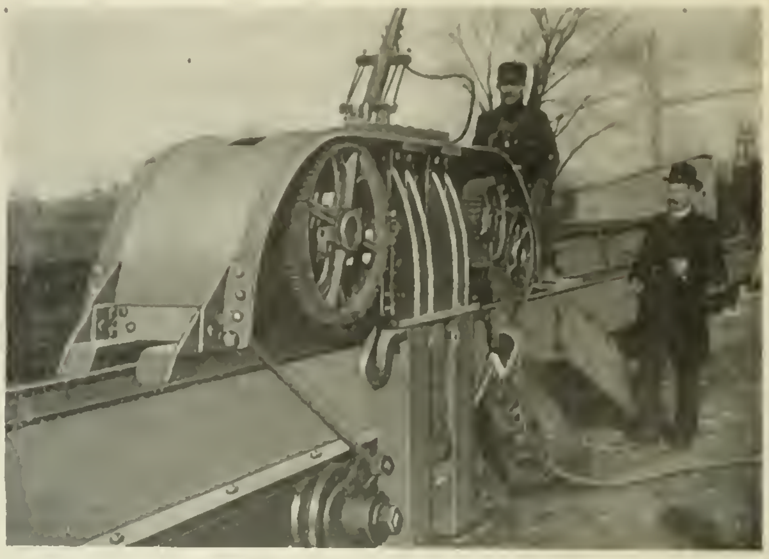


FIG. 4.—TOWING MOTOR WITH PART OF CASING REMOVED.

Structure electrically equipped for 80-hp	$6,290,000
300 motors, 80-hp	750,000
Total	$7,040,000

The gross earnings from the operation of the system, estimated at 50 cents a ton for 10,800,000 tons, would be $5,400,000. The operating expenses would be: Four per cent. on equipment, $281,600; cost of 24,000 hp, seven months' use at $35 per hp per annum, $490,000; wages, motormen for 300 motors (three men each) 8-hour shifts, $378,000; trackmen, $11,340; repairs, salaries, etc., $150,000; total, $1,310,940, making the net earnings $4,089,060.

The General Electric Company is in nowise associated with the enterprise, but has built the motors and furnished current, in the belief that it is proper to encourage such efforts. Mr. Carl W. Larsen, of its mining department, has put a good deal of time on the work, while Messrs. W. B. Potter and A. P. Jenks, of the railway department, have accumulated a large amount of data. The structural steel work of the track was all furnished by the Jones & Laughlin Company, of Pittsburg.

Telegraph Wire Garments.

The native women in the East African Protectorate have conceived a remarkable longing for telegraph wire. They find that nothing so completely adorns their scantily-draped persons as a few yards of telegraph wire wound around their waists and serving as a girdle. The toilet of no fashionable belle is complete without it. They wind it around their bodies and permit it to remain, even during the hours of slumber. No telegraph wire as yet has been imported to meet this fashionable demand. The result is that the stocks of wire imported for the sole purpose of stringing on poles were depleted until the authorities became fully aware that telegraph wire was the rage of the hour. In the interests of telegraphy the white officials now keep their wire under lock and key and hold the tribal chiefs responsible for the integrity of the lines through their territories.

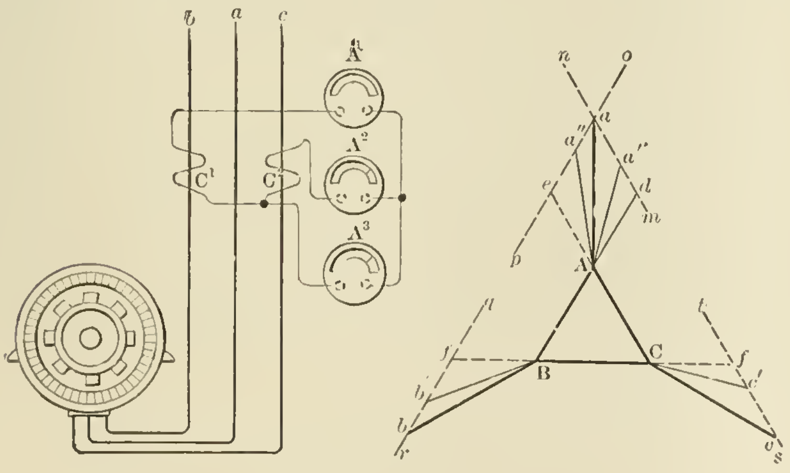
Distribution of Current in Three-Phase Systems.

By F. Hardie Jeannin.

While the following method of connecting up ammeters is not new, yet the analysis no doubt will prove new and interesting to practical electricians and station men in general. To those not acquainted with the theory of alternating current phenomena, it would appear at first sight that three ammeters connected to two current transformers as shown by the diagram of Fig. 1 would not give accurate results. That the ammeter connected in the common return of the transformers does give the current in the lead in which there is no current transformer, is easily understood when we remember that at any instant the sum of the amperes in any two leads is equal to the amperes in the remaining one.

The diagram of Fig. 2 will help make clear the shifting or change of relation that goes on when the distribution of the system is in any way disturbed. *ABC* is the delta of potentials for the three phases, and *Aa, Bb* and *Cc* are the currents in the leads at *A, B* and *C*, respectively, for balanced conditions. The point *a* can move along *mn* or *op*, in which case a corresponding change will occur in the location of point *c* or *b*, respectively. For the sake of simplicity, in the first case, *a* moving along *mn*, *Ad* is supposed to remain constant; and in the second case, *a* moving along *op*, *Ae* is supposed to remain constant. Suppose *a* is moved to *a'*. What is the result in regard to *b* and *c?* Since the current in phase with *AB* and *BC* is not altered by the terms of the supposition, it remains that the current in phase with *AC* only has varied. Therefore, the component *ad* of *Aa* is reduced from *ad* to *a'd*. And consequently *fc'* must be equal to *a'd*. Therefore, swinging *Aa* to *Aa'* causes *Cc* to swing to *Cc'*; no change occurring in the position of *Bb*, which means that the current in the lead at *B*, represented by *Bb*, has not undergone any change, either as to its phase relation with the potentials or its magnitude.

Again, suppose the point *a* moves along *op* to *a"*. Then *ae* becomes *a"e*, and consequently *bf* becomes *b'f*, *a"e* and *b'f* are, of course, equal. Also the point *c* remains unaltered. The lines *mn*, *op*, etc., are drawn here for balanced conditions merely as a nice starting place for the discussion. Therefore, for either balanced or unbalanced conditions, when any one of the three points *a*, *b* or *c* is moved along one of the lines, as *a* along *mn*, a corresponding change will occur in one of the remaining points, and no change in the third point. That is to say, when the change in the current distribution of a system falls within the terms of the above supposition, only two ammeter readings will be affected. If, however, a change should occur that would cause any point, as *a*, to leave the lines, as *mn* or *op*, a change will occur in all the points, which means that all the ammeter readings will vary, instead of only two.

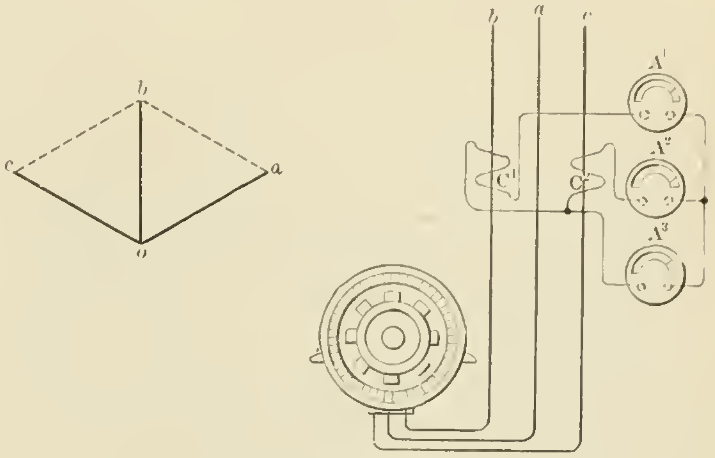


FIGS. 1 AND 2.

That the amperes recorded by ammeter A^3 is the resultant of the current in transformers C^1 and C^2, is also shown by the diagram of Fig. 3, where *ob* is the resultant. The diagrams of Figs. 2 and 3 will always give the same results. The diagram of Fig. 3 is for balanced conditions, and shows that *Aa* of Fig. 2 is the resultant of *Bb* and *Cc*.

If the connections were made as shown by the diagram of Fig. 4, the reading of ammeter A^3 would be as shown by *ob* of Fig. 5 for balanced conditions, which is clearly wrong; the readings should all be equal as in Fig. 3.

By conceiving *ABC*, Fig. 2, to become infinitely small, the points *A*, *B* and *C* will come together and form a single point, as *o* in Fig. 6. This brings us to the diagram of Fig. 6, in connection with which some interesting things will be noticed. Draw *AA*, *BB* and *CC* parallel to the potential vectors, and draw *oa*, *ob* and *oc* to some convenient scale to represent the currents in the three leads as given by the ammeters, the load being balanced.



FIGS. 3 AND 4.

Now, it is easily proved that for any given output, the sum of the three different sides forming the parallelograms is constant; for instance, the sum of ad_1, d_1o and oe_1 is constant for any condition of current distribution so long as the output remains the same. This statement can be put in a condensed form as follows:

$$(a+b+c)=k. \qquad (1)$$

where *a*, *b* and *c* are the three different sides, and *k* is their sum, which is constant for any given output. Since two of these sides are the components of the current as obtained from one of the ammeter readings, it follows that with one ammeter reading and angle ϕ or ω the other two readings can be obtained, and also their phase relation.

The first thing to do is to find the value of *k* in formula (1). To do this, note the output in watts from the indicating wattmeters. Then, proceeding as if the load were balanced,

$$I=\frac{W}{\sqrt{3}E}. \qquad (2)$$

also,

$$ad_1=\frac{I}{\sqrt{3}}, \text{ and, } I=ad_1\times\sqrt{3}. \qquad (3)$$

then from (2) and (3),

$$ad_1\times\sqrt{3}=\frac{W}{\sqrt{3}E}, \text{ and, } ad_1=\frac{W}{3E} \qquad (4)$$

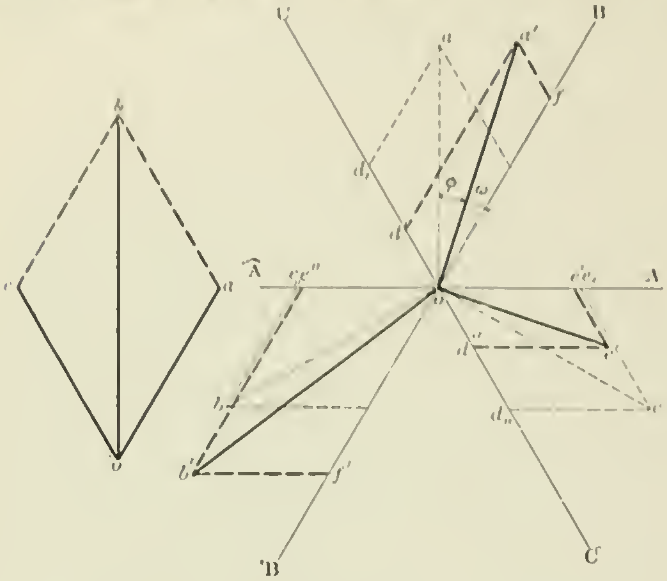
Since $ad_1=d_1o=oe_1$, $(ad_1+d_1o+oe_1)=3\times ad_1$, by multiplying (4) by 3 we get, $3\times ad_1=\frac{W}{E}$. Since ad_1, d_1o and oe_1 are the three sides, they can be represented by the letters *a*, *b* and *c* of formula (1); then $k=\frac{W}{E}$. Consequently,

$$(a+b+c)=\frac{W}{E}. \qquad (5)$$

Let *a* and *b* be the two components of one of the ammeter readings as before mentioned. Then from formula (5) the remaining side, or *c*, can be obtained; that is,

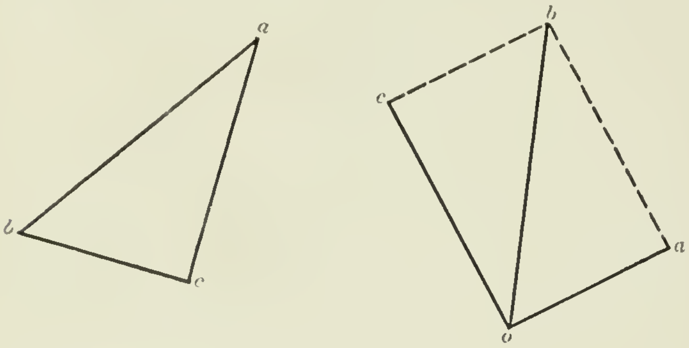
$$c = \frac{W}{E} - (a + b). \qquad (6)$$

We can now proceed with the diagram of Fig. 6. From formula (2) we obtain the value of *oa*, *ob* and *oc*; then with *oa'* as the known ammeter reading, at angle ϕ to *oa*, lay off *oa'*. Next draw *a'f* parallel to *CC*, and *a'd'* parallel to *BB*. Let *a'd'* = *a*, and *d'o* = *b*, then *oe'* will equal *c*; then from formula (6) find the value of *c*, and lay it off on *AA* both sides of *o*, that is, *oe'* and *oe''*. Also on *CC* lay off *od''* = *od'*, and on *BB* lay off *of'* = *of*. Complete the parallelograms with these lines as sides, and draw *ob'* and *oc'*, which will be the current in the other two leads.



FIGS. 5 AND 6.

If the results of Fig. 6 are correct, the vectors *oa'*, *ob'* and *oc'* should form a closed triangle; which is done in Fig. 7, showing the method to be correct. Also in the diagram of Fig. 8 the current represented by vectors *ob'* is shown to be the resultant of the currents represented by vectors *oa'* and *oc'*. The angle ω can easily be obtained if the wattmeter is connected in the lead corresponding to *oa'*, its potential coil being connected to the phase whose e.m.f. is parallel to *BB*. Let W^1 be the wattmeter reading, I^1 the current in that lead, and E^1 the potential.



FIGS. 7 AND 8.

Then $W^1 = I^1 \times \cos\omega \times E^1$, whence

$$\cos\omega = \frac{W^1}{I^1 E^1}. \qquad (7)$$

From a table of cosines the angle can be obtained. The ammeter whose reading is to be used must be in the same lead as the wattmeter from which the angle is determined. The two wattmeter readings are W^1 and W^2, and hence, W of formula (5) is equal to $W^1 + W^2$. Therefore, as far as the analysis is concerned, one ammeter is sufficient when there are two indicating wattmeters in circuit.

Reprieved by Telephone.

Governor Yates, of Illinois, recently granted long-distance clemency to a murderer, to avoid the possibility of a fatal delay in the mails. The sheriff was thus informed of a stay of execution over the telephone, but to make assurance doubly sure, a telegram was sent at the same time.

Calculation of the Apparent Inductance of Armature Coils.—I.

By C. C. HAWKINS.

1. *The two inductance quantities involved in commutation.*

In order to forecast the behavior of a dynamo from the point of view of sparkless running under varying loads, it is imperative that the designer should, among other calculations, make an estimate of the value of two highly complex quantities,* and such estimates, even if only approximate at the best, must be made with all the accuracy that he can command. The first of these quantities is the apparent self and mutual inductance ($L + \Sigma M$) of a section of the armature winding, on the assumption that all sections which are simultaneously short-circuited at a pair of adjacent brushes of opposite sign assist one another in retarding commutation, and though not necessarily at the same stage of commutation yet have a rate of current change equal and of the same sign. For this to be the case, the short-circuit current when plotted in relation to the time of commutation, T, must evidently give an inclined straight line passing across the horizontal axis of time from the full normal value $+ I$ on the one side to $- I$ on the other side of the diagram; the rate of change is then throughout constant and corresponds to a uniform current density over the contact surface of the brushes. The required inductance is an "apparent" one, since the flux which passes through the pole faces and thence onwards through the iron of the yoke has its variations damped out by the closed circuit of the exciting coils which surround the main magnetic circuit, so that its effect in the present connection is to all intents eliminated.† The second quantity is the apparent self-inductance of a section (L_s). due to the divergence of the actual short-circuit current from the inclined straight line, and on the assumption that the other sections which are simultaneously short-circuited but are not at the same stage of commutation are carrying the straight-line current, and thus so far as the excess or deficiency of current in the first section is concerned have only a damping action upon it; the second quantity has, therefore, especial reference to the last moment when the short-circuit is opened, and is "apparent" in a double sense, since it takes into account not only the damping action of the exciting coils, but also that of the other sections simultaneously short-circuited.

Both quantities in reality alter for different positions of the section under consideration within the slots of a toothed armature and for different positions within the interpolar gap; but in every case in order that any error may be on the safe side, the maximum value should, as far as possible, be taken, since upon this will depend in the main the tendency to sparking. During the process of design, the inductance can necessarily only be calculated, yet if the calculations are carried out by definite rules they yield comparative results of great value. A résumé of the general principles of the calculation may, therefore, be of service to the designer, and in the present paper will be supplemented by a consideration of the effect of different windings (especially in reference to the permeance of the surface of the armature core between the pole tips) in greater detail than the subject usually receives. Much might be done by experiment in the laboratory of the college or university to bring such results into closer relation to actual facts, yet in default of tests to check the somewhat arbitrary assumptions the designer must remain content with approximate *comparative* results, and must wait for future experiment to add the necessary qualifying or corroborative factors.

2. *The three components of armature inductance.*

The inductance of a section is divisible into the three parts corresponding respectively to the slot, to the surface of the core between the pole tips (all variations of the flux under the pole faces being *ex hypothesi* neutralized by the exciting coils), and to the end connections. The first item may be divided into the portion (*a*) due to the flux within the slot proper, and (*a'*) that due to the flux across the opening of the slot which may have overhanging edges; the former depends on the number of layers, etc., but for a given disposition of the winding is proportional to the ratio of the depth of the slot to its width, or to $\frac{t}{w_s}$; the latter is proportional to the ratio of the height of the opening to its mean width, or to $\frac{t_3}{w_3}$ (Fig. 1).

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* See Arnold, Die Gleichstrommaschine, Vol. i, Chap. xvi.

† See H. N. Allen, "Sparkless Reversal in Dynamos," Journal Inst. Elect. Eng., Vol. xxvii, p. 209.

The second item is divisible into the portions corresponding to the joint flux linked with all the simultaneously short-circuited sections (b), and to the local fluxes immediately linked with the section under consideration (b') or with two or more $(b'' + b''' + \dots)$. All the foregoing are proportional to the length of the core (l), and may be expressed through a term giving the virtual permeance of the core per centimetre of its length. The third item, on the other hand, has to do with the end connections and their length (l'). The expression for the apparent self and mutual inductance of one section in a lap-wound armature will, therefore, take such a form as the following:

$$L + \Sigma . M = \left(\frac{\tau}{N_2}\right)^2 \left[l . \left(a . \frac{t}{w_s} + a' . \frac{t_3}{w_3} + b + b' + b'' + b''' + \right.\right.$$
$$\left.\left. \dots \right) + l'c \right] \times 10^{-9} \text{ henrys,}$$

where τ is the number of active inductors counted all round the armature, and N_2 is the number of commutator sectors.

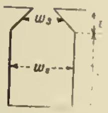


FIG. I.

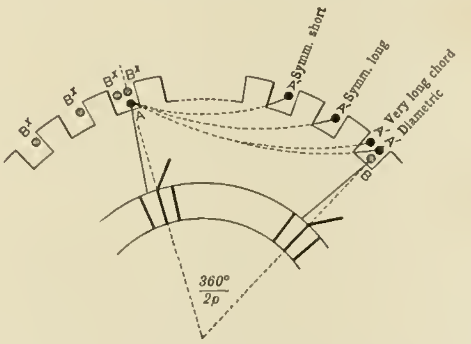


FIG. 2.—SUBDIVISION I. A.

Considering a lap-wound drum armature in which the number of wires in a spool side is $w = \frac{\tau}{2N_2}$, let it be assumed that the winding is disposed in two layers, and that no spool side is divided between two or more slots, any such division being an exception to the general rule of modern machines.

3. *Classification of windings and definition of terms.*

For the purpose of studying the effect of different arrangements of the winding, the cases which are of frequent occurrence in practice may be conveniently grouped into certain classes. The primary division must be into (I) those in which the number of commutator sectors per pole, or $\frac{N_2}{2p}$ is *whole*, and (II) those in which $\frac{N_2}{2p}$ is a *fractional* number. The difference between the two is that in the former class if the position of the short-circuited spool sides in a pair of consecutive interpolar zones has been set out, the remaining interpolar zones in the multipolar machine are merely repetitions of the first pair. In the latter class each pair of interpolar zones is not necessarily similar to every other. With toothed armatures which are more especially to be considered, the former class must again be subdivided into (IA) those in which the *number of slots* is *divisible by the number of poles*, whence every interpolar zone is precisely similar to every other, and (IB) those in which consecutive zones are dissimilar, owing to the *number of slots not being divisible by the number of poles*. Lastly, account has to be taken of the span between the two sides of a spool relatively to the pole pitch. Thus for the purpose of defining the various principal cases, let a narrow width of brush be taken, only just exceeding the thickness of a mica insulating strip, and let spool $A A'$ be at the moment undergoing short-circuit at one brush, say of positive sign; then in class (I) a second spool, $B B'$ is also undergoing short-circuit at the neighboring negative brush, and in each pair of interpolar zones there are four spool sides short-circuited. In subdivision (IA) when the one side, A, of a spool short-circuited at the positive brush is on the interpolar line of symmetry, the corresponding side, B, of a spool short-circuited at a neighboring negative brush will also fall on an interpolar line of symmetry. If now the second side, A', of the first spool falls immediately above or below B, A will also be correspondingly situated below or above the second side B^x, of some spool which is also short-circuited, and the winding by analogy from the two-pole case may be termed *diametric*. In the absence of this condition the armature is more or less chord-wound, and by reference to the span in teeth of the rear end connection (not to the pitch in spool sides), the different degrees of chord winding in common use may be arbitrarily defined and named as follows:

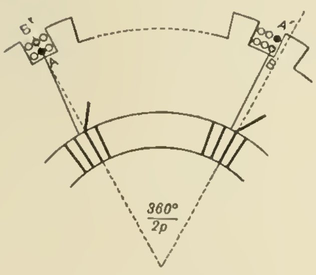


FIG. 3.—DIAMETRIC I. A.

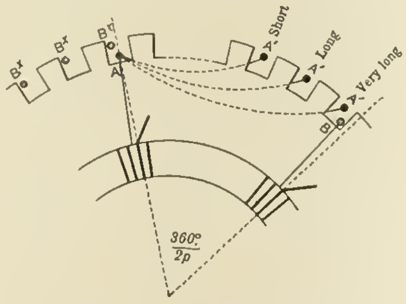


FIG. 4.—VERY LONG, SYMMETRICAL LONG AND SYMMETRICAL SHORT I. B.

Very long chord, when the degree is so small that spool side, A', falls within the same slot as B, although not immediately above or below it.

Long chord, when spool side A' falls within the slot adjacent to that of B, so that A' and B (or A and B^x) are separated by one tooth.

Short chord, when spool side A' falls within the slot next but one to that of B, so that A' and B (or A and B^x) are separated by two teeth and one slot. All these cases may be identified from Fig. 2.

With class (IB) if the two sides of a single element do not occupy similar positions within their respective slots, it is still possible for the winding to be *diametric,* so far that is to say that A' and B (or A and B^x) fall one above the other in the same slot (Fig. 3); yet if the number of sectors simultaneously short-circuited at each brush is increased beyond one with four spool sides per slot or beyond two with six spool sides per slot, a divergence arises from the inductance of the true diametric winding of (IA). With completely interchangeable coils the following cases may be distinguished:

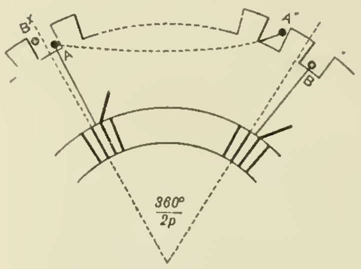


FIG. 5.—ASYMMETRICAL LONG I. B.

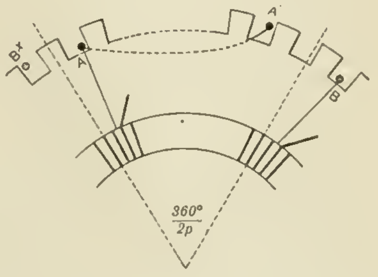


FIG. 6.—ASYMMETRICAL SHORT I. B.

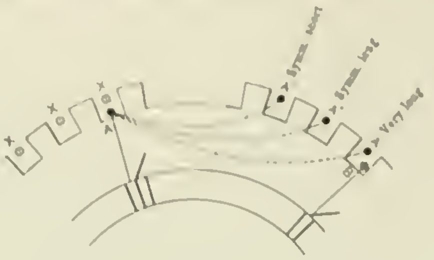
Very long chord, when it is still possible for the two spool sides short-circuited in each zone to fall within the same slot; thence if the span be shortened by one tooth there results *symmetrical long chord,* or if shortened by two teeth, *symmetrical short chord* under the present class (Fig. 4). Or the two consecutive zones may be entirely dissimilar, and we have *asymmetrical long chord* when in one zone A and B^x fall within the same slot, while in the other zone A' and B are separated by one tooth, and *asymmetrical short chord* when in one zone, A and B^x, are separated by one tooth, and in the other zone A' and B are separated by two teeth and one slot. Thus the asymmetrical cases fall respectively midway between the very long and symmetrical long chord of class IB, and between the symmetrical long and symmetrical short chord of the same class (Figs. 5 and 6).

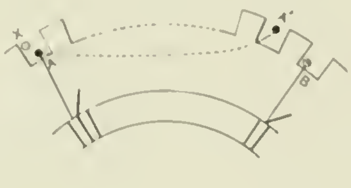
In class II with $\frac{N_2}{2p}$ fractional, the pair of consecutive zones giving the maximum inductance must be chosen if the armature be multipolar, since the remaining zones or some of them are dissimilar. For the purpose of defining the various cases, if the same narrow width of brush, barely exceeding the thickness of a mica strip, be taken, let spool $A A'$ be short-circuited at one brush; let the other spool sides in the same interpolar gaps which are connected to the sectors on which the brushes rest be lettered B and X, the former being near to A' and the latter to A. The immediate difference from class IB is that with our narrow brushes, B and X

are now not short-circuited and are, therefore, shown by dots and crosses as carrying oppositely directed currents (Figs. 7, 8 and 9). By the positions of *B* and *X* relatively to *A'* and *A* we have the analogous cases to those of class *IB*, viz:

Very long chord, when *A'* and *B* can fall in the same slot, and also *X* and *A*;

Asymmetrical long chord, when the one pair falls within the same slot, but the other pair is separated by one tooth;





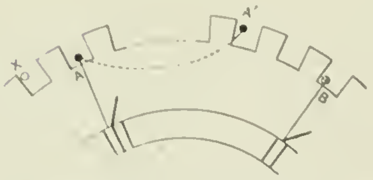


FIG. 7.—VERY LONG, SYMMETRICAL LONG AND SYMMETRICAL SHORT II.
FIG. 8.—ASYMMETRICAL LONG II.
FIG. 9.—ASYMMETRICAL SHORT II.

Symmetrical long chord, when in each case a tooth intervenes;

Asymmetrical short chord, when the one pair is separated by a tooth, and the other pair by two teeth and a slot;

Symmetrical short chord, when in each case a pair of teeth and a slot intervene.

As long as the spool sides are situated within the slots and in the layers, as shown in Figs. 4-9. their exact position therein is immaterial for our present purpose.

I. CALCULATION OF $L + \Sigma M$.

4. *Diagram of short-circuited wires for ordinary brush widths.*

After thus defining the various windings by means of the assumption of a very narrow brush width, the practical cases of greater brush widths by which more than one section is short-circuited at a time must be plotted and the diagram of the short-circuited wires in a pair of interpolar zones be built up. A specimen of the process is given in Fig. 10, where the case of six spool sides per slot is worked out for brushes of such width as to short-circuit three, four or five sections at a time. In all cases the section chosen for immediate consideration as giving the maximum *total* inductance is marked black, the remaining spool sides, which are simultaneously short circuited, being shaded. If one situation or section gives a higher slot inductance but a lower value for the surface-of the core inductance, it is obvious that the required situation cannot be accurately determined without a knowledge of the relative values of the slot and surface permeances as dependent upon the depth of slot and length of core; yet the uncertainty thereby introduced hardly needs to be taken into account in calculations of a confessedly approximate nature. A few remarks on the several classes as illustrated by Fig. 10 may in passing be made.

Class *IA*, $\frac{N_2}{2p}$ a whole number, and the number of slots also divisible by $2p$. With diametric, long or short-chord winding of this class, as in the ordinary lap-wound drum, so long as the maximum number s of sections simultaneously short-circuited by a brush is $< \frac{kn}{2}$, the number of sectors corresponding to a slot (kn being the number of spool sides per slot), the inductance, self and mutual, is simply s times the value which it has when only one section is short-circuited at each brush. But as soon as the short-circuited spool sides in each zone spread beyond the limits of a single slot, the inductance is no longer proportional to s, the slot portion remaining constant and the surface portion rising less than in proportion.

With diametric winding, the rear pitch reckoned in spool sides is $y_r = \frac{kn \times slots}{2p} + 1$; but with very long chord winding under this class when the number of sections is a multiple of the number of slots, i. e., with more than two spool sides per slot, there are evidently different degrees possible, according to the amount by which kn exceeds 2. Thus if $kn = 4$, there is only one case, when one side of an element occupies the right lower half and the other side the left upper half of a slot. Such a case has the advantage that the angle of advance of the center line of two adjoining spools exactly corresponds to that of the commutator sectors to which they are

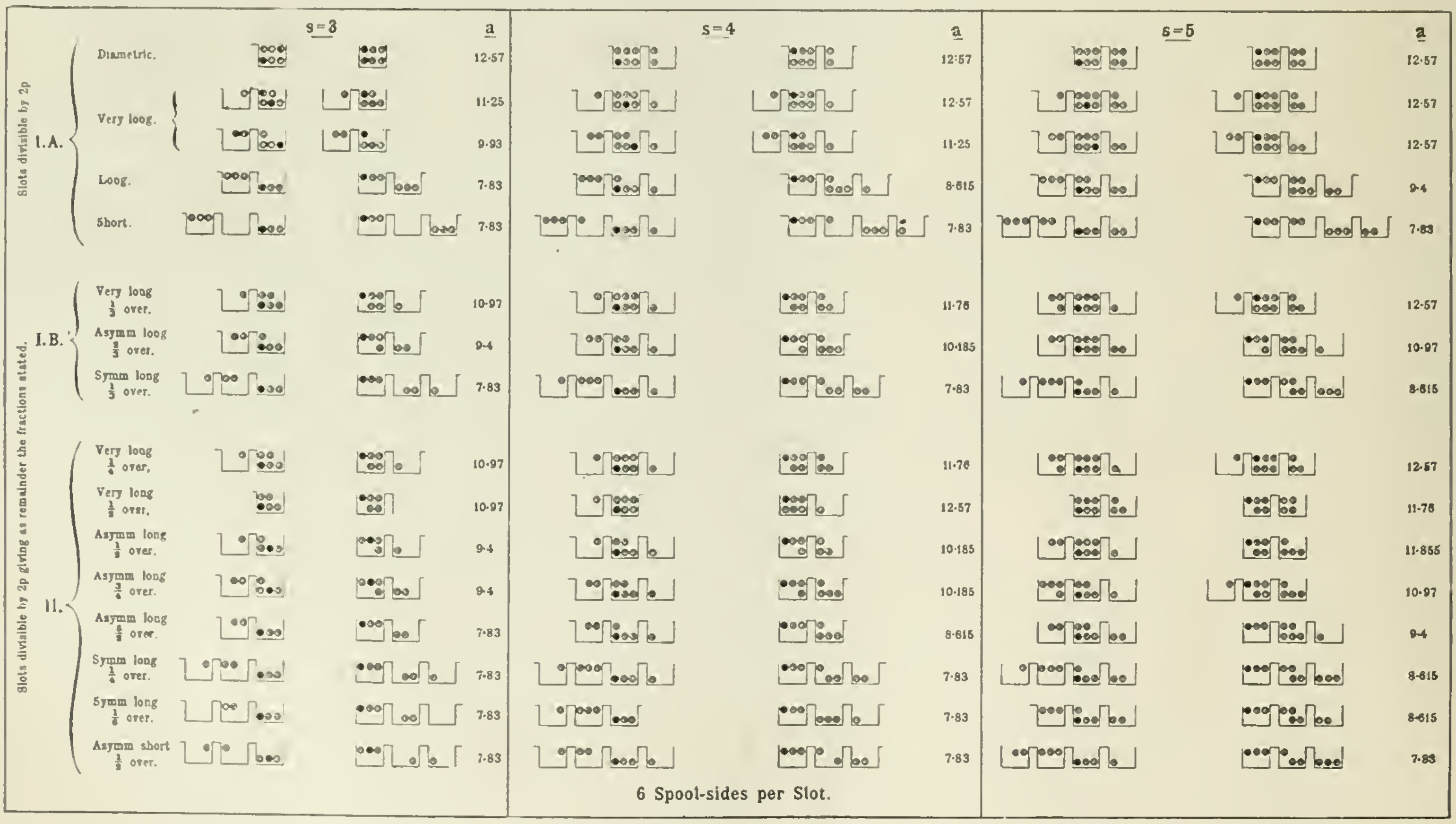

s=3
a
s=4
a
s=5
a
Slots divisible by 2p
I.A.
Diametric. 12·57 12·57 12·57
Very long. 11·25 12·57 12·57
9·93 11·25 12·57
Long. 7·83 8·615 9·4
Short. 7·83 7·83 7·83
Slots divisible by 2p giving as remainder the fractions stated.
I.B.
Very long 1/3 over. 10·97 11·76 12·57
Asymm long 2/3 over. 9·4 10·185 10·97
Symm long 1/3 over. 7·83 7·83 8·615
II.
Very long 1/4 over, 10·97 11·76 12·57
Very long 1/2 over. 10·97 12·57 11·76
Asymm long 1/2 over. 9·4 10·185 11·855
Asymm long 3/4 over. 9·4 10·185 10·97
Asymm long 5/6 over. 7·83 8·615 9·4
Symm long 1/4 over. 7·83 7·83 8·615
Symm long 1/6 over. 7·83 7·83 8·615
Asymm short 1/2 over. 7·83 7·83 7·83
6 Spool-sides per Slot.

FIG. 10.—SIX SPOOL SIDES PER SLOT $s = 3$, 4 OR 5.

connected; hence their reversing e.m.f. is precisely similar, and the method is on this account favorably noticed by Prof. Arnold.[‡] But although easily applied to bar armatures, it is, in the case of coils, accompanied by the disadvantage that two widths of coil are required, so that their resistance and inductance becomes dissimilar. The more usual arrangement with similar coils gives the same resistance to them, but different reversing e.m.f's and inductances, according to their positions in the slot. If $kn = 6$, there are two degrees when the rear pitch measured in spool sides is respectively

$$\frac{kn \times slots}{2p} - 1 \text{ (as in the preceding case) and } \frac{kn \times slots}{2p} - 3\text{; if}$$

$kn = 8$, there are three degrees, and so on.

Thus very long chord winding under class (*IA*) is closely analogous to diametric winding under class (*IB*); and the same divergences arise from true diametric winding when the number of simultaneously short-circuited sections is increased. For any given value of the brush width, the degrees of very long chord winding form a complete series of intermediate cases by which we pass in steps from diametric to long chord, and in precisely the same way the passage might be made from long to short chord, although this is not shown in the diagrams.

* * *

The Relative Reliability of Wireless and Wire Telegraph Systems.

By Reginald A. Fessenden.

Wireless telegraphy has now been in operation for some time and the question of reliability under certain conditions is one which might now be said to be definitely settled. The following results of tests during the years of 1900, 1901, 1902 and 1903 may be of interest:

In 1900 and 1901 a wireless system was in operation between Cape Hatteras and Manteo, Roanoke Island. The masts were 150 ft. high. This system was paralleled by an ordinary wire line and a telephone line.

Both telegraph and telephone lines were interrupted a great many times by storms. It is evident, however, that both lines must be put out of action at the same time to prevent communication, as when only one line is down messages can be transmitted partly by telegraph and the rest by telephone, or visa versa. In spite of this fact, there were twenty-seven days during which no messages could be transmitted by the wire telegraph or telephone lines.

During all this time there was not a single day during which messages could not have been sent by the wireless system had there been a permanent force of operators. In the early working of the system no trouble was experienced from atmospheric disturbances, they not being severe enough to prevent working. In the spring of the following year a series of very violent disturbances were experienced during certain portions of the day, which burned out the receivers then used, but as soon as a sharply selective system was applied this difficulty was overcome and the form of receivers then used has since been superseded by one much more sensitive and not subject to burn out. In passing it may be mentioned that the liability to destruction of the receiver is really a matter of no importance, because unless a system is sufficiently selective to cut out atmospheric disturbances it is only capable of limited use.

During the following year stations were established at Cape Charles City, Fortress Monroe and Ocean View. The masts were 50 ft. high and the distances 25 and 28 miles respectively. During the year no interruptions were experienced with the wireless lines, while on the other hand on three occasions the wire lines and telephone lines were put out of business.

In this connection it should be mentioned that on several occasions the fuses were burned out of the telephone cables, thus showing that even underground lines are subject to interruptions from atmospheric disturbances. In this connection also attention might be called to General Greely's article in a recent magazine in which he pointed out that at the most critical moment during the campaign at Santiago the wire lines were put out of action for a considerable time by atmospheric disturbances, and that no news was received until after the naval battle in which Cervera's fleet was destroyed.

As a sample of the condition of affairs during these storms, the following report will be of interest:

Fort Monroe, Va., May 25, 1903.

"In reply to your request for a statement of telegraph and telephone conditions at this place to-day, will say the following:

"After a severe rain, wind and lightning storm at 10 P. M. last night, the Postal Telegraph-Cable Company have no wires, turning over to the Western Union all their rush business and holding less important business pending the repairing of their lines.

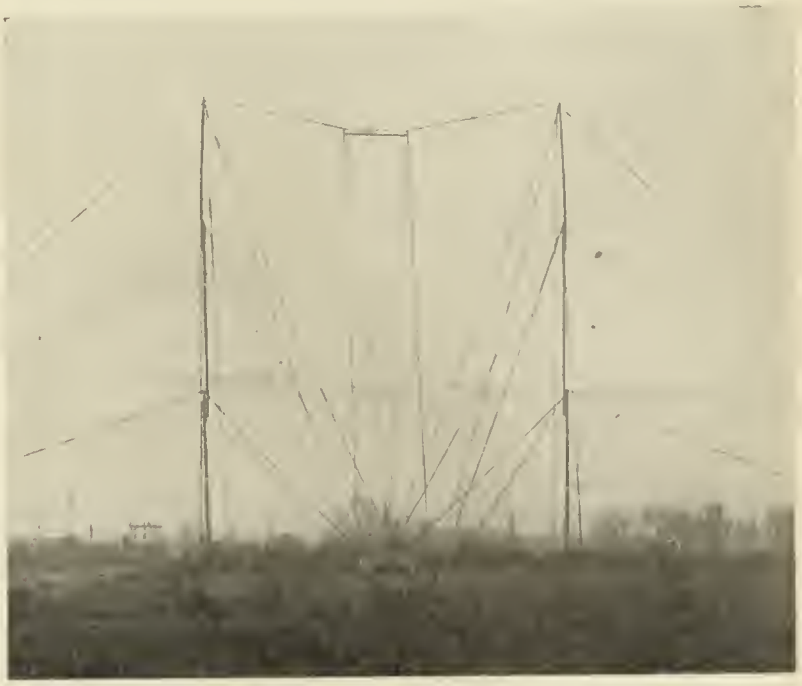
"The Southern Bell Telephone Company's exchange is completely isloated, having lost three land wires to Newport News, three cable circuits to Norfolk and six local circuits. With one exception, the last are all less than 400 ft. in length.

"The Southern States Telephone Company have also lost three or four cable circuits to Norfolk.

"I was at your station at 11 o'clock this morning and found your operator working with your Ocean View station with good results, none of your equipment or apparatus having sustained the slightest injury.

"The storm last night was of unusual severity, the wind being very high and accompanied by hard rain. The lightning flashes were very frequent and vivid."

During 1903 stations were erected between New York and Philadelphia, a distance of approximately 80 miles overland, the length of the verticals being 135 ft. Although these stations were working with only one-quarter of a horse-power of energy, the service has been quite satisfactory, 40 telegrams being sent and received daily during the hours devoted to practice. This is accomplished in spite of the fact that there are one hundred and thirty-five interfering stations both in New York and Philadelphia. Some very interesting results have been obtained as regards selectivity by the new methods used, and it has been found possible to turn on any station that is desired. Amongst other interesting points it was found possible to receive messages from the naval vessels at Oyster Bay, although on comparison with the messages sent by Brooklyn Navy Yard it was evident that the latter station did not succeed in obtaining communication with the ships. When it is considered that the messages received at Jersey City from Oyster Bay must have passed over the city of New York, with its numerous high buildings, the result must be considered very encouraging.



VIEW OF WIRELESS TELEGRAPH STATION.

Another interesting point is the fact that the news from the yacht races was received at the Philadelphia station, and that it was found that that station could select whatever sending station was desired to the absolute exclusion of all others. The Marconi messages, however, could not be deciphered as almost all of them were in cipher. A great deal of objectionable matter was received, some of such a character that the operators declined to take it down.

The most interesting point, however, in this connection is that, although several storms have visited the neighborhood, some of them with severe atmospheric effects, in no case has it been found necessary to stop work, except during a severe rainstorm, when the noise of the rain on the roof of the shed made it difficult to hear. In a suitable building this would not, of course, occur.

[‡] Die Gleichstrommaschine, vol. i, p. 128.

During the great storm of last month the writer was in Washington and desired to communicate with the Jersey City station. It was learned that the lines were working as far as Philadelphia, but that messages were delayed beyond there. The Philadelphia station was, therefore, telegraphed to and a report as to the condition of the Jersey City station was promptly sent back to us within a couple of hours.

These results, extending over a considerable number of years, seem to show that so far as reliability goes wireless telegraphy is superior to the ordinary wire lines. The fact may be definitely stated that aside from any future developments there is, at the present time, no condition of weather under which messages cannot be transmitted. Even thunderstorms of the greatest intensity, i. e., so strong that sparks can be drawn from the vertical do not prevent the transmission of messages, although occasionally a word will be lost.

The stations between New York and Philadelphia were constructed to test the effects of summer droughts and winter weather. It was anticipated that some difficulty might be met with during long droughts in the summer and zero weather in winter. The result of the tests, however, shows that with a properly-constructed wave chute no difficulty is obtained in transmitting messages during the dry spells. As the navy, from the result of its tests last winter between Washington and Annapolis found that the transmission was easier in winter than in summer, it is possible that the absence of sap from the trees may more than compensate for the freezing of the surface water, and that the cold will not prove a serious obstacle. In any case by next spring the data derived from the operation of these experimental stations will enable us to accurately design for any desired transmission.

During these experiments a curious and unexpected advantage of telephone receiving over instrumental receiving developed. While nearby stations, such as that at Coney Island, were easily cut out so as to be almost or quite inaudible at the New York station, attempts were made several times by parties in the near neighborhood to interfere with the work. Here the curious phenomena developed that if the interfering impulses were *strengthened* and the Philadelphia signals *weakened* the reading of the messages was quite easy. This phenomenon is possibly akin to that of the old lady who could only hear when a drum was beating, or, more probably, shows that if the *difference* in intensity is sufficiently great, within limits, both sounds are readily separated.

Since the above was written, the records of all messages sent between the New York and Philadelphia stations during the past two months have been carefully examined with a view to ascertaining what percentage of messages had to be repeated.

The records show a steady and uniform improvement. Previous to the time mentioned fully half the messages had to be repeated, but at the beginning of the two months the percentage of repeated messages had decreased to 5 per cent., partly on account of the signals being stronger, and tuning better, while during last month the average was not more than 2 per cent., and in many cases several hundred messages were sent without a single repeat.

As one of the operators points out, in making his report, this is really better than the average work on wire lines, especially since the average rate of transmission was between twenty-five and thirty-five words per minute, which is a high speed, even for wire lines. transmitted, many being in cable code or foreign languages, it was possible to send very little Phillips code, so that the speed represents practically nothing but regular Morse. Of course, in talking between stations outside of the hours devoted to practice, the operators use the regular operators' code and higher speeds are reached.

An Improved Method of Testing Large Alternators Under Full Load Conditions II. (*Concluded.*)

By B. A. Behrend.

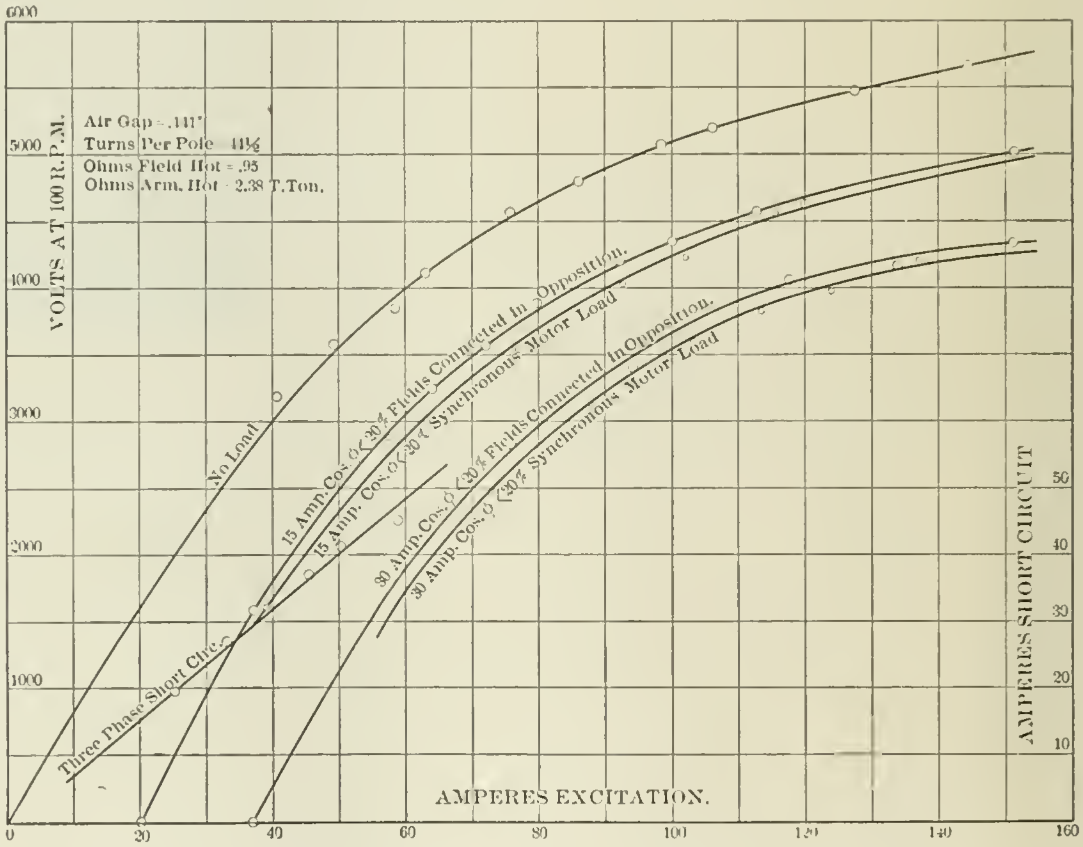
The improved method of testing alternators by circulating power can be used to carry out with great accuracy all the tests that have to be performed in order to know the characteristics of the machine.

DETERMINATION OF HEATING.

It is evident that the heating of the armature coils and of the field coils can be tested accurately as regards the C^2R loss, as full load current can be made to circulate through the armature coils and also full load current is carried by half the number of poles. It is not so obvious that the core loss of the machine is the same as under normal load conditions. Considering that the loss through hysteresis and eddy currents depends on the maximum inductions, between which the cycle of magnetization takes place, it appears resonable to assume that the core loss with the fields in opposition according to the new method here described is dependent only on the induction produced by the poles which act as generator. In order to ascertain this point experimentally and to dispel any doubts in regard to it, tests were made on two machines, first determining the core loss with the coils all connected in series, secondly with the coils connected in opposition, and a complete agreement was found between these two tests. It has thus become an experimental fact that the individual losses are the same in case the generator is carrying its full rated load under normal conditions or under the conditions as described in this paper. The method is, therefore, immediately available as the simplest possible form for the determination of the temperature rise for any part of the machine, a test which is extraordinarily cumbersome on large units if carried out in the usual manner.

DETERMINATION OF REGULATION OF ALTERNATORS.

In order to check the reliability of the method for the determination of the regulation of alternators at a low power factor, the following tests were made: A 72-pole alternator was operated as a generator on an under-excited synchronous motor and a load saturation was taken for different currents, as described at length in my paper read before the Institute in May, 1903. The alternator was then operated upon itself by exciting thirty-six poles with a large current and the other thirty-six poles with a weak current, and by computing from the short-circuit current, and the exciting current in the thirty-six poles that act as motor, the terminal voltage of the machine, a set of curves was plotted. The curves obtained by the former method lie slightly lower than the curves obtained by the



REGULATION AND SATURATION THREE-PHASE, 3800 VOLTS, 100 R.P.M.

latter method, which is due to the exceptionally large local fields in the machine experimented on, which was a 72-pole machine, the pole pitch being extraordinarily small on account of the small output and low speed of the machine. For this reason the generator was particularly fitted to test the method in regard to its accuracy. In both cases the power factor was very low, practically zero, or at least equivalent to a zero power factor as far as regulation is concerned. This method, therefore, yields at once the most simple way of determining the regulation of alternators on a power factor zero, and it is, therefore, the most natural way of determining the regulation in alternators. In my paper before the Institute, I recommended that the regulation of alternators should be tested on a power factor zero, and we, therefore, have now the means of so doing without incurring the slightest difficulty.

New Generating Station of the Rochester Gas and Electric Company.

The strategic situation at Rochester, N. Y., with respect to power for electrical generation is at the lower falls of the Genesee, which are 96 ft. high. The level of the river above the falls is about 124 ft. below the general level at the top of the high bank, the upper level of the river being thus nearly midway between the street level and the level of the river at the foot of the falls.

In order to fully appreciate the strategic situation, it should be understood that the Genesee River has a fall of 255 ft. within the city limits. This difference in level is utilized, first, by a dam at Court Street of 16 ft.; second, by a dam just above the upper falls of the Genesee about 95 ft. high; third, by the middle falls of the Genesee, nearly 30 ft. high; and finally by the lower falls of the Genesee.

Of the power of these several falls, the Rochester Gas & Electric Company by virtue of the ownership of original and inalienable water rights, which have been held to have all the attributes of real estate, controls in the neighborhood of 90 per cent. The company owns absolutely all of the water rights at the lower falls, where the water reaches the middle falls of Lake Ontario, and the remaining rights are well distributed on the races supplied from the dam at the upper falls and the dam at Court Street. It will thus be seen that the term "strategic advantage" is used advisedly in regard to the lower falls.

Necessarily after having done its work at the Court Street dam, the upper falls, and the middle falls, the water must be available at the lower and last fall of the Genesee River. It was this consideration that doubtless formed the principal factor in the erection of the important water power plant of the Rochester Gas & Electric Company at the lower falls, which is the subject of this article. Before undertaking the recent improvements at the lower falls, station No. 5 was a very large factor in the street lighting department of the company's business. It had, and still has, at the station at the foot of the lower falls, 31 Brush arc light dynamos, three 100-kw, 550-volt direct-current dynamos; two 70-kw, single-phase alternating-current generators operating at 1,100 volts, and two 100-kw and one 175-kw Edison machines. These are driven by fourteen turbines from two separate penstocks.

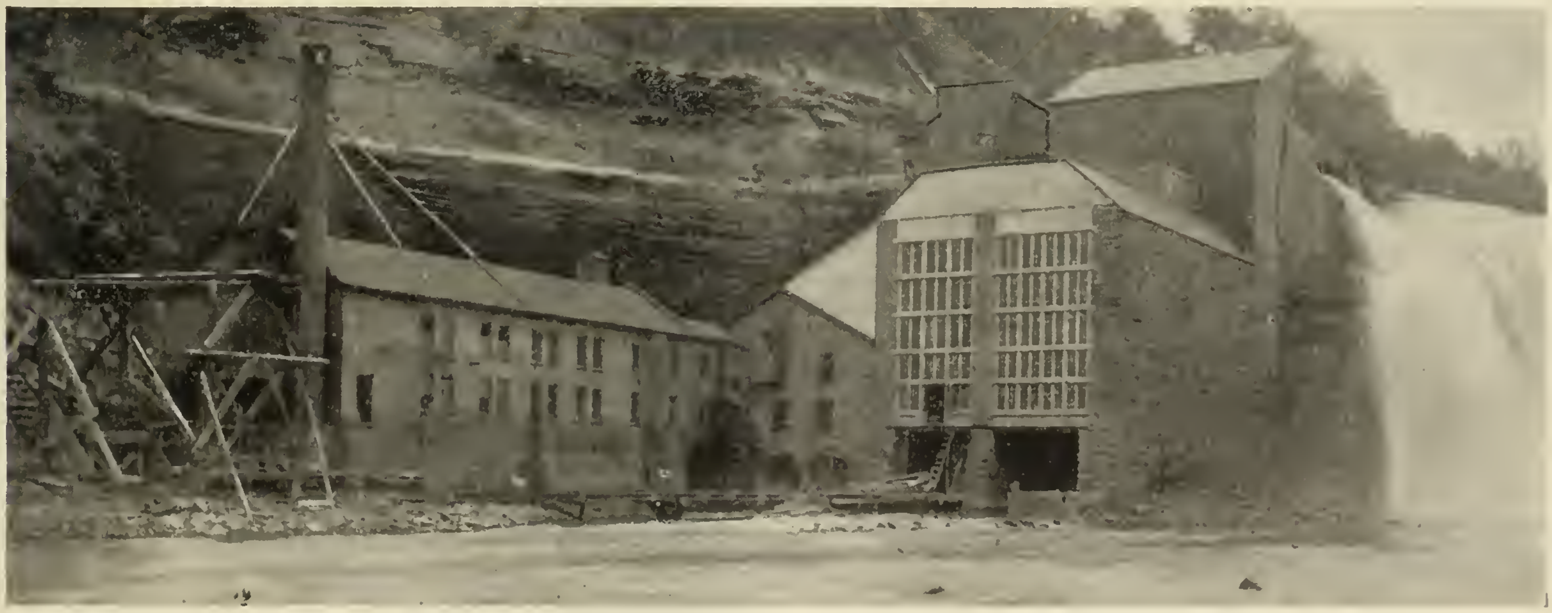


Fig. 1.—New Generating Station at Lower Falls of the Genesee, Rochester.

For the past two years work has been in progress having in view the greater utilization of the important water power at the lower falls. A new power house 47 x 90 ft. and 47 ft. high was constructed on concrete foundations placed in the rock at the river bottom at the foot of the lower falls. This power house is so constructed that it can be extended to the eastward towards the high bank of the river and its present proportions duplicated. At the outset the perpendicular fall of the escarpment was faced with concrete. The forebay was so enlarged so as to give a rock length of 80 ft. and at its westward or river end the rock was ballasted out, giving a depth of water at the new intake of 17 ft. In addition the dam was strengthened in order to avoid damage by spring freshets.

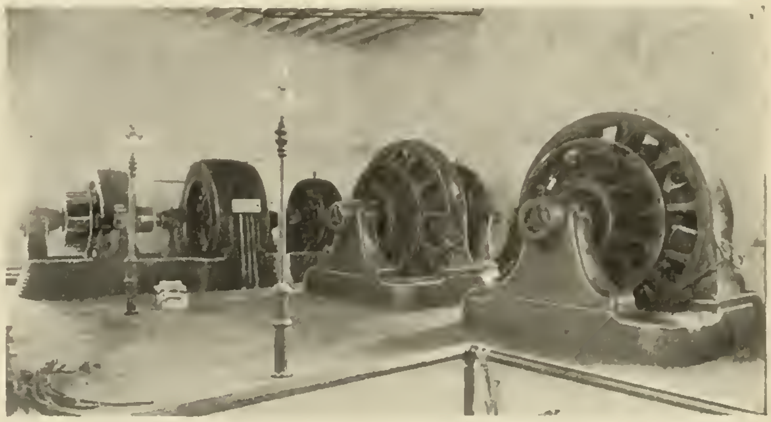


Fig. 2.—Interior View of Station.

From the forebay extend two penstocks 11 ft. in diameter, of which but one is as yet utilized. After covering over the brink of the fall it has a perpendicular descent to a point under the concrete floor of the power station, of 94 ft. and 6 in. Again curving it extends under the concrete floor a distance of 75 ft. It is constructed of steel ⅝ in. thick. The waste is through a tailrace 14 ft. deep with concrete flooring. This penstock supplies two Trump wheels of 2,200 hp, 42 in. in diameter, with 96 in. opening from penstock. They are each controlled by a Sturges governor, which has been found by actual practice to vary only 2½ per cent. from full load to no load. By an ingenious arrangement peculiar to this type of governor, the fly-wheels are brought to speed before the wheel. The speed of the fly-ball is similarly reduced before the speed of the wheel, this securing very close regulation. The fly-wheels are thus regulated by the velocity of the water. The governors are 50 x 32 in.

On the shaft of each of the turbines is a General Electric 1,200-kw, three-phase revolving field, alternating-current generator. It has 22 field pieces. The speed is 327 r.p.m. at 60 cycles, generating a current of 144 amp. under normal load at a terminal pressure of 4,150 volts. Since September 20 one of these generators has been in operation night and day without stopping, and has frequently been subjected to an overload of 35 per cent. for three hours. The exciter is at the extreme end of the shaft and is a multipolar machine giving 144 amp. at the speed of 327 r.p.m. under a potential of 125 volts. The station is furnished with a traveling crane of 25 tons capacity. The arrangements of the power station are such that this equipment of water pressure, turbines and generators can be doubled when desired.

The switchboard is situated on a gallery or pulpit on the falls side of the power house. The equipment is for a four-wire, three phase system. Each lead is equipped with ammeter, voltmeter and a time limit relay, which breaks in oil and lights pilot lamps. There is an ammeter and kilowattmeter on each phase and a voltmeter on each panel which can be operated on each phase. The current is fed to bus bars with separate panels on the switchboard for each machine and each set of feeders. There are also separate single phase feeders, which are also equipped with a time limit relay. There is also an ammeter and voltmeter in each single phase panel.

The feed wires are carried up the face of the power house next to the falls, where they enter conduits forming part of the race wall and are carried up the high bank, where they enter the underground conduit system. The latter work is being pushed rapidly to completion and in a short time the overhead wires will entirely disappear.

It will be thus seen that the possibilities of power distribution from the lower falls station of the company are very great. In fact, current is now being distributed to the uptown stations in large quantities. It is the opinion of those who have made a close study of the power situation in Rochester that the officials of the Rochester Gas & Electric Company have shown wise foresight and good business management in making the comparatively large outlay involved in the building and equipment of what is considered to be the most economical and profitable power plant in the State.

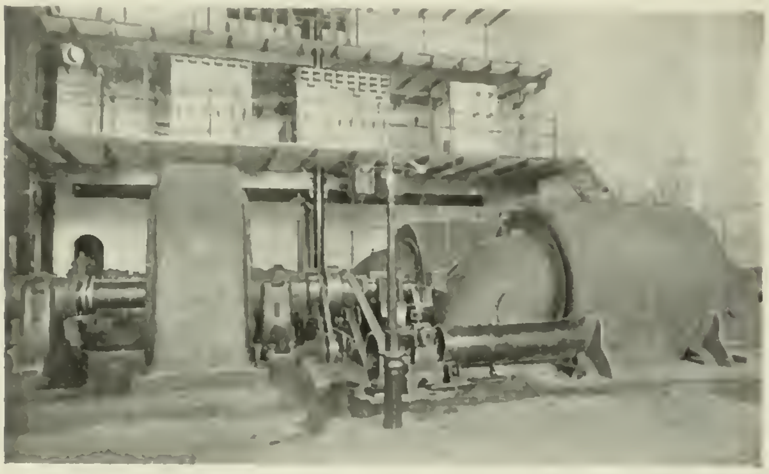


FIG. 3.—VIEW OF WATER WHEEL, GENERATOR AND SWITCHBOARD.

The main transformers station is situated on North Water Street in the exact center of the commercial district of the city of Rochester and is a stone building absolutely fire-proof. At present there are one Stanley 550-kw, two General Electric 500-kw and one Stanley 100-kw motor-generator sets with room for three more of 550 kw and ample switchboard capacity for the latter. The above-mentioned work has been done under the supervision of G. A. Redman, superintendent of the electric department.

American Rates for Current.

The National Electric Light Association, following up its useful work of special bulletins on features of lighting and power service, several of which have already been printed, has just issued its first bulletin of rates for lighting and power service, and covering statistics from a great many hundreds of companies scattered all over the country. For a first issue this is remarkably well done, and there are several features of value that must be commended. In every case the population of the community is given and then the rates are quoted for arc lighting, incandescent lighting and power. There is also a column for remarks, under which a great many interesting details are furnished. Such a pamphlet as this must prove very interesting and valuable to all the members of the association, and Mr. E. H. Davis, the secretary, is to be congratulated upon the good work done by his office in this compilation.

Trolley Traction on the Miami Canal.

The Miami and Erie Canal in the State of Ohio has recently been equipped with electric traction by the Miami & Erie Canal Transportation Company, the work being done by the Cleveland Construction Company, of Akron, Ohio. The section now in operation extends from Cincinnati to Middletown, a distance of about 42 miles. Current for this section is at present taken from the lines of the Cincinnati Gas & Electric Company as 4,200-volt, 60-cycle, three-phase current, received in a motor-generator station, which changes the frequency to 25 and separates the haulage system from the local lighting and power system. Part of the output, at 390 volts, feeds directly the first section of working conductors. The remainder is stepped up to 33,000 volts, and transmitted along the canal bank. At four reducing stations transformers receive the 33,000-volt current and deliver it to the working conductors at 1,170 volts. The locomotive receives this current and transforms it to 390 volts for use in the motors. There are two trolley wires of the grooved No. 0000 type, the track serving as the third conductor. This plan differs greatly from others, one notable feature being the use of a locomotive on a track along the canal bank and another important item being the application of the three-phase current.

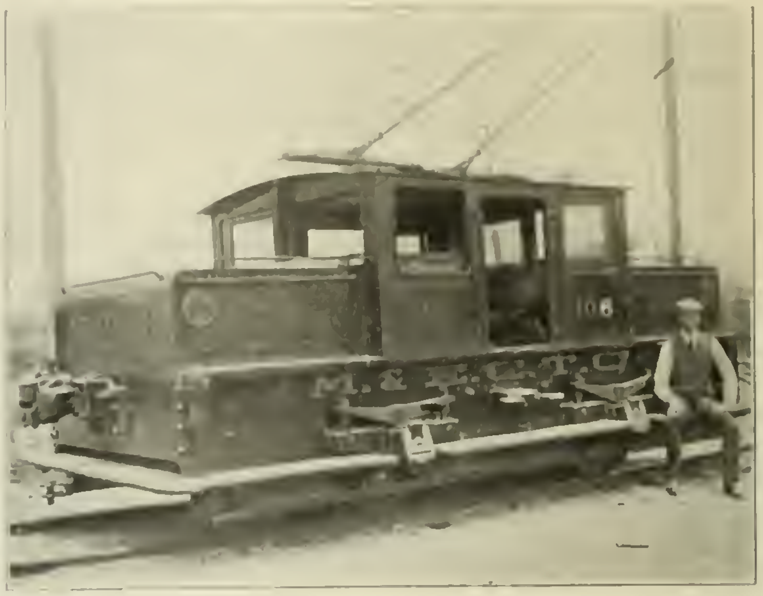


FIG. 1.—STANDARD CANAL LOCOMOTIVE.

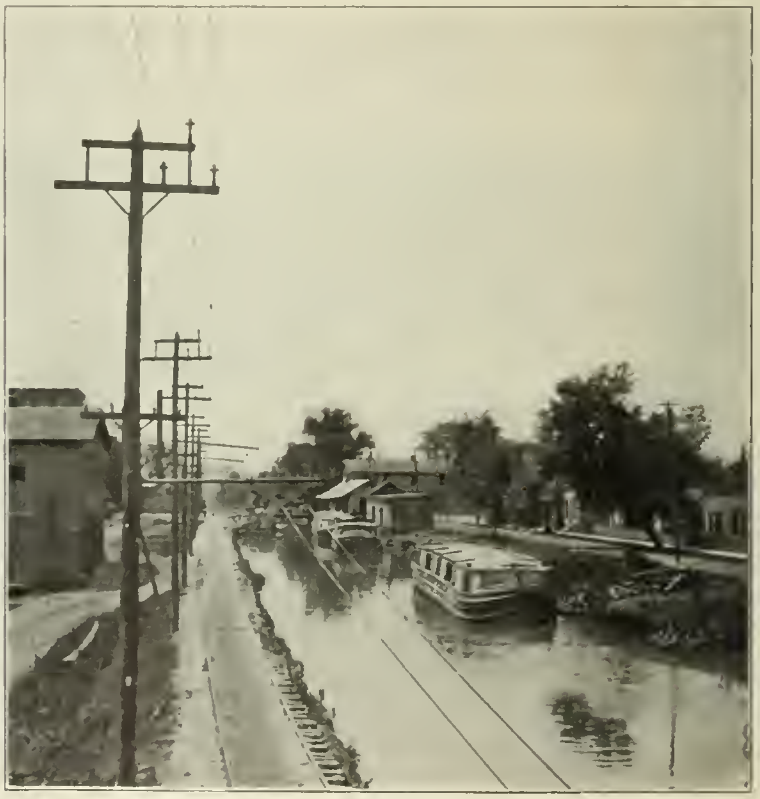


FIG. 2.—VIEW ALONG CANAL, SHOWING LINE AND TRACK.

The locomotive shown herewith in Fig. 1 is of compact type and weighs 55,000 pounds. It has four 33-in. wheels mounted on 6-in. axles with 5-in. journals, and to each axle is geared with double reduction an 80-hp, three-phase induction. These two motors are normally operated in tandem. The primary winding of the first motor is connected to the transformer secondaries, its secondary winding to the primary of the second motor, and the armature of this last is closed through a controller and a set of iron-grid resistances. This controller serves for reversal and speed variation when required, although the motors in tandem are designed to give the 3 mph to which the speed is, at present, limited by statute. In this normal operation the motors give 40 hp each, and a horizontal effort with 25 per cent. coefficient of adhesion of 9,600 pounds. The locomotives have not only hooks for making fast the towing cable, but couplers for the direct haulage of freight cars whenever desirable. As the track is well laid with 70-pound rails such haulage is quite feasible.

The seven locomotives were built by the Baldwin Works; the electrical equipment by the Westinghouse Company. The locomotive side frames consist of very heavy cast girders of channel section, framed across at the ends with similar castings. The axles are 6 in. in diameter with 5-in. journals, and the wheels are 33 in. in diameter, of standard railroad pattern, with 1¼-in. flanges and 4-in. tread. At the extreme forward end of each locomotive is the plug switchboard, behind that the transformers, then one motor, then the cab, with the controllers, then the second motor and behind that the rheostat, which fills up the rest of the space. The locomotives are 14 ft. long, 8 ft. 4 in. wide and have a wheel base of 7 ft.

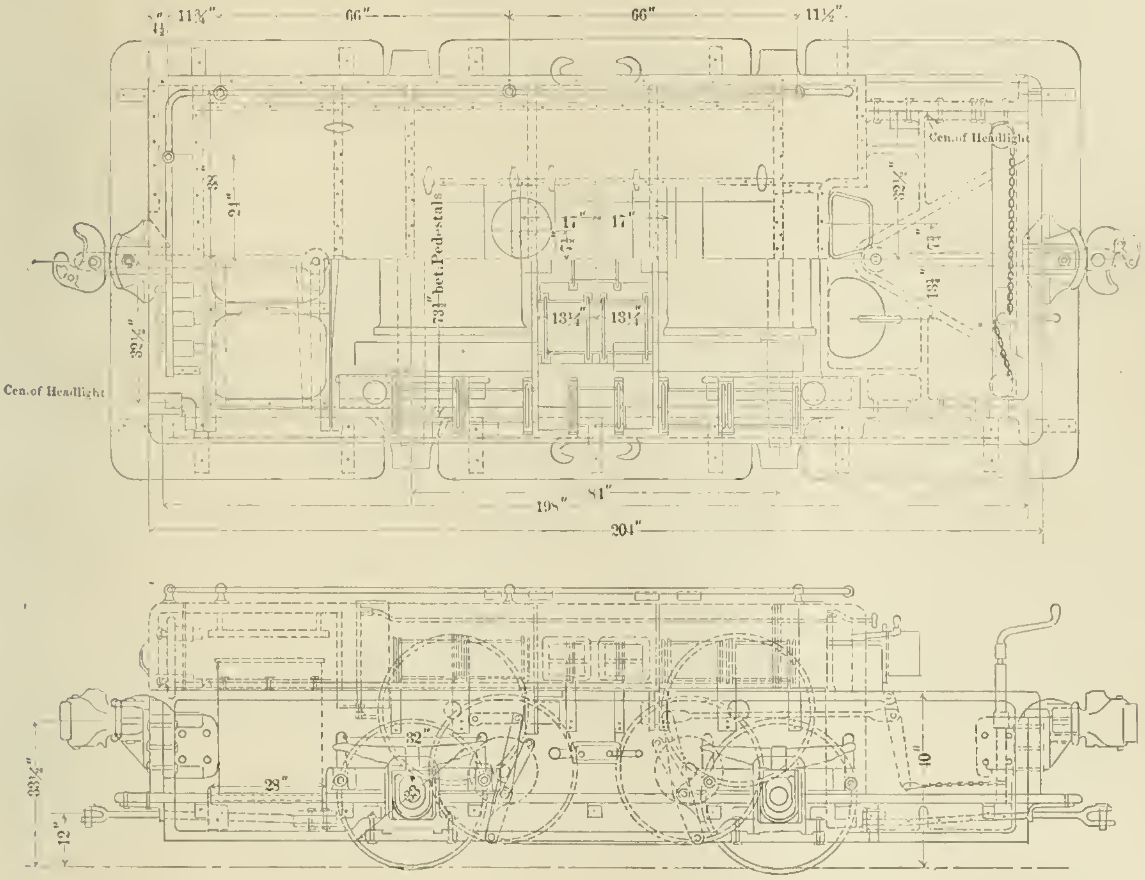


FIG. 3.—PLAN AND SECTION OF TOWING LOCOMOTIVE.

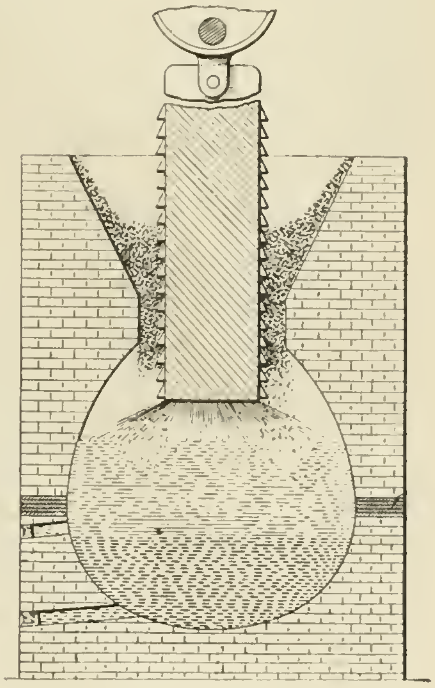
The extreme height of the standard locomotives was limited to 8 ft. 6 in. by the bridges and the extreme height of the switching locomotive, to be used at the southerly end of the line in Cincinnati, was made only 5 ft. 6 in. In this last, to save head room, the cab was omitted, and a cockpit provided for the motorman at the rear end, as in common practice with mining locomotives. The height of the trolley wires above the rail varies from 6 ft. under some bridges in Cincinnati to 22 ft. over railroad crossings, and is ordinarily 18 ft. Under the bridges north of the first half mile in Cincinnati the minimum height of the trolley wire is 9 ft.

The standard boat is 80½ ft. long exclusive of rudder, 13½ ft. wide and 9 ft. high, measured over all. Most of the boats are decked, leaving a clear height of 7 ft. 8 in. in the hold. There are some open boats for coal, gravel, empty barrels and other coarse and bulky freight. Loaded to a draft of 3 ft. such boats can carry about 65 tons, but in the present condition of the canal bed it is seldom practicable to load deeper than 30 in., at which they carry about 50 tons of freight. The transportation company has about twenty serviceable boats, acquired with a canal packet company which was purchased and has building facilities for the needed increase of its fleet. A telephone line for dispatching, etc., is also operated.

Recent Electrochemical Developments.

ELECTROMETALLURGY.

A patent was granted on November 3 to Prof. William S. Franklin, of Lehigh University, for the electric furnace shown below. A masonry structure contains a pear-shaped chamber communicating at its upper end with a short cylindrical passage, which opens into a flaring mouth. The lower portion of the hearth of the furnace is covered with a layer of carbon, which is connected by means of a metallic rod passing through the masonry structure with one pole of the source of current. A rod of carbon or metal which forms the other electrode is suspended into the top of the furnace. It is provided with downwardly-inclined teeth. The material to be acted upon is fed into the furnace by the reciprocation of the carbon rod. As the latter descends, the horizontal lower surfaces of the teeth engage the material and carry it downward. When the carbon rises both the action of gravity and the inclined upper surface of the teeth facilitate the passage of the teeth upward through the material without raising the latter, so that on the next downward stretch a fresh quantity of material is fed.



ELECTRIC FURNACE.

The first application of this furnace, described by the inventor, is to the reduction of iron ore. For this purpose the hearth of the furnace is first filled to a certain height with slag and the current is started. If the carbon rod dips into the slag the heat developed is altogether Joulean heat. If the carbon rod is raised above the slag, there is added to this the heat of the electric arc formed between the lower end of the rod and the slag. If then the iron ore is fed into the furnace through the mouth, it is reduced during its descent by the heat of the molten slag and the arc. When the ore reaches the intensely hot slag it melts and filters through the slag to the bottom of the receptacle, where it collects. The iron is drawn off through a tap hole in the bottom of the furnace, while the slag is kept at the proper level through a tap hole at a higher level.

Another application of the furnace is for the manufacture of glass. In this case the inventor uses glass itself for the first filling of the hearth, instead of the slag in the former example. The raw materials from which the glass is to be formed are fed through the mouth. They become heated as they descend until when they reach the surface of the intensely hot molten glass they are fused and form glass. Only one tap hole is here, of course, required.

A patent was granted on November 3 to Messrs. Oliver W. Brown and William F. Oesterle for the reduction of zinc from its sulphides (blended). The advantages of the process are said to be that the usual preliminary roasting is dispensed with, and that valuable by-products are obtained in the form of calcium carbide and carbon disulphide. The description of the process is rather short, but the gist of it is as follows: The inventors mix carbon (coke or coal) with zinc blende in a certain proportion and subject the mixture in an electric furnace to a heat "sufficiently high to produce the products desired." The zinc is reduced to metallic form and volatilized out and is condensed in the usual way, while the carbon, calcium and sulphur form calcium carbid and carbon disulphide.

MERCURY CATHODE PROCESS FOR ELECTROLYSIS OF BRINE.

While the Castner-Kellner process is at present the only mercury cathode process in actual operation on a large scale, there has been for some time a tendency toward intrenching on this monopoly. The only feature which appears to distinguish new processes of this kind from the Castner-Kellner process is the method by which the amalgam is removed from contact with the electrolyte and a fresh mercury surface is provided. We referred some time ago in these columns to the Bell process experimented with by the Pennsylvania Salt Manufacturing Company, and we have before us a patent, granted on November 3, to Mr. E. Hannon and assigned to the Solvay Process Company. In the process of Hannon the mercury cathode is at the bottom in connection with a basin containing pure mercury, while an overflow is provided by which the amalgam formed at the top of the mercury cathode (where it is in contact with the electrolyte), may run into another basin. By pressure from the first basin new mercury flows into the lower portion of the mercury cathode, and the amalgam formed in the upper part is caused to flow off continually, so that a fresh surface of mercury next to the electrolyte is continually provided.

BATTERY INVENTION.

A patent granted on November 3 to Mr. G. H. Rabenalt and assigned to the Gould Storage Battery Company relates to a construction of battery grid, to insure compactness and large active surface. The grid comprises outside bars, intermediate bars dividing it into a number of compartments, and relatively thin anchoring devices, which bridge these compartments and are provided with projecting bars, imbedded in the active material.

Another patent for an accumulator grid was granted on November 3 to Mr. J. von der Poppenburg. It comprises a non-conducting frame and a conductor grating provided with bendable arms which have interlocking connection with the frame.

Mr. H. P. Maxim has patented improvements in charging apparatus for automobile accumulators. The current available is generally not suitable for charging the batteries so that a motor-generator is required to give the proper charging current. There are dangers in this arrangement in so far as the current may fail in the motor circuit, and thus cause the generator to be run from the battery as a motor, the battery being discharged. The motor-generator may also continue to run after the battery has been fully charged, or a sudden overload may occur on either the generator or the motor. To provide against injuries from such causes, Mr. Maxim provides overload and underload interrupting means in the supply circuit, and overload, underload and overvoltage interrupting means in the circuit between motor-generator and battery.

A patent granted on November 3 to Messrs. G. Schauli and D. Loewenstein relates to a dry battery which has some new features of mechanical construction, while its main feature is that the filling mass between the zinc electrode and the depolarizing material surrounding the other electrode is formed by steeping raw rice in water until there is a partial formation of malt and then boiling it with a little water down to the consistency of syrup, [illegible] which the salts of the electrolytes are added to the hot mass.

Two patents granted to Mr. J. W. Gladstone refer to primary batteries, the new features being essentially mechanical details. Three patents granted to Mr. H. Halsey relate to mechanical details of the class of primary battery which this inventor is developing, and in which polarization is counteracted by the well-known means of a relative movement of the electrolyte and polarizable electrode.

New Telephone Patents.

NEW LOCKING DROP.

For bridging or branch terminal working, wherein the subscriber's line drop on a multiple switchboard is permanently connected to the line wiring irrespective of all jack contacts, the necessity of using a locking line drop is almost self-evident; for were not a locking up of the armature during the existence of a call provided, the answering operator of any line would be called in one or more times during each incoming call. Even with the locking drop some disturbance is made in front of the answering operator of a line receiving a call each time alternating signal current is put upon the line, unless some special means is provided to prevent it. The disturbing noise referred to is the rattle of the drop shutter hook and is prevented by causing the locking device to secure not only the drop shutter, but the hook also.

The latest idea in locking drop is the subject of a patent recently issued to H. P. Claussen, of Chicago, and assigned by him to the American Electric Telephone Company. The drop is provided with separate line and locking coils disposed front and back upon the same center line. The hook-raising armature pivots between and beneath the opposed coil faces and may be attracted by either one, the pulling power of the locking coil under normal excitation, however, far outweighing that of the line coil. When a line signal passes and the locking coil circuit is open in the jacks, the armature approaches the line coil and releases the shutter. After a plug has been inserted in a line jack and the locking coil circuit closed, the hook armature is held against all influence of the line coil, and in addition, as a safety measure, the drop shutter being of magnetic material, is held magnetically against the front face of the locking coil.

A TELEPHONE "SQUAWKER."

Telephone subscriber signals, since the passage of the attempts to call by means of abnormal receiver excitation, have been almost universally by means of bells, these having been provided with different sorts of gongs where the sound must be made distinctive. Round gongs, slit gongs, English chime gongs, sleigh and cow bells and even gongs of black walnut have been used. Every one has, however, depended in the end upon bells. In the patent issue of October 27, however, a new suggestion is brought forward by R. H. Ferguson, of Philadelphia, in a device which may be termed a telephone "squawker." This device has an electromagnet, the armature of which, through a linkage, operates two miniature bellows. These each feed a separate reed with resonating pipe to give a toot on each pipe for every stroke of the armature.

TELEPHONE BRACKETS.

With the increasing use of telephone desk stand sets and of roll-top desks, telephone subscribers are being more and more impressed with the fact that these two are at times an awkward combination, it being usually necessary to use one slide for the telephone, as to put it within the desk renders it awkward to answer calls; and in the exposed position on a desk slide the telephone set is exposed to a maximum of wear and tear from being knocked over and at times dropped even on the floor. To meet the emergency of late, several types of holder have appeared, and it is one of these brackets, a patent for which has been granted to S. J. Siegfried, of Chicago, that is shown with a desk stand set in position in Fig. 1. As indicated, the telephone may be swung about a vertical axis and may occupy any position from that shown in the full lines to that shown in the

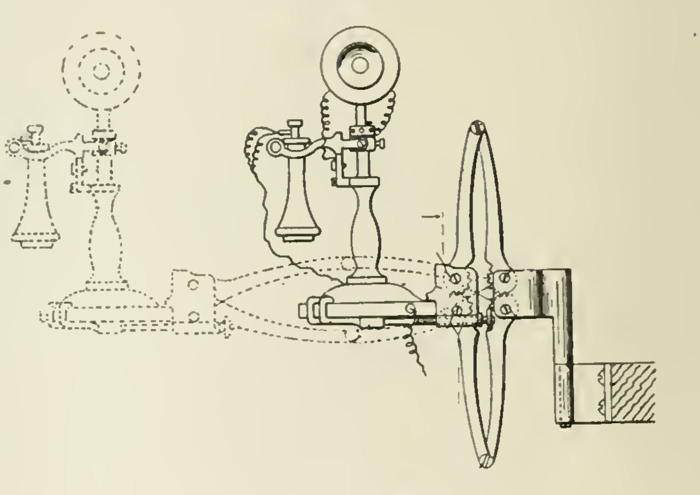


FIG. 1.—SIEGFRIED FOLDING BRACKET.

dotted lines. The construction of the arms with intermeshing gear teeth shows that the bracket will remain of itself in any intermediate or the extreme position. The desk stand is carried in a three-prong clamp and thereby held securely to the bracket.

Another telephone bracket, but one of an entirely different sort, and for an entirely different purpose, is the subject of a patent issued to G. W. Ganoe, of Philipsburg, Pa. This bracket is a receiver holder designed to hold the receiver to the ear during use. It has an automatic hook switch attachment, and as a point of novelty is carried by the transmitter arm and thereby automatically subject to adjustment for the different heighths of persons with this latter.

BRIDGING LINE SPLICER.

The method of splicing a bridge tap to a party line subscriber's line has been the subject of much consideration in the past. With hard-drawn copper line wire, good practice demands a sleeve joint which will not injure the skin of the wire, and yet every suitable splicing sleeve on the market requires that the line wire be cut in order to make the tap, the whole process resulting, therefore, in two splices. Fig. 2 shows a recently-patented tapping connector, which seems to overcome all difficulties. The sleeve of this connector is slotted from end to end and is made up with a slight taper. A plug of conducting material grooved to take the sizes of wires to be used and given the same taper slides within the sleeve. In making the splice the line wire is threaded into the sleeve, the tap wire is then inserted and the plug forced home, each wire lying in its own groove and tightly gripped by the resilient sleeve. It is evident that the splice may at any time be removed without injury to the main line wire. It would seem that the oval form shown in the lower left-hand corner of the figure will be the more serviceable one. The inventors of this connector are F. P. Fuller and J. J. Walsh, New York and Yonkers, respectively.

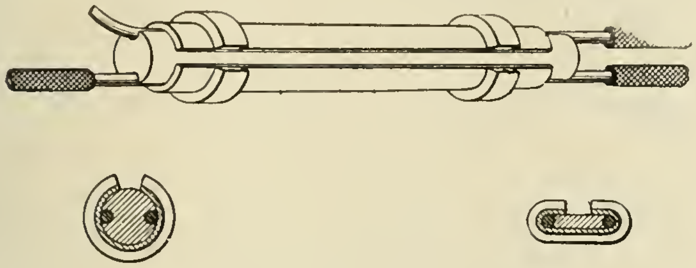


FIG. 2.—FULLER AND WALSH CONNECTOR.

ELECTRICAL DIVERTER.

"Electrical diverter" seems a rather novel name for a telephone lightning and heavy current protector, but it is the one selected as the title of a patent for such a device invented by A. C. Gilgen, of St. Louis, and assigned by him to the Central Telephone & Electric Company. The essential parts of the protector is a rectangular sectioned mica strip with terminals of metal mounted thereon, between which latter a piece of fine copper wire extends. This wire is spiraled about the mica and secured to the terminals by fusible alloy. The protector is normally in series with the line to be protected, and is held in clips near to a ground plate. The theory of action is that lightning upon the line will be forced off to the ground plate, probably by inductive action, while any excessive current will cause the copper wire to free itself from the fusible alloy.

ANTISEPTIC MOUTHPIECE.

After the routine antiseptic mouthpiece and sheet-of-paper-protector-patent boom it is a pleasure to find a distinctly new idea for the disinfecting of telephone apparatus irrespective of whether disinfection is or is not necessary. That this idea is novel probably none can dispute; but whether the cure may not be worse than the disease in at least some instances, we leave the reader to decide.

The device to be considered is described in a patent just issued to N. J. Tubbs, of Louisville, Ky., and consists of an automatic hot-air furnace under control of the telephone hook switch. The furnace thus becomes automatic in its action. The fuel is gas supplied to the burner through a flexible tube. A cock is, of course, interposed between the supply and burner, this cock being opened by the descent of the hook switch and closed by a mercury thermostat. The ignition of the gas is also controlled by the switch hook, this causing one from a coiled strip of percussion caps to be passed on to an anvil and to be struck off by a small hammer. Immediately beneath the receiver mouthpiece, as the receiver hangs on the hook, is a radiating surface exposed to the heat of the gas flame, while a metal tube leads to the transmitter. The heat from the flame thus thoroughly heats up both these instruments immediately after use, and disinfects them. When they are hot enough, the thermostat works and the operation is complete.

So far so good. What will happen, however, when the cap fails, as it is sure to do, and the gas flows through the transmitter? Suppose a smoker arrives about this time? Again, if the thermostat fails to shut off the gas, mercury fumes will surely fill the transmitter while the exposed hot metal tube will be always ready to assure the telephone user that the telephone is being regularly disinfected.

TIE WIRE.

Tie wires for securing conductors to insulators have heretofore consisted of a short length of soft-drawn or annealed wire of a diameter approximating that of the wires to be secured. Of course, different methods of wrapping the tie have been used, such, for example, as the "telegraph tie" and the "telephone tie," but the simple straight tie wire has been sufficient. Recently, a considerable movement toward self-tying insulators has been made, but thus far with indifferent success. Now comes a "formed" tie wire, the subject of a patent granted to G. F. Moore, of Mobile, Ala. This tie wire is formed with a semi-circular mid-section to fit the insulator, and with crimped terminals. The crimps and mid-section all lie in a horizontal plane, and the line wire may be secured by bending it back and forth across the tie wire so that it interweaves with the tie wire crimps, taking itself at the same time a registering series of vertical crimps. At the extremities of the tie wire there occurs one crimp in the vertical plane which hooks on to the line wire to prevent it from freeing itself by swaying.

AN AUTOMATIC CUT-OUT.

An automatic cut-out to prevent the continued blow of an excessive current is the subject of a patent of the issue under consideration. The inventor of this cut-out is E. M. North, of Brooklyn, N. Y. The cut-out is thermostatic in operation, two bars normally in the circuit, expanding from being heated by excessive current, become deflected. This deflection through a linkage and contact arm cuts resistance in series with the line for a slight motion, and later cutting the bars from circuit and eventually opening the line. As the bars cool off and go back to their normal position, the normal connections become automatically re-established.

The Telephone Crisis in Paris.

It appears to be the practice in France for various members of the Chamber of Deputies to make reports on the items of receipts and expenditures which go to constitute the general budget, and in conformity with this practice a report on the postal telegraph and telephone services has been made for the year 1903 by M. Marcel Sembat. A very interesting portion of this report deals with what may be called the telephone crisis in Paris, and some of the observations made in regard thereto are of interest not only to telephone engineers in America, but to those engaged in the art throughout the world. Mr. Sembat notes the fact that the subscription rate in Paris is 400 francs, or $80, and that the administration had promised to reduce this flat rate to 300 francs, although nothing of the kind has been carried out. The flat rate in Paris allows an unlimited number of conversations with all subscribers within the Paris exchange proper and all within the municipal boundary of Paris, which embraces 48 exchanges. There were in Paris on October 31, 1902, 29,478 main stations at 400 francs each, 261 state service stations paying 200 francs, 525 departmental service paying 300 francs, 52 season subscribers paying 200 francs, 51 interurban or toll line stations at 150 francs, and 9,988 extension lines to main lines paying 50 francs. This makes a total of 40,555 stations, or only 1.49 stations for every 100 inhabitants, this being much lower than usually obtains in other cities in Europe and far below what prevails in the United States. The apparatus, with the exception of the batteries, is furnished by the subscribers, but the maintenance is at the cost of the state. The patronage of the system, moreover, is not very extensive, as it appears that the daily use of the instrument does not reach above five conversations on the part of 53 per cent of the subscribers, while less than 9 per cent use the telephone more than 15 times a day.

Under these circumstances Mr. Sembat advocates the message rate system, which he states is already in use exclusively or combined with a flat rate in the United States, Australia, Japan, Germany, Denmark, Switzerland and Great Britain, and he points out also the remarkable increase in the yearly number of subscribers which has occurred as the result, instancing New York City, where the yearly increase of 530 under the flat rate rose to 6,862 under the measured rate.

Mr. Sembat insists that a reform of this kind ought to be made, although he admits that considerable change in mechanism and apparatus would be necessary, but he points out how inferior is the service given to the public at the present time, and some of his descriptions would be amusing if they were not pathetic, viewed from the standpoint of the subscriber. He describes the public standing in front of the telephones with eternal patient waitings, then wild calls and frequent sarcastic remarks not altogether destitute of blasphemy, stampings of the feet and a general attitude of excited indignation, which at last ends with a slamming down of the instrument and often a precipitated rush in a fiacre to the residence of the friend with whom it was desired to hold intercourse. On the other hand, the description of the employees by Mr. Sembat is equally discouraging, and a sort of half apology is made for the saucy or piteous replies of the telephone girl, who has lost her head, driven beyond her strength by overwork, and is pretty nearly out of her mind. Speaking as a socialist, Mr. Sembat says that no private company without laying itself open to all kinds of fines and penalties would have dared to do that which the state has done in respect to this matter, and he closes by remarking that, important as it is, to afford the majority of the people the use of the telephone, financial conditions are such that the new message rate or the new flat rate must be sufficiently large to prevent any further deficit in the budget.

Electricity for Swiss Railways.

Mr. O. J. Hughes, U. S. Consul General at Coburg, Saxony, reports to the State Department as follows: Owing to the increase in the price of coal during the last few years, Mr. Thormann, a prominent Swiss engineer, wished to find out whether it would not be an advantage to use electrical energy, furnished by hydraulic plants, over the whole of the railroad system of Switzerland. After investigating the subject he published a report which has awakened considerable interest and will no doubt bring about some practical results in this direction. He finds that the substitution of electricity for steam on the railroads is quite practicable and has many advantages, although it will not bring about any considerable reduction in the cost of operating the roads.

The five main railroads in Switzerland require over 30,000 hp daily. In order to organize a complete electrical service it will be necessary to obtain about 60,000 hp in the shape of alternating current of high tension, not counting the reserve supply, which is indispensable. Not taking into account the considerable number of falls which are not utilized in the country there exist already 21 large hydraulic plants which can give a total of 86,000 hp. These include the plant of Siel, near Linsiedl, which has a capacity of 20,000 hp; the Laufenburg plant, on the Rhine, giving also 20,000 hp; and five others, giving each 5,000 hp. He enumerates 21 plants which will be more than sufficient to supply the electrical energy needed for the Swiss railroads.

The cost of changing over the system would, of course, be considerable. It is to be noted, however, that the adoption of the electrical system would have the great advantage of doing away with the present consumption of coal, which is now imported, and that the use of hydraulic energy would be of great benefit in developing several branches of manufacturing.

The publication of Mr. Thormann's report aroused considerable attention in different quarters, and already one of the railroad companies has applied to the government for an authorization to use electric trains on a trial stretch of road 12 miles long.

Kentucky Independent Telephone Association.

The Kentucky Independent Telephone Association held its annual meeting in Paris, Ky., on October 13 and 14, last. Representatives from the leading telephone companies in the State were present. Papers were read on the following-named subjects: "The Manager and His Corps," by David Prewitt, of Winchester; "Toll Collections and Traffic Arrangements," by James S. Bailey, of Wauseon, O.; and "The Outlook," by John R. Allen, of Lexington, Ky.

The following-named gentlemen were elected officers for the ensuing year: President, D. L. Pendleton, of Winchester; vice-president, John T. Hinton, of Paris; secretary, James Maret, of Mt. Vernon, Ind. Executive Committee: David Prewitt, of Winchester; George S. Shanklin, of Lexington, and J. J. Mitchell, of Lexington. The time and place of the next annual meeting were left open for later decision.

CURRENT NEWS AND NOTES.

CABLES LAID ON GROUND.—With the idea of overcoming the suspension of communication with the north from Vancouver, B. C., by the government telegraph being broken by heavy snow falls, the Dominion Government will lay a cable over three ranges of mountains, strong enough to withstand whatever may fall upon it. E. A. Hawley, one of the foremen in charge of the construction in the north, who is now in Vancouver, said that sleet is the worst enemy of the telegraph lines in the North. The lines are being constantly broken and it is often very difficult to find the ends in the snow. Last winter the experiment was tried of laying a cable over the mountains, allowing it to be covered by the snow, and although it was not a complete success, it demonstrated the fact that with a proper wire there would be little trouble. A heavier and properly-insulated cable is now being prepared, of sufficient length to extend over three ranges of mountains, where the present trouble is experienced.

AMERICAN ELECTRO-MEDICAL SOCIETY.—The first annual meeting of this society will be held December 1, 2, 3, at the Masonic Temple, Chicago. This society, which already numbers over one hundred and fifty members, has for its object "investigation in electricity and allied sciences and the encouragement of their application to medicine and surgery by the formation of district and local societies." Papers will be read by Dr. John B. Murphy, Chicago; Dr. Byron Robinson, Chicago; Dr. G. Betton Massey, Philadelphia; Dr. J. Mount Bleyer, New York; Dr. C. S. Neiswanger, Chicago; Hon. John M. Smulski, city attorney for Chicago; Dr. J. Rudis-Jincinsky, Cedar Rapids, Iowa; Dr. H. Preston Pratt, Chicago; Hon. Edward B. Elliott, city electrician for Chicago; Dr. Clarence Skinner, New Haven, Conn.; Dr. J. N. Scott, Kansas City, Mo.; Dr. R. S. Gregg, Chicago; Dr. Mirhan K. Kassabian, Philadelphia; Dr T. Proctor Hall, Chicago; Dr. A. D. Rockwell, New York; Dr. Carl S. Beck, New York; Dr. Heber Robarts, St. Louis, Mo.; Dr. John E. Gilman, Chicago; Dr. Charles G. Davis, Chicago; Dr. C. P. Clemensen, Chicago; Dr. J. P. Hetherington, Logansport, Ind.; Dr. O. O. McMicheal, Chicago; Dr. O. S. Barnum, Los Angeles, Cal.; Dr. Elmore Pettyjohn, Chicago; Dr. George F. Hawley, Chicago; Dr. John E. Harper, Chicago; Dr. Lloyd Hammond, Chicago; Dr. Hamilton Forline, Chicago; Dr. R. H. Bartlett, Chicago; Dr. H. P. Fitzpatrick, Chicago. The secretary is Mr. T. P. Hall.

FARMERS AND THE TELEPHONE.—An item from Fargo, N. D., says: "The encroachment of modern facilities on older methods of doing business is strikingly exemplified in this part of the Northwest this fall. These days of private telephones and telegraph lines to every station and almost every big farm throughout the State have brought the farmers into touch with the terminal grain markets of Duluth and Minneapolis in such a way as to euchre the country elevator lines out of all chance of profits by advance information. Often the changes in quotations at either Duluth or Minneapolis are in the hands of farmers at their homes within ten or twenty minutes after they have been made, and in some cases elevator companies having country line houses have found it very difficult to keep even with the farmer. This is especially the case with a long-continued advance or decline. A farmer will store his grain in the country house nearest his farm, and as long as prices advance or remain stationary he will let it stay there, taking a storage ticket, which he leaves with a friend in town or at the bank. Being in such close touch with the terminal markets by telephone, he knows at once of any change in price, and if it is a decline he at once telephones to the bank or his agent to sell at the old price, and this is done so quickly that the sale is often made before the country elevator has received word by wire from Duluth to make a change in quotations. In that case the elevator line is out the difference in price, as it has to sell its grain on the terminal market at once."

WIRELESS TELEGRAPHY IN ITALY.—It is announced that the Italian Government will soon begin on the royal estate of San Rossore the construction of an extraordinarily powerful wireless telegraph station for the establishment of communication between Italy and the Argentine Republic.

A. I. E. E. MEETING.—The 181st meeting of the American Institute of Electrical Engineers will be held at the Chapter room, Carnegie Hall, 154 West Fifty-seventh Street, New York, on Friday, November 20, at 8:15 P. M. The following papers will be read and discussed: "The Electric Conductivity of Commercial Copper," by Lawrence Addicks; "The Comparative Behavior of Floating and Booster-Controlled Batteries on Fluctuating Load," by Lamar Lyndon.

REPORT OF A SPEECH BY "ELECTROPHONE."—Mr. Joseph Chamberlain made a speech at Birmingham, England, on the night of November 5, and, according to a London dispatch, reporters of the *Daily Mail* took the speech down in shorthand at London, a distance of 113 miles. What the British newspaper designates as an "electrophone" was used for this purpose, and it is stated that every word was distinctly heard by the reporters. The speech was printed verbatim and the paper was selling on the streets 27 minutes after the speech was concluded.

NICKEL MINES OF ONTARIO.—Professor Coleman, of the University of Toronto, who has recently investigated the Sudbury nickel ore deposits for the Ontario government, reports that he found the Sudbury deposit practically a continuation of the southern range, the whole forming a great oval 40 miles long and 20 miles broad. In quantity the Sudbury deposits surpass any other nickel deposits in the world; in percentage of nickel in the ore, however, they are hardly up to the deposits of New Caledonia. The average percentage of nickel is about 2.5 per cent., though some ore runs as high as 5 per cent. There is more sulphur and copper in the ore than in New Caledonia ores.

THE FRENCH INSTITUTE, according to a recent cablegram, has appropriated the sum of 7,000 francs for the purpose of "an investigation to settle a difference of opinion between French and American authorities concerning a point in electrodynamics." This doubtless refers to the Rowland experiment on the electromagnetic effect of a rotating electrostatic charge. Mr. Harold Pender has received a grant from the Carnegie Institution for an experimental investigation of the subject, to be made in Paris in collaboration with M. Victor Cremieu. The latter savant has attacked the correctness of Rowland's deductions from his experiment, and it is possible that the French grant was made in his interest.

BARBED WIRE TELEPHONY.—Two years ago a number of farmers in Eastern Washington became convinced that they could enjoy the benefits of a telephone system by connecting their barbed-wire fences and attaching telephone instruments. Within a year hundreds of miles of barbed-wire telephone lines were in use in the Palouse, Big Bend and Walla Walla wheat districts. Having become accustomed to the advantages of the telephone, the farmers are now dissatisfied with the slow method of the barbed-wire lines. In consequence, several good-sized corporations have been formed in various districts to supplant the barbed wire with pole lines and to give the rural communities better service. The farmers' pioneer lines have paid handsomely where charges were made, making large profits likely when better facilities are afforded.

PRICES OF CURRENT.—Mr. F. H. Mason, United States Consul-General at Berlin, states that on the first of January, 1904, the cost of electric current for lighting purposes in Berlin will be reduced from 55 pfennigs (13¾ cents) to 40 pfennigs (10 cents) per kilowatt-hour. This change of price is made to meet the competition of gas, which is furnished for lighting as well as for heating and cooking purposes at 3¼ cents per cubic meter (35.316 cu. ft.). The rates for lighting purposes per kilowatt-hour in some other European cities are as follows: Breslau, 17 cents; Budapest, 23½ cents; Christiania, 14 cents; Genoa, 18 cents; Cologne, Leipzig and Nüremburg, 18½ cents; Dresden, Frankfort, Munich and Hamburg, 15 cents; Copenhagen, 14 cents; Rotterdam, 17 cents, and Vienna, 15 cents. For power purposes electric current is supplied in Berlin as low as 17 pfennigs (4¼ cents) per kilowatt-hour, and when used in large quantities during daylight hours this price is still further reduced to 14 pfennigs (3½ cents).

TO RESIST THE CHICAGO UNION LOOP.—Organized opposition to the "encroachments" of the Union loop, together with demands for a better service, are the features of a movement initiated by property owners in the four streets occupied by the loop. A permanent organization, employing an attorney, has been formed to accomplish the reforms which business men have been urging for a year or more. The objects of the organization are: The prevention of any further encroachment over the streets, such as the extension of platforms, the removal of all signs on platforms and in cars, the removal of disused stairways along the loop, and the lessening of the noise on the latter. The corporation counsel has already ordered work which was under way on the extension of the platforms, suspended, and the Union Loop Company, through its attorney, has applied for an injunction to restrain the city from interfering with the plans. A stay of proceedings has been granted until the property owners can be consulted.

RADIOACTIVE WELLS.—Prof. H. A. Bumstead, of Yale, in a recent interview, says: "At the request of Prof. J. J. Thomson, who was visiting here last spring, Prof. Wheeler and myself undertook to find out if a radioactive gas existed in the deep-level waters of this vicinity. He called our attention to the work done in the Cavendish Laboratory on a radioactive gas found in waters coming from deep levels in that region. We secured some water for experiment from a spring near New Milford, Conn., which was estimated to be about 1,500 ft. deep, and found that it was radioactive. We then took some water from one of the surface lakes here, which is used as a reservoir, and we found this, to our surprise, to contain a strongly active gas. We tried the water direct from the lake, and after it had come through the pipes, but the result was the same. The water was then taken and after the gas had been expelled was aerated by dropping and allowed to stand for sixteen days, but it did not recover the power of giving off an radioactive gas. That was the experiment that indicated that the gas does not come from a radioactive substance dissolved in the water."

"A ROUSING TIME."—An item from Boston, Mass., says: "W. E. Shaw, of Brookline, gave an 'electrical party' last night, the feature of which was the exhibition of an electric clock for blind deaf mutes. Mr. Shaw is deaf and dumb, and he was assisted in demonstrating the workings of his invention by Tommy Stringer, blind, deaf and dumb, who is making great progress in the sciences. The clock not only tells the time, but alarms the sleeper by agitating a lever which is connected by a string to a pillow, causing the pillow to move up and down, the vibrations being communicated to the sleeper by a touch. A circuit is closed, by which an electric current is sent through a small incandescent lamp in front of a parabolic mirror, the rays of which are thrown into the face of the sleeper. It releases a spring connected with a hammer, which falls upon a fulminating cap, the loud explosion of which at close quarters is perceptible to a deaf person. It also gives notice of the entrance of burglars by any of the above methods, by means of connection by a wire with the doors and windows. It gives indication of fire by electric thermostats placed anywhere on the premises."

AN EMPLOYERS' UNION.—At Chicago, on October 30, with the election of D. M. Parry, of Illinois, as president, the formation of the Citizens' Industrial Association of America was completed. The organization is fully national in scope, and includes manufacturers, tradesmen and other employers of labor. Other officers were elected as follows: First vice-president, J. C. Craig, of Denver; second vice-president, E. W. McLeary, of the National Electrical Contractors' Association, Detroit; third vice-president, J. T. Hoile, of the Manufacturers' Association, New York; treasurer, A. C. Rosencrantz, Evansville, Ind. Resolutions were adopted by the organization. They refer to strained relations between employer and employees and their bad effect on business conditions; demand ample protection for all seeking to earn a livelihood, and continue in part: "In carrying on a firm and uncompromising contest with the abuses of unions as now constituted and conducted, at the same time acknowledging the free right of workmen to combine, and willing that the combination when rightly constituted and conducted may prove highly useful, we earnestly desire to act, and believe we are acting, in the true interests of the workingmen themselves." A convention of the Association will be held in Indianapolis next February.

THE METRIC SYSTEM IN GREAT BRITAIN.—Some weeks ago we referred to the endorsement of the metric system by the British Congress of Chambers of Commerce of the Empire at its Montreal meeting in August, and we give below the text of the resolution. Lord Strathcona was the honorary president of the Congress and Lord Brassy the president. The honorary vice-presidents include the principal higher officials of the Empire. At the Montreal meeting there were present delegates from 75 British chambers of commerce, and from the chambers of the principal commercial cities of India, Ceylon, Egypt, South and Central Africa, Canada, the West Indies, Australasia, Hong Kong and Malta. An amendment to the resolution recommending that the appointment of a royal commission be asked to consider the question of the adoption of the metric system was voted down by a large majority, one of the speakers saying that the original resolution should not thus be weakened, but that the matter should be so forced upon the government that it will be bound to take action. The resolution was adopted as follows, with few dissenting voices: "That this Congress, having had under its consideration the following resolution, adopted at the conference held in London during the months of June, July and August, 1902, between His Majesty's Principal Secretary of State for the Colonies and the Prime Ministers of the self-governing colonies of the British Empire, namely: 'That it is advisable to adopt the metric system of weights and measures for use within the Empire, and the Prime Ministers urge the governments represented at this conference to give consideration to the question of its early adoption,' hereby expresses its hearty concurrence therewith, and urges upon the Government of the United Kingdom the necessity for legislative measures being taken in the interests of British trade and commerce to make the use of metric weights and measures compulsory."

LETTER TO THE EDITORS.

Impulse vs. Impact in Steam Turbines.

To the Editors of Electrical World and Engineer:

Sirs:—There is a confusion of phraseology in most of the papers on the subject of the steam turbine, which I consider important enough to call attention to.

Mr. W. L. R. Emmet in his paper before the American Philosophical Society, published in your columns April 11, 1903, as well as the writer of the editorial in the issue of May 23, and in the article in the same issue constantly speaks of the "impact" of the steam against the vanes. For instance, we read on page 609, issue of April 11:

"In steam turbines the expansive force imparts motion to the steam itself, and this motion is given up to a revolving part by impacts of the moving steam upon it."

Again on the same page, speaking of Parsons turbine, Mr. Emmet says:

" . . . . giving up its velocity by impact with the moving vanes!" and again on page 610 the same author is found to say:

"This process of expansion in nozzle and subsequent abstraction of velocity by successive impacts with wheel vanes is generally repeated. . . . . "

The writer of the editorial on page 857 says:

"The energy of this moving stream is then transformed into mechanical motion through impact on the vanes. . . . . "

And the writer of the article on the "Curtis Steam Turbine" says, on page 859:

"A jet striking a surface will exert definite pressure against that surface, the value of which, in the case of normal impact, is expressed by half the square of the velocity per second into the mass of fluid delivered against the surface per second. Should a surface against which such a jet impinges, such as that of a vane attached regularly to a shaft, remain fixed, there will, of course, be no energy delivered to the shaft; it is also evident that should the vane have the same velocity as the impinging jet, no energy will be delivered, since there is no exchange of velocity between the jet and the vane. The maximum amount of energy delivered will be, when the vane has one half (or, more accurately, a little more than one half) the velocity of the jet, for, in that case, the remaining velocity in the jet after impact will equal the velocity of the vane, and, therefore, be incapable of imparting further energy. Consequently, leaving aside any secondary actions, in order for a single-wheel steam turbine to act at a maximum efficiency, its vanes should have a velocity of about 2,000 ft. per second . . . . . . "

The writers of these articles from which I have cited at length, seem to believe that the energy of a jet is imparted to the vanes of a turbine through the "impact" of the jet against the vanes. If such is their belief, it seems necessary to call their attention to the fact that what the turbine designer is most anxious to avoid is this very "impact," which means a loss of energy. Substitute for the word "impact" the word "shock," and it is unnecessary to further comment on the necessity of avoiding "impact," i. e., "shock" in turbines, whether for steam or for water.

The writer of the article on the "Curtis Steam Turbine" gives a proof for the fact that the most favorable velocity of a single-wheel turbine should be one-half the velocity of the jet. In the first place, it need hardly be remarked that this is true only for turbines operating as "action" turbines, i. e., turbines in which the entrance velocity of the jet into the running vanes is equal to the spouting velocity, or the velocity of free efflux. Such turbines are the Girard turbine and the Pelton turbine. The De Laval steam turbine also belongs to the same type. In single-wheel turbines in which the full spouting velocity of the jet is not used, i. e., in "reaction" turbines, the peripheral velocity of the wheel is always considerably greater than one-half the velocity of the jet.

As to the proof that the peripheral velocity of a single-"action" turbine wheel should be approximately one-half the velocity of the jet, the reasoning of the author of the article on the Curtis steam turbine is erroneous. The true reason is that, in order to abstract the energy of the jet "without impact or shock," it is necessary that the velocity of the moving vane be such that the fluid can glide into the bucket along the vane without losing energy by impact or shock. The jet once having entered the bucket or vane, it is essential to bring the velocity of the fluid down to as small a value as possible, and this is done by the peculiar curvature of the vane. Assuming the angle of entrance of the vane equal to the angle of the vane where the jet leaves it, it follows at once that, neglecting friction, and assuming the fluid to leave the wheel normally to its surface, the velocity of the vane at which impact is avoided must be equal to one-half the velocity of the jet multiplied by the cosine of the angle at which the jet is inclined to the surface of the wheel.

Following the reasoning of the author on the Curtis steam turbine, it can easily be proved that the efficiency of a turbine in which the fluid acts by impact never exceeds 50 per cent., for by his assumption the vane is supposed to move at one-half the velocity of the jet, and it follows that one-fourth of the original energy remains in the jet, whereas another one-fourth of its original energy is destroyed by the impact of the jet against the vane. Thus, only 50 per cent. of the energy of the jet can be utilized, which 50 per cent. would yet be considerably diminished by frictional resistances.

The writers of the articles from which we have quoted have obviously confounded "impact" with "impulse." In dynamics we understand by "impulse" a difference in momentum, by momentum being understood the product of mass into velocity. In "action" turbines this momentum is utilized, and for that reason such turbines have been termed "impulse turbines." Such loose phraseology is apt to produce incalculable harm, by introducing a confusion of ideas, which is to be especially guarded against with a subject such as that of the steam turbine, about which the general engineering public for some reason or other seems to be profoundly ignorant.

South Norwood, Ohio. B. A. Behrend.

[Whether "impact or impulse" is the proper word to use in descriptions of turbine action appears to be rather a matter of convention than one of correct phraseology. The first mentioned word refers more especially to an act of contact or "impression by touch," while "impulse" relates to the dynamic results of such contact—the former being necessary to the latter. That is, one is the condition and the other the result. It is true that ideas connected with impact of solid bodies may be transferred to fluid action, thereby confusing thought; but the other significations of the word "impulse" may, in its use as suggested, also give rise to similar confusion of thought. As to the analogy of the pile driver, there can be no such thing as "shock" in fluid action, and the analogy to that extent is not apposite. Under certain conditions internal eddies may result, involving lines of energy, but these are rare.

In the illustration of the action of the impinging jet to which Mr. Behrend refers, it was assumed that the jet would flow off the vane in reverse direction to the direction of motion of the vane. For maximum efficiency in the ideal case, this implies that the jet should have a reverse velocity equal to the forward velocity of the vane, or a zero velocity with respect to the earth, or, in other words, that the vane should have one-half the velocity of the impinging jet. Mr. Behrend in this case apparently has confused relative and absolute velocities, and his ratio ad absurdam that the efficiency of a turbine in which the fluid acts by impact never exceeds 50 per cent., thus rests on false premises. The condition considered is, of course, and as indicated in the article, an ideal one, not attainable in practice. In the general case the most efficient ratio of jet and vane velocity will depend upon the angle of vane and angle of approach, and does not permit of any simple expression.

The definition which Mr. Behrend in the final paragraph of his letter gives of impulse, is not that which is usually accepted. In fact, the definition of impulse as a differential of force makes it simply force. The fact is that the words "impulse" and "impact" have always been used with some breadth of meaning, but usually the context is so clear that no such confusion should result as Mr. Behrend fears.—EDS.]

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Single-Phase Motors Without Phase Difference.—LATOUR.—An article illustrated by diagrams in which the author first recapitulates the results of a former article which was referred to in the Digest July 4, and in which he gave the theory of a repulsion motor, the stator of which is wound like a modern armature having only a single winding like that in a direct-current dynamo. The operation of such a repulsion motor near synchronism is perfect in respect to commutation. In practice, if running with carbon brushes, it may be used between rather wide limits of speed. The starting torque is as great as for a polyphase induction motor, with resistances inserted in the rotor winding. A special feature of the repulsion motor is that at no speed is there any energy consumed in resistances. Such a motor with fixed brushes shows the general properties of a series motor, namely maximum torque when running up from rest, and zero torque at a theoretically infinite speed. If the question of commutation, when starting under heavy load, may be assumed as solved, such a motor is very suitable for hoisting and traction purposes, although it has the serious disadvantage that its power factor is rather low. The author now shows that it is possible to build, without special complications, single-phase motors with commutators which have a power factor equal to unity. If *n*-phase currents are supplied to a two-pole, ring-armature with commutator by means of *n* brushes symmetrically distributed around the commutator, the reactance of the ring diminishes with the speed and becomes zero at synchronism, while beyond synchronism the ring acts as condenser. But if single-phase currents are introduced through two opposite brushes, the inductance is constant at any speed. It is, however, as easy to obtain the same results in the latter case as in the former. If, besides the brushes, *a b*, through which the single-phase current is supplied to the armature, another set of auxiliary brushes, *c d*, is used, as shown in Fig. 1, the two currents between the two sets of brushes produce two fluxes; and it is shown that the reactance of the ring armature diminishes with increasing speed, and becomes zero at synchronism, while beyond synchronism the ring acts as a capacity. We have here the same phenomena as in a polyphase motor. The commutation at the brushes *a* and *b* is perfect at any speed, while at the brushes *c* and *d* the commutation is perfect at synchronism only. Below synchronism there is a counter e.m.f. in the segments short-circuited by the brushes *c d*, which is too strong for thhe commutation of the current, *J*, and above synchronism the counter e.m.f. is too small. The conditions of commutation are most difficult at starting. Under the supposition that the commutator has *m* segments, and that *v* volts are applied between *a* and *b*, the counter e.m.f. in question becomes $\pi v \div m$. This e.m.f. may become 2.5 or 3 volts without danger if carbon brushes are used. If the rotor of Fig. 1 is placed in an ordinary single-phase stator, it is at once seen that a single-phase motor with a power factor equal to unity can be attained. If, for instance, the stator is connected in parallel with the rotor with the aid of a transformer for diminishing the voltage, a shunt motor is obtained analogous to the direct-current shunt motor. For a certain position of the brushes the motor, when not loaded, attains a certain characteristic speed equal to synchronism, or below synchronism or above synchronism; and when the motor is loaded without changing the position of the brushes, the speed drops by a few per cent. It is preferable to arrange it so that the speed of the loaded motor corresponds to synchronism. Such a motor being neither a synchronous nor a non-synchronous motor, is called a "panchronous" motor. A shunt motor which is adjusted to operate at no load without phase difference, continues to operate without phase difference when loaded. This single-phase shunt motor may be used for shops or in power transmission work. It is started by disconnecting the rotor and stator and operating the motor as a repulsion motor. Since the method of starting is easy, the author thinks that this shunt motor may even find application for traction, if it is not required to use a variable speed. The series connection (as shown in Fig. 2) is, however, more interesting for traction purposes. The author gives the mathematical theory and shows that the torque at any speed is essentially a function of the position of the brushes, and may be adjusted accordingly. When tested, such motors are said to have given very good results.—*Elek. Zeit.*, October 22.

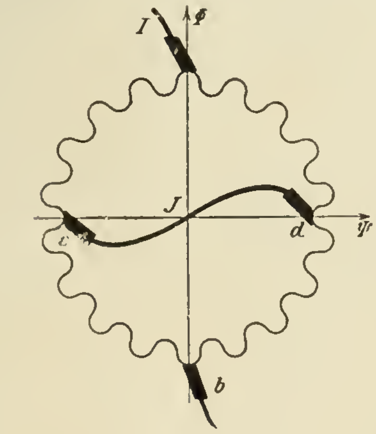


FIG. 1.—LATOUR SINGLE-PHASE MOTOR.

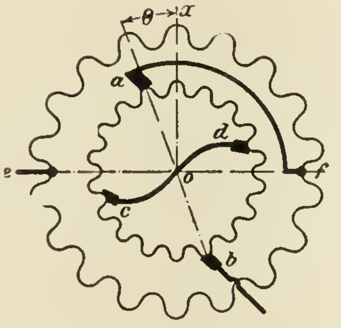


FIG. 2.—SERIES SINGLE-PHASE MOTOR.

Compensated and Compounded Alternators.—HEYLAND.—A brief reply to the article of Meyer abstracted in the Digest November 7. The writer says that his former communication was apparently misunderstood by Meyer, since his own remarks related to generators already made and fully tested, and the suppositions advanced by Meyer are for the most part fallacious.—Lond. *Elec.*, October 23.

FLYNN.—Another communication on Meyer's article. He thinks that only a very small saving can be achieved in the width of an alternator by increasing the armature ampere-turns in the case of a machine excited in the ordinary way, since it will be necessary to work with less density at no load in order to keep the increase in the exciting ampere-turns, required to uphold the voltage at full load, within reasonable limits. Nothing but a very material reduction of the self-induction of the armature winding can lead to a real saving in such a case. He refers to a method which he has applied for getting constancy of voltage. He used an arrangement similar to a hot-wire voltmeter, of the Hartmann & Braun type (made by the Stanley

Company in this country), carrying a horizontal lever instead of the usual pointer, and traveling through a comparatively wide angle for a very small alteration in voltage. This lever closed the circuit of one or the other of two magnetic clutches, determining the travel of a spindle which cut resistance in or out of the exciting circuit, as required, in order to keep the voltage constant. The main voltage transformed down to a suitable value was applied to the relay terminals. Had compounding been required, an electromagnetic relay would have been used. The arrangement worked very well and kept the voltage of the alternator constant within the limits of the machine, for all loads and power factors.—Lond. *Elec.*, October 23.

An editorial note stating that as the difference of opinion between Heyland and Meyer appeared to be largely on the question of the actual cost of the machines in question, the editor had written to the two companies which Heyland and Meyer represent and asked them to quote for two machines of standard size. Heyland's company sent a quotation, while Meyer refused to do so because he feels that the comparison of two quotations of different firms on the basis of a plant which will never be in existence, is of very little practical use. He thinks that to arrive at conclusions of any value, the quotations of both types of machines should be made at least on the same basis of profit, guarantee and workmanship. He says that the question of cost is not the only issue, but that a break-down in the exciting arrangement of the generator would be a serious matter with the Heyland type. With the standard type, provisions are always made for a separate source of excitation, but with the Heyland type a complete generator has to be kept as spare, and since the starting of the engine and the paralleling will take some time, it may mean a serious overload on the station.—Lond. *Elec.*, October 23.

Output Coefficient.—Esson.—An article on a basis for the comparison of dynamo designs. He criticizes some points in an article of Hobart, abstracted in the Digest of October 10. The gist of the contention is as follows: There is an active surface of certain dimensions moving in a magnetic field with a certain velocity, and the quality of the design is indicated by the magnitude of a coefficient which expresses the "generative value" of each square inch of surface moving at that particular velocity. This value depends on the magnetic induction in the gap, on the spread of the poles, on the relation between the iron and the copper on the active surface, on the current density in the conductors, etc. The writer states that as a matter of every day estimating there has been used in the offices of a British manufacturing company for some time a set of curves connecting the cost of the machine with its D^2L dimensions, and in Fig. 3 is shown the form these curves take. The reason for taking D^2L instead of $D\,L$ is that in connecting the dimensions with the output, the latter involves taking into account the surface velocity, while in estimating, revolutions per minute are always dealt with and the curves are, therefore, in a handier form for estimating purposes than would be the $D\,L$ curves. Hobart prefers the latter, however, because he has found that it approximates in practice, taking the overall dimensions of the armature, a straight line. This may prove a very useful coincidence. The author objects, however, to Hobart's designation of the expression $W/\pi\,D\,L \times$ *r.p.m.*, as "specific output" for two reasons. First, the dimensions of the space on the armature taken up by end connections have no place in an expression that purports to show whether the active surface has been utilized to advantage, for the simple reason that the space so taken up is not active. Secondly, the expression, while containing in πD r.p.m. the surface velocity, does not contain the other essential factor, which is the extent of the surface, but only one of its dimensions. In an editorial note on the article, it is pointed out that Esson does not dispute the utility of Hobart's results, and that the point of the latter's article is that $\pi D\,L$, when L is taken as the length of the armature over the end connections, is a true criterion of cost, so that the ratio $W/\pi D\,L$ measures the efficiency of design in regard to cost, if the output is considered to be proportionate to speed. It seems, however, that Hobart did not contemplate applying his criterion over such large ranges of speed as Esson does, and the latter is perhaps right in maintaining that if widely different speeds are to be compared, a formula with D^2 in it gives a ratio more justly entitled than Hobart's to be called "specific output."—Lond. *Elec.*, October 23.

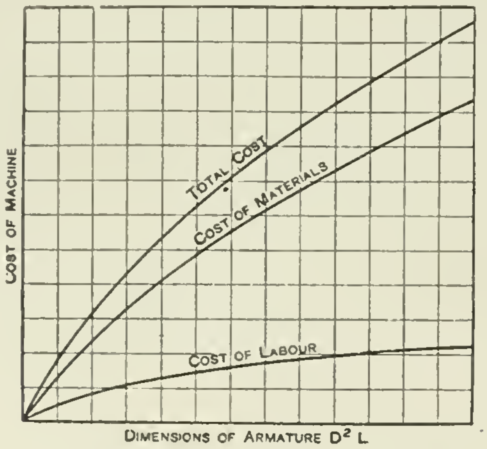


FIG. 3.—CURVES FOR OUTPUT COEFFICIENT.

Iron Losses.—Press.—A communication referring to his article abstracted in the Digest November 7. He points out that in this article the factor "2½ times" refers to eddy losses entirely. In the machines in question the total experimental determined iron losses were found to follow a law such that, with a fair degree of accuracy, they could be split up into two components, one dependent directly on the frequency for a given density and the other dependent upon the square of the frequency. The first component was found to agree very well with what would be expected to occur by measuring the hysteresis losses by means of the ordinary laboratory ring experiments. The second component, however, depending upon the square of the frequency (presumably the eddies) was found to be 2½ times greater than would be expected assuming a sine wave of flux. When analyzing the flux distribution curves and taking note of the character of the flux wave, this factor "2½ times" is practically accounted for.—Lond. *Elec.*, October 23.

REFERENCES.

Surging of Alternators Connected in Parallel.—Benischke.—A very long communication in which he continues his polemic with Goerges and Rosenberg concerning the mathematical theory of the phenomenon of surging of alternators when connected in parallel. He strongly maintains his position against that of his opponents.—*Elek. Zeit.*, October 22.

Dynamo Design.—An anonymous article on the influence of some constants on the dimensions of a dynamo. The article gives general rules for dynamo design, and as it is chiefly mathematical, containing many tables, it cannot be satisfactorily abstracted.—*Zeit. f. Elek. u. Masch.*, October 16.

LIGHTS AND LIGHTING.

Osmium Lamp.—Some notes taken from a report of the *Deutsche Gasgluehlicht A. G.*, which sells the osmium lamp in Germany. In a test made by the German Reichsanstalt of 38-volt osmium lamps during 600 hours, it was found that the consumption of current of the 30 and 35-cp lamps was 1.28 amp., so that the consumption of power is 1.43 to 1.58 watt per candle of average illumination perpendicular to the axis of the lamp. A considerable decrease of the candle-power during the 600 hours was not observed. Other tests were made by Wedding, who found that the osmium lamp when suspended vertically consumed 1.4 watt per candle against 2.5 to 3.5 watts with the carbon filament lamp. The absolute life of the lamp is far beyond 1,000 hours. Although one lamp was destroyed after 520 hours, the others which were tested had an absolute life of more than 3,320 hours. The higher the candle-power, the longer the absolute life. The "net" life of a lamp is the time in which the candle-power is reduced to 20 per cent. of its original value; none of the tested lamps decreased its candle-power to such a degree before the filament was destroyed. This means in practice a considerable advantage over carbon filament lamps. While the latter lose candle-power on account of the blackening of the globe, the osmium lamps remain clear and decrease in candle-power much more slowly. An auxiliary apparatus for introducing the osmium lamp has been placed on the market under the name of "divisor." This is a device for dividing the voltage into several equal parts, and is to be used where the lamps are not to be worked in series, but independently of each other. It is a transformer with a single winding (meaning evidently an inductance coil), divided, for instance, in three equal parts. When its terminals are connected to a voltage of the network equal to 120 volts, this voltage is divided into 3 × 40 volts. This enables one to supply three circuits of osmium lamps independently of one another. The advantages of this device over an ordinary transformer are higher efficiency and smaller cost. The company is making two types of these devices, one for 3 × 2 and one for 3 × 10 lamps.—*Elek. Zeit.*, October 22.

REFERENCE.

Lamp Fittings.— An illustrated description of several novelties in incandescent lamp fittings, placed upon the market by continental manufacturers.—*Zeit. f. Beleucht,* October 20.

POWER.

Gas Engines and Steam Turbines for Dynamo Driving.—An editorial note referring to a recent report of Robinson on the impending change in engineering practice indicated by the frequent adoption in new projects of gas engines or steam turbines instead of reciprocal steam engines for driving dynamos. It is said that British engineers were the pioneers in fast-speed engine practice, and in the application of steam turbines to dynamo driving. The first gas-driven electricity works of a large size was a British one. Yet for some reason the British engineers did not pursue their advantage and slow-speed engines became fashionable. "Continental engineers took up the problem of gas engine design where the British left it, and American engineers found it expedient to test the capabilities of the steam turbine principle for large units. In both cases their enterprise was attended with satisfactory results, and now British engineers are taking up again what they discarded several years ago." —Lond. *Elec.,* October 23.

Electric Power in Textile Mills.—A brief illustrated article on the use of electric power in a small British textile mill. A 75-hp, three-phase induction motor is located at one end of the twisting shed and drives the line shafting by six cotton ropes running on groove pulleys. Twenty twisting frames are at present driven by the motor, each having 180 spindles running at 2,500 r.p.m. The frames are driven by belts from the line shafting, and any of them can be disconnected when required by the use of loose pulleys. It is believed that the polyphase induction motor is superior to any other type of motor for this work.—Lond. *Elec. Eng.,* October 23.

REFERENCES.

Turbo-Electric Generating Plants.—Wilkerson.—A paper read before the Leeds local section of the British Institution of Electrical Engineers. The author believes it is now becoming generally recognized that where condensing water is available, the steam turbo-generator has established a record for reliability, efficiency and durability, which constitute it a formidable rival to reciprocating engines, be they slow, medium or high-speed. Descriptions are given of the following turbines: De Laval, Parsons, Westinghouse-Parsons, Willans & Robinson, Brush-Parsons, Curtis. The economy of space and building and the economy in steam consumption are pointed out, and other advantages of steam turbo-generators are referred to.—Lond. *Elec.,* October 23.

Electricity in Mining.—Allen.—A fully illustrated article on the electrical and mechanical equipment of the Kimberley mines, which are said to represent an example of an up-to-date plant and advanced practice.—*Eng. Mag.,* November.

Mechanical Applications of Electricity.—Richard.—The first part of a fully illustrated article in which the author describes various new electromagnetic couplings; also stops controlled electrically from a distance.—*L'Eclairage Elec.,* October 24.

TRACTION.

Denver Tramway System.—A description of the main power house, the transmission and distribution system and special features of construction of the Denver Tramway Power Company. The new main power house will supplant five separate stations located in different parts of the city, from which current was formerly supplied for the operation of the several lines comprising the Denver system. There are five generating units, the engines being of the cross-compound type. Three are rated at 1,300 hp with a maximum capacity of 2,000 hp, directly-connected to 800-kw, direct-current railway generators, operating at 110 r.p.m., and delivering current at 575 volts. There is also one engine of 2,700-hp capacity, operating at 75 r.p.m., and directly connected to a 1,600-kw, direct-current railway generator delivering current at 575 volts. The fifth unit comprises a 2,400-hp engine operating at 94 r.p.m., and driving a 1,500-kw, three-phase, 2,300-volt, 25-cycle alternator, current from which is transmitted to the sub-stations. An elaborate system has been worked out for condensing the exhaust from the engines and for cooling the condensing water, which is described in detail. The direct-current switchboard, which was especially designed for this plant, consists of 42 feeder panels, 4 generator panels and 3 station panels. The negative and positive leads are separated as widely as possible, the generator panels being all negative and the feeder panels all positive, with a positive switch brought out to the equalizer stand at the generator bus. The alternating-current switchboard comprises two generator and three feeder panels. One high-tension feeder line has been built from the power house to a sub-station at the company's shops, and current will be transmitted directly at the generating voltage of 2,300. The equipment of this sub-station comprises seven 185-kw, oil-cooled transformers and two 500-kw rotary converters. Another high-tension feeder line will be carried to Arvada. Current will be transmitted on this line as far as Berkeley at 2,300 volts, and at this point a transformer station will be installed to raise the line voltage to 26,400 volts for transmission to the rotary converter sub-station at Arvada. Provision has been made in the distribution system for the establishment of other rotary stations, one of which will be located on the opposite side of the city, and to which current will probably be delivered at 2,300 volts. One of the heavy feeder lines is carried across the South Platte River and over the railroad tracks in the lower part of the city. The details are fully described.—*St. R'y Jour.,* October 10.

High-Tension Direct-Current Thury System for Traction.—Blackstone.—An illustrated article on the trials made at present on a large scale on the line from St. Georges de Commiers to La Mure. The main traffic of this line is transportation of anthracite coal. Under the peculiar conditions of the road the number of trains and the number of cars drawn by a steam locomotive is limited. To increase the capacity of the line, electric locomotives have been resorted to, giving more power than the steam locomotive formerly used. Each locomotive is provided with four 600-volt, 125-hp, direct-current, series-wound motors connected in series. There are two trolley wires, the e.m.f. between the same being, therefore, 2,400 volts. The rails are used as the neutral in a three-wire system, for this purpose being in electrical connection with the joint between the second and third motors. The tension between each trolley wire and the rails is, therefore, 1,200 volts. The total weight of the locomotive is 50,500 kg. The electric operation of the line was inaugurated in August with good success.—*L'Eclairage Elec.,* October 24.

REFERENCES.

Austrian Mountain Road.—A description, taken from a report of Jordan, of the Mendel Railway, which is the first electric mountain road in Austria. On its steepest part it is operated as a cable road, beginning with a grade of 17.7 per cent. and terminating in a grade of 63 per cent. Three-phase currents are transmitted to a converter station near the road, where they are converted into direct currents. On the part which is operated by cable one car is always ascending the grade while another one is running down. On the other part of the road the trolley system is used.—*Elek. Zeit.,* October 22.

London District Railway.—A note on a recent report of Yerkes on the rapid progress which is being made in the "electrification" of the District Railway, and in the construction of the "tube lines" which are in the hands of his company. Extended precautionary measures are taken against the spread of fire, all the platforms being of cement, wood being completely discarded. Even the wooden staircases on the District Railways are to be replaced by iron ones.—Lond. *Elec.,* October 23.

Interurban Freight and Express.—A description of the organization, methods and facilities for handling express, baggage and freight of the principal interurban lines entering Cleveland.—*St. R'y Jour.,* October 24.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

British Gas-Driven Central Station.—An illustrated description of the recently-opened Ryde electricity works. The generating sets are operated entirely by producer gas. Since the district is essentially residential, the load curve can never be of the most profitable nature. It was, therefore, decided to put down plant of the least expensive type. Accumulators have been installed to deal with light loads when the station is shut down entirely. There are two sets of three-cylinder vertical gas engines of 200 maximum brake horse-power each, for a continuous working load of 150 hp at 210 r.p.m., each coupled directly to a six-pole, 480 to 530-volt dynamo, giving 200 amp. The engines work on the "Otto cycle" and are fitted with three cylinders, the cranks being set so that the shaft receives an impulse at every two-thirds of a revolution. Governing is effected by "throttling" the explosive mixture. The frequency of the impulses is the same for all loads, the predetermined ratio of gas and air remains constant, but the quantity of mixture admitted to the cylinders is controlled by the governor, and thus the consequent strength of the impulse is in proportion to the load carried by the engine. The use of three cylinders and consequent frequency of explosions, coupled with the method of governing by "throttling," results in a very even turning movement of the crank shaft, and renders the engines particularly suitable for coupling directly to dynamos. By the adoption of the vertical type of construction, vibration is reduced to a minimum, and thus very heavy foundations are unnecessary. Some information is given on various mechanical details of the engines. Besides the two dynamos, a "balancing transformer" is provided, consisting of two separate machines. It is capable of dealing with an out-of-balance current of 100 amp., when not driving the two boosters, or of dealing with 15 amp. when driving them at full power. The balancing set is coupled directly to two booster dynamos for charging the storage battery, each being capable of giving a current of 100 amp. at 85 volts. These four machines are fitted on one girder bedplate, all armatures being coupled together. The battery of 260 cells has a capacity of 750 amp.-hours at the 75-amp. rate. About three miles from Ryde is the village of Sea View, and Spring Vale lies between them. Both these places and the road which joins them with Ryde, are lighted by the Ryde station, which, for this purpose, contains two motor-alternators of 5 kw and 20 kw, respectively, supplying single-phase currents at 2,500 volts, with a frequency of 50 periods per second to a concentric high-tension main having a section of 0.025 sq. in. By the side of this main a low-tension main is laid, having four cores of 0.05, 0.03, 0.05 and 0.012 sq. in. in section, respectively. Both these mains are looped into three transformers, two situated along the line and the third at Sea View. The first three cores of the latter cable form the low-tension alternating-current distributor for private lighting between Ryde and Sea View, while the 0.012-sq.-in. core, with the neutral (0.03) is used solely for lighting incandescent lamps along the road. The transformers are situated in the top chamber of the feeder pillars, shown in Fig. 4. Each pillar is divided into three main compartments. The upper main compartment contains a 30-kw transformer. In the lower main compartment are placed the low-tension switch, links, etc. The middle compartment contains the high-tension switch and fuses and is again subdivided by a steel shelf through which projects the handle of the switches, as seen on the right hand of *A*. Since it is proposed to disconnect two transformers out of the three during hours of light load, and to switch them in again at night, a key to the smaller upper compartment only is given to an unskilled laborer. He will switch on or off both secondary and primary without being able to get at any live part whatever. The public lighting will also be controlled by a switch in this small compartment. The low and high-tension switches are mechanically coupled by levers joined by means of a pin working in slots. This arrangement insures the breaking of the secondary before the primary and the making of the primary before the secondary. In Fig. 4, *B*, it will be seen that the inner conductor of the concentric high-tension main may be cut off from the transformer by removal of links 1 and 2. The same applies to the outer, which is earthed at the station. This facilitates testing and in the event of a fault occurring on either conductor, the section may be isolated and the transformer fed back.—Lond. *Elec.*, October 23.

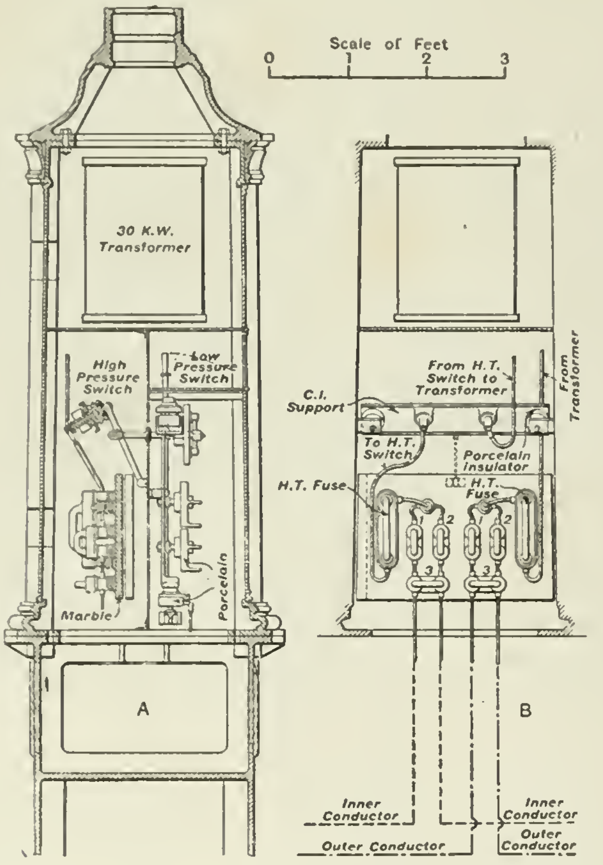


FIG. 4.—FEEDER PILLAR.

Increasing the Voltage in 110-Volt Central Station.—WYKANDER.—A communication referring to the proposal which has repeatedly been made and which has to some extent been introduced into practice (especially in England), to double the voltage in three-wire, direct current systems, with 2 × 110 volts, in order to increase the capacity of the network. This change has serious disadvantages, especially the necessity of rewinding the dynamos and motors, doubling the number of cells in the storage battery, connecting arc lamps in groups of four instead of two in series, and replacing the incandescent lamps by others for a double voltage, which are less efficient, etc. He also thinks that the increase of the capacity of the network thus obtained is often very much more than can be utilized in practice. He thinks that in most cases it would be preferable to increase the voltage to a small degree only, say from 2 × 110 to 2 × 125, 2 × 130. The capacity of the network is thereby increased by about 19, 29 or 40 per cent. Such an increase could be generally made use of to good advantage and would not involve the disadvantages first referred to, the only necessary change being a slight increase in the number of cells of the storage battery used.—*Elek. Zeit.*, October 22.

REFERENCE.

Calculation of Transmission Lines.—HRUSCHKA.—The conclusion of his article in which he discusses with the aid of diagrams the graphical method of calculating power transmission lines with converter stations.—*Zeit. f. Elek.* (Vienna), October 18.

WIRES, WIRING AND CONDUITS.

Cables.—J. SCHMIDT.—The first part of an article on the construction and manufacture of cables for other purposes than telephony and telegraphy (the Germans designate all branches of electrical engineering, except telegraphy and telephony, as Starkstromtechnik, and, therefore, speak of Starkstromkabel. We have no word for this except we adopt Swinburne's "heavy electrical engineering.") The author gives briefly an outline of the test made when a cable is delivered to the purchaser and of the guarantees which are generally given by the manufacturer. He states that cables for an e.m.f. of several thousand volts are nothing unusual now. Several firms make cables for 10,000 to 20,000 volts normal e.m.f., and no manufacturer would hesitate to make cables for higher voltages and to give corresponding guarantees. A German company is stated to have the facilities for making cables up to 40,000 volts. Another company exhibited at the Duesseldorf Exposition a three-core, 5,000-volt cable of 5 km. length, a three-core, 10,000-volt cable of 3 km. length, and a three-core, 50,000-volt cable of 750 metres length, the latter being used for lighting the main entrance. The same company exhibited a three-core cable, which was made for a normal voltage of 15,000, and was tested at the exposition up to 100,000 volts. As conducting material for underground cables, copper is used nearly exclusively, and only in very special cases has aluminum been used. The copper used has generally a resistance of one ohm for 60 metres length and one square millimetre cross-section. The smallest cross-section used in cables is one square millimetre. The largest is one thousand square millimetres. The author begins by giving a general outline of the various factors which determine the quality of a cable. The article is to be continued.—*Elek. Anz.*, October 18.

ELECTRO-PHYSICS AND MAGNETISM.

REFERENCES.

Dispersion of Dielectric Constants.—MARX.—An account of experiments concerning the change in the capacity of a liquid condenser with the frequency of the discharging current. Drude has shown that for waves having a frequency of a thousand million per second, the dielectric constants of some liquids vary with the frequency. The present author has examined longer waves, say, about 10 to 34 metres in length. Within this region no dispersion was found in the case of petroleum and benzol. In water also no dispersion of the dielectric constant could be traced.—From *Ann. d. Phys.*, No. 11; abstracted in Lond. *Elec.*, October 23.

Action of Iodine on Copper Films.—Houllevigue.—An account of a method of measuring the thickness of metallic films obtained by cathode projection. The thickness is measured by converting the film of, say, copper into iodide by suspending close to it a grain of iodine. Newton's rings are produced and by their color and configuration the thickness of the deposit may be deduced. When the thickness of the film is below 40 $\mu\mu$, it cannot be converted into iodide.—From *Jour. d. Phys.*, October; in Lond. *Elec.*, October 23.

Cathode Fall in Helium.—Defregger.—An account of an investigation in which, in connection with the work of Mey, the author studied the "cathode fall" of a number of metals in helium, where a chemical action between the metal and the gas is excluded. The fall in helium generally is remarkably slight. The succession of the metals found by Mey is not maintained in helium.—From *Ann. d. Phys.*, No. 11; abstracted in Lond. *Elec.*, October 23.

Electro-Chemistry and Batteries.

Standard Electrodes.—W. McA. Johnson.—As a continuation of his articles on electrode voltage the author gives an illustrated description of the standard electrodes in practical use, especially of the hydrogen and calomel type. The advantages of the normal hydrogen electrode in fixing a line dividing the two classes of metals—base and noble—by their electrolytic pressure, and giving a measure of the chemical potential of the cathode and catholyte, and anode and anolyte, are so great that its use as a zero point in expressing electrochemical data saves much mental labor. As a working standard the hydrogen electrode presents, however, too great technical disadvantages. For most research work, the calomel electrode is admirable in its constancy and ease of manufacture. Its results can always be reduced to the normal hydrogen standard. For most practical work with a soluble metallic anode and metallic deposition, a standard electrode of the same metal and the same electrolyte as is used in the large vat is advantageous for two reasons; it is easy to make and set up, and it records differences between the original conditions of the electrochemical system and those set up by the changes in course of electrolysis.—*Electrochem. Ind.*, November.

REFERENCE.

Electrolytic Copper Refining.—Schwab and Baum.—A full account of the experiments which the authors have made to determine the best current density and temperature for copper refining. The paper contains all results in form of tables and diagrams. As the results of this investigation have already been given by Bancroft in a recent Electrochemical Society paper, references to the abstract of this paper in Electrical World and Engineer, September 26, page 519, must suffice.—*Jour. of Phys. Chem.*, October.

Units, Measurements and Instruments.

REFERENCES.

Electrochemical Units of Measurement.—Nernst.—A full abstract of a paper presented before the Berlin International Congress for Applied Chemistry. In this paper Nernst, as chairman of a special committee of the German Bunsen Society, proposes a table of electrochemical symbols. It was adopted by the congress, together with an amendment of Noyes to appoint an international committee of five, which shall report on this subject to the next congress to be held in Rome in 1906.—*Electrochem. Ind.*, November.

Testing Railway Motors.—Abry.—In an article of his series on shop testing of motors and generators for commercial service, he deals with tests of the direct-current series railway motor.—*Elec. Rev.*, October 31.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—An article and an editorial on recent legislation of British crown colonies with regard to wireless telegraphy. The result of this legislation is practically to reserve to the government of each of these colonies a monopoly in wireless telegraphy. Not only is the transmission of commercial messages forbidden, except under license, but the actual erection or use of any wireless telegraph apparatus is made illegal unless with express authorization. It is pointed out editorially that to insure an effective system of wireless telegraphy between ships and land an international agreement must be reached.—Lond. *Elec.*, October 23.

Calculator Board.—Raymond-Barker.—Supplementary to a former article describinb an instrument, called a calculator board, he now begins a series of notes in which he shows how to apply the calculator board in practice. The notes are especially written for the use of those officials at cable stations responsible for the routine cable tests and for the localization of any cable breaks that may occur.—Lond. *Elec. Rev.*, October 23.

New Books.

Die Elektrochemie. Industrie und Gewerbe. Ausstellung in Düsseldorf, 1902. Von H. Danneel. Halle: Wilhelm Knapp. 84 pages, 66 illustrations. Price, 6 marks.

This is an amplified reprint of a report published by the author in the *Zeitschrift für Elektrochemie* on the electrochemical and metallurgical exhibits at the exposition held at Düsseldorf in 1902. It contains some interesting information on magnetic separators, the Elmore copper process, and the Goldschmidt thermit process.

BOOKS RECEIVED.

Cours D'Electricite. By H. Pellat. Paris: Gauthier-Villars, 2 volumes. Vol. I, 329 pages, 145 illustrations. Vol. II, 522 pages, 221 illustrations. Price, 28 francs.

Friction and Lubrication. By William M. Davis. Pittsburg: The Lubrication Publishing Company. 225 pages, 60 illustrations. Price, $2.

A New Apparatus for Making Direct Reading Measurements of Electrical Conductivity.

By Wm. Hoopes.

About three years ago the writer was confronted with the problem of accurately determining the conductivity of 100 or more samples of wire in each single working day, and as this appeared impossible with any form of apparatus then on the market, necessity compelled the construction of a special piece of apparatus which would permit the result to be obtained. Accordingly, I designed and had made for the Pittsburg Reduction Company a new form of apparatus for measuring the conductivity of aluminum. This piece of apparatus has been in continuous service since. The arrangement by which it is made direct reading is, I believe, new. As the same arrangement can be used for the measurement of conductivity of copper, iron and other metals, and as it saves a large amount of time in making these measurements, I believe that a description of it will be of interest. As I have designed it, it is arranged to make the measurements on short samples of rods or wires about 38 in. long. The arrangement of the scales which makes the apparatus direct reading may be explained by referring to Fig. 1.

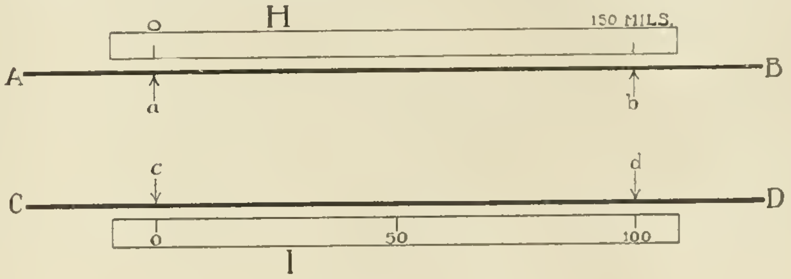


FIG. 1.—ARRANGEMENT OF SCALES.

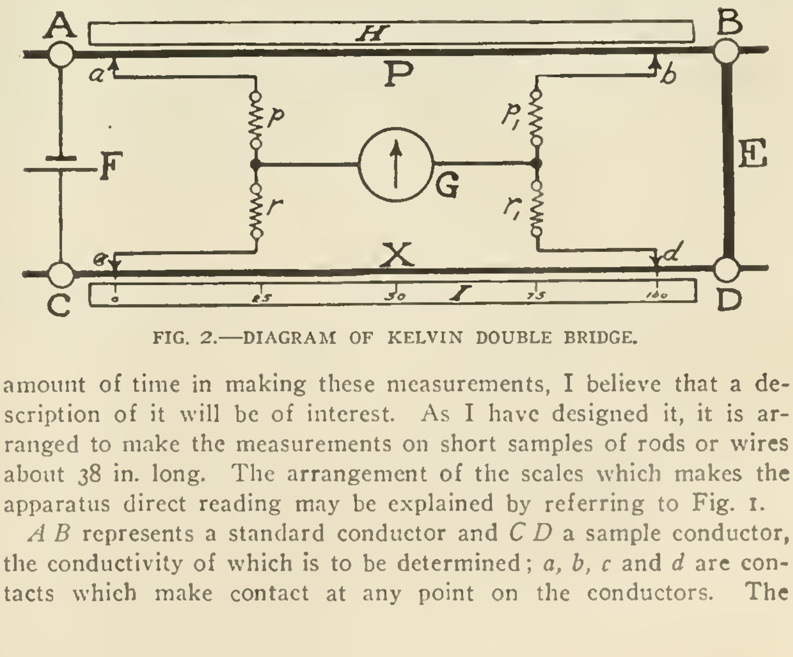


FIG. 2.—DIAGRAM OF KELVIN DOUBLE BRIDGE.

A B represents a standard conductor and *C D* a sample conductor, the conductivity of which is to be determined; *a*, *b*, *c* and *d* are contacts which make contact at any point on the conductors. The apparatus requires, in addition to what is shown in the figure, some means of determining when the resistance of the portion *A B* between the points *a* and *b* is equal to the portion *C D* between the points *c d*. As this may be done in several ways, and as it has nothing to do with making the apparatus direct reading, I shall reserve a desription of what I consider the best method until later. The arrangement of the scales can best be illustrated by an example. The scale *I* is in all cases the same and is divided into 100 equal parts. Assume the wire, *C D*, to be soft copper and to have a diameter of 150 mils. The length of 100 divisions on the scale *I* of this wire would have a certain resistance in ohms if the wire were at a temperature of 20° C. and were 100 per cent. conductivity, Matthiessen standard. Call this resistance *R*. The wire *A B* is then to be made of the same material and of such a size that a length of it having the resistance *R* at 20° C. will come on the scale *H*. A division is made on the scale *H* and marked 150 mils at such a position that the resistance of *A B* between *o* and this division is *R* at 20° C. To make a conductivity reading, the wire, *C D*, being 150 mils in diameter, the points *a b* are set at zero and the 150 mils mark, respectively; the point *c* is set at 0 and the point *d* is moved until the indicating device shows that the resistance between *c* and *d* is equal to that between *a* and *b*. If *C D* is 100 per cent. conductivity, *d* will obviously come to rest at 100 on the scale *I*, and this will be the case whatever temperature the two wires have, provided only they have the same temperature. If, however, the conductivity of *C D*, is less than 100 per cent., the point *d* will come to rest nearer 0, as *C D* will have a higher resistance and a shorter length of it will equal *a b*. The amount which the contact *d* moves toward 0 will be exactly proportional to the increase in resistance, and consequently to the decrease in conductivity. If the conductivity of *C D* is 98 per cent., then 98/100 of 100 divisions will have exactly the same resistance as 100 divisions of 100 per cent. conductivity.

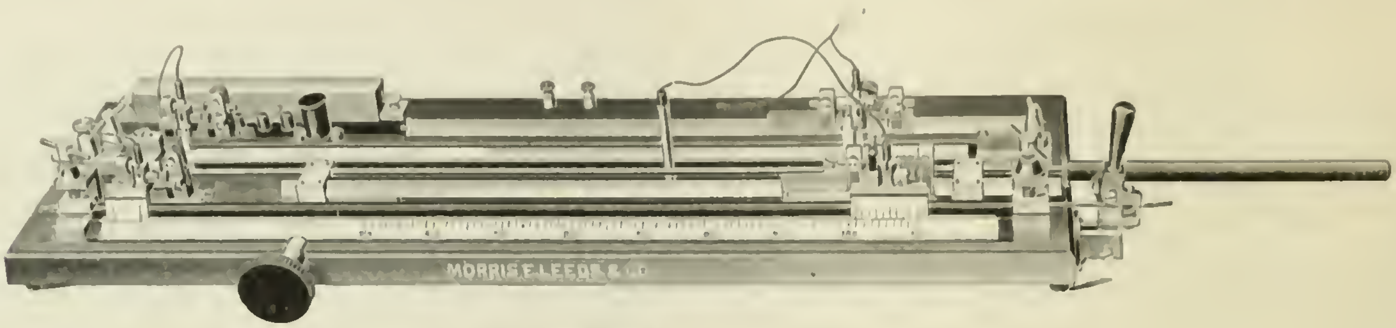


FIG. 3. GENERAL VIEW OF BRIDGE.

The apparatus is consequently direct reading for copper wires 150 mils in diameter. To make it so that it can be used with other size wires, other points must be laid off on the scale *H*. For instance, a wire of 300 mils diameter would have four times the cross section of a wire of 150 miles diameter, and consequently a length of it of 100 divisions on the scale *I* would have only ¼ the resistance of the 150-mil wire. The point 300 on the scale *H* would consequently have to be chosen so that the resistance between it and 0 is ¼ that of the resistance between 150 and 0. In the same way a large number of other points may be laid off on the scale *H*, so as to make a single standard wire serve for a range of sizes of sample wires. I have found a length of 25 in. for the scales *I* and *H* satisfactory in practice. Using these lengths, I have not considered it advisable to make the scale *H* cover such a wide range as the above example would indicate, as short lengths on the scale H would require too great refinements of the apparatus to make the length measurements to the required degree of precision. I have considered it advisable not to extend the graduation much nearer to 0 than the middle point of the scale. This obviously makes a single sample wire and its scale cover a range of sizes from a cross section corresponding to the outer point of the scale to a cross section twice as great corresponding to the middle point of the scale. In other words, a single scale could be used for wires having a cross section *n* circular mils to wires having a cross section 2*n* circular mils; this is the same as covering a range of three numbers on the Brown & Sharp scale. I have found it advisable to extend the graduations slightly so that in a series of standard wires their scales will slightly overlap and they may thus be compared among themselves.

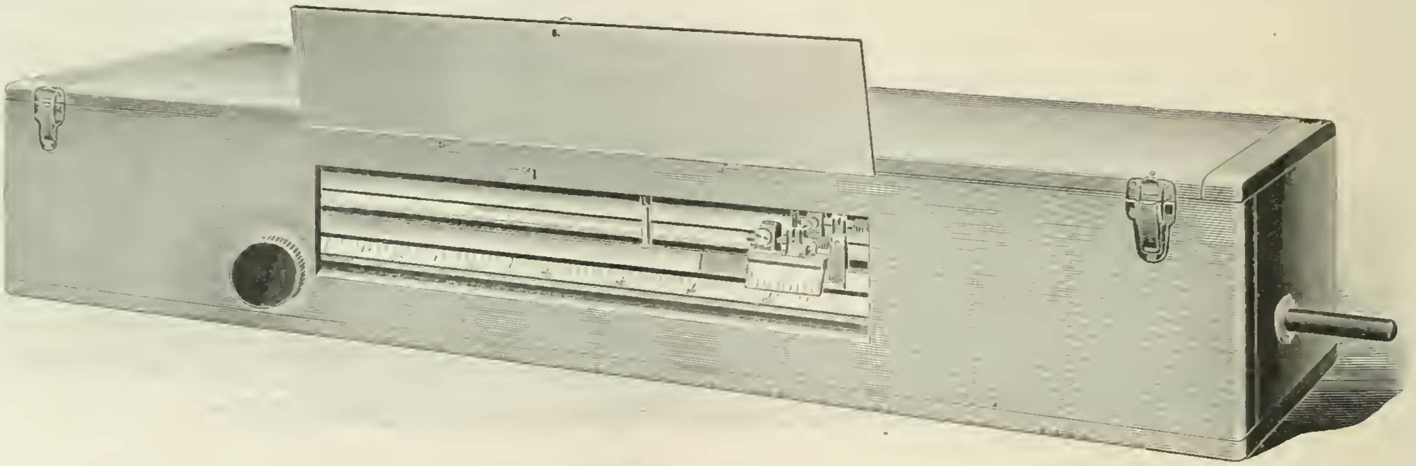


FIG. 4. BRIDGE ENCASED.

In practice it is troublesome to determine accurately, by measurement, the cross section or diameter of a wire 25 in. long, as a number of measurements have to be made and the average taken. It is usual to determine the cross section by weighing a piece of known length and from a known or assumed specific gravity calculate it. To avoid this calculation, I have made use of the following simple expedient: A cutting-off machine is used which cuts off all of the samples to a definite length. These pieces are then weighed and their weight recorded. The scale *K* is graduated in weights instead of diameters or cross sections. Having determined the weight of a sample, cut off to the proper length, its conductivity is measured by the following simple operations: First, put the sample in the position *C D*. Second, set *b* at the position marked with the weight of sample in grams. Third, move *d* until the galvanometer shows a balance. From the position of *d* the conductivity is read off directly from the scale.

The arrangement that I have adopted for showing that the resistance of the portion of the conductor *A B* between the contact points, *a* and *b*, is equal to the resistance of the portion of the conductor, *C D*, between the contact points, *c* and *d*, is the well-known Kelvin Double Bridge. It is illustrated in diagram in Fig. 2. In this figure p and $p_1 r$ and r represent three accurately adjusted equal high resistances. P and X represent the resistance of the conductors between the contact points, *a* and *b*, and *c* and *d*, respectively. By the theory of the bridge, $P \div X = p \div r = p_1 \div r_1$ if there is a current flowing and the galvanometer shows no deflection. As the resistances p, p_1, r and r_1 are made equal to each other, a galvanometer balance shows that $P = X$. Provided the ratio coils are accurately adjusted, errors due to contact resistances are the only ones that can occur. To prevent these the resistances p, p_1, etc., are made high so that contact resistances in series with them will not seriously influence the total. It will be observed from the arrangement that these contact resistances do not figure at all into the resistances of the standard or test piece, but only figure into the resistance of the ratio coils, and even there the error is only due to the difference in contact resistance. There is no objection to making the resistance of these ratio coils high, as the apparatus remains amply sensitive when a proper galvanometer is selected, and does not in any case require the use of a sufficiently large current to heat the standard or sample enough to introduce errors.

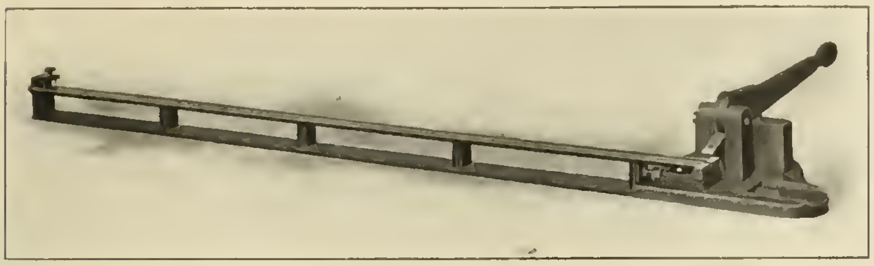


FIG. 5.—WIRE CUTTING MACHINE.

The apparatus was made for me by Morris E. Leeds & Co., now the Leeds & Northrup Co., of Philadelphia. In the following figures the form in which it has been made up is shown. The details of the design were all made by the manufacturers. Fig. 3 shows the bridge. The standard conductor is shown in the back and the two contacts on it are made by means of knife edges; one remains set at the zero position and the other slides up and down, so as to take any position on the scale. By a special locking device, the latter is arranged so that it cannot be moved along the standard except when the knife edge is raised. This is arranged to prevent wear on the standard. The sample wire is clamped in the front and also has two knife edges making contact on it, one at the zero position, which remains fixed, and the other at the other end, which is movable. Wires which are not perfectly straight can be stretched straight by means of the device shown at the right-hand end. The long rod also projecting from the right-hand end is used to give large movements to the contact knife edge, and the handle projecting from the front towards the other end works a rack and pinion which gives it small movements. The exact position of the knife edge is read by means of a vernier and is easily readable to 1/10 of 1 per cent. and estimated to 1/20 per cent. In order to keep the two wires at the same temperature, the entire apparatus is enclosed in a case which is lined with metal and which is shown in Fig. 4. The two handles for operating the movable knife edge of the sample project from this case. The case is lined with metal to prevent errors due to radiated heat. The small door in front which covers a glass opening and is shown open in the illustration, is also of metal. In Fig. 5 the cutting-off machine is shown, by means of which wires are cut off to the definite length of 36 in. A simple form of balance is used for weighing wires to a sufficient degree of accuracy if they are size No. 10 B. & S. gauge or larger. If the wires are smaller than No. 10, they have to be weighed in an analytical balance. As the process requires that they be weighed before they are measured, it is necessary to make the weighing without folding up the wire. This cannot be conveniently done on an ordinary balance, and consequently a special arrangement has been adopted. One of the scale pans of the balance is replaced by a thin walled tube, which projects out of the top and the bottom, and which hangs from the top of the case when the balance is in the arrest position. With this arrangement it is a simple matter to weigh wires to the required degree of accuracy.

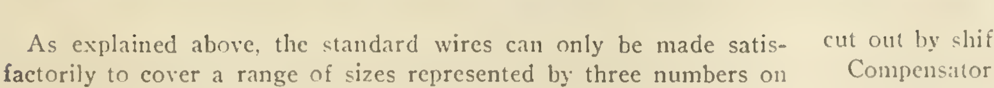


FIG. 6.—SINGLE STANDARD AND SCALE.

As explained above, the standard wires can only be made satisfactorily to cover a range of sizes represented by three numbers on the Brown & Sharp gauge. If the apparatus is to be used for measuring a large range of sizes, it is consequently necessary that it be made so that the standards can be replaced. This is accomplished by mounting the standard wire and its scale on a piece of hard rubber, which is strengthened with metal. The two ends of the wire are so arranged that when the standard is screwed into place by means of the heavy clamp screws shown in Fig. 3, the electric connections are made at the same time. As any number of these standards may be supplied for a single bridge, it can be used for an extensive range of sizes, and can also be used for wires of different materials. A single standard with its scale is shown in Fig. 6.

The simplicity of the process of making the measurements will be evident from the following directions which cover all of the steps that are necessary. The sample wire is cut off to length in the cutting-off machine, Fig. 5. It is then weighed in one or the other of the balances referred to, depending on its size, and the weight having been noted, clamped into place in the bridge. The movable contact on the standard is set on its scale at the reading taken from the balance. The entire apparatus is then shut up in its case, Fig. 4, and after it has remained there a sufficient length of time for the standard and the sample to assume the same temperature, the movable contact on the sample is adjusted until the galvanometer shows a balance. The metal lid is then lifted and the percentage conductivity can be read directly from the scale, through the glass window.

Induction Motors.

In order to meet the various demands met in power work, the General Electric Company has developed three different types. One of these is distinguished by the characteristic that it has a variable starting resistance inside the motor secondary or armature; the second has a short-circuited armature, and is used with a starting compensator which is connected in the motor primary or field circuit, and the third is like the first-mentioned, but the armature is equipped with collector rings and the resistance is external and can be cut in or out by means of a controller.

The motor with starting resistance in the armature is provided with a short circuiting switch placed in such a position that at starting all the resistance is included in the armature circuit. As the motor increases in speed, the resistance may be gradually cut out by a movement of the resistance handle. By this arrangement, a large starting effort is obtained with a limited starting current. The starting resistance is of simple and rigid construction, and occupies only a small space within the armature spider. It is so designed as to give a maximum starting torque at least 50 per cent greater than the full load running torque with about 50 per cent above full load current. If small starting torque is adequate, the starting current may be proportionally reduced.

When the effect of a large starting current is not objectionable in the line, or when a motor is not required to start with full load, the induction motor with starting compensator may be used. This type of motor has the advantage of greater simplicity in construction. The armature is of the squirrel cage type, consisting simply of bare copper rods, laid in slots which contain little or no insulation. The motor may be started if desired without the usual starting compensator by simply closing the field or primary switch. It will then carry its load up to nearly synchronous speed, but with a first rush of current of six or seven times full load current. In order to cut down the starting current of this type of motor when the maximum starting torque is not required, a starting compensator is used. It is connected between the line and the motor like a transformer, reduces the potential at the terminals of the motor, and consequently diminishes its starting current. For full load torque at starting, this type of motor requires approximately four times full load running current or about four times the current required by the ordinary motor under similar conditions. If, therefore, the starting current must be kept at or below full load current, the motor cannot be expected to exert more than one-quarter full load torque at starting. As soon as the motor reaches its maximum speed, the compensator should be cut out by shifting the switch handle to the running position.

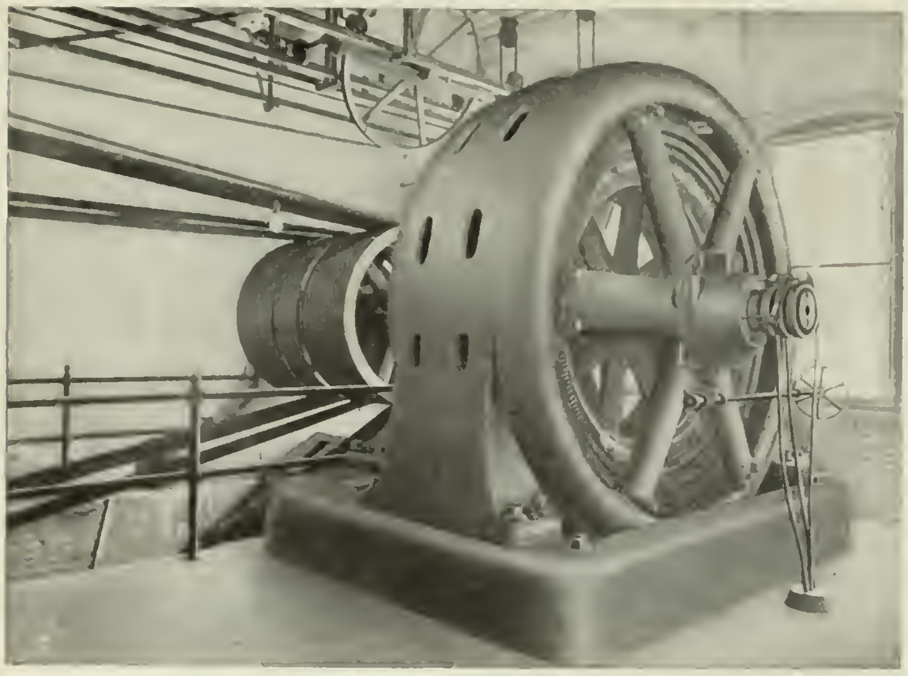
Compensators are equipped with oil break switches and cartridge fuses. These fuses are connected in the line only when the starting switch of the compensator is thrown on the running position. This arrangement insures ample protection to the motor, making an additional switch and fuses for the line unnecessary.

The motor for variable speed is generally used for cranes, hoists, elevators, etc., for the reason that it gives a high power factor and efficiency at reduced speeds, and particularly excels in having so much smaller losses in the motor itself. Further, its variation in speed for changes in load at lower speeds is small. The rheostat, where most of the losses are concentrated, is external, and therefore readily designed to remain continually in circuit, and to give any variation in speed that could be obtained from a shunt wound continuous current motor with a regulating rheostat in its armature circuit, and with the same efficiency of control.

The variable speed motor with secondary control takes less current from the line at starting, for the same torque, than a motor with primary control. They will give within the limits of synchronous speed and maximum torque, any speed with any torque, depending upon the amount of resistance employed.

In consideration of the intermittent nature of variable speed service generally, and of the fact that the classification of the motor gives its rating on the basis of continuous operation, due allowance should be made in determining the proper motor to be used.

Induction motors for hoisting are designed to have a breaking-down point of not less than three times their rated torque. Taking this into account in connection with the fact that the average hoist does not run over 10 per cent of the time, so that there is no trouble from heating, it will be observed that in general the proper motor to use will be one the rated horse-power of which is the same as the theoretical horse-power of the work. The additional requirements to overcome friction and allow for acceleration are covered by the increase in output made possible by the intermittent service. Slow speed motors are recommended whenever induction motors are to be geared, as in hoisting. This prevents excessive gear teeth speeds with the resultant breakage of gears, and also reduces the power required to accelerate and retard the motor armature.



1000-HP INDUCTION MOTOR.

Induction motors can be constructed for two speeds, half normal speed being obtained by changing from normal to double the number of poles. For the rotor, a short-circuited winding is used. At half speed such a motor will have approximately half its normal capacity.

Large induction motors are in many cases preferable to synchronous motors since they can be operated under conditions where synchronous apparatus would have a tendency to hunt. Induction motors have a greater torque at starting, require no auxiliary equipment with exception of starting device, and consequently can be operated with less attention and less experienced attendance. They are constructed in all three of the types above mentioned. In the larger units, however, it is desirable, even where the resistance is used only for starting, to have it separate from the motor and to use collector rings. Such motors, unless for variable speed, are furnished with a switch inside the armature so that the collector rings can be short circuited after the motor has reached normal speed.

The General Electric Company has manufactured during the past year twenty-two induction motors of 500 hp and over, aggregating 15,600 hp, or an average of over 700 hp each. A motor of 1,000 hp made for the U. S. Rubber Reclaiming Works, is shown in the accompanying illustration.

Form K motors having a double throw line switch may be started under low voltage from taps on the secondary of transformers instead of employing compensators for this purpose. This arrangement is especially desirable on account of simplicity and cost where several motors are located close to the bank of transformers from which they are operated.

Within the limits of variation found under ordinary conditions, there is no serious objection to either an increased voltage or a reduced frequency, except, of course, that in the latter case the speed of the motor will be reduced in the same ratio as the frequency.

When the voltage is decreased, however, the maximum output of the motor will decrease as the square of the voltage, and when the frequency is increased, the maximum output will decrease approximately as the square root of the frequency.

Christmas Tree Lighting.

The trouble and difficulty incident to wiring a Christmas tree for incandescent lamps has heretofore been the only drawback to their use. To remedy this the General Electric Company has prepared an outfit of sockets and cord connected and completely made up, ready for immediate use. The cord is simply draped over the tree, the lamps placed in their sockets, the connecting plug attached to the nearest electric fixture and the current turned on. All the lamps are instantly lighted and burn without further attention as long as desired. The outfit is light and flexible, thoroughly well constructed and "fool proof."

ELECTRICALLY-ILLUMINATED CHRISTMAS TREE.

Each regular outfit comprises some 50 ft. of flexible cord with tiny sockets, arranged in three branch festoons, and 28 one-candle-power miniature genuine Edison lamps in plain and colored bulbs, sufficient for the average Christmas tree. The outfit is neatly packed in a handsomely decorated wooden box, and forms a safe and charming Christmas gift for any household. Special outfits containing a larger number of sockets for large trees can be furnished when desired. The outfit is of value not only for Christmas trees, but also for general house decoration upon the table, about the walls or around columns, over the balustrade or from chandeliers—at all times and seasons. An outfit once purchased lasts for years and can be used repeatedly with no trouble or further expense. It is believed that if the field of application for such work is investigated by those who are interested in the sale of light, current or supplies, they will find a large and growing demand for such devices as that just noted—whether for Christmas or for any other season.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The continued movement of money to the interior, high rates of interest in the loan market and the unfavorable developments in the steel trade adversely affected the stock market. One of the results was a severe break in prices for United States Steel securities and this influenced both the industrial and general railway list. The transactions were on a small scale and mainly professional. Prior to Tuesday—election day—considerable strength and activity developed in the local New York traction stocks, based on predictions of a change in the municipal administration, but the rise failed to be sustained when the result of the election was determined. Further shipments of money from New York to Western and Southern cities resulted in an estimated loss of some $10,000,000 by the banks. The prevalent rate for call money is about 4½ per cent., and time money ruled at 6 per cent. Boston advices are to the effect that the market there during the week ruled slow, with a general easier tendency. The week's closing prices of tractions showed a gain of ½ point for Brooklyn Rapid Transit, which closed at 35¾ after having recovered from 34½, the lowest figure, the highest being 37½. Metropolitan Street Railway closed at 109, this being a net loss of ¾ point. Manhattan Elevated made a gain of 1¼ points, closing at 136½, which was ¼ below the highest figure of the week, the lowest being 134¼. General Electric fell to 146, but closed at 147, this, however, being a net loss of 1½ points; the highest quotation was 152¼. Transactions in this stock were limited, only 2,125 shares having been sold. Westinghouse common reached 138, but receded and closed at 135, which was the lowest figure of the week and a net loss of 2 points. Western Union made a net gain of ¼ point, closing at 83. Following are the closing quotations of November 10:

NEW YORK.

	Nov. 4	Nov. 10		Nov. 4	Nov. 10
American Tel. & Cable......	78	78	General Electric.	150	148
American Tel. & Tel........	128	125	Hudson River Tel...........	..	..
American Dist. Tel....	24	23	Metropolitan St. Ry.........	110¼	111½
Brooklyn Rapid Transit ...	35⅝	37	N. E. Elec. Veh. Trns........	..	..
Commercial Cable.	..	140	N. Y. & N. J. Tel............	..	140
Electric Boat	20	19	Marconi Tel.................	..	..
Electric Boat pfd............	44	42	Western Union Tel...... ...	83	82½
Electric Lead Reduction.. .	*1⅛	⅞	Westinghouse com....	136	134½
Electric Vehicle.............	5½	5⅛	Westinghouse pfd..........	165	162½
Electric Vehicle pfd........	8	8½			

BOSTON.

	Nov. 4	Nov. 10		Nov. 4	Nov. 10
American Tel. & Tel	127⅛	126¼	Western Tel. & Tel. pfd....	75	75
Cumberland Telephone....	..	*115	Mexican Telephone.........	1⅛	1⅛
Edison Elec. Illum...	244	240	New England Telephone. .	*123½	123
General Electric............	150	146	Mass. Elec. Ry..	18⅛	18½
Western Tel. & Tel.........	8½	8	Mass. Elec Ry. pfd.... . .	77½	76

PHILADELPHIA.

	Nov. 4	Nov. 10		Nov. 4	Nov. 10
American Railways.........	43	42	Phila. Traction..	95¼	95½
Elec. Storage Battery.. ...	47	45	Phila. Electric.............	6⅛	6
Elec. Storage Battery pfd.	47	45	Phila. Rapid Trans........	12	11¾
Elec. Co. of America.	7⅜	7⅜			

CHICAGO.

	Nov. 4	Nov. 10		Nov. 4	Nov. 10
Central Union Tel.	..	..	National Carbon pfd.......	..	86
Chicago Edison.........	140	140	Metropolitan Elev. com.....	17	17
Chicago City Ry....	167	165	Union Traction	6	5½
Chicago Tel. Co	115	120	Union Traction pfd.........	30	29
National Carbon	17¼	20			

*Asked

CHICAGO LAKE STREET L.—A reorganization of the Lake Street Elevated Railroad Company has been made and will be carried out as soon as practicable. A new company with a new name is to take over and operate the property. The new company will be capitalized as follows:

	New.	Old.
Stock, common	$6,000,000	$10,000,000
Stock, preferred	3,200,000	....
First mortgage bonds	5,000,000	5,860,000
Income bonds	....	1,023,500
Totals	$14,200,000	$16,883,550

The plan of reorganization sets aside $2,000,000 of preferred stock, $2,000,000 of common stock and $500,000 of treasury bonds, the proceeds of which with the $200,000 assessment paid by the stockholders on the basis of $2 per share, will be used for paying the indebtedness of $1,400,000. The Northwestern Elevated Railroad Company has agreed to accept a settlement of its claim of $770,000, a debenture note of the company for $350,000, payable in five years, with 2 per cent. interest. In consideration of the reduction of the bonds from $5,860,000 to $5,000,000, the bondholders will be requested to present their bonds to have stamped upon them that fact, and also a provision that they may be redeemed by the company on any interest pay day, at 105 with accrued interest. The $3,200,000 of preferred stock will go to the income bondholders to the amount of 80 per cent. of the par value of their bonds. The existing stock of a face value of $10,000,000 is to be wiped out. In its place will be issued $6,000,000 of common stock and $3,200,000 of preferred stock.

LIGHTING IN NEW JERSEY.—The Public Service Corporation, of Newark, N. J., has arranged for the purchase of all of the stock of the Central Electric Company, which is located at Metuchen, and which supplies light and power to that town besides the municipalities of New Brunswick, Perth Amboy, Rahway, Woodbridge, Raritan Township, Carteret, Bound Brook, Dunellen and South Plainfield. The purchase price of the stock is quoted at $17.50 per share. The Central Electric Company has a capitalization of $750,000, together with an issue of bonds aggregating a like amount. The bonds are 5 per cent. first mortgage gold bonds, secured by a consolidated mortgage on all the property of the company, and are payable in forty years from July 1, 1900. The Central Electric was organized a few years ago by the consolidation of the Middlesex Electric Company, the Edison Electric Illuminating Company, the Raritan Electric Light & Power Company, the Rahway Electric Company, and the Bound Brook Electric Light, Heat & Power Company.

MICHIGAN TELEPHONE COMPANY.—A dispatch from Detroit, Mich., states that the Michigan Telephone Company was purchased on November 4 at foreclosure sale by N. W. Harris, of Chicago, for a syndicate of bondholders of the company, for $4,100,000. The only other bidder was Gen. E. P. Meaney, of New York, representing the American Telephone & Telegraph Company, who bid $4,000,000. The upset price for the property was $2,500,000. George W. Harriman, of Boston, the dispatch adds, made formal protest against the sale in behalf of himself and other stockholders, declaring that he believed the plant was being sacrificed. The Michigan company was the subsidiary company of the Bell system in the State of Michigan. It is stated that the interest has been due for a year on $5,000,000 first mortgage bonds.

GERMAN ELECTRICAL OUTLOOK.—A leading New York house is said to have just sold in Berlin a block of stock of the Schuckert Company, one of the leading electric concerns in Germany, at 114½. A year ago this stock sold around 75. The advance illustrates the revived confidence in German circles.

CAMBRIDGE (MASS.) STOCK INCREASE.—The stockholders of the Cambridge Electric Light Company, at a special meeting, have voted to increase the company's capital stock from $600,000 to $700,000 by the issue of 1,000 shares of new stock.

Commercial Intelligence.

THE WEEK IN TRADE.—On the whole, trade and industry presents a quieter aspect, the unseasonable weather affecting retail trade at many centers, while conservatism in providing for future requirements restricts jobbing trade. Relatively the most activity exists in the South, where the growth of the cotton movement at the high prices ruling stimulates business at many centers. In industrial lines reports of curtailed production indicate that demand is somewhat lagging. Railway earnings are feeling the effects of smaller receipts of wheat, but still they show increases over all preceding periods at this date. Prices display an easier tendency except for cotton, which is at the highest level reached for many years at this season. Finished iron and steel head the downward movement of manufactured goods, but there are signs of reawakening in the foreign and domestic demand, which, it is hoped, will bring about improved conditions. President B. F. Jones, Jr., of the Jones & Laughlin Steel Company, of Pittsburg, states that consumers have been holding off for some time expecting a reduction in prices. Rock bottom having now been reached, he looks for an immediate revival in the trade, and a resumption of all the mills to their full capacity. It is officially announced that the only changes in the prices made at the recent New York conference were in Bessemer steel billets, which were reduced from $27 to $23 a ton, and steel cars from $32 to $26 a ton. Finished products remain unchanged. After an idleness of five or six weeks about 2,000 men have resumed work in the McKeesport mill district. The commercial failures during the month of October were more numerous than in any month since January last, and the heaviest for October since 1893. They numbered 1,086, the liabilities aggregating $18,387,567. Manufacturing failures numbered 316 with an aggregate of $11,995,309 in liabilities, and the trading failures numbered 720 with liabilities of $5,536,129. The heaviest increases of failures in commercial enterprises were in iron, foundries and nails. In commenting on the above record, R. G. Dun & Co point out that it is encouraging that the abnormal big commercial liabilities last month were largely provided by a few failures. Less than 3 per cent in number accounted for about 54 per cent. of the defaulted indebtedness. The number of failures for the week ending November 5 aggregated 216, against 217 the week previous, and 148 the corresponding week last year. The copper market was quiet but firm throughout the week, a fair amount of business having been transacted. Inquiry from Europe continues quite brisk. The closing quotations are 13½ to 13¾c. for Lake, 13¼ to 13½c. for electrolytic, and 13 to 13¼c. for cathode and casting stock.

MORE POWER PLANTS NEEDED.—In February the New York State Railroad Commission investigated the matter of improving the condition of passenger transportation in New York City. In June the commission made a report of its investigations. It has now made a second report with reference especially to the capacity of the electric power houses of the several street railways. The report says that lack of foresight in providing for increased business has been shown by the Brooklyn Heights, the Coney Island & Brooklyn, the New York & Queens County, and the New York & North Shore Companies. "The Manhattan Elevated road," says the commission, "has not sufficient power of its own to fully and reliably operate its lines; it has, however, made arrangements with other companies to secure a necessary supply. The Metropolitan Street Railway (Interurban) and the Union Railway have an ample supply of power to operate more than the maximum number of cars now in use. The Brooklyn Heights Company, operating most of the surface and all the elevated lines in Brooklyn, has not sufficient power to operate the requisite number of cars for the accommodation of the public." The commission gives statistics showing a great and rapid increase of traffic on nearly all the lines operating in New York and Brooklyn. Arrangements have been perfected by all except the New York and Queens County to provide power for the operation of an increased number of cars. The report says that prolonged strikes have delayed the completion of power houses and the securing of the necessary machinery.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the "chloride accumulator," has recently closed a contract through the Canadian General Electric Company, Limited, its representative in Canada, for an installation in the power house of the Toronto Railway Company. This battery, to be used on its system, consists of 276 cells having a capacity of 3,000 amp. for regulating. A contract has also been closed with the Bangor Public Works, Bangor, Me., for a railway battery consisting of 264 cells having a regulating capacity of 160 amp. This battery has containing cells of sufficient capacity to allow of a future increase of 50 per cent. The Carnegie Steel Company has contracted for the installation of a battery at its Youngstown (Ohio) works for use in regulating the violent fluctuations of load due to the starting and stopping of motors, this battery having a capacity of 1,600 amp. at 200 volts. The Chicago Edison Company has contracted for a battery for its Haddock Place station having a capacity of 16-800 amp.-hours at 128 volts. Contracts have also been closed with the United States Government for a battery at Fort Totten, consisting of 62-640 amp.-hour cells, the Stevens Building, Detroit, Mich., 140-160 amp.-hour cells, the House of the Good Shepherd, Roxborough, Mass., 62-160 amp.-hour cells, and Johnson-Kahn Company, 68-560 amp.-hour cells, these latter installations being for lighting and power work.

WIRELESS TELEGRAPH CONTRACTS.—We are informed that the "Telefunken" Company for wireless telegraphy, of Berlin, has received another large order from the United States Navy, for the equipment of ten more ships. The United States Navy will, therefore, have in a short time more than 60 stations of this system. The station equipment last ordered will be shipped directly to Eastern Asia in order to be installed on board the ships of the American navy stationed there. It is to be assumed that in this way a larger number of stations for wireless telegraphy will be formed at the coast and in the interior of eastern Asia. The company mentioned is very active at present in the sea north of Germany, to equip all light ships with apparatus for communication with the coast stations of the German navy. The Swedish navy has also adopted the Telefunken system and operates at present more than 20 stations. This year's naval manœuvres have given satisfactory results with respect to the reliability of the system and the distance of the transmission of messages, so that the equipment of further stations is expected.

MAGNETIC SEPARATION OF ORES.—We have received the following from the Maschinenbau-Anstalt Humboldt, of Kalk, near Cologne: "Our attention has been drawn to an extract appearing in your issue of the 1st of October under the heading, 'Magnetic Separation of Ores—Fabre,' and we should not like to let this pass without pointing out that it does not quite correctly describe the situation, as we, the above named company, have taken over the management of the Wetherill business which was formerly in the hands of the owners, the Metallurgische Gesellschaft, of Frankfort, of the Wetherill patents, by arrangement with the European Wetherill syndicate. In our works we have a perfectly-arranged testing station, which can be placed at the disposal of people interested. The Wetherill separators are manufactured in our works, and we have already fitted up a large number of plants with them."

POWER FROM THE OHIO.—A special dispatch from Cincinnati of November 9 says: "Leading electricians from all parts of the country were in conference here this afternoon over the proposition to utilize the falls in the Ohio River at Louisville for power for traction, electric light and other plants throughout Indiana, Kentucky and Ohio. The Philadelphia syndicate which controls the traction lines in Cincinnati, Indianapolis, and other parts of Ohio and Indiana has had experts examining into the feasibility of the plan for some time, and they have reported favorably. At Louisville to morrow the engineers who were here to day will confer with government engineers before taking the matter up with Congress."

PELTON WATER WHEEL CONTRACT.—The Edison Electric Company, of Los Angeles, has recently contracted with the Pelton Water Wheel Company, of San Francisco, for two 500-hp water wheels to drive electric generators in the new station on Lytle Creek, near Redlands. This makes the fifth hydraulic station of the Edison Company. The wheels will work under 480-ft. head and will be equipped with needle regulating nozzles, adjustable by hand, and leather-packed ball joints, operated by governor. The generators will be two General Electric machines, taken from another plant, and will operate at a speed of 375 r.p.m. The contract also calls for two exciter water wheels.

CANADIAN WESTINGHOUSE COMPANY.—A Canadian correspondent writes that work is being rapidly pushed upon the factory of the Canadian Westinghouse company at Hamilton, Ont., which will give employment to 1,000 men. The American company, he states, has upon its books, at the present time, unfilled contracts and orders for Canada of upwards of $750,000 worth of electrical apparatus. Until the completion of the works at the city of Hamilton electric apparatus for the Canadian market will be manufactured at Pittsburg, Pa., but will be sold through the agents of the Canadian company.

C. & C. MOTOR ORDERS.—The C. & C. Electric Company reports a considerable picking up in the demand for small motors for clothing manufacturing plants, etc., in New York. Three C. & C. motors varying from 8 hp to 40 hp, are to be installed in the new Rogers Building, Fourteenth Street and Sixth Avenue. The motors will be used for operating Sturtevant ventilating apparatus. An order has been secured from Australia for small motors, which are to be utilized for driving the printing presses of the *Sydney Bulletin.*

ELECTRIC ELEVATORS.—The *New York Times,* in its new building on West Forty-second Street, is putting in five passenger and two freight elevators, all electric, furnished by the Otis Elevator Company. The passenger cars will each have a carrying capacity of 3,000 pounds and will travel at a speed of 500 ft. a minute. One will be equipped with a special gearing by means of which it will be enabled to handle the safes which come into the building. This elevator will be capable of lifting a safe weighing 6,000 pounds.

THE WAGNER-BULLOCK ELECTRIC COMPANY, of San Francisco, has been awarded the contract for generators and other equipment for the Cedar Falls Light & Power Company, for $17,685.80. Former bids had been rejected because several had failed to cite samples of machinery in successful use for a longer period than six months. The Wagner-Bullock Electric Company agrees to have part of the equipment installed within five and a half months' time after acceptance of its bid.

BRAZILIAN LIGHTING AND POWER PROJECT.—South American advices state that E. Gandolfo & Co., of Rio de Janeiro, are primarily interested in a project to erect a large plant in the Brazilian capital for the purpose of generating current for light and power use in Belgrano, Saavedera, Villa Mazzini, Villa Devote and General Urquisa, all suburbs of Rio.

ENGINES FOR NEW LONG ISLAND POWER HOUSE.—Two 20-in. x 40-in. x 42-in. tandem compound engines are to be installed in the new plant at Rockville Center of the New York & Long Island Traction Company. The contract was secured through the New York office of the C. & G. Cooper Co.

BALL ENGINE CONTRACT.—The Presbyterian Hospital, New York City, has ordered from the Ball Engine Company, Erie, Pa., two direct-connected units, one of 135 hp and one of 100 hp.

General News.

THE TELEPHONE.

OSCEOLA, ARK.—Two switchboards of 150 drops capacity each are in operation at the exchange of the Tri-State Telephone Company, which has 200 subscribers. The company owns 150 miles of toll line, and it is its purpose to build 20 more miles of metallic copper toll line and 30 miles of metallic iron. It may put in an automatic exchange in addition next year.

LONE ROCK, ARK.—Mr. E. A. Faris, manager of the Batesville & Winnerva Telephone Company, informs us the outlook is most promising, that the country has just been opened up by a new railroad, new towns are springing up and being settled rapidly and the old towns are growing. An additional exchange and 100 miles of toll line are planned for early erection.

ATLANTA, GA.—An up-to-date system of underground police and fire alarm wires is being completed in Atlanta.

AUGUSTA, GA.—The Strowger Automatic Telephone Company, of Augusta, has completed a connection with the Wilkes Telephone Company, giving an enlarged out-of-town service.

WASHINGTON, ILL.—The Washington City Rural Telephone Company has been incorporated; capital $10,000. Incorporators: George M. Myers, Paul G. Goddard and E. Garber.

STAR CITY, IND.—The Star City Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $50,000. The incorporators are William L. Bott, George L. Buck, Michael Fuff, N. A. Murphy and J. L. Lowrey.

INDIANAPOLIS, IND.—Long distance telephone lines reaching through northern Indiana as well as local lines were considerably inconvenienced and put out of service for several hours Oct. 31 by earth currents coincident with the appearance of sun spots.

COLUMBUS, IND.—Fire damaged the exchange of the Citizens' Telephone Company. Several lines in the country were burned out and the cable containing over one hundred city lines was burned in two. These lines will all be out of service until a new cable can be installed.

BATESVILLE, IND.—The Batesville Telephone Company has completed its organization and filed articles of incorporation with the Secretary of State. The capital stock is placed at $5,000. August Bloenner, John W. Wilker, George A. Bass and E. C. Timmerman are the promoters.

INDIANAPOLIS, IND.—S. P. Sherrin, president and general manager of the New Long-Distance Telephone Company, is the recipient of much praise for having permitted the use of the company's wires free of charge to the friends of the 15 foot-ball students killed in the recent railway wreck in this city. By means of these wires the families of the unfortunate athletes were immediately communicated with in various parts of the state.

VINCENNES, IND.—The City Council has threatened to repeal the ordinances granting franchises to the Central Union Telephone Company and the Knox County Home Telephone Company for a refusal or failure to furnish the National Rolling Mill Company, of this city, with telephone service. The rolling mill company employed non-union men to build its plant and the union men employed by the telephone companies refused to run the wires or place the telephones in the rolling mill offices. The council takes the view that a refusal of union men to place telephones is not a sufficient excuse and resolved that it would be the policy of the city to look to the bonds of the telephone companies on file with the city, for all reparation occasioned by the failure of the telephone companies to place telephones in offices of the rolling mill company, upon proper application. The council takes the ground that the companies must give the service or forfeit their franchises.

DETROIT, MICH.—The Michigan Telephone Company has been purchased at foreclosure sale by N. W. Harris, of New York, for a syndicate of bondholders of the company for $4,100,000. The only other bidder was General F. P. Meaney, of New York, representing the American Telephone & Telegraph Company, who bid $4,000,000. George W. Harriman, of Boston, made a formal protest against the sale on behalf of himself and other stockholders, declaring that he believed the plant was being sacrificed.

STILLWATER, MINN.—The Northwestern Telephone Exchange Company has commenced the operation of its new system.

HALLOCK, MINN.—Swanson and Halvorson, of Warren, Minn., have bought the local telephone exchange here and will make improvements.

NEBRASKA CITY, NEB.—The Nebraska City Telephone Company has increased its capital stock from $50,000 to $100,000.

OMAHA, NEB.—The Postal Telegraph Company is building a line between Omaha and Denver along the Union Pacific Railway.

DEMING, N. M.—The Luna County Telephone & Improvement Company has been organized here with a capital stock of $100,000 for the purpose of establishing and operating a complete telephone system in this city. The incorporators are Sigmund Lindauer, Newton A. Bolich, Frank Du Launey and John J. Jeffries, all of Deming.

NUNDA, N. Y.—The Nunda Telephone Company will construct a line to Dalton and another to Brooks Grove. The company has just completed four lines in the town of Portage, and 25 subscribers have been connected therewith.

ASHEVILLE, N. C.—The city board of Asheville has passed the ordinance merging the Citizens Telephone Company into the Southern Bell Telephone Company. There was much opposition on the part of the citizens.

ZANESVILLE, OHIO.—The Woodsfield Telephone Company is rebuilding 50 miles of toll line and putting in cable additions. It will build six miles of new toll line this fall and improve the system generally; and will also build an exchange at Beallsville, Ohio. The Dayton exchange has grown from 150 subscribers in 1902 to 275 at the present time. Its rates are $12 and $15.

BLUFFTON, OHIO.—A 300-drop Eureka board, and North and Swedish-American instruments are in use at the exchange of the Bluffton Telephone Company, which has at present 420 subscribers, 128 of which were added in the last 11 months. The rates charged are $12 and $24 per annum. Mr. O. G. Snyder, manager, informs us that a few rural lines and one toll line are projected, and that the outlook seems fair for an increase next spring. The company has practically all the farms within a radius of from four miles north to nine miles west, east and south, one sub-station and twenty-eight telephones, all metallic toll and party lines through the country.

GUTHRIE, OKLA.—The lamp signal system is now being installed by the Guthrie Telephone Company. Ericsson apparatus is used. There are 750 subscribers, with 150 more to connect.

KINGFISHER, OKLA.—A new office is being built for the telephone exchange at Kingfisher, owned by Mr. W. J. Steele, who contemplates installing a new Kellogg switchboard. Service is furnished to 255 subscribers.

PERKINS, OKLA.—About 30 miles of rural lines are projected by the telephone exchange owners at this place,—Messrs. J. M. Boone & Sons. The system comprises 25 subscribers, with good prospects for an increase in this number.

PONCA CITY, OKLA.—The Pioneer Telephone Company, through the local manager, Mr. E. A. Hildebrand, informs us that its outlook is very good, that it is offered more business than they can handle. Three hundred miles of toll lines have recently been built. At Ponca City there are 300 subscribers, Ericsson apparatus being used.

WOONSOCKET, S. D.—The Woonsocket Telephone Company uses Standard Telephone & Electric Company's telephones. It has 128 subscribers.

SALEM, S. D.—A 200-drop Western Telephone Mfg. Company's switchboard is operated by the Salem Telephone Company which has 117 subscribers.

SCOTLAND, S. D.—Ninety subscribers are furnished with telephone service by the People's Telephone Company which uses instruments manufactured by the Standard Telephone & Electric Company.

MITCHELL, S. D.—One hundred subscribers were added to the list of the Mitchell Telephone Exchange this year, making 375 at the present time. "Eureka" apparatus is used. The company reports a steadily increasing business and a good outlook.

DEADWOOD, S. D.—The Nebraska (Bell) Telephone Company has completed the laying of conduits, having constructed four or five miles of conduit along the principal streets, with laterals extending along the alleys and side streets to reach distributing poles.

MARYVILLE, TENN.—There are 165 patrons of the Maryville Telephone Exchange, and about 150 miles of toll line. This is a mutual exchange, and the outlook is good for a steady growth.

MARTIN, TENN.—A gain of about 40 telephones a year is the record of the Weakley County Telephone Company, which has at present 240 subscribers. The charges are $1.25 for residences and $2.25 for business per month.

MEMPHIS, TENN.—The Memphis Telephone Company reports a most encouraging outlook. The company began business in August, 1902, and now has 3,100 subscribers, with 40 miles of toll line of which it is building more. The charges are $2.50 for residence and $4 for business service.

NEWPORT, TENN.—The Newport Telephone Company now has connection with Asheville, N. C., and is building an exchange in Greenville, Tenn. When the latter is completed, it will be connected with all towns from Knoxville, Tenn., to Lynchburg, Va.

MORRISTOWN, TENN.—It is planned to build a number of new toll lines by the Citizens' Telephone Company. This company expects soon to have connection with Chattanooga and Bristol (Tenn.) through the intervening independent telephone companies. It has 230 subscribers in Morristown and 70 outside of that place. Mr. Thomas N. Horner is secretary and treasurer.

TRACY CITY, TENN.—There are 294 subscribers to the Dixie Telephone Company which operates a 300-drop American Electric switchboard. Mr. K. A. Banholzer, the general manager, states that several large coal companies are preparing to open up within ten miles of Tracy City and build new towns, and the Dixie Company is preparing to supply them with telephones as they may need them.

SMITHVILLE, TEX.—A telephone company is being organized here for the purpose of installing and operating a local exchange. S. L. Staples can give information.

COMMERCE, TEX.—The Commerce Telephone Company is making part of its toll lines, of which there are some 55 miles, metallic, and is extending and increasing the exchange at Commerce, which has 140 subscribers.

CENTER, TEX.—The Sabine Valley Telephone Company, Mr. W. A. King, manager, has 115 subscribers at Center. The company has 150 miles of toll lines and plans to build 50 miles more.

AMARILLO, TEX.—The installing of a larger switchboard is under consideration by the Amarillo Telephone Exchange which has 290 subscribers, paying $3 for business and $1.50 per month for residence service.

BEAUMONT, TEX.—The Beaumont Telephone Company has 850 subscribers, and an increase to the full cable capacity—1400—is looked for. It charges $3 and $2 a month. Stromberg-Carlson instruments are employed.

BIG SPRINGS, TEX.—General Manager C. L. Alderman, of the Western Telephone Company has connections with 800 miles of toll lines, and toll lines to the extent of 214 miles are under contemplation. Kellogg apparatus is used. The company has 210 subscribers.

COLEMAN, TEX.—A toll line from this place to Burkett, 20 miles, is projected by the Coleman Telephone Exchange. This system has recently passed from the ownership of Mr. D. W. Watson to Mr. R. G. Hollingsworth. Wire has been ordered for some ranch telephones 12 and 15 miles from town, in addition to the Burkett line.

ABILENE, TEX.—The Roberts Telephone & Electric Co. operates a 300-drop Kellogg switchboard and a 100-drop Connecticut Tel. & Elec. switchboard, and numbers at present 375 subscribers, who pay $3 per month for business, $1.50 per month for office and $1 per month for residence service. The company has recently added 30 miles of toll line and contemplates adding 15 miles more. Mr. C. W. Roberts is president and general manager.

WARRENTON, VA.—An addition of 20 miles of toll line and 25 subscribers are in prospect by the Warrenton Telephone Exchange, which now numbers 120 subscribers, using "Sumter" apparatus. The company writes that the demand for telephone service is beyond its expectations and is taxing its resources to keep up with the growth.

LYNDEN, WASH.—Local business men are forming a company to install a telephone exchange here.

DODGEVILLE, WIS.—The Wisconsin Telephone Company is building a line between this city and Madison.

ST. CROIX, WIS.—The St. Croix Valley Telephone Company furnishes service to 250 subscribers, operating a 100-drop Standard switchboard.

LODI, WIS.—The Lodi Telephone Company is using at present the grounded system on a metallic board. There are 206 subscribers who pay $1 per month.

PRESCOTT, WIS.—The Prescott Telephone Exchange numbers 118 subscribers, who pay 75c. per month each. Mr. George S. Hollister is manager. "Victor" apparatus is used.

PORTAGE, WIS.—A 500-drop Standard board is operated by the Portage Telephone Company which has 450 subscribers paying $1 a month. An encouraging outlook is reported.

FORT ATKINSON, WIS.—Some farmers' lines are to be built by the Jefferson County Telephone Company, which has 255 subscribers and uses Standard Tel. & Elec. Company apparatus.

SHARON, WIS.—A Sterling 200-drop switchboard, with 120 installed, is operated by the Sharon Telephone Company. Twenty-five miles have recently been added. The charges are $1 and $2 per month.

VIROQUA, WIS.—The Viroqua Telephone Exchange was built in 1897, commenced with 47 subscribers; it has now 260. The outlook for the future is very good, and four farmers' lines are projected.

MONROE, WIS.—A 500-drop Standard switchboard is operated by the Monroe Telephone Company, with its 475 subscribers. Not a rapid but still a satisfactory growth is the report of Secretary Louis A. Hodges.

MAZOMANIE, WIS.—The Mazomanie Telephone Company reports a steady growth and good outlook. It has 200 subscribers and operates 100 miles of toll line. Standard and Kellogg apparatus are here represented.

SPARTA, WIS.—The Monroe County Telephone Company, which has been in operation four years, operates a 220-drop Standard switchboard, and has 220 subscribers and 150 miles of toll line. It is planned to build some farmers' lines.

NEW RICHMOND, WIS.—The Phoenix Telephone Exchange, owned by F. W. Epley, operates a 200-drop "Express" switchboard. It numbers 160 subscribers, who pay $2 per month for business and $1 per month for residence service.

MAUSTON, WIS.—The telephone service at this place is under the control of the Mauston Electric Light & Power Company. There are 285 subscribers, Standard Telephone & Electric apparatus being employed. A good outlook is reported.

GRAND RAPIDS, WIS.—The Wood County Telephone Company is planning to spend $8000 in rebuilding and improving the plant, adding a 100-drop section of board, hanging considerable cable, etc. The 490 subscribers use Stromberg-Carlson instruments.

MERRILL, WIS.—The reconstruction of its entire system has just been completed by the Merrill Telephone Company which bought the poles and lines of the Wisconsin Telephone Company. The subscription list has doubled in two years at Merrill and has now 420 names.

MINERAL POINT, WIS.—The Mineral Point Telephone Company operates at present a 200-drop switchboard of Standard make, but reports that this will probably have to be increased to 400 drops. From 60 subscribers in 1899 to 220 in September, 1903, shows that the company has had a very healthy increase.

ELKHART LAKE, WIS.—An exchange at Chilton, with a 100-drop Stromberg-Carlson switchboard, one at Kiel with 100 drops, another at New Holstein with 25, and a fourth at Elkhart Lake with 50 drops, are operated by the Eastern Wisconsin Telephone Company. The company has a total of 200 subscribers and 220 miles of toll line.

MARSHFIELD, WIS.—The owner of the telephone system at this place, Mr. J. C. Marsh, reports that he has a first-class, up-to-date exchange and fine offices, owing also the building. An increase of 150 during the next two years is anticipated. Three hundred subscribers are supplied with service through the 400-drop Stromberg-Carlson switchboard.

OAKFIELD, WIS.—There are 117 subscribers to the Oakfield Telephone Company, using American Electric apparatus. Mr. W. E. Bristol informs us that it had about 600 messages per month over its line to Fond du Lac where it had, until recently, connection with the Little Wolf River Company, now in the hands of the Wisconsin Telephone Company (Bell).

RHINELANDER, WIS.—The system of the Rhinelander Mutual Telephone Company is full metallic central energy and is giving the best of satisfaction. The Bell Company has had to take down its wires. A 400-drop American board is operated, on which 375 connections are made. The company has just installed 3750 feet 50-pair and 1000 feet 25-pair cable, and contemplates installing more cable.

RACINE, WIS.—During the past year the Racine Telephone Company has increased its subscription list by 500 names, and has now 1700 subscribers. This increase has come without the aid of a solicitor. It is expected to show during the coming year a similar increase to that of the past twelve months. An exchange has recently been started at Kenosha, Wis., and the Racine Company will have connection to that city, which has a population of 20,000. Sterling apparatus is used.

LACROSSE, WIS.—Mr. H. M. Rounce, manager, LaCrosse Telephone Company, furnishes the following: "This company has recently installed a new common battery board of the latest type, using the Dean four-party selective system. Our board is the first built by the Kellogg Company using 45 volts. During the past year we have added about 20,000 feet of cable and largely rebuilt the plant. The prospect seems good to add to our subscription list. We are hampered quite a bit by not having some good copper long distance lines. The toll lines we have cover the surrounding country for about 50 miles very well, but further than that we cannot get good service." The Kellogg switchboard installed here has a capacity of 3600; there are 950 subscribers at present.

SAN JUAN BAUTISTA, MEX.—Many new telephone exchanges have been established in towns in this state. There are at present 428 miles of telephone lines in the state of Tabasco of which this city is the capital.

MERIDA, MEX.—A submarine telephone cable is being laid across the arm of the Gulf between Progreso and near-by towns on the coast. An underground cable is also being laid between Merida and Progreso.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—Bids will be received Nov. 24 by the Executive Committee Alabama Girls' Industrial School, Morris Hotel, for construction work and wiring for an electric light plant. Address Francis M. Peterson, president.

DOUGLAS, ARIZ.—The Douglas Improvement Company will increase the capacity of its electric light and power plant here. Additional machinery will be purchased.

CLIFTON, ARIZ.—George Pence, of El Paso, who is promoting the electric power project for this city and the town of Morenci, announces that he has interested New York capital in the enterprise and that the work of construction will commence as soon as the necessary surveys are completed. The power will be obtained from the San Francisco and Gila rivers and 4000-hp is promised.

BERKELEY, CAL.—A heating and lighting plant, to cost $50,000, is to be installed at the University of California. Plans for the new system have been prepared by John Galen Howard and Prof. C. L. Cory.

SAN FRANCISCO, CAL.—A. G. Wishon, manager of the San Joaquin Power Company, in which H. E. Huntington is interested, has received advices from Washington saying that his application for a power site on Government land on the Tule River in Fresno County, Cal., had been approved. The construction of an electric power house will be commenced in the near future, the location being 20 miles east of Porterville. About 600-hp can be developed.

SULPHUR SPRINGS, COLO.—The Hot Sulphur Springs Light, Power & Water Company has been organized with Frank N. Briggs, president, and D. P. Howard, secretary. This company proposes to construct water works and an electric light plant. Work will soon be commenced on a dam across Grand River in Byers' cañon, which will furnish water power for the enterprise.

WINDER, GA.—The city has purchased a site for an electric light plant, which will cost $15,000. It will have a capacity of 30 arc and 500 incandescent lamps.

EATONTON, GA.—The Eatonton Electric Cotton Mills and electric plant, together with two valuable water powers on Little River have been purchased by J. B. and Burke Floyd, of Savannah, Ga., for $42,000.

FAIRMOUNT, IND.—The town board is making arrangements to install an electric lighting plant, to cost $15,000. The citizens have agreed to pay five years' lighting bills in advance in order to ensure the installation of the plant.

SHOALS, IND.—The Martin County Hydraulic Company has been incorporated to construct a dam in east fork of White River, and build and operate a water plant to generate electric power. W. L. Stoy and D. A. Yoder are chief promoters.

RUSHVILLE, IND.—Bids will be received by Harry Lakin, City Clerk, on Nov. 19 for 100-kw and one 250-kw generators direct connected to engines; switchboard, piping, transformers, lights, etc.; also one for a 250-kw belted type single-phase generator, one engine arranged for belt, belting, switchboard, piping, lights etc.

SOUTH BEND, IND.—The South Bend Electric Company has been awarded the contract for lighting streets for a term of 10 years on a basis of 450 lamps, at 4,000 hours, as follows: For 7.5 ampere, series enclosed, alternating current, arc lamps, $78.75 with wood pole lines; $83 with iron poles and $95 with underground system; for 50-cp incandescent lamps, $30.60.

DELPHI, IND.—A great deal of interest is being taken here in the proposed improvement of the Wabash and Tippecanoe rivers. It is suggested to drain the Kankakee into the Tippecanoe which empties into the Wabash. The proposed scheme will solve the water power problem at Horse Shoe Bend where it is proposed to build a dam for power to generate electricity.

VINCENNES, IND.—The National Rolling Mill Company, anxious to complete its plant, asked the local electric light company to place arc lights in the street, so that work could be done night and day. The Rolling Mill Company employs non-union labor and the union men employed by the electric light company refused to place the lamps in the street and in the company's offices. At a regular meeting of the council on Oct. 27 the electric light company was ordered to do the work or forfeit its franchise. The council held that the company must give the service and the refusal of one set of men to do the work was not sufficient excuse.

ESSEX, IA.—Farris & Eastman, of Clarinda, Ia., are reported interested in the construction of an electric light plant for Essex.

OTTAWA, KAN.—The city is discussing the question of municipal ownership of water and light, as a result of a request from the company which now has the contract for a renewal of the franchise.

DANSVILLE, KY.—It is proposed to construct an electric light plant, to cost about $30,000. Prof. Gordon is engineer.

NEW ORLEANS, LA.—The Special Lighting Commission of Council rejected the bid of the Colonial Electric Company of New York for the construction of a municipal electric light plant, and adopted a resolution authorizing the Comptroller to secure bids for lighting the city for 10 years as per specifications drawn by the City Electrician and City Attorney.

SARANAC, MICH.—The Village Board has granted D. G. Huhn a 30-year franchise for an electric light plant, and made a 10-year contract for lighting.

AITKIN, MINN.—It is stated that the Council will purchase additional machinery for the municipal lighting plant.

CHISHOLM, MINN.—P. E. Dowling and Jas. Falk, of Eveleth, Minn., have submitted a proposition to install an electric light plant.

SAG HARBOR, L. I., N. Y.—The citizens have voted to issue $24,000 bonds for an electric light plant.

FILLMORE, N. Y.—W. L. Youngs, of Fillmore, is interested in the Fillmore Electric Light & Power Company. Water power is to be used to generate electricity.

OTEGO, N. Y.—The Otego Lighting Company, of Otego, has been incorporated, to manufacture and sell electricity for light, heat and power purposes. Directors: B. Cook Broodfoot and Vincent S. Fuller, of Otego.

EDENTON, N. C.—The First National Bank of Elizabeth City has purchased the $30,000 issue of 5 per cent. 30-year water and electric light bonds issued by the town of Edenton, N. C.

CHARLOTTE, N. C.—An electric lighting plant consisting of a triple expansion engine with direct coupled dynamo and 110 arc lights has been ordered from the General Electric Company for the new Hoskins Cotton Mill at Charlotte.

SALISBURY, N. C.—The Yadkin River Electric Power Company, of Salisbury, has been incorporated, with a capital of $5,000,000, by the Whitney Company, of Salisbury; Geo. I. Whitney and H. L. W. Hyde, of Pittsburg, Pa., and Egbert R. C. Hambley, of Salisbury.

CHARLOTTE, N. C.—The Westinghouse Electric & Manufacturing Company is preparing plans on a contract for electrical equipment and machinery for a big water power plant on Catawba river at Mt. Island, N. C. E. D. Latta, of Charlotte, N. C., is interested. The new plant, it is said, will supply power for manufacturing and municipal use.

NEWTON FALLS, OHIO.—Wade Gardner, City Clerk, writes that the city is investigating the cost of water works, a sewerage system and electric light plant.

SHAWNEE, OKLA.—The Shawnee Light & Power Company has been organized with a capital stock of $200,000 for the purpose of establishing and operating an electric light and power plant here. C. N. Jackson, of Shawnee, is one of the incorporators.

HOUSTON, TEX.—The Water Works Company here is preparing to install an electric filter for the purpose of purifying all the water furnished the city for domestic purposes.

SAN SABA, TEX.—The San Saba Light & Ice Company has been organized here with a capital stock of $15,000. The company will install an electric light plant. The incorporators are T. C. Henry, J. W. Longley, John H. Martin, T. A. Murray, W. S. Sanderson and U. M. Sanderson, all of San Saba.

OLYMPIA, WASH.—The Kilbourne Clark Company, of Seattle, has secured the contract for the electric lighting plant for the capitol at $10,500.

WALLA WALLA, WASH.—It is stated that bids will probably be received Feb. 15 for the proposed $250,000 hydro-electric station on Walla Walla River for the North-Western Gas & Electric Company. Samuel Storrow, Los Angeles, Cal., is engineer.

NEW LONDON, WIS.—The citizens have voted to issue bonds for an electric light plant.

BELOIT, WIS.—According to press reports, Beloit College will build a central plant to supply steam heat and possibly electric light for the several buildings on the campus. The plant will be erected this fall and enlargements made next year; it will cost from $25,000 to $30,000.

HAMILTON, ONT.—Owing to the immense increase of business, the Cataract Power, Traction & Light Company has been obliged to secure more power, and has let a contract to F. H. Dickenson, of Hamilton, for a series of extensions, the first of which will be the enlarging of the power house at DeCew Falls.

OTTAWA, ONT.—A company, composed of residents of the city of Kingston, Ont., has secured the control of the Mississippi Falls, about 55 miles from Kingston with the intention of developing power there. It is stated that upwards of 10,000-hp can be easily obtained at these falls, and could be profitably marketed at from $15 per horse power per annum. There is a fall of 85 feet at this point. Drawings, etc., have been secured and submitted to an expert for his report.

THE ELECTRIC RAILWAY.

LOS ANGELES, CAL.—H. M. Russell, of the Ventura & Bakersfield Electric Railway Company, has just returned from the East, where, it is stated, he has floated $3,500,000 of bonds. Construction work has actually begun, and a graders' camp is established at Oxnard. Considerable difficulty was experienced in getting water-front privileges at Hueneme.

LOS ANGELES, CAL.—It is stated that H. E. Huntington is to be associated with President Harriman, of the Southern Pacific, in the work of building electric railways throughout southern California. It is announced that Harriman has purchased at least one-third of the stock of the Pacific Electric Railway Company and other corporations of which Huntington is the head. This move is made by Harriman to share in the profits of the electric lines that parallel the Southern Pacific.

MACON, GA.—The Macon Railway & Light Company has installed in its plant here a steam turbine of 1000 horse-power.

CANTON, ILL.—The Illinois General Electric Railway Company, recently incorporated to build an electric railway at Canton, has organized as follows: U. G. Orendorff, president; W. O. Dean, first vice-president; R. F. Henkle, second vice-president; James A. Lawrence, third vice-president; W. D. Plattenberg, secretary; E. A. Heald, treasurer.

COLUMBUS, IND.—The City Council has granted a thirty-five year franchise to the Columbus, Greensburg & Richmond Traction Company.

LAPORTE, IND.—The City Council has granted a fifty-year franchise to the Northern Traction Company of Indiana, which is projecting an interurban line from South Bend to Chicago, via this city, Valparaiso and Hammond.

SOUTH BEND, IND.—George F. McCulloch, president of the Union Traction Company, is fostering a scheme of centralization for the lines entering this city. It includes the merger of the Indiana Railway Company, the South Bend & Southern Michigan Railway Company, the Indiana Western Railway Company and probably the Chicago & Indiana Air-Line Railway Company, with a line which Mr. McCulloch is now building from Peru to South Bend. When these lines are completed there will be a chain of lines reaching from Indianapolis to St. Joseph, Mich., with a network of feeders crossing Northern Indiana from east to west.

COUNCIL BLUFFS, IA.—The promoters of the Council Bluffs, Tabor & Southern Electric Railway company are now in the East negotiating the sale of bonds for the new line from Council Bluffs to Rockport, Mo.

TABOR, IA.—The promoters of the electric railway from Council Bluffs, via Tabor to Rockport, Mo., known as the Council Bluffs, Tabor & Southern Electric Railway Company, are now in the East negotiating the sale of bonds.

WASHINGTON, IA.—The organization of the Iowa City, Kalona & Washington Railway Company has been completed by filing articles of incorporation with the Secretary of State. The main line of the company will extend from Iowa City, via Kalona to Washington, a distance of about 35 miles. The capital is $50,000. The officers are G. G. Rodman, president; W. P. Coast, vice-president; W. J. Welch, secretary; C. M. Keck, treasurer. These named parties, with G. S. Carson, G. W. Wagner, W. G. Smith, A. N. Alberson and S. W. Brookhart, constitute the board of directors.

LAKE CHARLES, LA.—C. L. Bland, representing the company which owns the Shreveport Electric Railways, is in the city negotiating with the local street car company to purchase its track and franchise. If the deal is closed the new owners will put in an electric line, it is said.

BALTIMORE, MD.—The United Railways & Electric Company is considering a plan to extend its Charles Street line to Roland Park.

MAYNARD, MASS.—The Lowell, Acton & Maynard Street Railway Company has completed its electric railway between Maynard and South Acton, Mass.

WORCESTER, MASS.—At the annual meeting of the Worcester & Blackstone Valley Street Railway Company M. J. Whittall, of Worcester, was reelected president; Alfred Thomas, vice-president and treasurer, and Willard Ballon, clerk.

BROCKTON, MASS.—Local reports are to the effect that Stone & Webster, of Boston, are considering the question of building an electric railway between Brockton and Stoughton. A line over this route was originally projected by the Brockton, Canton & Dedham Company.

BOSTON, MASS.—The Blue Hills Street Railway Company has petitioned the Railroad Commissioners for authority to issue first mortgage bonds, not to exceed $250,000, for building branches and extensions, power houses and car houses, acquiring and equipping additional rolling stock, abolishing grade crossings and paying betterment assessments for widening streets.

BOSTON, MASS.—The Railroad Commissioners have approved the petition of the Marlborough & Framingham Street Railway Company for authority to issue capital stock to the amount of $105,000 for the purpose of purchasing, at the receiver's sale, the street railway property formerly belonging to the Marlborough Street Railway Company and to make permanent improvements thereon.

LANSING, MICH.—The St. Louis Electric Railway Construction Company will be incorporated under the laws of the State of Michigan for the purpose of building an electric railway line from Grand Rapids to Saginaw via Ionia, Hubbardston, Carson City, Summer, Crystal Lake, Ithaca, Alma and St. Louis, a distance of about 110 miles. Marcus Pollasky, of Detroit, is the principal promoter.

LANSING, MICH.—The Michigan & Indiana Traction Company has been incorporated under the laws of Michigan to succeed the Michigan Central Traction Company and build an electric railway from Battle Creek to Lansing via Grand Ledge. The capital stock of the company is $200,000, and the organizers are E. F. Pangborn, C. J. Austin and W. N. Dibble, all of Battle Creek.

ST. PAUL, MINN.—President Thomas Lowry, of the Twin City Rapid Transit Company, says that the directors will take up the proposed new interurban line this winter, and it is not at all unlikely that construction work may be taken up in the early spring. Mr. Lowry says it also possible that the company may build to White Bear Village next spring.

GREENWOOD, MISS.—The City Council of Greenwood has granted a fifty year franchise to the Greenwood Electric Company, which contemplates building an electric railway to be eventually extended to a number of nearby towns.

ST. LOUIS, MO.—Bids were opened Oct. 23 by the Board of Public Improvements for the extension of the municipal railway from Baden to Bissell's Point. The lowest bidders were Frum & Colnon, at $45,404.75. The Board will doubtless award them the contract.

JERSEY CITY, N. J.—The Hoboken & Manhattan Railroad Company, of Jersey City, has been incorporated to construct the New Jersey end of the trolley tunnel entrance to New York; capital, $500,000. Incorporators: William G. McAdoo, Frederick B. Jennings, Edward F. C. Young, Charles L. Corbin, H. P. McCullough, Edward R. Green, Charles W. King.

BALLSTON SPA., N. Y.—It has been decided to extend the Ballston Terminal Railroad straight through Saratoga County to Hagaman's, where it will meet the Amsterdam trolley extension, making a through line from Amsterdam to Albany.

SYRACUSE, N. Y.—At the annual meeting of the stockholders of the Syracuse, Lakeside & Baldwinsville Railway the following officers were elected: W. Judson Smith, president; Franklin J. Kaufman, vice-president; A. R. Peck, treasurer, and E. J. Chapman, secretary.

PORT WASHINGTON, N. Y.—At the election on Nov. 3 a resolution was voted upon to grant a franchise for the construction of an electric railway along the North Hempstead Turnpike from the dividing line between the townships of Oyster Bay and North Hempstead to the Greater New York line at Little Neck.

TOLEDO, OHIO.—The Toledo, Bay Shore & Michigan Railway Company has been incorporated by Frank D. Cope and Frank B. Gunning, of Pittsburg; Frank M. Ohl, Willis F. Brown and J. R. W. Cooper, of Toledo.

ZANESVILLE, OHIO.—Fred S. Colby, of Newark, is surveying a line from Zanesville to Cambridge. This will connect with the Columbus, Newark & Zanesville Traction Company's line now being completed into Zanesville. The line will be eventually extended to Wheeling.

LAWTON, OKLA.—The Lawton, Wichita Mountain & Western Electric Railway Company has been incorporated with $220,000 capital. The incorporators are C. W. Johnson, of Montgomery, Ala.; S. P. Brunbage, of St. Louis; J. R. Bratton, of Carthage, Mo.; Edward F. Mitchell, of El Reno; D. R. Rankin, R. A. Hubard, Charles Mitscherick and J. H. Russell.

SUMPTER, ORE.—A project is being pushed here for the construction of an electric railway between this city and Bourne. Three-fourths of the capital required, estimated at $100,000, will be put up by Henry Hewett, of Tacoma, and the balance of the total cost will be raised among the mining men operating in the vicinity of the two cities.

HARRISBURG, PA.—It is reported that J. M. Stockbridge, J. H. Alexander and other Detroit capitalists are forming a company to construct an electric railway between this city and Lebanon.

CHAMBERSBURG, PA.—Officials of the Chambersburg & Gettysburg and Chambersburg, Greencastle & Waynesboro Electric Railway Companies were in conference here recently on the proposition to build an electric railway from Fort London to Blair's Mills. The power house and car house will probably be located at Dry Run.

HARRISBURG, PA.—Charters have been issued by the State Department as follows: Irwin & McKeesport Railway Company, capital stock, $45,000; president, John George, Irwin; directors: Charles Fritchman, Frank M. Fritchman, William W. George, John George, Irwin; Joseph C. Boyd, Pittsburg; The Lancaster & Southern Street Railway Company, capital stock, $84,000; president, James G. McSparran, Furniss; directors: C. A. Fondersmith, William Wohlsen, Thomas K. Worthington, Frederick Shoff, Lancaster; James G. McSparran, Furniss. California & Allen Port Street Railway Company, capital stock, $50,000; president, R. B. Drum, California; directors: W. C. Smith, E. C. Drum, C. H. Drum, A. T. Morgan, California. Bank & Broad Street Railway Company, capital stock, $5000; president, J. C. Boyce, Pittsburg; directors: Hugh M. Stilley, Scott Township; George Hughey, West Liberty; George A. Krupp, Paul S. Ache, J. C. Boyer, Pittsburg. The Farmersville & Terre Hill Street Railway Company, capital stock, $48,000; president, S. M. Seldomridge, Farmersville; directors, E. H. Burkholder, A. E. Burkholder, S. M. Seldomridge, Farmersville; Dr. B. J. Reemsnyder, Hinkletown; John H. Fry, Lancaster.

PROVIDENCE, R. I.—The Providence & Burrillville Street Railway Company has been granted a franchise in Lonsdale to build an electric railway through the town from the Woonsocket boundary to the North Providence boundary line of the town.

RICHMOND, VA.—The Virginia Passenger & Power Company is reported to have engineers in the field surveying for a line from Richmond to Ashland, about 16 miles.

SALEM, W. VA.—Homer B. McKinley, of Salem, is reported to have secured a street railway franchise in Clarksburg for the Salem Terminal Traction Company, which will begin constructing next spring.

HAMPTON ROADS, VA.—The Vandergrift Construction Company, of Philadelphia, has filed a lien for $112,944 against the Hampton Roads Railway & Electric Company, which is claimed to be the balance due for construction work for the company which recently went into the hands of a receiver.

CHARLOTTESVILLE, VA.—The property of the Charlottesville City & Suburban Railway Company is advertised to be sold at Charlottesville on Nov. 10, under foreclosure of mortgage. The property includes a street railway ($3\frac{1}{2}$ miles), ice plant, electric plant, 110 acres of land, with mineral springs, hotel, etc. The sale will be made subject to a mortgage of the Piedmont Construction & Improvement Company, dated Feb. 1, 1895, to secure $25,000 first mortgage bonds, and also subject to a lien to secure the payment for new rails recently bought by the company. The mortgage trustees are Micajah Woods, R. T. W. Duke, Jr., and C. Guy Robinson.

WHEELING, W. VA.—It is said that the Wheeling & Western Traction Company, which is controlled by interests identified with the Wheeling Traction Company, is completing the preliminaries looking to the early construction of its proposed line between St. Clairsville and Barton.

VENADO, MEXICO.—A project is on foot to build an interurban electric railway between this place and towns and this section, with a connection to be made with the Mexican National Railroad.

NEW INDUSTRIAL COMPANIES.

THE INTERNATIONAL ELECTRIC METER CO, Chicago, has been incorporated to manufacture electric specialties; capital, $10,000. Incorporators: W. W. Cheney, Jr., Samuel Solomon, O. C. Peterson.

THE WESTERN AUTOMOBILE COMPANY has been incorporated at St. Louis, Mo., with a capital stock of $10,000, all paid. The incorporators are Marion L. J. Lambert, Samuel Breadon and Samuel B. McPheeters.

THE NICHOLAS LIGHTNING ARRESTER COMPANY has been incorporated at Columbus, Ohio, with a capital stock of $15,000 by C. E. Nicholas, Savannal Nicholas, Wm. A. Hopkins, Jr., T. R. Prall and Edward B. Thomas.

LEGAL.

SUBWAY FRANCHISE IN NEW YORK.—Mr. George Hill, counsel for the Independent Telephone Company, has applied to Justice Clarke, in the New York Supreme Court, for a peremptory mandamus to compel Commissioner Robert G. Monroe, of the Department of Water Supply, Gas, and Electricity, to permit the company to construct and maintain its lines of electrical conductors in the present subways of the Underground Rapid Transit Railroad Company, and to construct whenever necessary such subways throughout the city to carry its lines. The city was represented by Assistant Corporation Counsel Edward J. McGuire, who presented an affidavit of Alexander E. Orr, president of the Rapid Transit Commission, to the effect that this company had not received permission from the commission to occupy any portion of the conduits of the underground railway or to place its lines in the streets. The moving company, Mr. McGuire said, had absolutely no rights in the streets of the city, and the acts of the commission could not be controlled by the court. He said that if the application were granted the company would make an effort to place its wires in any and every street in the city. Justice Clarke reserved decision.

OBITUARY.

MR. W. L. ELKINS.—We regret to note that Mr. William L. Elkins, the street railway magnate, died on November 7 at his residence, Ashbourne, near Elkins Park, Pa., after an illness of more than a month. Death was directly due to heart failure caused by hardening of the arteries. He is survived by three children—George W. Elkins, Mrs. George D. Widener and Mrs. Sidney Tyler. Mr. Elkins was born on May 2, 1832, in western Virginia, of Quaker parentage. He was educated in the Philadelphia public schools, and at the age of 16 he engaged in the lumber business. In 1852 he entered the produce and shipping business, dealing extensively in agricultural products. Later he sold out his business and going to western Pennsylvania became interested in the production of oil. Returning to Philadelphia he engaged in the business of refining crude oil and in this way laid the foundation of his immense fortune. He was identified with the oil interests until 1880 when he sold out his interests to the Standard Oil Company. In association with P. A. B. Widener and W. H. Kemble he then became interested in street railways all over the country and with them organized the Philadelphia Traction Company, which recently became the Philadelphia Rapid Transit Company. Mr. Elkins was one of the re-organizers of the United Gas Improvement Company and was president and director of many other enterprises, including the Electric Storage Battery Company, the Philadelphia Electric Company, Electric Company of America, Consolidated Traction Company of New Jersey, etc.

EDUCATIONAL.

WORCESTER POLYTECHNIC INSTITUTE.—During the last few months two exceedingly interesting machines have been built at the Washburn shops of the Worcester Polytechnic Institute, under the direction of the U. S. Bureau of Forestry. These machines were designed for the driving of screw spikes into railroad ties at the Worcester Polytechnic Institute by Alton L. Smith, professor of machine design. These screw spikes are designed to replace the spike ordinarily used by railroad companies, and an effort will be made by the Bureau of Forestry to introduce their use into this country. They are already extensively used in France, Belgium, Germany and other European countries. The advantage of the screw spike lies in the fact that it will allow the use of softer wood for railroad ties than is possible where the ordinary form of spike is employed. If the machines which have just been built are successful, it is expected that many of the softer kinds of wood, such as spruce and poplar, can be employed for railroad ties. With the old form of spike, experiment has shown that the life of one of these ties did not exceed six or eight months, but with the screw spike it is expected that they will last for some years. One of the machines in question was built for the New York Central and the other for the Pennsylvania Railroad Company.

PERSONAL.

DR. J. W. RICHARDS, of Lehigh University, is to lecture on November 12 before the Franklin Institute on "The Electrolysis of Water."

MR. W. McL. WALBANK, formerly general manager of the Lachine Hydraulic & Land Company, of Montreal, has been appointed to be first vice-president and chief engineer of the Montreal Light, Heat & Power Company.

MR. F. W. LE TALL, who is a patent agent connected with the Westinghouse patent bureau in London, is now on a visit to the United States, and is taking the opportunity to study American electrical and engineering practice.

MR. THOMAS M. JENKINS has resigned as general manager of the St. Louis & Suburban Railway Company, St. Louis, Mo. Mr. Jenkins has not outlined his plans for the future, but it is understood that he will remain in St. Louis.

MR. B. B. THWAITE, of England, is now visiting this country in connection with his blast furnace power system, of whose efficiency favorable reports have been received here. He is also known in connection with the development of plans for the application of electricity on canals.

MR. IRVING H. REYNOLDS will shortly retire from the Allis-Chalmers Company and the duties of chief engineer will be assumed by the engineers in charge of the various departments; these engineers availing themselves of the advice of Mr. Edwin Reynolds, the consulting engineer of the company.

MR. D. W. COONS has severed his connection with the Hydra Battery Company as a director and treasurer. He has been in poor health for some months and has left New York for the Magno mud baths at Attica, Ind., going thence to Los Angeles, Cal., for a complete rest before resuming business.

MR. J. J. BELLMAN has recently been elected vice-president of the Indestructible Road Bed Company, which controls the franchises and charter of the Sandusky, Monroeville, Belleville and Norwalk Traction Company. It is expected that active construction on this road will commence in the Spring, with Bellman & Sanford as electrical engineers.

SIR CHARLES METCALFE, who has been in this country for a few weeks, accompanied by his partner, Mr. G. A. Hobson, has sailed for England, after visiting some of the power transmissions and electrical factories. As already noted, he is deeply interested in the plan for utilizing some of the vast power of the Victoria Falls on the Zambesi River.

COL. ISAAC M. HUTCHISON, of Mexico City, who represents the interests of several prominent American manufacturing concerns in the southern republic, has left for Mexico after several weeks' visit to the States. He is president of the Mexican Car & Foundry Company, which is to build a plant in Mexico City. Contracts for equipment comprising electric plant machine tools, etc., will be awarded immediately.

MR. JOHN MAHONEY has been appointed general superintendent of the St. Louis & Suburban Railway Company, St. Louis, Mo. Mr. Mahoney is a practical street railway man of nearly thirty years' experience. In his new duties, Mr. Mahoney will have complete charge of the operation of the lines while most of the duties of former general manager Jenkins will devolve upon Julius S. Walsh, Jr., son of President Walsh, who has been vice-president of the road since last January.

MR. ALEX. HENDERSON, of the conduit department of the Sprague Electric Company was the recipient last week of a very flattering testimonial from the electrical contractors of the country. The members of the Electrical Contractors Association of New York City had a beefsteak banquet at the famous "Morgue" on November 5, when 75 persons were present, including several leading architects and electrical engineers. During the course of the evening Mr. Charles L. Eidlitz presented Mr. Henderson with a handsome silver loving cup with this inscription: "Presented to Alexander Henderson, M. T., by his friends in the National Electrical Contractors' Association, 1903." The "M. T." had reference to Mr. Henderson's valued services as master of transportation, but the qualities of the recipient were also a strongly prompting motive. The "M. T." might also be said to have reference to the cup itself. If Sir Thomas Lipton wants lessons in cup lifting he should have been on hand that night.

Trade Notes.

OIL FILTER.—The Cleveland & Electric Illuminating Co., Cleveland, Ohio, has just sent a duplicate order for a 200-gallon oil filter with automatic water separating device, to the Burt Mfg. Co., Akron, Ohio.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out samples of its O. K. duplex telephone wire. It is made in three colors: brown, maroon and black. Sample and prices will be gladly furnished upon application.

THE STATION EQUIPMENT COMPANY, 204 Dearborn St., Chicago, has brought out in an attractive booklet a list of machinery which it has on hand ready for immediate delivery. The book contains 28 pages, devoted to direct and alternating current generators, motors, engines of various types, boilers, motor-generators, transformers, etc.

THE CUTLER-HAMMER MFG. COMPANY, of Milwaukee, Wis., states that its catalogue presents the most complete line of electric controlling devices ever listed. Every consulting electrical engineer is advised to secure a copy to put on file for reference. It will be gladly furnished on request, and the applicant's name added to the mailing list to insure receipt of further bulletins as issued.

EDISON STORAGE BATTERY COMPANY, Edison Laboratory, Orange, N. J., has just issued its first catalogue, and a very handsome one it is. We recommend every one of our readers to send and get a copy, for it not only shows the battery in its complete present form, but illustrates the parts and gives a large amount of descriptive and technical text. It is understood that in addition to the type of battery here shown, the company is now developing three or four more for special lines of work, to be put on the market next Spring. Some details about these cells are also given.

SPECIAL TRAIN DE LUXE.—Mr. Milton C. Roach, the General Eastern Passenger Agent of the New York Central Railroad, who is well known in electrical circles, has just returned from a most successful personally conducted trip with the New York City Group No. 8 of bankers attending the recent bankers' convention in San Francisco. The special train, which was luxuriously equipped, had aboard no fewer than 125 ladies and gentlemen, and the run out and home over eight railroad systems covered more than 7500 miles. Mr. Roach has received many congratulations upon the success attending this run, and a great many people in the electrical field have expressed the wish and hope that some day either the National Electric Light Association or the American Street Railway Association, or both, will be tempted to make a similar run out to the Coast. Neither national body in some 20 years of existence has ever got even so far as Denver, and in view of the remarkable electrical developments all over the Pacific Slope, it is thought high time that Mr. Roach were given an opportunity to show that he can take as good care of electrical magnates as he can of bankers.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 3, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

742,830. METALLURGICAL PROCESS; Oliver W. Brown, Bloomington, and William F. Oesterle, Marion, Ind. App. filed May 14, 1903. (See page 806.)

742,852. ELECTRIC FURNACE; William S. Franklin, South Bethlehem, Pa. App. filed Dec. 3, 1900. (See page 805.)

742,856. BATTERY; James W. Gladstone, West Orange, N. J. App. filed Sept. 17, 1903. (See page 806.)

742,857. BATTERY; James W. Gladstone, West Orange, N. J. App. filed Sept. 17, 1903. (See page 806.)

742,861. SYSTEM OF ELECTRICAL DISTRIBUTION; Josef H. Hallberg, New York, N. Y. App. filed Feb. 20, 1903. A motor having its field magnets connected across the distributing circuit and its armature supplied by a constant potential, operates certain devices for varying the excitation of the field magnet of the main generator to maintain the potential of the current in the distributing circuit, constant.

742,863. ELECTROLYTIC APPARATUS; Edouard Hannon, Brussels, Belgium. App. filed Oct. 4, 1898. (See page 806.)

742,864. ELECTROLYTIC PROCESS; Edouard Hannon, Brussels, Belgium. App. filed Oct. 4. 1898. (See page 806.)

742,865. ELECTROLYTIC PROCESS; Edouard Hannon, Brussels, Belgium. App. filed Oct. 4, 1898. (See page 806.)

742,886. CHARGING SYSTEM FOR SECONDARY BATTERIES; Hiram Percy Maxim, Pittsburg, Pa. App. filed March 12, 1903. (See page 806.)

742,890. TELEPHONE TIE WIRE; George F. Moore, Jr., Mobile, Ala. App. filed July 29, 1902. (See page 806.)

742,895. CUT-OUT FOR ELECTRIC CIRCUITS; Edgar Mosher North, Brooklyn, N. Y. App. filed Jan. 21, 1903. (See page 807.)

742,906. ELECTRIC SWITCH; James T. Robb, New York, N. Y. App. filed April 15, 1903. A switch adapted for chandeliers and having a frame within which the operative parts are mounted and which is carried within a yoke secured to the fixture, whereby the yoke can be adjusted and the switch afterwards introduced in place.

742,926. POTENTIAL REGULATOR FOR ALTERNATING CURRENT CIRCUITS; Harve R. Stuart, Wilkinsburg, Pa. App. filed March 12, 1903. A transformer having a plurality of windings each of which comprises electrically connected, but physically separated coils, the electrical connections being such that the outer coils constitute the inner portions of the circuit.

742,933. ELECTRIC MOTOR CONTROLLER; Walter N. Vance, Chicago, Ill. App. filed July 2, 1902. A railway controller, the object of the invention being especially to insure safety in operation, the various parts being interconnected and interlocked to prevent a change of circuit unless the conditions for the change are first made right.

742,963. ELECTRIC HEATER FOR LIQUIDS; Frank Briggs, Torquay, England. App. filed Aug. 23, 1902. Two elongated electrodes are located in a tank for liquid, the liquid being heated by the passage of current through it between the electrodes.

742,976. ALTERNATING CURRENT CIRCUIT CONTROLLER; Cornelius D. Ehret, Philadelphia, Pa. App. filed April 5, 1902. Control circuits and apparatus controlled thereby, such circuits being so adjusted as to their electrical constants that a change in frequency of the energy flowing in them will cause either a rise or fall of potential in the control circuit, such variation being utilized to control the main circuit.

742,997. MANUFACTURE OF ELECTRICAL INSULATING MATERIAL; Carl Jung and Adolf Kittel, Vienna, Austria-Hungary. App. filed April 21, 1900. An insulating material containing a mixture of casein, oil and sulphur vulcanized.

743,011. TELEGRAPHIC TRANSMITTING ATTACHMENT FOR TYPEWRITERS; Albert E. Morelock, Topeka, Kan. App. filed Jan. 27, 1903. An attachment for typewriters wherein the stroke of a key suffices to put in operation mechanism which automatically transmits the dots and dashes which denote the letter represented by the key.

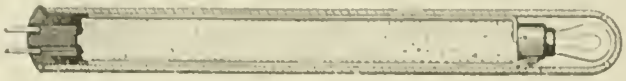
743,012. TELEGRAPHIC TRANSMITTER; Albert E. Morelock, Topeka, Kan. App. filed May 11, 1903. A modification of the preceding invention.

743,024. ELECTRICAL DISPLAY SYSTEM; Francis L. O'Bryan, Winston-Salem, N. C. App. filed Dec. 20, 1902. An improved switching apparatus for electric signs.

743,028. STEADYING RESISTANCE FOR ELECTRIC LAMPS; Henry N. Potter, Göttingen, Germany. App. filed Aug. 9, 1899. The ballast conductor in series with the glower has a resistance which increases at an abnormally high rate when traversed by current that is greater than the normal maximum for the glower.

743,029. BALLAST DEVICE FOR ELECTRIC LAMP CIRCUITS; Henry N. Potter, Pittsburg, Pa. App. filed Dec. 29, 1899. The temperature of the ballast is raised during the period of heating the glower to conductive temperature, so that the ballast will be in condition to prevent the initial inrush of current through the glower.

743,030. TERMINAL FOR ELECTRIC LAMP GLOWERS; Henry N. Potter, New Rochelle, N. Y. App. filed May 1, 1903. An electric lamp glower having a distributed metal terminal, every portion of which is substantially equidistant from a given point in the axis of the glower body.



743,306.—Therapeutic Appliance.

743,031. INSULATING MATERIAL; George T. Pratt, Westbrook, Maine. App. filed Jan. 24, 1902. The material is composed of leather pulp having a strengthening fibre mixed therewith and impregnated with mineral wax, rosin and alum.

743,044. DYNAMO; John D. Spence, Somerville, Mass. App. filed Sept. 28, 1901. The invention resides in having one of the windings of a compound wound armature used for the field excitation in connection with a secondary battery.

743,056. WIRELESS TELEGRAPHY; Ferdinand Braun, Strassburg, Germany. App. filed April 18, 1899. (See Current News and Notes.)

743,082. DYNAMO-MACHINE; Dugald C. Jackson, Madison, Wis. App. filed Aug. 11, 1902. (See Current News and Notes.)

743,101. RAILWAY BOND; Henry E. Procunier, Oakpark, Ill. App. filed Sept. 22, 1902. Relates to the formation of the terminal of the bond which is driven into a hole in the rail.

743,102. BATTERY-GRID; Gustav H. Rabenalt, Buffalo, N. Y. App. filed Nov. 5, 1902. (See page 806.)

743,122. PRINTING TELEGRAPH RECEIVER; James D. White, London, Eng. App. filed Jan. 3, 1903. Details of a page printer.

743,136. WIRE WINDING MACHINE; John G. Bauer, Ravenna, Ohio. App. filed April 24, 1903. A machine for winding wire around a flat carbon brush.

743,153. TROLLEY MECHANISM; Charles I. Earll, New York, N. Y. App. filed Sept. 20, 1901. The trolley cord passes over a sheave at the upper end of the pole and thence through the tubular pole to a spring drum at the base thereof.

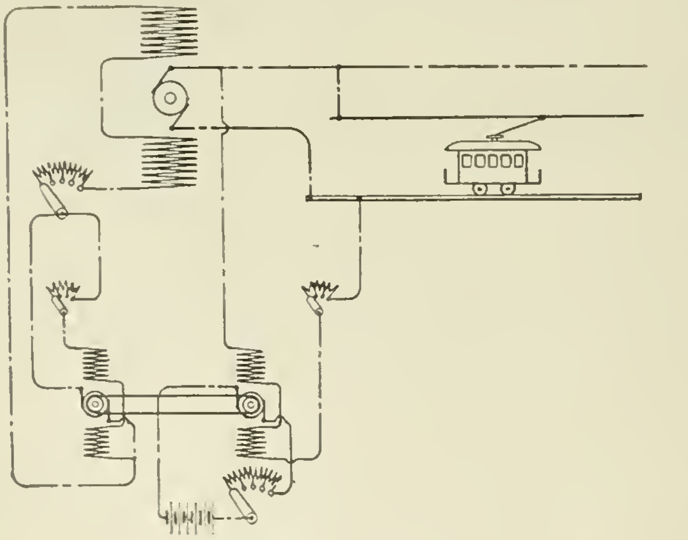
743,173. RATCHET OPERATED ELECTRIC SWITCH; William Kingsland, London, England. App. filed June 1, 1903. Details.

743,188. ACCUMULATOR PLATE OR GRID; Johannes von der Poppenburg, Charlottenburg, Germany. App. filed May 13, 1903. (See page 806.)

743,206. INCANDESCENT ELECTRIC LAMP SOCKET; August Weber, Sr., Schenectady, N. Y. App. filed Dec. 10, 1902. Improvements in the locking connection between the sleeve and cap of the socket.

743,207. INCANDESCENT ELECTRIC LAMP SOCKET; August Weber, Sr., August Weber, Jr., and John Weber, Schenectady, N. Y. App. filed Feb. 13, 1903. Details of the insulating base and the manner in which the switch mechanism is mounted thereupon.

743,236. ELECTRODE FOR ARC-LAMPS; Hugo Bremer, Neheim, Germany. App. filed Aug. 5, 1899. (See Current News and Notes.)



742,861.—System of Electrical Distribution.

743,237. ELECTRIC-ARC LAMP; Hugo Bremer, Neheim, Germany. App. filed March 7, 1900. (See Current News and Notes.)

743,238. ELECTRIC-ARC LAMP; Hugo Bremer, Neheim, Germany. App. filed May 2, 1901. (See Current News and Notes.)

743,239. ELECTRIC-ARC LAMP; Hugo Bremer, Neheim, Germany. App. filed Nov. 23, 1901. (See Current News and Notes.)

743,240. ELECTRIC-ARC LAMP; Hugo Bremer, Neheim, Germany. App. filed July 16, 1902. (See Current News and Notes.)

743,241. ELECTRIC-ARC LAMP; Hugo Bremer, Neheim, Germany. App. filed Aug. 2, 1902. (See Current News and Notes.)

743,245. RAILROAD SIGNAL AND ALARM; Albert E. Caughey, Omaha, Neb. App. filed May 2, 1901. A railway signal comprising a starting mechanism in circuit with track wires, a vibrating armature to strike a gong and a device for operating the starting mechanism to reset the same after the signal has been actuated for a suitable length of time.

743,246. COMBINED CUT-OUT AND CONTROLLING SWITCH; Lee S. Chadwick, Ridley Park, Pa. App. filed Feb. 11, 1903. A pin switch used to disable the primary circuit of a spark coil, the switch being attached to the steering wheel of an automobile.

743,272. SAFETY TROLLEY ALARM; William M. Gruner and William C. Fink, Springdale, Pa. App. filed Sept. 14, 1903. A second trolley wheel with a wide tread follows the main wheel to engage with the wire when the main wheel leaves it, and an alarm is sounded when the event occurs.

743,273. ELECTRIC BATTERY; Henry Halsey, New York, N. Y. App. filed Jan. 10, 1903. (See page 806.)

743,274. ELECTRIC BATTERY; Henry Halsey, New York, N. Y. App. filed June 23, 1903. (See page 806.)

743,275. ELECTRIC BATTERY; Henry Halsey, New York, N. Y. App. filed June 23, 1903. (See page 806.)

743,281. SWITCH; Martin E. Hepburn, Chicago, Ill. App. filed Feb. 12, 1903. Details.

743,306. THERAPEUTIC APPLIANCE; George M. D. Merwin, St. Louis, Mo. App. filed March 10, 1903. A translucent colored tube containing an electric lamp, an electric heater and medicinal salt, whereby actinic rays, warmth and medicated vapors can be conveyed directly to a diseased membrane.

743,315. DIRIGIBLE TORPEDO; David W. McCaughey, Chicago, Ill. App. filed Jan. 8, 1902. The various electro-magnetic devices for controlling the speed, rudder, etc., are operated by variations of intensity of current through a single conductor.

743,331. MEANS FOR REMOVING SLEET, ETC., FROM ELECTRICAL CONDUCTORS; Elias E. Ries, New York, N. Y. App. filed Sept. 4, 1903. The power rail or conductor is made a part of a second circuit carrying a current of large heating capacity.

743,337. BATTERY; Georges Schauli and Dolf Loewenstein, London, England. App. filed July 14, 1903. (See page 806.)

743,346. ELECTRICAL CONNECTOR; Joseph G. Swain, Youngstown, Ohio. App. filed Nov. 20, 1902. Details.

743,348. ELECTRIC SWITCH; George B. Thomas, Bridgeport, Conn. App. filed June 8, 1903. Details.

743,353. DEVICE FOR DISINFECTING TELEPHONES; Nelson J. Tubbs, Louisville, Ky. App. filed March 18, 1903. (See page 807.)

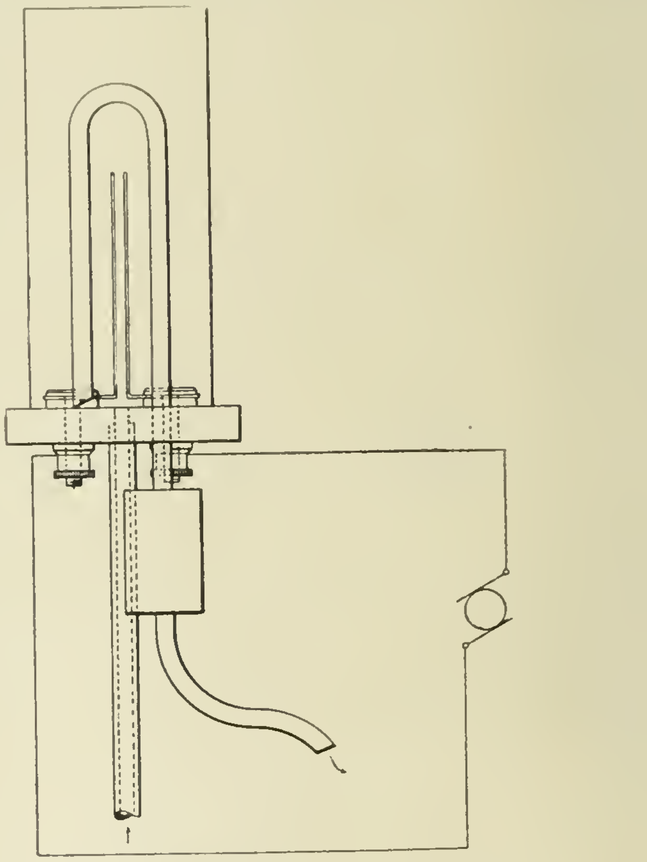
743,358. INCANDESCENT ELECTRIC LAMP SOCKET; August Weber, Jr., Schenectady, N. Y. App. filed June 25, 1903. Details.

743,364. ELECTRIC MOTOR; Edward B. Wilford and Adolph W. Schramm, Philadelphia, Pa. App. filed Aug. 10, 1903. By connecting the armature to the field winding in such a manner that a portion only of said winding is in series with the armature, the remaining portion gives rise to an action which maintains the armature and field current in phase with each other.

743,3[illegible] MAGNETIC MEDICAL APPARATUS; Emile Bachelet, Tacoma, [illegible] App. filed Aug. 12, 1903. An apparatus by which the human body [illegible]tion thereof can be placed in a magnetic field.

743,373. ELECTRO MAGNETIC THERAPEUTIC APPARATUS; Emile Bachelet, Tacoma, Wash. App. filed Oct. 2, 1903. A modification of the preceding patent.

743,378. AUTOMATIC SELF-DROPPING TROLLEY POLE; John Delane, Terre Haute, Ind. App. filed March 23, 1903. The rise of the trolley pole above the wire actuates a trip allowing it to fall to the roof of the car, the last part of the movement being retarded.



742,963.—Electric Heater for Liquids.

743,384. APPARATUS FOR BREAKING ELECTRIC ARCS; Harold Hastings, London, Eng. App. filed March 21, 1903. A series of blades placed above and below across the space occupied by a fuse; the blades are connected with the conductors through a resistance and are said to be effective in destroying an arc.

743,396. METHOD OF OPERATING ELECTRIC LAMPS; Henry N. Potter, Pittsburg, Pa. App. filed Feb. 14, 1901. Consists in raising the temperature of the ballast and inducing therein the condition under which it produces its maximum corrective effect, before the glower has been brought to a conductive state.

12,165. SAFETY SPEED LIMITING MEANS; Garrett W. Henricks, Indianapolis, Ind. App. filed May 28, 1901. The magnetic generator used to supply the spark in gas engines is mounted in an adjustable manner so that the pressure of its pulley against the fly-wheel of the engine can be varied.

Electrical World and Engineer

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ELECTRICITY ON THE MANHATTAN.

For a great many years this journal advocated the adoption of electricity on the Manhattan elevated road, but Mr. Russell Sage and a few others like him pooh-poohed the idea with equal persistence. Now that electric traction prevails over the whole system, thanks to the vigorous policy of the present management, it is at once seen to have justified every word that was said in its favor. We give elsewhere the figures of the last annual balance sheet. They speak for themselves, but one or two points may be made. Up to the time of the change, the Manhattan system had not been able to earn 7 per cent. upon the old stock. Now that the stock has been increased by $7,200,000, the earnings equal about 10 per cent. upon the old and 8½ per cent. upon the new capital. The wages of the employees have been increased during the year, and the hours of work have been cut down. The growth is demonstrated by the totals of gross earnings for the last four years. Earnings were but $9,115,348 in 1900; in 1901, $9,620,564; in 1902, $11,067,746; 1903 the total was $12,651,977, but the operating expenses have been falling off in their percentage. In 1902 the percentage of expenses to earnings was 51.19. In 1903 it was only 42.02.

This is no unusual experience. It has, indeed, been common and recurrent ever since the trolley came in. It will be renewed and repeated every time a steam railroad management has sense enough to drop its locomotives and turn to electric motors. It is the best of bull arguments for the future of railroad properties, which, as they approach the limits of net earning capacity under the old régime, have magnificent new opportunities opened up before them in a field of transportation that has the Manhattan on one horizon and Zossen on the other.

TRACKLESS TROLLEYS.

During the past year or two the subject of trackless trolleys has been taken up in Europe and our pages have recorded experiments and results in France and Germany with electric vehicles of the automobile type, receiving their current from overhead wires. In this issue we illustrate some experiments which have lately been made with a fair showing of success by an American system at Scranton, Pa. This, so far as we are aware, exemplifies all that is being done in the United States in this direction at the present time, although there has been talk in the newspapers of proposed trials at Schenectady with one of the European systems. As to the future of such work, it is very easy to build up agreeable conjectures in regard to the number of lines which might be equipped along city thoroughfares and country roads, where tracks would not be permitted or where it would not pay to lay them. But there are many good things in electrical development which do not make the headway one would expect of them. Sometimes the hour is not ripe; sometimes the ultimate conditions are not altogether favorable; sometimes the public does not take kindly to the new departure, but for whatever reason it may be, the invention or idea whose merits can be argued with great plausibility is slow in taking hold. It may be somewhat this way with regard to the trackless trolley. It has been talked about for a good many years past, but to-day only two or three lines are running; and the reason why it lingers is not quite clear.

It is said that the trackless trolley takes twice as much current for the same passenger service as does a regular trolley line, but this should not stand in the way of an extensive adoption of the system if there are places where it could be utilized to advantage. One hears a good deal about insuperable objections to trolley tracks, and the availability of these trackless systems, but it is not quite plain whether the public prejudice is against the track or against the overhead construction, or against both. In the long run, a great many of these objections disappear and the trolley goes in. As between trackless trolleys and regular storage battery automobiles, it would appear that the honors are at present easy, but regular automobile stages have not made anything like the inroads into the transportation business that the public has been led to expect.

THE POLICE TELEPHONE.

The utilization of the telephone in connection with police patrol work is not new, dating back as it does to the efforts and success of Mr. John P. Barrett, in Chicago, in the very early eighties. But the system just inaugurated in New York City and put into operation in the first police precinct is certainly a new departure and the beginning of a new regime. Just how far beyond Manhattan it may go no one could say at this period, but on the face of it there are sundry merits not easy to disregard, and the question interests telephone people all over the country. Under the contract with the New York Telephone Company the Police Department has called for over 600 police telephone stations, which will be employed in each of the 29 precincts in numbers varying between 20 and 30 per precinct. This obviously gives control of a wonderfully complete network of communication. It is also obvious that it is a radical departure from the old plan of buying outright at large cost a separate and independent police patrol system.

How far the new plan will be superior to the old remains to be proved. We understand that the telephones are in series groups of six, but that is an objectionable feature in technique that can readily be changed. The essentially novel feature is that all the work of installation, maintenance and operation, aside from the police operators at each precinct switchboard, is to be done by the telephone company by its own regular staff, so that the police force will not have to maintain its own construction, line and repair force to look after wires, batteries and other accessories. Under such conditions the work ought certainly to be well done.

It will be observed also that this is a variation upon the popular plan of municipal ownership and control. The plant involved is all private plant, and an annual rental is paid for its use. Just how far this plan could be carried in other departments we do not know; but on the face of it it has the appearance of a sensible, business-like arrangement, worthy of repetition.

THE CHOICE OF WATTMETERS.

Mr. MacGahan's article on page 837 emphasizes the importance of an accurate knowledge of the properties of a registering watt-hour meter. It is pointed out that recent improvements in watt-hour meters have been of great commercial value to the central station. At first sight it would appear that in a distributing system a meter should, above all things, be accurate at full load. It is, of course, highly desirable that, at full load, a meter should record correctly. But when it is observed during how short a period a meter works at full load, and during how long a period it works at a comparatively small fraction of full load, it becomes evident that, above all things, a meter should be nearly accurate at light load.

A recording watt-hour meter may be accurate within a very satisfactory small limit when it is first installed, and then, as time goes on, fall away from grace. In such cases the error, is nearly always attributable to increase of friction in the moving system. Very rarely does a meter in service get over-active in old age. Much more frequently is it overtaken by laziness and a low constant. When such is the case through friction, the error will be magnified at light loads, since at that time the ratio of frictional opposing torque to driving torque will be large. Consequently, the meter which has the largest driving torque per watt, or the largest full load torque, will be the meter which is least likely to retard seriously at light load through undue mechanical friction.

When a station manager installs a motor in his plant, say for driving a hoist, he is supposed to know the starting torque of the motor, and to have ascertained its sufficiency for the load to be carried. Until recently he was not supposed to know the starting torque of the watt-hour meters installed on the premises of his customers. Now, however, he is supposed to be acquainted with the torque in gramme-centimetres of his meters at their minimum load, and to have satisfied himself that it will be sufficient, not only to overcome the greatest friction that is likely to occur in normal use, but also that it will be so much greater than the friction as to make the error small, on the lowest load the meter will have to work upon.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The most recent volume of the proceedings of the A. A. A. S. has just been issued. It weighs two pounds and contains 594 uncut pages. Why scientists should have to expend time in the process of cutting pages two at a time by hand in order to read the contents, when a machine can cut them all in less than a second at one stroke, is hard to comprehend. As a relic of barbarism in a society formed to advance science, such an unnecessary labor-creating device is distressing.

More than half of this heavy volume, or 312 pages, is devoted to an enumeration of the 3,596 members of the association, and other purely secretarial matter, of very trivial importance to the average reader. It would surely be more economical to keep the printed list of members, on demand, at the headquarters of the association, and spare the mails and bookshelves of the country this superfluous pound of dreary text. The gist of the publication comprises nine addresses made in nine of the ten sections, respectively. These are of much interest, and they extend over 140 pages, or less than one-quarter of the volume. Wasteful as the publication is, it is welcome and worthy on account of these nine papers.

There are two sections of the association, whose proceedings are of especial interest to ourselves and to our readers, namely, section B, on Physics, and section D, on Mechanical Science and Engineering. Fifty-five papers are stated to have been read in section B. Of these several appear from their titles to have interest for electrical engineers. Yet these papers are not published. A list of titles like headstones in a cemetery is all that marks the labors of each author. Fortunately, some of these papers have been rescued from oblivion by the charity of other printing presses. The Physical Society, for example, has printed some. But it is surely a grief and a shame to see so much index and so little literature in this volume with the scattered titles of murdered pages calling for more generous treatment. Such wholesale slaughter of scientific effort is more appropriate to a mediæval age. It can only be excused by the direst necessity. If these papers cannot be printed owing to want of funds, an organized effort should at least be made to have other associations rescue and print them. Nevertheless, the policy of the association has been to give out as little to the technical press as possible, lest peradventure the dead should have more room and less company. It is earnestly to be desired that the association should do all in its power to give permanence to the papers committed to its trust. At least, if they cannot be printed, they should be collected and preserved in the archives, so that members can have subsequent access to them.

British Engineering Standards Committee.

The Engineering Standards Committee of Great Britain has recently issued a statement of the resolutions they have adopted concerning standard direct-current pressures, and also concerning alternating-current frequencies. In this country the American Institute of Electrical Engineers recommend the standard generator terminal voltages of 125, 250 and 550 volts, which, with 8 per cent. drop in transmission, represent 115 volts, 230 volts and 506 volts, at motor terminals, respectively. The British committee favor 110, 220, 440 and 500 volts at consumer's terminals. This is practically the same as American practice, with the additional pressure of 440 volts.

With us the standard street railroad pressure at the cars is 500 volts, while for private right-of-way railroads 600 volts is sometimes used. These are also the pressures recommended by the British committee. With us the frequencies of alternating current are 25, 40, 60 and 120 cycles per second, the frequency of 40 being relatively rare, and the frequency of 120 being on the decline. The British committee recommended 25 and 50 cycles per second. The essential difference, therefore, between the A. I. E. E. and British recommendations is that while we have 25 and 60 cycles per second, they have 25 and 50.

It is to be hoped that sooner or later there may be standard frequencies and standard pressures all over the world. This standardization of machinery naturally tends to aid industry and promote trade throughout the world. All are gainers by it. It is greatly to be desired that an International Electrical Congress should take the subject under consideration.

Rates for Lighting and Power.

Among the numerous good offices extended by the National Electric Light Association to its members, its recent report on the rates for lighting and power charged throughout the country is conspicuous. With the increased use of water power on the one hand and of underground distribution on the other, two opposing influences have been at work, the one tending to lower prices, the other to maintain them. Besides, the old contract system is rapidly disappearing, and is being replaced by the meter system with all sorts of ingenious modifications based on the nature of the service and operating to favor the large and steady consumer. The report before us gives fuller information as to the present customary charges than anything we have yet seen in the line of electric lighting statistics. Its most conspicuous feature is the evident tendency to favor the consumer by lower prices. The old basis of 20 cents per unit with small discounts, or approximately 1 cent per lamp-hour, is now seldom maintained, and when used at all is generally modified by discounts for prompt payment large enough to form a substantial reduction. Common prices are 15, 17 and 18 cents per unit, with rather liberal discounts. Many plants in the regions of cheap coal have come to even lower prices, as have water power plants generally, and the number of plants charging as low as 10 cents per unit is rather surprising. For power service 10 cents with large discounts is rarely exceeded, with many plants selling at 5, 6 and 8 cents, with ample discounts to the larger consumers. The lowest figure for power which we have noted is 1 cent per unit for consumers taking 300 hp or more, but sliding discounts bringing the price down to 2 or 3 cents per unit are common in case of water power plants or those in regions of cheap fuel. One cent per unit is a very low figure, necessarily the result of peculiarly favorable conditions.

In looking over the list of rates there is widespread evidence of a struggle to secure something better than a flat rate with sliding discounts. It is for the interest of most plants to favor the consumers who call for a large and steady load, and capacity charges loom up in the list under numerous forms. A few plants use the maximum demand system in some form, but more depend upon a fixed minimum monthly charge and service charges in one form or another. A device not uncommon in the West is an increased rate for residence lighting, although a few plants in situations where residence lighting must be cultivated grant it a specially low rate. On the whole, it is very clear that much remains to be done in the way of devising a simple and fair system to take account of the nature of the demand for energy. It is a subject which has provoked much controversy, most of it fruitless. After reading over the discussions of the matter one is forcibly reminded of Carlyle's characterization of metaphysics: "High air castles are cunningly built out of words, well laid, moreover, in good logic mortar; wherein, however, no knowledge comes to lodge." We are strongly under the impression that most of the systems proposed attempt too much. It is as if they attempted to lay out a standard line of shoes by means of a formula based on the average proportions of the human foot, instead of furnishing arbitrary sizes, each made in several widths. It would be interesting to determine the possibilities of a flat rate with customers rated according to the nature of the service in classes A, B, C, etc., each class carrying its own simple set of discounts. Of course, there would have to be occasional close decisions, but we doubt whether the total annual number of kicks would be out of the ordinary. Something of the kind was occasionally tried in the early days of motor service, but not in the systematic way that is needed to secure practical results. It may be possible to devise a system that can automatically take account of all contingencies; but it is likely to be complicated, and like other complicated things, to get out of order when subjected to trying conditions.

An interesting side light is thrown on this very valuable document by a recent consular letter giving the current rates for electric light and power in various continental cities. The lowest figure is that which will apply in Berlin after January 1 next—10 cents per unit for lighting, and for power purposes down to a minimum of 3½ cents per unit. This is a little lower on lights and a little higher on power than the prices in American cities of comparable size. In other continental cities the prices range about as they do here, but we think that the American plants are the more liberal to users of motors. In the smaller cities and towns we are disposed to the belief that American prices will range lower than the continental ones. Of course, we gain here in the average cost of fuel, although losing on the labor account; but altogether the American plants make a very liberal and business-like showing. We are glad to note that the next report of the National Electric Light Association upon this topic will contain the prices of fuel at the various points concerned, which will be a valuable addition to the other information. The cost of fuel is generally the main factor in the local conditions as to price, particularly in the smaller cities. When underground service has to be undertaken the situation changes and reductions in price become somewhat difficult. Hence, it is never fair to expect extremely low figures in the larger cities, unless under exceptionally favorable conditions.

What Electricity Has Done for the Manhattan Elevated.

The beneficial effects of the adoption of electricity in place of steam for traction are well shown in the annual report of the Manhattan Elevated Railway Company, of New York City, whose system is now known as the Manhattan Railway Division of the Interborough Rapid Transit Company. At the meeting the members of the old board, President Gould made these remarks: "Since the last annual meeting the electrical equipment of the company's lines has been completed and the expectations of the management have been fully realized, both as to increase in carrying capacity and economy of operation. On April 1, 1903, the lease of your company to the Interborough Rapid Transit Company took effect and possession of the property was delivered on that day to the lessee, which has since operated the railway. The statement of operations presented, therefore, relates in detail only to the six months ending March 31, 1903, and with respect to the last six months includes only the dividend rentals paid by the lessee."

The gross earnings of the company for the six months ended March 31, 1903, were $6,441,437; operating expenses, $2,819,764, and net earnings, $3,621,673. For the remaining six months of the fiscal year the report includes the $1,656,000 paid to the Manhattan Company by the Interborough Company in dividend rentals to make a grand total of $10,996,772 of surplus and income. Dividends paid to the Manhattan stockholders amounting to $3,894,000 are deducted, leaving the total surplus on September 30, 1903, $7,102,772, compared with a surplus on September 30, last year, of $6,372,418.

A combination of the report of the Manhattan Railway Company for the six months ended March 31 last, before it became a division of the Interborough Rapid Transit Company, with that for the six months ending September 30, shows that the gross earnings of the Manhattan Company for the year increased $1,584,231, and by a decrease of $115,921 in the operating expenses, the net earnings were increased $1,700,152. The balance, after the payment of interest and taxes, increased $1,397,736, and was brought up to $4,723,798. This is equal to 8.56 per cent. on the entire $55,200,000 capital stock of the company, and compares with a surplus in 1902 equal to 6.93 per cent. on the $48,000,000 stock at that time outstanding.

The report of the Manhattan Railway Division of the Interborough Company states that in the last six months 125,548,740 passengers were carried, as compared with 108,164,184 for the corresponding period last year, an increase of 17,384,556. Evidence as to the excellent results attained by the installation of electricity as the motive power is shown by the fact that the operating expenses of the company for the period mentioned were 42.02 per cent., as compared with 51.19 per cent. last year, when steam locomotives drew the trains.

The number of passengers carried in the last quarter was 59,443,304, as compared with 50,464,936 last year, and 66,105,436 in the quarter ended July 1 last. For the quarter ending July 1 last year 57,699,243 passengers were carried. Moreover, all these passengers have benefited greatly by the increase in speed of the trains and the lessened running time per trip.

Electrochemistry at the Mass. Institute of Technology.

According to an announcement in the *Technological Review*, published by the Massachusetts Institute of Technology, Boston, a new laboratory devoted exclusively to electrochemistry was opened at the beginning of the school year. This laboratory has been equipped to provide facilities for the professional work in the senior year of students electing the schedule of electrochemical studies offered as an independent option in Course VIII, and for graduate students desirous of taking up this line of work.

Instruction in electrochemistry has been given to students in physics since 1894, but the recent rapid development of the industrial applications of the science determined the department several years ago to extend the work and to lay out a schedule of studies directed particularly to this end. This course was officially announced by the Institute in the summer of 1900. Provision for somewhat similar work had already been made at the Polytechnikums at Zurich and Darmstadt, and more recently special electrochemical laboratories have been established at Karlsruhe, Aachen, Berlin and Manchester (England). In this country, too, distinct courses in electrochemical engineering and electrometallurgy are now offered at the University of Wisconsin and at Lehigh, respectively, while more or less specialized instruction in electrochemistry is offered at many of our more progressive technical schools and universities.

The course as laid out at the Institute aims to give a student a thorough grounding in the principles underlying electrochemical problems in general, and so much of electrical engineering as will enable him to deal with the various power problems which are likely to arise in connection with the installation of electrochemical plants. To this end the course provides for a thorough training in theoretical and applied electricity, these subjects forming the foundation for the professional work in electrochemistry, which extends throughout the fourth year. Instruction in organic chemistry, mineralogy, assaying and metallurgy, and in the elements of machines and engineering, is also given to as great an extent as practicable.

The work in electrochemistry proper consists of a thorough course of lectures on theoretical and applied electrochemistry, accompanied by extended laboratory work on electrochemical methods and measurements, and on technical processes carried out on a scale sufficiently large to give the student some just idea of the factors which determine their efficiency. To provide for this work, the new laboratory opened in October as a part of the Rogers Laboratory. It was not until this summer that the space vacated by the Electrical Engineering Laboratories made the equipment of this laboratory possible. The laboratory occupies the rooms formerly devoted to the Physico-chemical and Heat Measurements Laboratories in the basement of the Walker Building, these laboratories being now removed to more commodious quarters. It is 95 by 30 ft., and is divided into two distinct parts, one being devoted to electrochemical measurements and analysis, and the other fitted up for technical work. In the former the students' desks are arranged in groups of four, and are very completely equipped for electrochemical investigations. In the center of each group of desks is a large electrically-heated and regulated porcelain-lined thermostat. Each desk is provided with a 2, 12½, 25 and 110-volt circuit, rheostat, stirrer, gas, water and suction. Besides an equipment for analytical work, each student is given a complete set of electrochemical measuring apparatus, including a Weston ammeter and voltmeter with three scales, Lippmann electrometer, potential boxes, conductivity bridges, voltameters, etc. The whole class is thus able to work at the same time on subjects which are being concurrently discussed in the lectures, and thus, in conferences held weekly on the current work, to compare results of each other's experiences. The laboratory is also equipped with special arrangements for electrochemical analysis. Special rooms adjacent to the laboratory are equipped for measurements of electrical conductivity, dielectric constants, etc.

The laboratory of applied electrochemistry is equipped with a double-current motor generator of 25-kw capacity, which furnishes 1,000 amp. at 25 volts or 2,000 amp. at 12½ volts. Other voltages may also be obtained by varying the field of the generator. The generator is designed for electrolytic processes requiring large currents, such as occur in the manufacture of aluminum and of alkali. A storage battery of large capacity is also provided for depositions requiring currents at low constant voltage.

For processes requiring intense heat, but not electrolysis—for example, the manufacture of graphite, carborundum, carbides, etc.—the laboratory is provided with power from a single-phase alternator of 30-kw capacity, which, it is expected, will be still further increased another year. By means of a special transformer designed in the department this energy can be transferred from 160 volts to 10 volts in steps of 10 volts each. The transformer may thus be used to obtain any multiple of 10 volts desired. A complete set of alternating and direct-current electrical measuring instruments will be available for determining the electrical energy expended in the various processes studied.

The inauguration of a schedule of studies of the character outlined has been already justified by the call for men to fill electrochemical positions and by the number of students who have elected the course. Seventeen students were registered in October in the three upper classes, of whom eight are in the graduating class and two are graduates of other colleges.

The staff of the department has been strengthened for carrying out the new work by the return of Dr. Thompson, who made a tour of inspection of foreign electrochemical laboratories two years ago, and who has since been making a special study of electrochemistry at the Polytechnikum at Zurich.

The Chateaugay Water Power in the North Country.

WHILE much money and work are being expended upon the development of the larger water powers in this country, what is possibly an equal amount in the aggregate is being devoted to the utilization of smaller powers scattered all over the country, powers many of which are too remote or too insignificant to have attracted public general attention or to be known very far beyond their immediate vicinity. Of late years the United States has been gone over with a fine tooth comb by investigators and promoters looking for just such powers to develop, and there is no doubt that for some years to come they will afford opportunity to engineers and occupation to manufacturers, upon a large scale, although the units at any one of them may be spoken of as small as compared with those required at such places as Niagara or the Shawinigan.

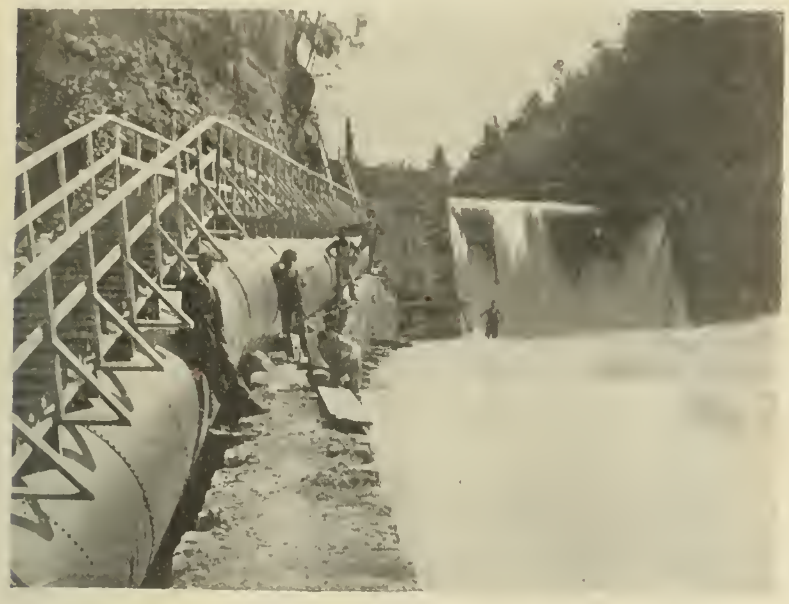


FIG. 1.—VIEW OF DAM AND PENSTOCK FROM POWER HOUSE.

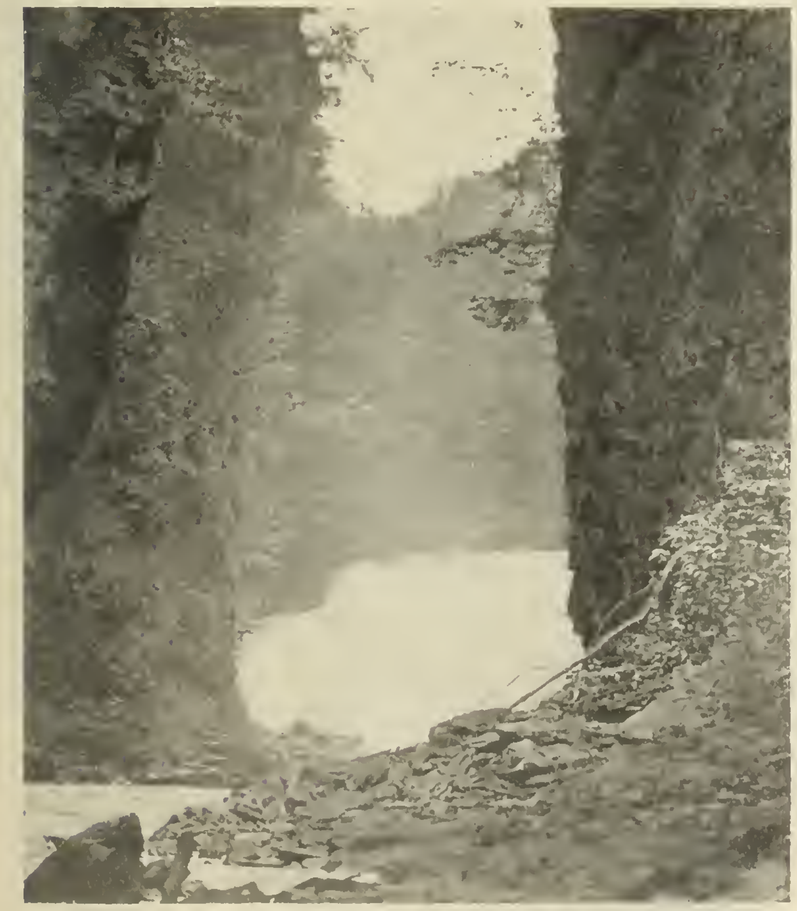


FIG. 2.—CHATEAUGAY CHASM BEFORE ERECTION OF DAM.

An interesting example of this class of work is found in the plant which has recently been installed in that section of New York State which Mr. Irving Batcheller, in his charming historical fictions, speaks of as the "north country." The Chasm Power Company, of Chateaugay has developed at that prosperous little village on the Rutland Railroad, a dozen miles from Malone, the county seat, a plant which is illustrated in the accompanying cuts and which has but lately gone into operation.

The Chateaugay Chasm is an outlet for the river and lakes of that name, as shown by our map. The river finds its way at this point through a narrow gorge hemmed in by walls of solid rock varying in height from 60 to 200 ft. Back of the river lies a chain of lakes furnishing an abundant supply of water under considerable head. The Chasm Power Company has built its dam just above the lower falls of the beautiful chasm and at the foot of the lower falls has located its plant. The dam is built of stone and cement to a height of 49.3 ft., making the distance from the top of the dam to the foot of the lower falls 88.7 ft. The penstock is 280 ft. long and 7 ft. in diameter, and as can be seen from the cuts is solidly built. The power house is of stone, 40 ft. by 60, built against the face of the cliff, and is so arranged that it and the penstock allow the installation of three hydroelectric units. The company has purchased of the Westinghouse Electric & Manufacturing Company a polyphase generator of 180 kw. as an initial equipment, but it is intended to install the two other units as soon as possible, as there is avail-

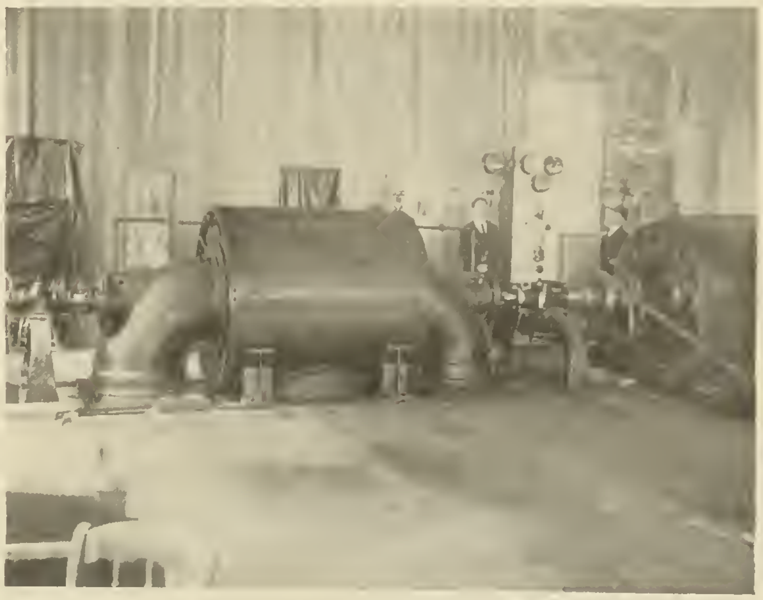


FIG. 3.—ONE OF THE UNITS.

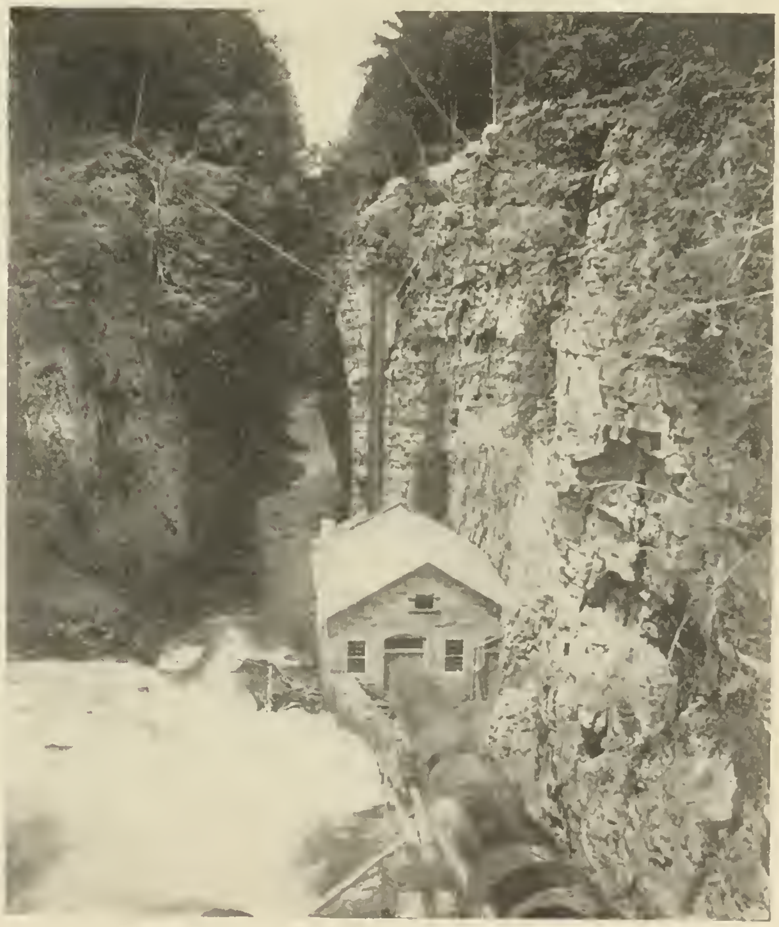


FIG. 4.—POWER HOUSE, PENSTOCK AND CHASM FROM DAM.

able at least 1,000 hp on the spot and a feasible 2,000 hp is in sight. The water wheel was supplied by the Risdon-Alcott Turbine Company. It is intended not only to utilize this power locally, but to transmit it to the various points in the vicinity.

The generator is of the three-phase, 60-cycle type, current being generated at 2,100 volts and stepped down to 105 volts for light and power service. The turbine is of the cylinder gate type, capacity 300 hp under 84 ft. head, and is controlled by a Lombard governor. The current is already used for light, heat and motors, and the Chateaugay circuits have been running since July 1. The company is now building a line from Chateaugay to Burke, a distance of five miles. In order to develop business, and having but low fixed charges, the management is quoting liberal and low rates. The prices for lighting are on a flat basis, being $2 a year for 16-cp lamps for residences, and $3 a year for offices and business places. The rate for motors has been put at $20 per year per hp. As might be expected, there is not a great deal of manufacturing in the immediate vicinity, but with cheap power, living and rents, and intelligent labor, the company believes the conditions are attractive for industries of various kinds. Besides, as the beauties of the gorge and chasm remain undisturbed, except at this particular point, the tourists to the vicinity can now enjoy all the advantages of electricity, not previously obtainable.

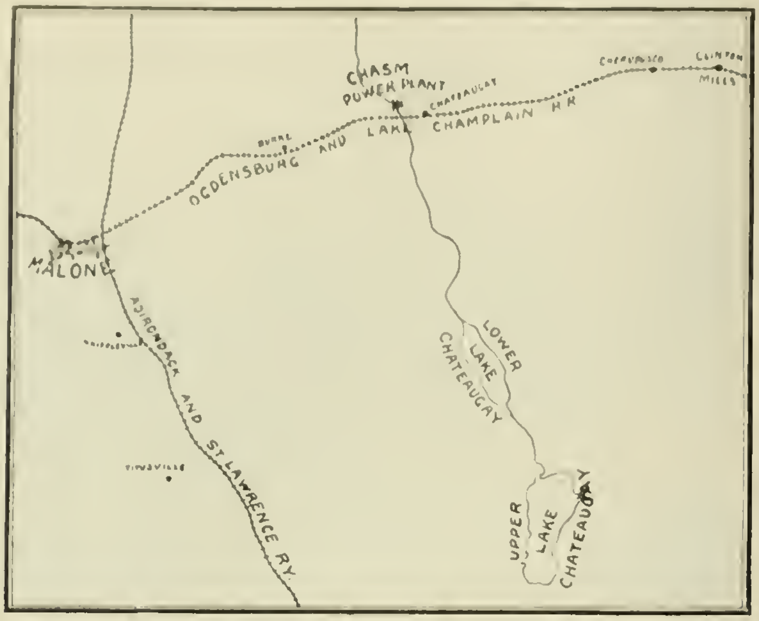


FIG. 5.—MAP OF WATER POWER REGION.

The company has been organized with a capital of $35,000 and secured for less than $4,000 its water power privileges and power house site. The president of the company is Mr. C. L. Bentley; the vice-president, Mr. W. B. Ryan; the secretary, Mr. A. B. Cooney, and the treasurer, Mr. E. S. Duffy.

Talking with London.

A special cable dispatch to a New York daily paper from London of November 14 says with uninformed optimism: "Prophecy is dangerous, but with a full realization of its pitfalls the correspondent of the *Sun* ventures the following prediction: Within three months, probably before New Year's, direct telegraphic communication, without intermediate repeating stations, will be established for the first time between New York and London, and telegrams will be exchanged at a speed of more than four times the previous capacity of any cable. I am tempted to go a step further and express the strong expectation that within a year it will be feasible to converse by telephone between New York and London as it is across Manhattan. Perhaps it is as well to confess that it is easy to prophesy when you know. The feat of rapid communication between London and New York as a matter of fact has been greatly surpassed recently in actual practice; in other words, the problem of cheap and rapid long-distance communication has been solved, and the credit for this signal triumph of modern science belongs to England. I am compelled to await the permission of the inventors before making more than this general announcement."

Direct-Current Traction at 1,200 Volts in France.

It is well known to our readers that Mr. R. Thury, of Geneva, Switzerland, has done a great deal of interesting work with direct-current power transmission at high voltages. At a time when the application of high-voltage alternating current to traction work is under discussion, a further effort of M. Thury and his associates is worthy of note, being nothing less than the operation of a trolley system in Southern France with direct current at 1,200 volts. The road and its details are illustrated herewith.

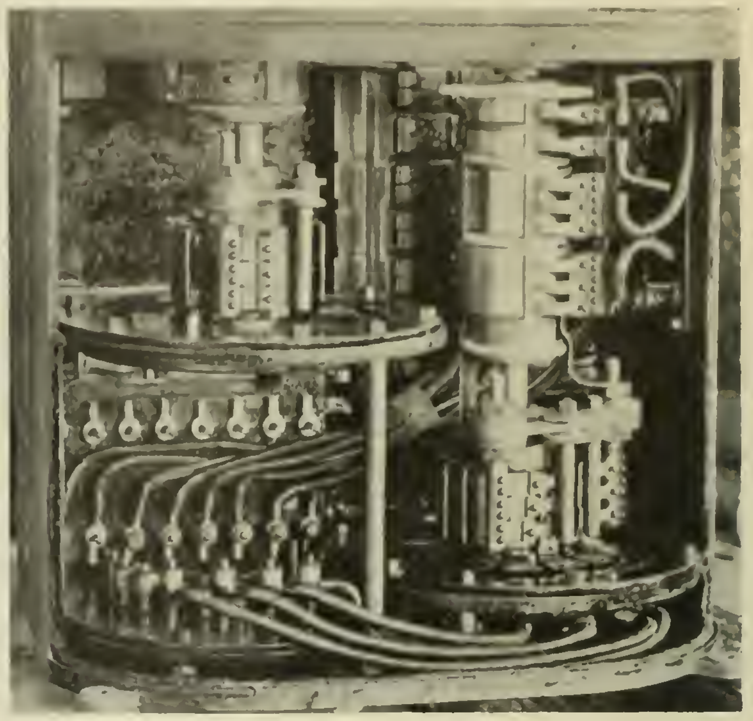


FIG. 1.—CAR CONTROLLER.

The line in question extends between St. Georges de Commiers and La Mure, about 20 miles apart, near Grenoble, and its main business appears to consist of freight. Hitherto the work has been done with steam locomotives, but as there is abundant and cheap water power in the vicinity, electricity has been resorted to, and the first of the new locomotives is now in service. It weighs about 50 tons and is of 500-hp capacity, there being in fact four motors of 125-hp capacity each, two on each truck. These are connected in series and require 185 amp. at 625 volts. The line is equipped on the three-wire system so that the voltage between the outside wires

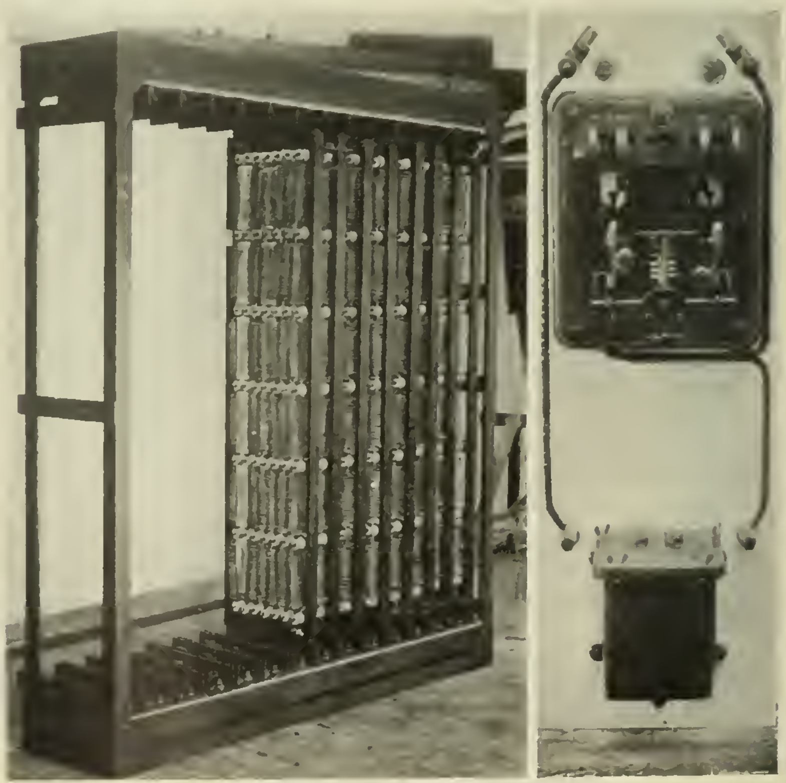


FIG. 2.—RESISTANCES AND CIRCUIT-BREAKER.

is 2,400 volts. A diagram of the three-wire connections is shown. The road—of 1 metre gauge—is a grade with slight slope, and the loaded train comes down with the motors arranged to run as generators and act as brakes, being connected to the resistances. For breaking the circuits, oil switches are used. Hauling 20 cars of a gross weight of 111 tons, the locomotive makes a speed of about 22 km. per hour on the 2¾-per-cent. grades. The motor and gear are shown in Fig. 3.

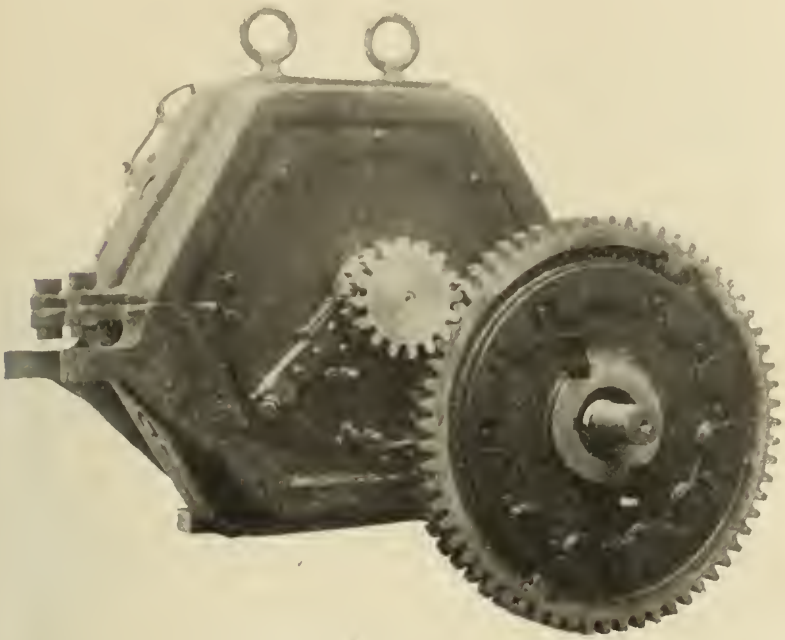


FIG. 3.—MOTOR AND GEAR.

The overhead construction is solid, with double contact wires and double sets of Siemens sliding bone contacts, under the slight upward pressure of 2 kg. The overhead line consists of two "figure 8" copper wires, 114 mm. cross section, in span on wooden poles. As already stated, the voltage is 2,400 volts between the outside wires, and 1,200 volts between each contact wire and the rail forming the neutral. Thury direct-current motors have, however, been successfully built and operated up to 3,600 volts.

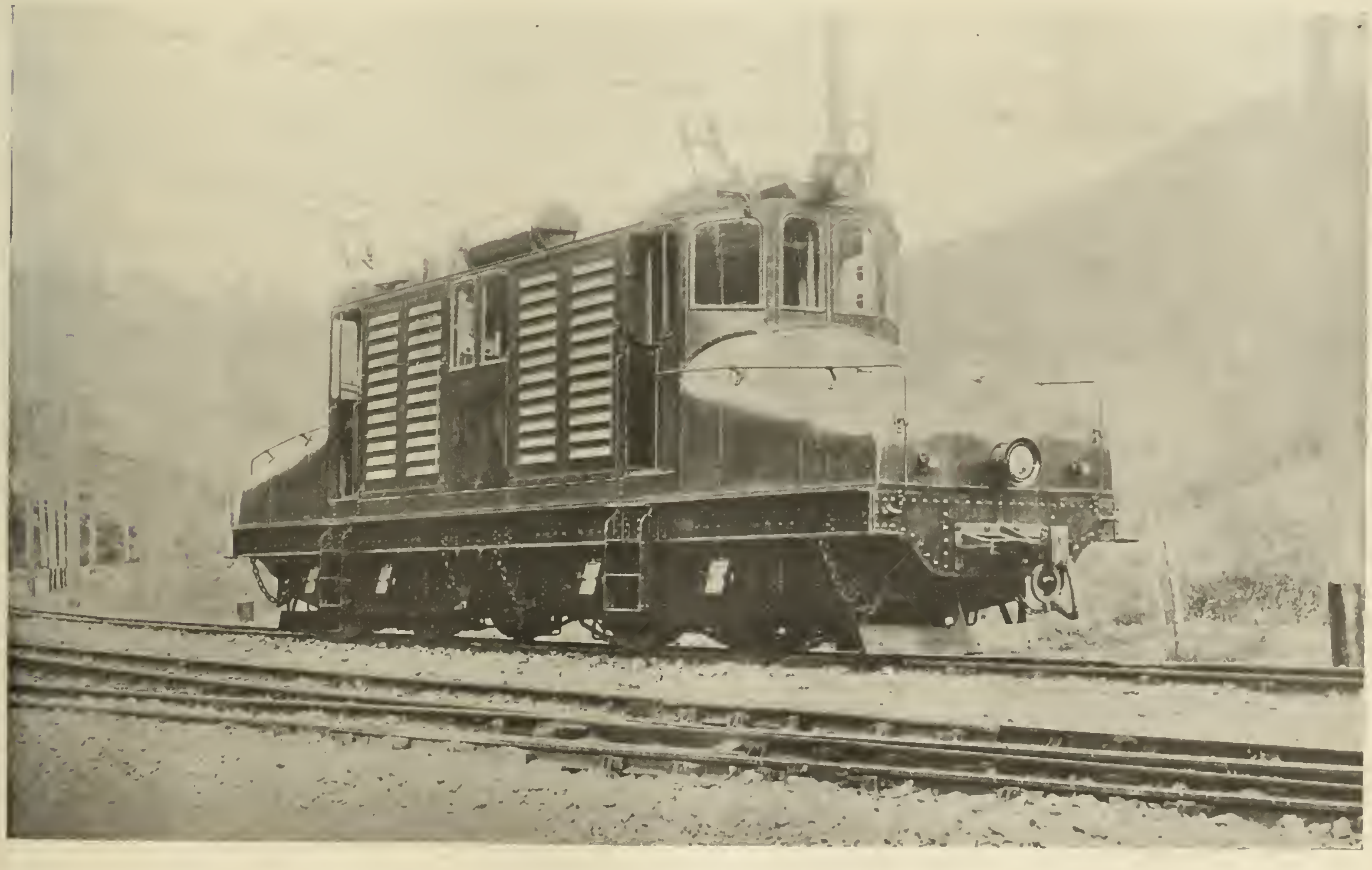


Fig. 4.—General View of Locomotive.

A car controller is installed at each end of the central cabin of the locomotive, of the type shown in Fig. 1. Special care has been taken with insulation in view of the high voltage used, and as will be seen a large number of contacts are provided through the combination of the two sets. One shaft carrying 12 contacts and the other 8, no fewer than 96 steps are obtainable. The resistances employed in association with the controllers are carried in the motorman's cabin and are built up as shown in Fig. 2. These are large enough to absorb easily the electric braking current produced by the locomotive on the descent when the motors are run as generators. The locomotive has also a hand braking system and an air system for which the compressor is driven by a small motor of 4 hp, at 1,200 volts. The circuit-breaker, oil switch, fuses, etc., are shown in Fig. 2.

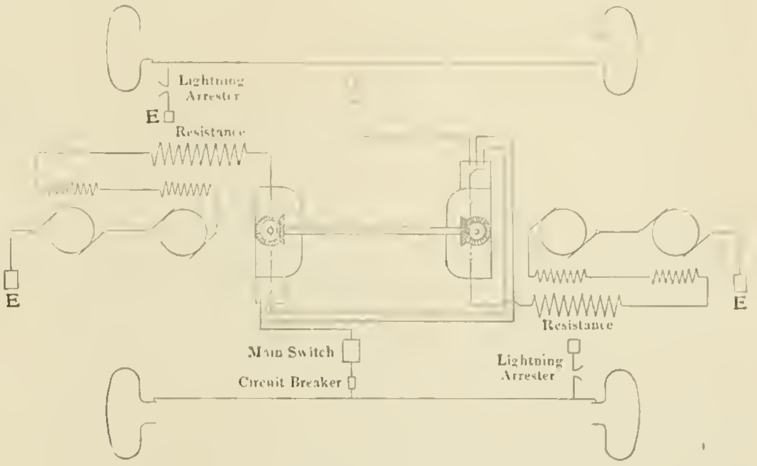


FIG. 5.—DIAGRAM OF CONNECTIONS.

The electrical construction of this interesting system was executed by the Compagnie Generale de Construction and by the concern operating under the Thury patents, i. e., the Compagnie de l'Industrie Electrique et Mecanique de Geneve.

◆

New York Central.

A section of the Rome, Watertown & Ogdensburg Railroad which is leased by the New York Central Railroad is to be equipped with electricity immediately and the electric cars of the Central system will be run to and from all points along the southern shore of Lake Ontario.

Melting Sleet on a Third Rail.

By W. A. Del Mar.

FROM time to time electric heating as a method for removing sleet from the contact rail has been suggested. The idea seems an excellent one at first thought and engineers have been tempted to make experiments with the view to finding the quantity of electrical energy required for the purpose. These experiments have always shown that the energy required to heat the rail is exceedingly large, and principally on this account the method has never been adopted. The object of this article is to show why this large amount of energy is required.

It is a difficult matter to show just what expenditure of energy would be necessary to raise the temperature of the rail a certain number of degrees, but it is easy to show that a large amount can be expended without appreciably affecting the temperature.

When one pound of water has its temperature raised one degree Fahrenheit above the air, it absorbs about one thermal unit, equivalent to 0.2835 watt hour. The specific heat of iron being only about 0.114 that of water, one pound of rail will absorb but 0.0323 watt hour when its temperature is raised one degree. Now, it can be assumed that in order to melt ice from a contact rail, the temperature must, under fairly normal conditions, be raised at least ten degrees Fahrenheit. A system for heating the rail which would fail a few degrees below freezing point would scarcely be worth installing, so that this assumption of ten degrees rise is quite a moderate one. From the figures given above it appears that in order to heat one pound of rail ten degrees Fahrenheit in one hour, 0.323 watt-hour would have to be used, regardless of the losses by radiation, convection, etc. On a 100-pound rail this amounts to 10.75 watts per foot on the assumption that no heat is lost in any way whatsoever; but in actual cases the losses are very great.

The heat radiated from a square foot of rusty iron is found by experiment to be about 0.7 B.T.U. per hour per degree Fahrenheit difference of temperature between the iron and air—provided that such difference does not exceed 30°. This is equivalent to 0.198 watt per sq. ft. per degree. Now, on one foot of 100-pound rail there are 2.08 square feet of surface. Hence, the radiation per foot of rail will amount to 0.412 watt per degree. This does not allow for losses by convection, evaporation, etc. Assume that in heating the rail ten degrees the average difference between the air and rail is five degrees. The radiation will then be at the rate of about 2.1 watts. If this quantity be added to the heat used in raising the temperature of the iron, a total of nearly 13 watts is obtained as the power necessary to heat one foot of 100-pound rail ten degrees in one hour. On a railway having fifty miles of 100-pound contact rail, this would amount to 3,432 kw, assuming a dry rail, no ice to melt and no loss by evaporation and convection. This quantity has to be greatly increased in order to supply energy for melting the ice.

One pound of ice at 32° F. requires the expenditure of 142.65 B.T.U. to melt it without raising its temperature. This is equivalent to 40.44 watt-hours. Hence, in order to melt one pound of ice in one hour, 40.44 watts are required. A deposit of sleet or snow one-eighth of an inch thick covering two-fifths of the surface of a 100-pound rail, weighs about half a pound per foot. Hence on 50 miles of contact rail there would be 132,000 pounds which is to be melted in one hour would require a provision for that period of 5,280 kw. This is assuming a heating efficiency of 100 per cent.; that is, neglecting losses by convection, radiation, etc.

In the case of a sleet deposit, it would of course not be necessary to melt a film one-eighth inch thick, for if a film, say 1/100th inch thick were melted, the remainder would be so loosened as to be easily removed with a brush or scraper. A film 1/100th of an inch thick on ⅖ of the rail surface would weigh 10,560 pounds on 50 miles of 100-pound rail. Assuming a heat efficiency of 100 per cent., this would require to melt it in one hour, a provision of about 427 kw. This would merely supply the latent heat in melting. If the rail were kept 10° F. hotter than the air, the radiation in one hour would require at least 550 kw, assuming a perfectly dry rail. In order to heat the rail 10° F. in one hour about 2,830 kw are required, assuming no losses. Thus the minimum power required to melt 1/100th of an inch of sleet from 50 miles of 100-pound rail, amounts to at least 3,800 kw. This neglects two of the greatest sources of heat loss, namely, loss by evaporation and by wind convection. It is possible that there might be conditions under which it is not necessary to heat the rail 10° F., but a sleet melting system would not be worth installing if it could fail at such a moderate temperature as 10° below the freezing point, besides which in practice the ice would have to be melted in much less than one hour.

Experiments with contact rails have shown that if the rail is kept moist with water 10° hotter than the air, the temperature of the rail will not rise even if 16 watts per square foot are expended on it. With 100-pound rail this is 32 watts per foot length. This power on fifty miles of rail amounts to about 8,500 kw. Thus practice shows that an expenditure of 8,500 kw on 50 miles of 100 pound rail has no effect in heating the rail, regardless of the important matter of melting ice.

It might be suggested that it is useless to heat so much rail at a time; that in fact it might be better to heat one section at a time and then go on to another. This is impossible, however, owing to the low heat storing quality of iron. As shown above, the heat capacity of a foot of 100 pound rail is only 10.75 watt hours, a quantity that would be dissipated in a few minutes. Not only is the cost of energy for electrically heating the third rail enormous, but the cost of apparatus for generating, transforming and distributing this energy is quite absurd, considering the doubtful value of the system under the best conditions.

Contrast the electrical method with the use of hot water. One pound of ice at the melting point can be melted by using 142.65 B.T.U. A deposit of ice ⅛ inch thick on ⅖ of the surface of 50 miles of 100 pound contact rail weighs 132,000 pounds. To melt this 18,829,800 B.T.U. are required. If water at 180° F. be used, 104,590 pounds will be required. This is about 1,700 cubic feet at a heating efficiency of 100 per cent. Assuming the heating efficiency to be only 10 per cent., the number of cubic feet required will be 17,000. If the ice be below the freezing point, a few cubic feet must be added to this. Suppose it to amount to 20,000 cubic feet, which can be contained in a few tank cars of moderate size. Of course, in order to prevent this water freezing on the rail, it must contain salt or some other substance that lowers the freezing point of water. There are serious objections to the hot water method, but these may yet be overcome, and then the sleet scare will be relegated to the past with the scores of other bugbears that have worried engineers and set inventors to work on ideas barren and futile.

The Induction Coil Spark.

By Alfred G. Dell.

Some years ago I pointed out in an article that it is better to change the wires of the secondary of an induction coil, where a reversal is wanted, than to reverse the primary current. At that time I had been occasionally using an induction coil interrupter consisting of a platinum point and a spring with a flat piece of platinum striking against the point when making and breaking the circuit. The platinum was frequently cleaned. I found that there was generally a change in the length of the spark in the secondary whenever I reversed the primary current. At the time I did not know the cause of the change in the spark length, but since seeing the note in the Digest of September 19, 1903, on "Assymmetry of the Mercury Break," I am enlightened.

It is well known that when a spark is made between a point and a plane surface, the spark is longer when the point is positive and the plate negative (See "Experiments with Electric Waves," Electrical World and Engineer, May 18, 1895). When the point is negative and the plate positive, the self-induced discharge should be positive from the point and negative from the plate, in which case the spark of self-induction should be longer than when the current is in a reverse direction, and it would take more condenser capacity to break up the spark than in the latter case. The self-induced discharges could not be of the same sign, and the back rush, or dying away, of the current would certainly reverse the signs of the self-induced discharges. The above appears to be a simple explanation of the change in the spark length.

I have also found, when the break is composed of two round platinum wires, and the current has been used in one direction for some time, that there is a slight difference in the secondary spark length when the current is reversed. On examination of the break point I found that one side had a sharp point raised, fitting into a hollow in the other, which would account for the difference in spark length. It called to my mind the condition of two arc light carbons with a direct current.

Calculation of the Apparent Inductance of Armature Coils.—II.

BY C. C. HAWKINS.

Class *IB*. The nature of the figures obtained in this class entirely depends upon the value of the fraction by which $\frac{\textit{slots}}{2p}$ exceeds a whole number. The smaller this remainder, the nearer can the pitch of the coils be brought to equality with the pole pitch in slots, and by this criterion the cases may be arranged in a sequence of progressive divergence from the diametric case with interchangeable coils. If the remainder is < ½, it is possible for the two spool sides in each of a pair of consecutive zones to fall within the same slot, so that for values below ½ we have very long chord if the rear pitch has its maximum length, or symmetrical long if shortened by one tooth, while for values of the remainder from ½ upwards we have what has been above defined as asymmetrical long or short chord arrangements according to the span. A table of values of the remainder can, therefore, be drawn up as below, which for the case of completely interchangeable coils indicates to which class any winding must be assigned.

	Remainder giving very long or sym. long.		Remainder giving asym. long or asym. short.		
2 spool sides per slot.			Not possible.		
4 " " " "			½		whatever the no. of poles.
6 " " " "	⅓			⅔	with 6 poles.
8 " " " "	¼		½	¾	with 4 or 8 poles.
" " " " "			½		with 6 poles.
10 " " " "	⅕	⅖	⅗	⅘	with 10 poles.

With bar armatures or with non-interchangeable coils, any of the above fractions can yield diametric winding or symmetrical long and short-chord windings if the pitch is shortened.

In class II, with $\frac{N_2}{2p}$ fractional, the subdivisions are in exactly the same way dependent upon the remainder which the fraction $\frac{\textit{slots}}{2p}$ leaves. For example, with six spool sides per slot the possible cases are as follows:

	Remainder giving very long or sym. long.			Remainder giving asym. long or asym. short.				
				½				with 2 poles.
		¼		½		¾		with 4 poles.
6 spool sides per slot.	⅙			½			⅚	with 6 poles.
	⅛	¼	⅜	½	⅝	¾	⅞	with 8 poles.

By comparison of the simpler diagrams it is seen that as we proceed down the scale from the longer to the shorter chords, the process is as it were a gradual *shearing* apart of the two layers of wires from their highest degree of concentration in any one class.

In class I, for the same value of *s* the brush contact may have any width between a minimum of (*s*-1) sectors + (*s*) micas and a maximum of (*s*) sectors + (*s*+1) micas; but of the two limits the latter is the better, since the time of short-circuit always increases in direct proportion to the width, yet the $L + \Sigma M$, even under the least favorable conditions, is never increased quite in the same proportion. The same argument might equally well be used to prove the advantage of a wide brush so as to short-circuit a large number of sections; yet although on paper this is true, it must be borne in mind that in practice a limitation is set by the short-circuited coils coming under the pole tips, or even filling the entire interpolar zone; when this is the case, many of the assumptions made no longer hold in their entirety, and other secondary reactions upset the conclusions that might otherwise be drawn.

In class II, for the same value of *s*, there is again a maximum and a minimum value of the brush width, and *different* numbers of short-circuited spool sides may result, according as the widths approaches the lower or the upper limit. It is, therefore, necessary to select a fixed relation for comparative results, and in all the diagrams for this class, the average is taken by which the brush width is (*s* — ½) sectors + (*s*) micas.

5. *Calculation of slot inductance.*

The *slot inductance* is easily elaborated from a few simple cases. Thus with a single spool side containing *w* wires at the top of a slot (Fig. 11), within the region of its own depth, which is practically equal to $\frac{t}{2}$, the self-induced flux across the slot is increasing in density at a uniform rate as we advance upwards towards the opening; at the same time the wires with which this flux is linked are also increasing at the same uniform rate. The integral of the line linkages for one C.G.S. unit of current or the inductance is then

$$\frac{4\pi}{3} \times w^2 \times \frac{t}{2 w_s} \times l = 4.19\, w^2 \frac{t}{2 w_s} \times l.$$

Let a short-circuited spool side be now added in the lower layer (Fig. 12), its wires being shaded in order to distinguish it from the considered section of which the wires are black; a certain amount of mutual inductance is thereby added. The flux due to the second spool side has a uniform density across the upper half of the slot, but the black wires with which it is linked gradually increase. The integral of the line linkages, or the mutual inductance, is then

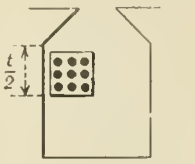


FIG. 11.

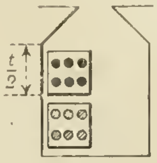


FIG. 12.

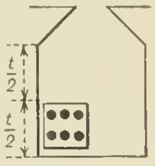


FIG. 13.

$$\frac{4\pi}{2} \times w^2 \times \frac{t}{2 w_s} \times l = 6.28\, w^2 \frac{t}{2 w_s} \times l.$$

If now the considered spool side be at the bottom of a slot (Fig. 13), within the lower half of the slot to the height $\frac{t}{2}$, there will be the same flux and the same inductance due to it as in our first case, but to this has now to be added a further self-induced flux of uniform density in the upper half of the slot linked with all the wires; whence the additional inductance is

$$4\pi \times w^2 \times \frac{t}{2 w_s} \times l = 12.57\, w^2 \frac{t}{2 w_s} \times l.$$

If in either of the two layers there are *j* spool sides short-circuited instead of the single one above shown, it is only necessary to multiply the corresponding item by *j*. The three leading cases when expressed in a form immediately applicable to our equation are, therefore, as follows:

(*x*) If the flux density across the slot and the wires with which the flux is linked are both increasing, the inductance per cm. length of core is $\left(\frac{\tau}{N_2}\right)^2 \times 0.52\, j \frac{t}{w_s} \times 10^{-9}$ henrys.

(*y*) If one is constant and the other is increasing.

$$\left(\frac{\tau}{N^2}\right)^2 \times 0.785\, j \frac{t}{w_s} \times 10^{-9} \text{ henrys.}$$

(*z*) If both the flux density and the wires with which the flux is linked are constant, $\left(\frac{r}{N_1}\right)^2 \times 1.57\, l \frac{t}{w} \times 10^{-9}$ henrys,

while the inductance per cm of core from the flux across the opening of the slot due to r short circuited spool sides within the slot is invariably

$$4\pi w^2 l \frac{t_3}{w_3} = 12.57\, w^2 l \frac{t_3}{w_3} = \left(\frac{r}{N_1}\right)^2 \times 3.14\, l \frac{t_3}{w_3}$$

The four cases enumerated above rise in the proportion $\frac{\pi}{6} : \frac{\pi}{4} : \frac{\pi}{2} : \frac{\pi}{1}$, and into these elements any complicated case may be resolved. Thus, if one neutral zone be considered alone in the first place, the values of the coefficient, a, for the different cases of Fig. 14 are:

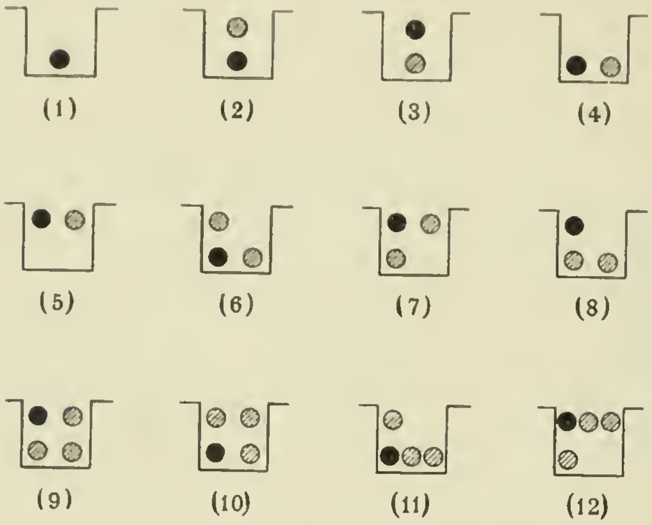


FIG. 14.

(1) $a = x + z = 2.09$,
(2) $a = x + z + y = 2.88$,
(3) $a = x + y = 1.31$,
(4) $a = 2(x + z) = 4.19$,
(5) $a = 2x = 1.04$.
(6) $a = 2(x + z) + y = 4.975$.
(7) $a = 2x + y = 1.825$.
(8) $a = x + 2y = 2.09$.
(9) $a = 2(x + y) = 2.62$.
(10) $a = 2(x + z + y) = 5.76$
(11) $a = 3(x + z) + y = 7.055$.
(12) $a = 3x + y = 2.345$.

In Fig. 10 tables of the value of a for the pair of zones are given for each case, from which will be seen the progressive reduction as the winding is spread out for any given value of s. The value of a' for any slot is quickly found by simply counting the number of short-circuited spool sides in the slot which contains the considered section (marked black) and multiplying this number by 3.14; it hardly requires, therefore, to be tabulated.

The International Wireless Telegraph Conference.

Mr. John I. Waterbury, United States delegate to the recent international wireless telegraph conference, has contributed to the November *North American Review* an article summarizing what was done or proposed at Berlin last August. His statement is as follows, as noted editorially last week:

The 4th of August was fixed and forty-three delegates were assembled, eleven being from Germany, three from Austria, three from Spain, three from the United States, six from France, four from Hungary, four from Italy, three from Russia. The proceedings were conducted in French, and the *Avant Propos*, or programme of discussion, consisted of a series of propositions and sub-articles covering the details of each. The first was to cover the point as to whether any company should be allowed to act as the Marconi Company had acted, and the others dealt with minor matters regarding distressed ships, tariffs, men-of-war, etc. Broadly speaking, the first was the only real question, the others being entirely subordinate, and there was much carefully prepared argument and discussion. On the one side, elaborate arguments were made to show that the Marconi Company really lead the world, and that, if their stations were compelled to receive messages from inferior apparatus, not only would they be unjustly injured in their interests, but the world's good service would be jeopardized; that it was too soon to think of formulating rules to fetter a new discovery in its development; and that, if the Marconi Company had won any advantage over their rivals, it was by fair business competition in which their rivals had been so far worsted.

On the other hand, it was held that the Marconi Company had declined to compete with any one else over the same proving ground; that their claimed superior results were no better than those obtained by officers of the different governments there represented; that it was well known that other people could communicate as satisfactorily as Marconi could, and that it was not too soon to recommend the formulation of some rules which would prevent the Marconi Company from developing a world monopoly which would stifle all independent research; the fact being that whereas cable companies only exploit telegraphy by means of cables, and do not manufacture cables or the apparatus for signalling, the Marconi Company were not only endeavoring to monopolize the exploitation of wireless telegraphy, but also of the apparatus by which such signals are made and received.

The discussion was very interesting; and, when it came to voting, the action of the various governments was a curious study. All the European nations have a government monopoly of all means of communicating information by electricity; and the vote of France, Germany, Austria, Hungary and Russia was prompt against the Marconi monopoly. Italy was in favor of the Marconi Company, being bound to it by a contract in consequence of Marconi's having, in Italy's opinion, the most perfectly organized system and the best apparatus. England held her decision in complete reserve, but signed the minority report with Italy, on the ground that, though the British Government had a monopoly of the telegraph, this authority was not supposed to extend beyond the marine league, and Marconi and every one else had a perfect right to operate wireless telegraphy between the coast and ships at sea, and make such rules as they chose regarding each other without interference from the government.

The United States delegation held, first, that the United States Government had paramount authority over any wireless telegraph association doing business either between the States of the Union or with foreign countries; and, second, that any such organization came under the common carrier law, which, by decision of the Supreme Court, compelled any one coming under that law to receive and transmit messages from any suitably equipped vessel or station. The vote of the delegates of the United States was thus cast with the majority.

Another very curious question raised and argued at great length was, whether the Marconi Company was entitled to an indemnity in case the recommendation of the majority became law. Italy was in favor of an indemnity. England would not admit an indemnity, but suggested that a surtax would be reasonable on all messages sent by rival apparatus. The other nations, including the United States, were against either an indemnity or a surtax, the idea of the United States delegates being that neither the Marconi Company nor any one else was entitled to an indemnity or surtax because they had erected stations on our soil without having consulted our laws.

Minor matters, such as rates, and what part should go to the ship and what to the shore stations, were discussed *pro* and *con;* but, as the laws of the United States permit the utmost latitude in such matters, the United States delegates considered that business alone would ultimately regulate them, and that it was a matter of too small importance to discuss at the present time. The European nations held somewhat different ideas, because of their absolute control in such matters; but the general idea prevailed that the tariff should be equitable and in proportion to the telegraphic work done.

The work of such a conference as this could be at best but preliminary, as its name indicates; but the result of the examination, for the first time, of the wireless telegraphic situation as it is to-day points very clearly to the advisability of a subsequent congress, whose delegates shall be fully instructed and endowed with sufficient authority to go more deeply into the question in all of its relations.

The Choice of Wattmeters.

By Paul MacGahan.

Much has recently been written concerning the increased amount of revenue obtained by companies supplying electricity to the public, owing to the adoption of the more modern and accurate wattmeters that have lately become available. Cases have been cited of lighting companies being remunerated for from 40 per cent. to 65 per cent. of the total power generated, thus obtaining a sufficient increase over former revenue to convert their stock from a doubtful investment to one paying excellent dividends.

This has opened the eyes of progressive station managers to the progress of events, and most of them have already abandoned the wattmeters in vogue five or ten years ago, replacing them by the newer types. To those who have not yet decided which of the modern wattmeters to adopt, or who have reason to believe that they have decided wrongly, the following notes regarding comparative features may be of interest:

It is well known that the most important reasons why the total power delivered to the consumer is not paid for are, first, that at light loads the old types of wattmeters run entirely too slowly or actually not at all; and, second, that these same meters run too slowly at all loads owing to increased friction from wear. It is very seldom that a meter is found running faster after any considerable period of service, as such a condition can only be due to an aging of the permanent magnets, and in the present state of the art of making magnets the aging, if any, is very slight.

Many wattmeters are loaded the greater portion of the time to only 10 per cent. to 20 per cent. of their normal capacity, and it is evident that an error under such conditions may become a very serious thing, yet none of the old-style wattmeters, after a month or two of such service, could show an error less than 10 per cent. to 25 per cent. at light loads.

The sale of alternating current for power purposes has brought about problems of correct registration at low power factors, and with varying frequencies, wave forms, voltages, loads and temperatures. Each of these causes produces its own error, and all added together give the maximum error in registration. When it is stated that a wattmeter is accurate within 2 per cent., it is meant that all these causes, each of a magnitude such as would be found in actual operation, and all acting in unison, produce a resultant error not exceeding 2 per cent.

The ideal wattmeter, to meet the requirements of the station manager, should sustain the highest possible initial accuracy over its whole range during its term of service. It should also be dust, water and insect-proof, and so constructed as to make tampering impossible.

To obviate the latter contingency, there should, of course, be provision for the electric light company's seal. It would also be a great advantage if the wattmeter is sold, sealed by the manufacturer, so that in case of a dispute with a customer, his seal and guarantee could be referred to as proof of calibration by a responsible and disinterested party. Moreover, a manufacturer cannot in self-protection guarantee a wattmeter not sealed by himself, and therefore cannot be expected to make repairs without charge, as it would be impossible to detect any change in adjustment after leaving his hands. It is evident, therefore, that an unsealed wattmeter is unguaranteed.

The only excuse for a manufacturer supplying unsealed wattmeters is in cases where their moving element is so heavy that the jewel bearings would not stand the rough handling due to shipment, and has to be inserted after the wattmeter is in place. It should be understood, of course, that the manufacturer's seal does not prevent the purchaser from repairing his own wattmeters if he so desires.

In testing a wattmeter for initial accuracy, observations should be made at the extreme variations of voltage, frequency, power factor and temperature likely to be met with in the electric light company's distributing system. Curves should be plotted under each condition for various loads from 1/50 to 1½ times full load. It is very important to see that the meter will not creep on shunt current alone, or that at least it should not from this cause make a full revolution of the disc; half a revolution of creeping is unimportant, as it may be due to a mechanical unbalancing of the disc.

Care should be taken also that the measuring apparatus used should be suited to the capacity of the wattmeter under test. Thus it would be quite absurd to test a 5-amp., 100-volt wattmeter down to 50 watts or less, using a 1,500-watt indicating instrument for a standard, as the latter cannot be read with sufficient accuracy on less than 200 watts. It should not be forgotten that an integrating wattmeter has a range of legibility several times as great as that of any indicating instrument now on the market. Therefore, when indicating wattmeters are used as standards, about three instruments of different capacities should be used for testing an integrating wattmeter at different loads.

Overload capacity is an important consideration in the selection of a wattmeter. It permits the use of a smaller meter, thus increasing the accuracy of registration at light loads and decreasing the cost of the meter equipment. Thus when a house having an installation of 20 100-volt lamps is to be metered, a 5-amp. wattmeter having reasonable overload capacity is entirely sufficient, for generally only 5 to 10 lamps will be burning at one time. The meter should be able to carry a load of 15 lamps (7½ amp.) continuously with accurate registration, and 20 lamps (10 amp.) for a short period without danger of injury.

It would necessitate a long running test extending over several months upon many wattmeters of different makes to obtain an actual experimental comparison of the light-load permanency of any one of them, but fortunately this quality can be judged accurately at the start by giving attention to the following considerations:

The moving element being supported on a delicate jewel, and driving a train of gears, friction of the jewels and gears is inevitable, and is generally compensated for at calibration. This friction is a variable quantity and is dependent upon the wear. Therefore, as the wear increases, the wattmeter will gradually fall behind, as the initial friction compensation remains constant.

It is hardly necessary to consider the friction of the recording train, as the speed of the wearing surfaces is exceedingly small, and the torque overcoming the friction is comparatively enormous, due to the multiplication, or leverage of the gears. Thus when the torque at the disc is 1 cm.-gm, the torque at the first dial would be from 1,000 to 10,000 cm.-gm., and ten times more at each succeeding dial. As a matter of fact, when a wattmeter having a properly designed and constructed recording mechanism is stripped of its gear-train, the most delicate tests fail to measure any diminution in the friction.

Thus the all-important consideration is the weight on the jewel bearing and its effect on the accuracy of the recording mechanism. In the case of the ordinary cup jewel and pivot, the amount of weight supported by the bearing is of the utmost consequence. The greater the weight of the moving element, the more rapid the wearing of the jewel and pivot, and the greater the danger of cracking or otherwise damaging the jewel by jarring during or after shipment. Thus, for instance, the weight upon the jewel is doubled, trouble therefrom is enormously increased.

It should be remembered in this connection that watches are not made accurate by powerful springs, giving strong driving power or torque, but by careful jeweling and light moving parts, and that, from the similarity of mechanism, the same principle would hold true for wattmeters. Light weight of moving element should, therefore, be of primary importance. It is also desirable as an adjunct of this light weight, that the driving power or "torque" of the meter should be a maximum. The greater the torque the smaller will be the effect of friction upon speed. For example, a wattmeter with full-load torque of 10 cm.-gm. and uncompensated friction of 1 per cent., or .1 cm.-gm., will require 1 per cent. of full load current to start; and as the friction is approximately a constant quantity at all loads, the meter will record 50 per cent. slow at 2 per cent. load, 25 per cent. slow at 4 per cent. load, etc. If the torque should be increased to 20 cm.-gm. at full load, without an increase of friction, the meter starting with ½ per cent. load will record 25 per cent. slow at 2 per cent. load, 12 per cent. slow at 4 per cent. load, etc.

There are two methods of obtaining a high torque in the induction wattmeter, the first and easiest being by increasing the amount of metal in the disc, thus reducing its resistance and increasing the induced current. But by this means the weight and torque increase together and no advantage is gained, as the ratio of torque to weight remains the same, and the friction effects and jewel troubles increase enormously. The second and correct method is to increase the electrical efficiency of the motor element driving the disc.

It must be borne in mind, therefore, that a high torque, which has been shown to be a desirable element in a wattmeter, may be present solely on account of the heavy moving parts which have been shown to be objectionable. It is only by keeping the moving parts as light as possible and the torque relatively high that the best results are obtained.

Transposition of Telephone Lines: Cross-Talk and Induction.

At the annual meeting in New Orleans of the Association of Railway Telegraph Superintendents, Mr. Frank F. Fowle, of the engineering staff of the American Telephone & Telegraph Company, read a paper with the above title, which forms an interesting contribution to the subject of telephone line disturbance arising from reactance and leakage.

The introduction treats of the four properties of transmission lines—resistance, inductance, leakage and capacity. The well known formulæ for the inductance and the capacity of a single aerial wire and an aerial metallic circuit of two wires were given, with mention of the conditions under which the formulæ hold true, and of the effect of wire insulation and the presence of adjacent parallel circuits. The distribution of the energy in a transmission line was explained, it being pointed out that the resistance and the leakage reactions are dissipative and are sources of energy loss, while the inductance and the capacity reactions are non-dissipative and are, directly or indirectly, the means whereby energy may be transmitted. For telephonic transmission a line is of greatest efficiency when the inductance and the insulation resistance are each a maximum, and when the resistance and the capacity are each a minimum. That is, the resistance reaction should be small and the inductance, leakage and capacity reactions should be great. The line wires serve as a guide and the energy is propagated principally in the dielectric immediately surrounding the wires. The total storage capacity for energy, per mile of line, is exceedingly small, but the velocity of propagation is slightly less than the velocity of light, on ordinary lines of small inductance, and a transmission line is virtually a small energy reservoir operated at an enormous velocity.

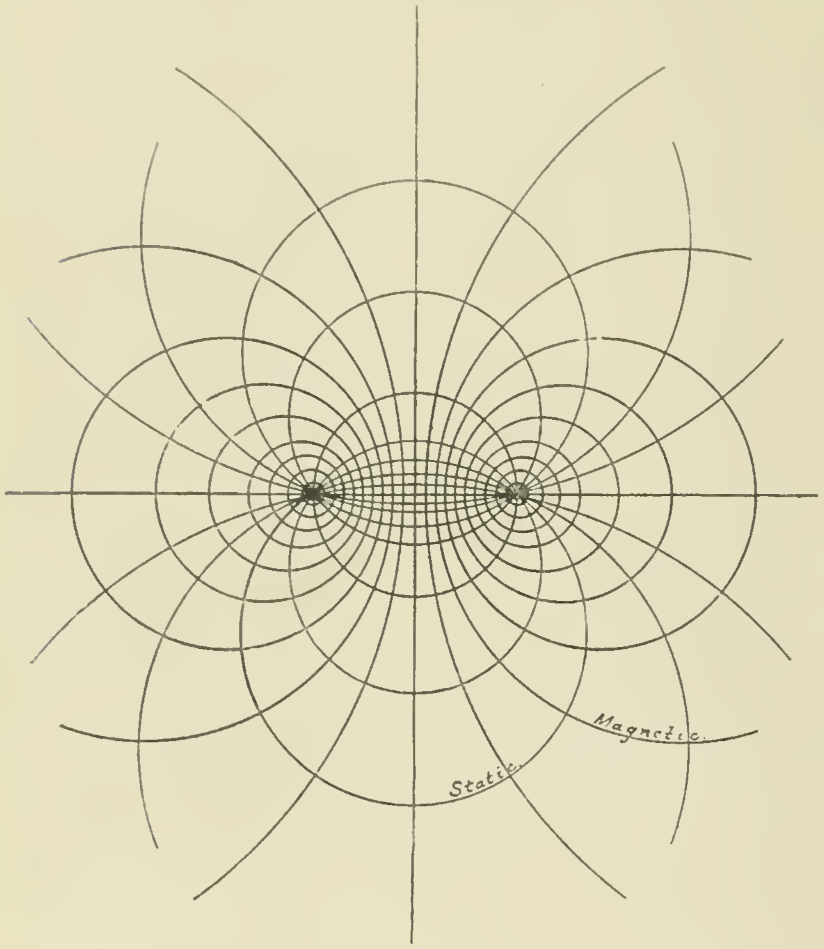


FIG. 1.—STATIC AND MAGNETIC FIELDS OF A METALLIC CIRCUIT.

The field about a metallic circuit of two aerial wires may be investigated from the equation,

$$F = 2I\left(\frac{1}{r_1} - \frac{1}{r_2}\right) \qquad (1)$$

where F is the force at a point perpendicularly distant r_1 from one wire and r_2 from the other wire, and I is the current traversing up one wire and down the other; and the further equation,

$$V = 2q_1 \log \frac{r_2}{r_1} \qquad (2)$$

where V is the potential at a point perpendicularly distant r_1 from the wire whose charge is q_1 per unit length and distant r_2 from the other wire. Fig. 1 shows the field about such a line.

The lines of magnetic flux are also the equipotential lines of the static field. If the perpendicular straight line in Fig. 1 be taken as coincident with the surface of the earth the distribution of the field above the earth is that for a single aerial wire employing an earth return. The intensities of the magnetic and the static fields diminish very rapidly at distances away from the circuit a few times the separation between the wires or between the wire and the earth. How this intensity varies along the X axis is shown in Figs. 3 and 4 in the paper, calculated from expressions (1) and (2).

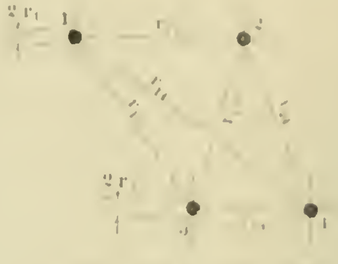


FIG. 2.—TWO METALLIC CIRCUITS.

Considering the presence of a parallel metallic circuit within the field of Fig. 1, if the two wires of the second circuit lie on the same magnetic flux line, it is evident that they will be at the same electric potential, and that there will pass between them none of the magnetic flux lines, due to the circuit whose wires appear in Fig. 1. Therefore, the circuits will be mutually non-inductive and an e.m.f. or a current in one will be without effect on the other. When the wires of the two circuits are in any other relation the two wires of the second circuit will experience a difference of potential between them and they will enclose between them part of the magnetic flux, due to the first circuit.

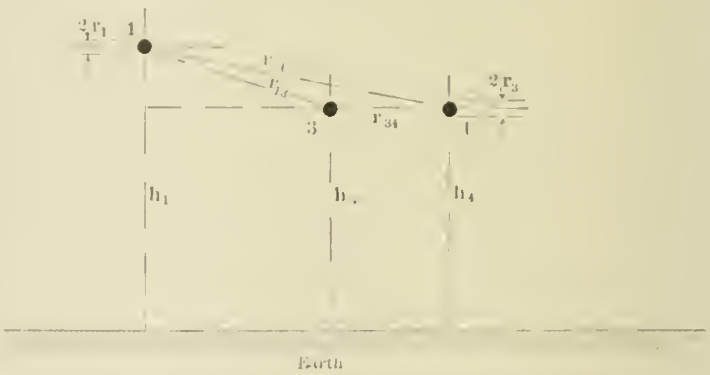


FIG. 3.—ONE METALLIC AND ONE GROUNDED CIRCUIT.

The mutual capacity and the mutual inductance are given for three cases: two metallic circuits, one metallic and one grounded circuit, two grounded circuits. The deduction of these formulæ is based on Heaviside's method in Vols. I and II of his "Electrical Papers," and Heaviside's method is based on Maxwell. The formulæ of the last case are omitted because they may be found in the "Electrical Papers" before mentioned. For two metallic circuits the results are as given below, with reference to Fig. 2, in which the a wires are 1 and 2, and the b wires are 3 and 4:

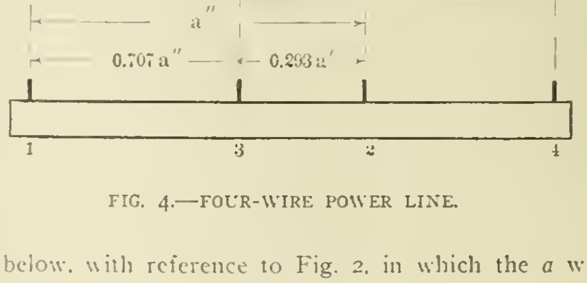


FIG. 4.—FOUR-WIRE POWER LINE.

$$-C_{ab} = \frac{2\log_{10}\dfrac{r_{14}\,r_{23}}{r_{13}\,r_{24}}}{\left(2\log_{10}\dfrac{r_{12}^{\,2}}{r_1^{\,2}}\right)\left(2\log_{10}\dfrac{r_{34}^{\,2}}{r_3^{\,2}}\right) - \left(2\log_{10}\dfrac{r_{14}\,r_{23}}{r_{13}\,r_{24}}\right)^2} \qquad (3)$$

$$C_a = \frac{2log_{10}\dfrac{r_{34}^2}{r_3^2}}{\left(2log_{10}\dfrac{r_{12}^2}{r_1^2}\right)\left(2log_{10}\dfrac{r_{34}^2}{r_3^2}\right)-\left(2log_{10}\dfrac{r_{14}\,r_{23}}{r_{13}\,r_{24}}\right)^2} \qquad (4)$$

$$C_b = \frac{2log_{10}\dfrac{r_{12}^2}{r_1^2}}{\left(2log_{10}\dfrac{r_{12}^2}{r_1^2}\right)\left(2log_{10}\dfrac{r_{34}^2}{r_3^2}\right)-\left(2log_{10}\dfrac{r_{14}\,r_{23}}{r_{13}\,r_{24}}\right)^2} \qquad (5)$$

$$M_{ab} = 0.3706\left(2log_{10}\frac{r_{14}\,r_{23}}{r_{13}\,r_{24}}\right) \qquad (6)$$

In the equations, C_{ab} is the mutual capacity between circuits 1-2 and 3-4, C_a is the capacity of circuit 1-2, C_b is the capacity of circuit 3-4, and M_{ab} is the mutual inductance in mil-henries per mile. To reduce (3), (4) and (5) to microfarads per mile, the results should be multiplied by 0.07768. The condition of no mutual interference is given in (7).

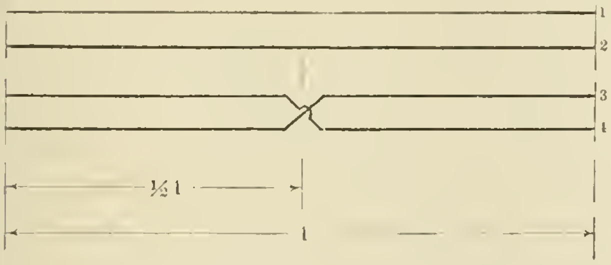


FIG. 5.—DIAGRAM OF TRANSPOSITION.

$$r_{14}\,r_{23} = r_{13}\,r_{24} \qquad (7)$$

For one metallic and one grounded circuit the results are as follows, reference being made to Fig. 3, in which *a*, or wire 1, is the grounded circuit and *b*, or wires 3 and 4, are the metallic circuit:

$$-C_{ab} = \frac{2log_{10}\dfrac{r_{14}\,r_{23}}{r_{13}\,r_{24}}}{\left(2log_{10}\dfrac{2h_1}{r_1}\right)\left(2log_{10}\dfrac{r_{34}^2}{r_3^2}\right)-\left(2log_{10}\dfrac{r_{14}\,r_{23}}{r_{13}\,r_{24}}\right)^2} \qquad (8)$$

$$C_a = \frac{2log_{10}\dfrac{r_{34}^2}{r_3^2}}{\left(2log_{10}\dfrac{2h_1}{r_1}\right)\left(2log_{10}\dfrac{r_{34}^2}{r_3^2}\right)-\left(2log_{10}\dfrac{r_{14}\,r_{23}}{r_{13}\,r_{24}}\right)^2} \qquad (9)$$

$$C_b = \frac{2log_{10}\dfrac{2h_1}{r_1}}{\left(2log_{10}\dfrac{2h_1}{r_1}\right)\left(2log_{10}\dfrac{r_{34}^2}{r_3^2}\right)-\left(2log_{10}\dfrac{r_{14}\,r_{23}}{r_{13}\,r_{24}}\right)^2} \qquad (10)$$

$$M_{ab} = 0.3706\left(2log_{10}\frac{r_{14}\,r_{23}}{r_{13}\,r_{24}}\right) \qquad (11)$$

The notation is the same as previously employed, C_a being the capacity of the grounded circuit and C_b that of the metallic circuit. To reduce (8), (9) and (10) to microfarads per mile, the results should be multiplied by 0.07768. Expression (7) holds for the condition of no mutual interference in this case also, if r_{23} and r_{24} are given their proper values, namely, $r_{23}^2 = r_{13}^2 + 4h_1\,h_3$ and $r_{24}^2 = r_{14}^2 + 4h_1\,h_4$. It is interesting to note that there is practically possible an arrangement of two metallic circuits, for no mutual induction from formula (7) and applicable to a four-wire, two-circuit telephone line, or to a two-phase, four-wire power line, as shown in Fig. 4, where 1 and 2 is one circuit and 3 and 4 the second circuit. The induced currents may be arrived at approximately for short lines by the following formulæ:

$$E_b = M_{ab}\,\omega\,I_a \qquad (12)$$

$$I_b = C_{ab}\,\omega\,E_a \qquad (13)$$

where the subscript *a* denotes the primary or disturbing circuit and *b* the secondary or disturbed circuit; $\omega = 2\pi n$ where *n* is the frequency. The induced e.m.f. is circuital and the induced current transverse in circuit *b*.

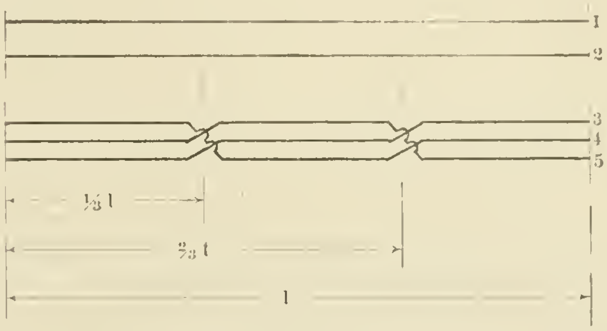


FIG. 6.—METHOD OF TRANSPOSING THREE WIRES.

It is evident from the formulæ for mutual capacity and mutual inductance that interchanging the two wires of a metallic circuit reverses the signs, but not the magnitudes of the constants of mutual interference. Such an interchange of the wires amounts to a rotation of the circuit through 180° and is the definition of a transposition. The effect of a transposition in a given circuit, on an adjacent circuit, is to reverse the direction in the adjacent circuit of the induced e.m.f. and current, with reference to the parts of the adjacent circuit on opposite sides of the transposition. It does not matter in which circuit the transposition is made, but the transposition, at the same point, of both circuits does not change the signs of the constants of mutual interference.

Considering Fig. 5, the presumption is that the e.m.f. and the current in the disturbing circuit are constant in phase and in intensity throughout the distance *l*. Therefore, *l* must be short enough so that this is sensibly true; even in this case a slight current will flow toward the terminals, due to the fact that the transverse induced current will not entirely vanish through the transposition, owing to the slight impedance of this short path. Fig 6 shows the method of transposing a plane circuit of three wires. In general the transposition of an *n* wire plane circuit will require, in a given section (*n*-1) transpositions at intervals throughout the section of 1/*n*th the total length; if the *n* wires be uniformly disposed around a circular circumference, each transposition will be a rotation of the circuit of 1/*n*th of a revolution, always in the same direction.

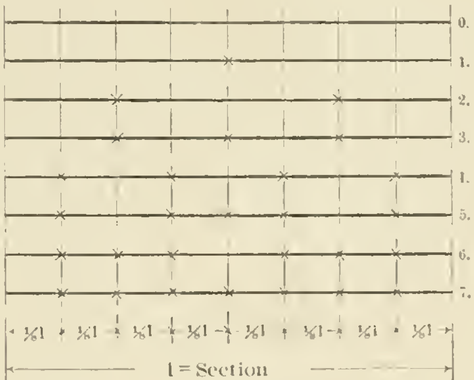


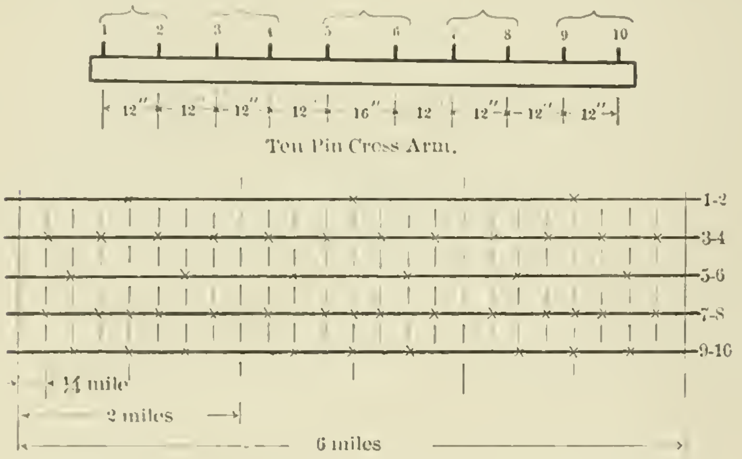
FIG. 7.—EIGHT TYPES OF TRANSPOSITION IN A STANDARD UNIT SECTION.

The transposition of telephone lines is treated by means of adopting a unit section, of a few miles in length, within which all the circuits are made mutually non-inductive. The advantage of this is realized in treating heavy complicated lines; a starting point is selected and the transposition section applied consecutively until reaching some abrupt change in the line where the exposures are altered, and the remaining length of line, if the total length is not an integral multiple of the length of the standard section, is added to the previous section or made a section by itself, extending or shortening the standard section to meet the requirements of the special end section. Fig. 7 shows the manner of developing a system of mutually non-inductive circuits.

Eight types are shown, the simplest type being untransposed and the last, or eighth type, having seven transpositions; a metallic circuit is there represented by a single line. The term "exposure," referring to Fig. 5, is defined as $l/4$. Fig. 7A shows the exposures in the following table:

	0	1	2	3	4	5	6	7
0								
1	½							
2	¼	¼						
3	¼	¼	½					
4	⅛	⅛	⅛	⅛				
5	⅛	⅛	⅛	⅛	½			
6	⅛	⅛	⅛	⅛	¼	¼		
7	⅛	⅛	⅛	⅛	¼	¼	½	

The upper row and the left-hand column refer to the circuit numbers of Fig. 7. Consider, for example, the exposure of No. 0 to No. 6: the second and the fifth transpositions in No. 6 are without sensible effect, if l is not great, because a transposition at the junction of two contiguous non-inductive sections is without effect. These two transpositions are necessary, however, when considering the exposure of No. 6 to other of the circuits. The choice of a length for l will depend on conditions; it should not exceed ten miles and should not be so short that transpositions will fall within the line spans. The best standard of exposure in use is one-fourth of a mile between adjacent circuits on the same cross arm; in this case cross talk will be absolutely inapparent under normal conditions. For circuits which are not adjacent the following rule is given: Calculate from equation (6) the mutual inductance between two adjacent circuits on the same cross arm for one-fourth mile: for any other exposure calculate the mutual inductance from (6) for one mile and divide the latter result into the former and the quotient will be the theoretically permissible exposure in miles. It would have been equally logical to use the mutual capacity, but the results would be practically the same, which is explained in detail in the paper. A case of a ten-wire, five-circuit line is worked out on the basis of a quarter mile standard with l equal to two miles. The following table gives with reference to Fig. 8, the theoretically permissible exposures of five circuits on a ten-pin arm, based on an exposure of circuit 1 and 2 to circuit 3 and 4 of one-fourth mile, the tabular values being in miles:



FIGS. 8 AND 9.—TRANSPOSITION OF TEN-WIRE LINES, USING TWO-MILE SECTIONS.

	1-2	3-4	5-6	7-8	9-10
1-2					
3-4	0.25				
5-6	0.90	0.21			
7-8	2.85	1.31	0.21		
9-10	4.95	2.85	0.90	0.25	

Fig. 9 illustrates the case of ten wires using two-mile sections. Considerable latitude is possible in applying this method, but the number of transpositions should be kept a minimum. Any discontinuity in the exposures should be made the junction of two contiguous sections; a discontinuity is constituted by a junction at which lines enter or leave the main line, such as junction poles, cable poles or intermediate offices, changes in the distribution of circuits in the line, etc. Cross talk between grounded lines of considerable length will be very serious and there is no cheap practical remedy now available. The use of aerial unsheathed cable represents the worst situation as regards induction; such cables, if of considerable length, should have a grounded sheath. The use of phantom circuits requires transposition of circuits as a whole. For example, if circuits 1-2 and 3-4 are employed as a phantom, it is necessary, in transposing, to change wires 1 and 2 to pins 3 and 4, and wires 3 and 4 to pins 1 and 2. Such phantom transpositions will be necessary if two or more phantoms exist on one pole line and a single phantom will not usually be a satisfactory quiet circuit unless transposed.

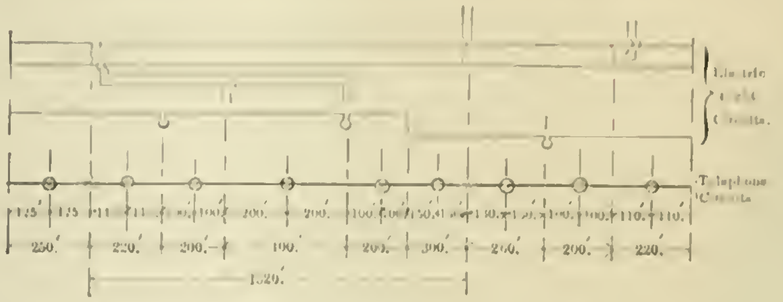


FIG. 10. TRANSPOSITION IN CASES OF COMPLICATED EXPOSURE TO ELECTRIC LIGHT AND POWER CIRCUITS.

The transposition of telephone lines to eliminate induction from electric light or power circuits is treated from the standpoint that any point in the exposure where the disturbing e.m.f. or current changes in phase or in intensity should be the junction of two contiguous special transposition sections. Fig. 5 shows the procedure in the simplest case; if circuit 1-2 were bridged by a transformer the procedure would be to divide the total exposure into two sections, each transposed at its middle point, the transformer being at the junction of the two sections. This principle would apply equally if 3-4 were bridged at some intermediate point by a subscriber's loop—as in the case of a party line. The general rule given is: "Treat as one section the distance between two consecutive changes of any character in any of the circuits: transpose all the telephone circuits at the middle of each such section."

Two figures are given in the paper, one representing a case of exposure to constant potential circuits, with the necessary transpositions, and one representing the treatment of constant current exposures. A third figure, Fig. 10, represents both cases combined. Transpositions in the telephone circuits to eliminate cross talk should be located at the junctions of sections which are non-inductive with respect to the electric light or power circuits.

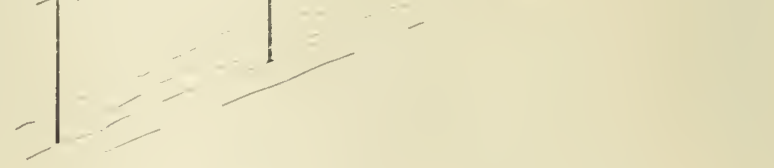


FIG. 11.—TRANSPOSITION OF A THREE-PHASE LINE.

The crosses within the circles, in Fig. 10, represent the transpositions to eliminate induction, meaning that all the circuits are transposed, and the plain crosses represent those to eliminate cross talk, meaning regular transposition points of a system. The exposure represented is that due to a constant-potential, single-phase distribution and a constant current arc or incandescent line. It is not general practice to transpose distributing systems, but transpositions in high-tension transmission work are frequently employed. Fig. 6

should be followed in three-wire lines, either single or polyphase. The well-known "spiral" is shown in Fig. 11, which illustrates the transposition of a three-phase line on the basis of a right-hand spiral of one-third revolution.

Another example of transposition is given in Fig. 12 for single-track, long-haul electric railway service: Where wires 1, 2 and 3 transmit power at high tension, three-phase, wire 7 is for the block signal circuit, wire 8 is the feeder and 5-6 the telephone circuit. Apply the method of Fig. 10 in transposing 3-6; treat spirals, feed taps to the trolley wire, signal boxes, turn-outs, junctions and telephone stations as discontinuities in the exposure of 5-6 and transpose midway between two consecutive discontinuities, throughout the exposure.

It is usually preferable, where a telephone line parallels a power line, not to depend on transpositions in the power line, but to consider them as discontinuities in the exposure and to make the telephone line dependent on its own properties only and not partly on those of a foreign system. The disturbances from constant potential power circuits, parallel at distances of 40 or 50 ft., are not usually serious for exposures under one mile, and for longer exposures the regular transpositions may suffice. A single-wire, arc light line is the most serious proposition, and if it is close to the telephone line it will cause prohibitive disturbances for exposures upwards of a few hundred feet. When the exposure becomes so complicated that transpositions are necessary every few feet and occur frequently in the spans it is necessary to resort to twisted pair insulated wire, aerial cable or electro-magnetically shielded conductors. Not infrequently the disturbances from a system on which service is given for twenty-four hours a day are noticeable only at night; this is usually conclusive evidence that the disturbance is principally electromagnetic.

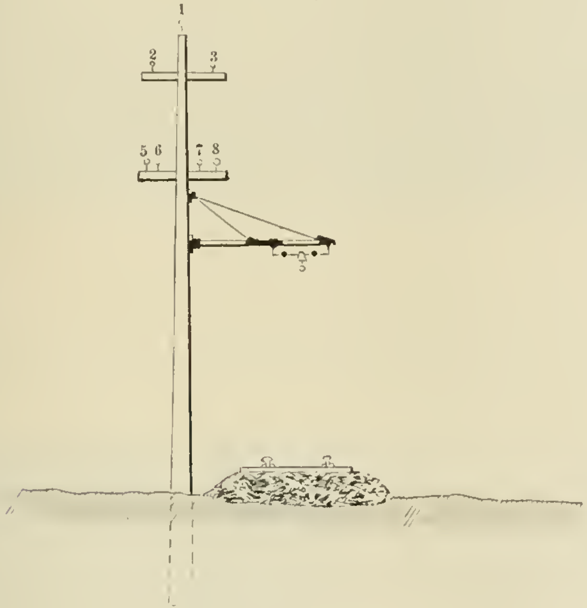


FIG. 12.—TRANSPOSITION FOR SINGLE-TRACK RAILWAY SERVICE.

The permissible current in a telephone receiver which will not interfere with received transmission varies with the frequency, the wave form and the sensitiveness of the receiver. The approximate range of this current in commercial receivers is from 5×10^{-5} amp. at low frequencies to 5×10^{-6} amp. at high frequencies, meaning by the latter, 200 or 300 cycles. In this connection it is obvious that receivers of low sensitiveness in conjunction with transmitters of maximum power give the best results.

The joint occupancy of pole lines by telephone, telegraph, fire alarm, power and electric light systems is common in suburbs and residential districts. All wires should be securely tied and insulated at all points and the wires should have a reasonable clearance with reference to trees and all foreign objects. Slack in any of the circuits renders the transpositions, in general, less effective. Poor construction and poor maintenance will vitiate the expected results from a perfect system of transpositions. Leakage may be avoided by good construction and extra stress should be laid on this point. The power and electric light wires should be strung as close together as practicable, in order to reduce the induction, and as far as possible from the telephone circuits.

The lines which are least likely to break or to get into trouble should occupy the highest position on the line. For this reason and the reason that telephone development usually experiences the most rapid growth, the power and electric light lines should usually be above the telephone wires; in the reverse case ample room should be left for telephone linemen to reach their own wires without hazard from the power wires.

Joint occupancy of lines is probably inadvisable when the voltages exceed 5,000, excepting the case of constant-current arc circuits. When the voltage exceeds 10,000 the systems should be on separate pole lines and the minimum distance between the butts of poles should be such that when the highest line falls toward the other line it will completely clear it. Any construction which will permit a high-tension line to become crossed with a telephone or a telegraph line in case of a general break-down is to be condemned. At crossings with high-tension lines the telephone line should cross underneath if possible and the poles should be so arranged that the greatest length of broken wire which can swing downward will clear the lower line; an insulated screen of guard wire should be interposed between the lines. As to the question of adequate protective devices on the telephone lines, it is probably cheaper to eliminate the danger by spending a considerable amount in moving the lines, because no cheap practical protective devices are available.

Recent Electrochemical Developments.

PRODUCTION OF CHROMIUM FROM CHROME-IRON ORE.

A patent was granted on November 10 to Messrs. R. Suchy and H. Specketer, of Griesheim, Germany, for a method of treating chrome-iron ore. It is based on the fact that the chromium can be extracted in a simple manner by treating the chrome-iron ore in hot acid solutions with oxidizing agents, such as peroxide of lead, peroxide of manganese, permanganate, chrome acid, etc. The dissolving action of these oxidizing agents is explained by their turning the protoxide of iron contained in the chrome-iron ore into peroxide of iron, whereby a dissolution is rendered possible.

The operation is carried on as follows: Chrome-iron and about double the quantity of sulphuric acid (of about 50° Baume), which is required for combining with the bases of the ore to form salts, are heated in a suitable vessel, while a quantity of chromic acid extending that required for oxidizing the protoxide of iron or peroxide of iron is added. This excess of acid is not absolutely necessary, but accelerates the reaction. The excess of sulphuric acid forms chromo-sulpho acid from the sulphate of chromium, and thus facilitates the separation of the chromium from the iron. The mixture is heated up to a temperature from 120 to 150° C., the solution going on smoothly and easily. At a temperature of about 150° iron is precipitated as a white sulphate of iron, which is hardly soluble in water, while the sulphate of chromium forms with the excess of sulphuric acid chromo-sulpho acid, and can thus be easily separated from the sulphate of iron by filtration.

So far the process is purely chemical, but an electrochemical method may be made use of to apply a smaller amount of oxidizing agent than is necessary for the dissolution. In this modification of the process a small quantity of sulphate of chromium or sulphate of lead or of another salt capable of undergoing a high degree of oxidation by electrolysis, is added to the sulphuric acid and chrome ore. This mixture is heated while an electric current is passed through it, chromic acid being thereby produced which dissolves the chrome-iron ore while being itself again reduced. By the electrolysis the oxidation is kept going on until the whole quantity of chrome-iron ore is dissolved.

MISCELLANEOUS.

A patent was granted on November 10 to Mr. Charles E. Acker, of Niagara Falls, N. Y., the well-known inventor of the Acker process for the electrolysis of sodium chloride. It relates to the mechanical details of a carbon electrode and conductor, designed particularly for use in electrolytic operations with high current densities and in fused electrolytes. A carbon block constitutes the working head and a carbon "shank" constitutes the conductor and support, removably secured to the carbon block. Provision is made to protect the shank and the junction between the shank and the outside metallic conductor against oxidation from the atmosphere. The lower active surface of the carbon block is corrugated or grooved to permit the ready escape of gases, the grooves being deepened somewhat toward the periphery of the electrode.

Three patents were granted to Messrs. S. Blackmarr and J. L. Willford, of Minneapolis, for a method and apparatus for converting oxygen into ozone by silent discharge. The method consists in applying the current from the secondary of an induction coil to the opposite sides of a wall of dielectric material, like glass, through wires or coils of wires which are at all points in contact with the wall. Air or oxygen is passed along the wall in proximity to the wires.

A patent was granted to Mr. F. de Marc, of Brussels, for an electric heating apparatus. A thread of carbon is used as resistance wire inside a metallic case which, after having exhausted the air from it, is filled with an atmosphere of a gas or vapor that conducts the heat well and does not attack the hot carbon, such as hydrogen, ammonia, carbonic oxide, silicate of hydrogen, nitrogen, oil gas, acetic ether, acetic acid. The metallic casing is preferably made of copper and blackened to obtain a high conductive power and emission of heat.

A patent was granted to Mr. E. Tweedy, of New York City, for mechanical details of arranging the diaphragm in a double fluid cell

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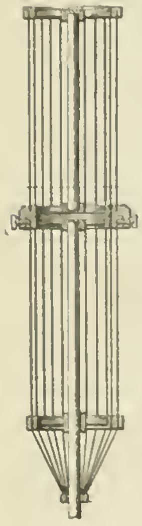
New Fessenden Wireless Telegraph Patents.

By A. Frederick Collins.

TWO recent patents granted to Prof. Reginald A. Fessenden are divisional reissues of serial No. 177,820 and relate to aerial wires for the propagation of electromagnetic waves in general and to uniformly distributed capacities in particular.

In all other forms of aerial radiators and resonators the coefficients of capacity and inductance are "bunched," and this is one of the fundamental differentiating features of the Fessenden system. The object of uniformly distributing the capacity, which is great when compared with its complementary inductance, is to produce in the first place a more efficient system of radiating aerial wires, and in the second place the translation of electric oscillations set up therein into the alphabetic code used in telegraphy without the intervention of especial wave detectors.



CAGE.

By this method of capacity distribution it has been found by the inventor, according to the text of his patent, No. 12,169, that a much closer approximation to a pure sine wave is obtained on account of fewer harmonics being generated, and in order to fulfil these conditions in a physical way a number of parallel wires are formed into a cylindrical cage, as shown in the diagrammatic drawing. The ends of the radiating wires are supported by a ring made of insulating material. This gives the aerial conductor a low resistance and at the same time a capacity that is large when compared with a single-wire radiator.

By using such a radiator and receiving aerial the second condition is fulfilled, since, as it is stated in Fessenden's patent, No. 12,168, a low frequency is obtained. In the ordinary type of oscillator the frequencies range from 100,000 to several millions per second, sending out waves of proportional length.

Lodge has shown in some of his earlier experiments (1897) that by increasing the value of inductance and capacity of a closed oscillator system the frequency could be slowed down to such an extent that a musical note was emitted. The writer made a series of experiments in 1901, which were published in the *Scientific American*, June 18, 1902, wherein it was shown that by adding capacity and inductance to an open circuit, one terminal of which was connected to earth, the period of oscillation was reduced to a value represented by mechanical vibration; and by this method articulate speech was reproduced in a complementary resonator system. The date of Fessenden's original patent was August 12, 1902.

In the case of Lodge's and the writer's own experiments, the coefficients were "bunched," whereas in the Fessenden patents the capacity is distributed. What is said above is not intended to imply that Prof. Fessenden is claiming letters patent for a wireless telephone system by electromagnetic waves, but merely to show the difference in the conclusions arrived at by Lodge, Fessenden and the writer. The greatest value of the Fessenden method lies in its application to syntonic wireless telegraphy, since a sine wave is after all the vital factor in electrical resonance.

Trackless Trolley Experiments at Scranton, Pa.

Due probably to the fact that the average roads in Europe are so much better than they are in the United States, experiments with what are known as trackless trolleys have been far more frequent and successful there than here. We have noted from time to time in illustrated articles the work that has been done in Germany and France with vehicles of this description. It would appear from the data recorded that the results are of an encouraging nature, even although from the absence of the track the effort is so much greater that at least twice as much current is required for the same tractive effort. We are glad to be able to call attention to an experimental line now being operated in this country at Scranton, Pa. As will be seen from the engravings in Figs. 1 and 2, the vehicle is practically an omnibus of the automobile type having a trolley car platform with step at the rear, and a seat in front for the motorman with steering gear, controller, brake mechanism, etc. The under-running framework of tubular steel carries an automobile motor which need not be here described as it is proposed to make changes and improve-

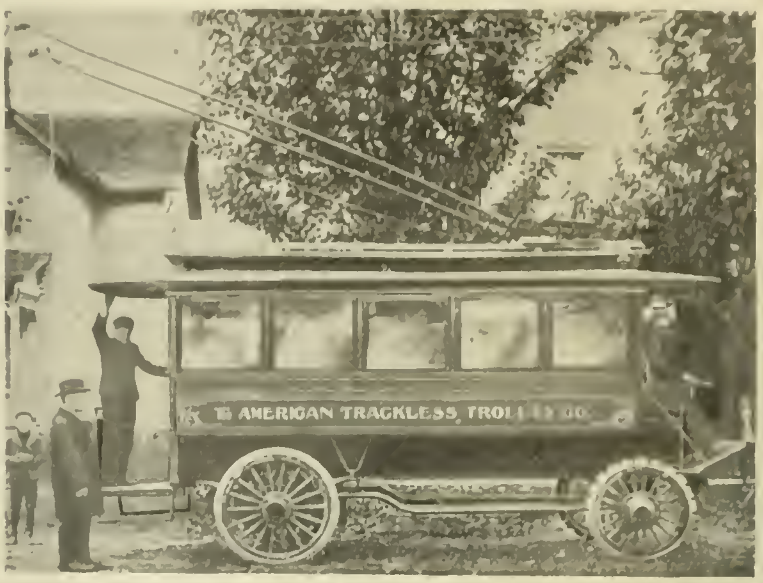


FIG. 1.—TRACKLESS TROLLEY 'BUS.

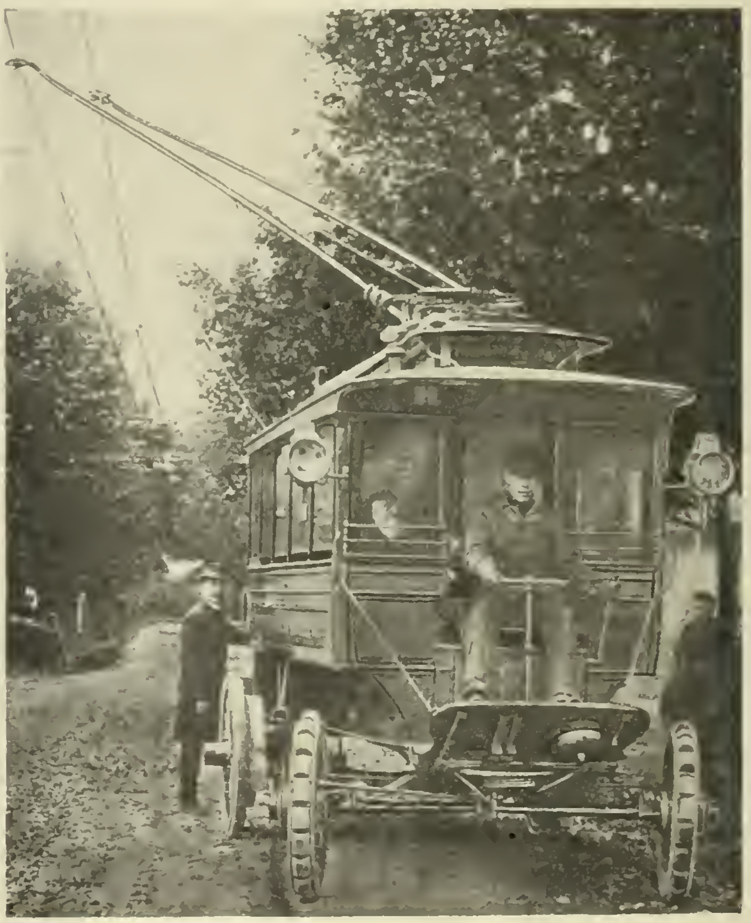


FIG. 2.—FRONT VIEW OF TRACKLESS TROLLEY 'BUS.

ments in this particular respect. The interest centers chiefly in the overhead construction, which of course is of a double trolley type, as shown in the detail diagrams. The trolley allows the coach to turn out a distance of 15 ft. to either side of the road and thus permits the driver to handle his vehicle just as readily as though it were entirely free and unattached.

The system shown is not only adapted to two wires but three wires. In the latter arrangement the center, or third wire, serves as the common feed wire, the two outside wires being the return circuit. With the three-wire system no switches are necessary at the line terminals where loops are arranged for that purpose, but with the two-wire system a switch is located at the entrance of the loop at each end of the line, as shown in the diagram, Fig. 3. The feed wire is carried around the loop to *c*, where it is insulated from the return wire, *b*. When the trolley wheel reaches the wooden track or switching piece, *d*, it is thrown over to the wire, *a*, returning to its original position under the influence of the spring, *e*. Fig. 4 shows the two-wire track and the trolleys in contact therewith, while Figs. 5 and 6 show the trolleys themselves as well as the method of guiding the trolley wheel across gaps. The overhead system appears readily adaptable to sharp curves and even to passing regular trolley lines, while of course spurs can be extended to car barns, passenger depots and freight houses.

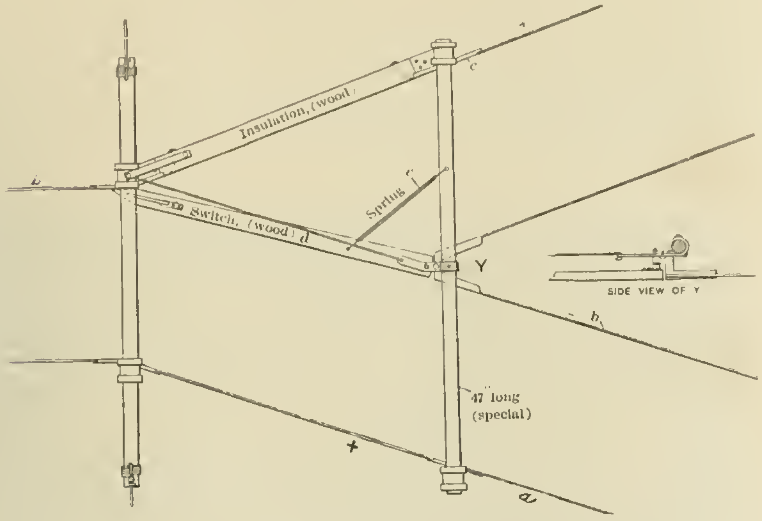
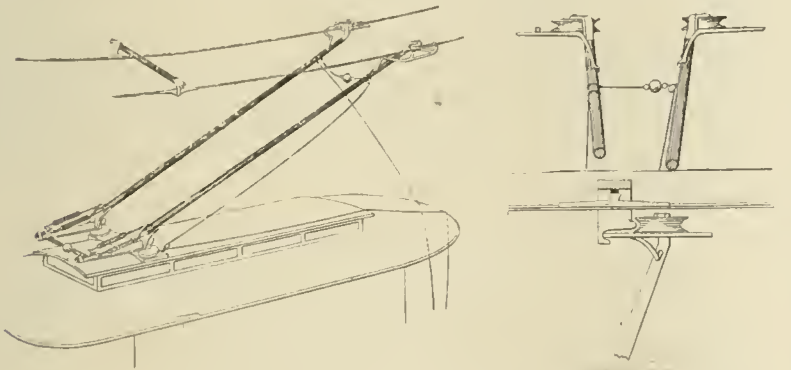


FIG. 3.—OVERHEAD SWITCH.



FIGS. 4, 5 AND 6.—DETAILS OF TROLLEY.

As to the cost of the system, the installation of trolley wires and supports is put at $1,600 per mile, while the cost of a coach carrying 20 passengers seated and 15 standing, with full equipment of motors and trolleys, is put at $2,600 each. The installation at Scranton was made by Mr. F. G. Tilton, of the American Trackless Trolley Company, of Boston, whose president, Mr. A. B. Upham, is the inventor of the system.

Non-Interfering Wireless Telegraphy.

A cable dispatch from Rome Nov. 14 says: "The naval authorities have been experimenting with the Artons system of radiotelegraphy. It is said that the experiments have conclusively proved that messages transmitted by this system in a given direction can only be received at the station to which they are sent."

New Telephone Patents.

A NEW TRANSMITTER MODIFICATION.

The last patent issue brings forth a novel transmitter modification. This is the invention of Alfred Stromberg, of Chicago, who naturally assigns his patent to the Stromberg-Carlson Company. The novelty in this transmitter lies in the mounting of the carbon granule case within a central opening of the diaphragm instead of the now common practice of using a threaded stud for uniting the electrodes and diaphragm. Fig. 1 shows a sectional view of the working parts of the transmitter, which has many of its details evidently founded upon those of the solid-back transmitter, for many years so successful. The assembly of parts is, however, quite different, for the granular button is turned end for end, the usual back electrode and carbon retaining box moving with the diaphragm; while the other electrode is rigidly secured to the bridge. An annular mica disc forms the flexible connection between the stationary electrode and the granule box, while annular clamping nuts upon the threaded exterior of the box serve to form a semi-flexible connection between the diaphragm and box.

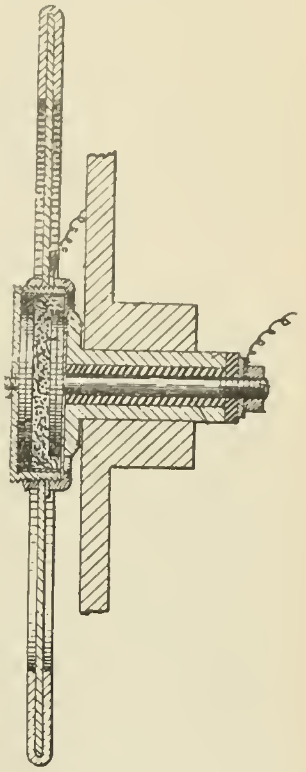


FIG. 1.—STROMBERG TRANSMITTER.

TWO SUB-STATION CIRCUITS.

One of our contemporary journals, a short time ago, in answer to an inquiry of a correspondent concerning so-called "anti-side-tone," or low side-tone circuits, stated that no such arrangement of circuit was in existence. As a matter of fact, a great deal of work has been done to develop such a circuit; and for a year or two past the operators' circuits of a number of large central offices have been provided with induction coils almost eliminating side-tone. A few months ago we noted in these columns a patent for a subscriber's station circuit, the principal object of which circuit was the cutting down of side-tone. This week we have at hand for consideration another such circuit. This latter is the subject of a patent granted to George K. Thompson, of Newton, Mass., and assigned to the American Telephone & Telegraph Company. This new circuit is shown at the left of Fig. 2, from which it is seen that a three-part induction coil is used. The secondaries each cover one-half the length of the core, while the primary extends from end to end. By this arrangement and a suitable poling of the coils a minimum of mutual induction may be made to take place between the two secondaries, while the primary has a maximum of inductive effect on both secondaries. A further examination of the circuit shows that one secondary with the receiver forms a local circuit, while except for this removal of the receiver from it the remainder of the circuit is the American Bell standard. The coil as used is wound with No. 26 wire in the primary to thirty ohms, and with No. 31 wire in the secondaries each to twenty-six ohms, the receiver being seventy-five ohms and the condenser two microfarads. To

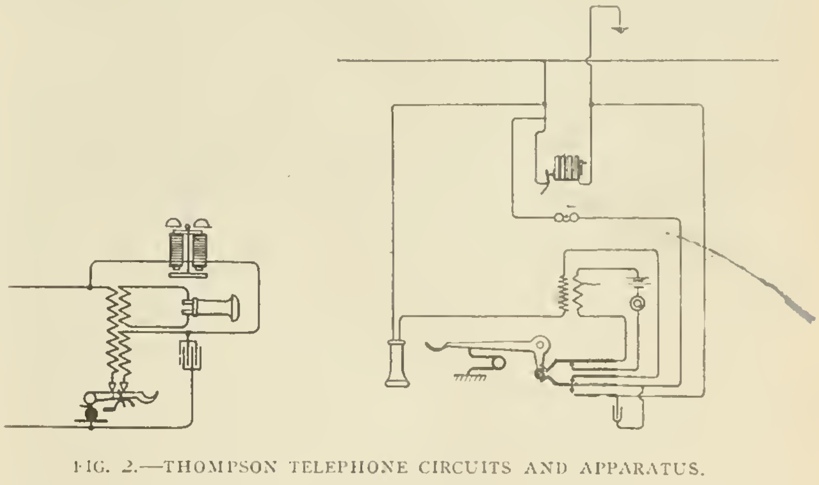


FIG. 2.—THOMPSON TELEPHONE CIRCUITS AND APPARATUS.

all who have experimented with sub-station circuits, the reason for the present wiring of parts will be evident, it being well proven that a receiver connected in local circuit, as shown, gets little side tone, while the retention of a secondary linked with the primary and transmitter retains all the efficiency of transmission of the present standard Bell circuits.

Another new sub-station circuit is that shown at the right of Fig. 2. This is a magneto system circuit, and the main object in view is to interpose a condenser in the receiver circuit, and thus raise the impedance of that circuit to such an extent that the presence of a receiver across the line due to the carelessness of some subscriber will not cause the failure of the bells. The peculiar construction of the hook switch with contacts to normally short circuit the condenser is made to protect the latter from puncture by lightning. This circuit is the property of the Stromberg-Carlson Company, who have obtained the patent by assignment from the inventor, Garrison Babcock, of Chicago.

NEW EXCHANGE CIRCUITS.

This issue of patents brings to light three common battery exchange circuits, two for manual switchboards and one automatic. One of these, invented by W. A. Taylor, of Chicago, and assigned to the Kellogg Switchboard & Supply Company, is almost identical with a system recently patented by Mr. K. B. Miller, and described a week or two ago. This is a system employing two-strand connecting cords and using repeating coils to connect inductively the circuits of the two cords of a pair. Mr. Miller's circuit was rendered of questionable value by the use of plug socket switches to control his supervisory signal circuits. In the present system the use of these plug socket switches has been obviated by inserting a condenser in the middle of each side of the repeating coil, the windings being split to allow of this arrangement.

The second manual board circuit also requires but two strands in the connecting cords, but in so far as shown in the patent no "busy test" is provided. Double-lamp supervision is, however, accomplished, the lamp being shunted out by the supervisory relays exactly as in the standard switchboards of the Bell companies. Cut-off jacks supersede the cut-off relay, and that part of the supervisory lamp circuit usually controlled through this latter and the connecting cords is transferred to an auxiliary locking relay whose contact and coil are in series. Normally this relay is re-energized, but if the ringing key be thrown an auxiliary contact in this key closes the relay circuit until such time as the relay armature can come up and thus cause the relay to hold its circuit closed. The operator's listening key also has an auxiliary contact which is opened whenever this key is thrown. This contact is also associated with the auxiliary relay circuit, being in it in series. When a conversation is complete and both supervisory lamps are bright the auxiliary relay must be unlocked to dim them. This is, of course, accomplished by momentarily throwing the listening key and breaking the auxiliary relay circuit until the armature can fall back and open its contact. G. L. Cragg is the patentee of this system, having assigned his patent to the Stromberg-Carlson Company.

The automatic system at hand for consideration is the joint work of Messrs. M. C. Rorty and A. M. Bullard. It is quite different in detail from the automatic system of these same inventors described in these columns a year ago, yet it accomplishes exactly the same results, providing not only for connection of subscribers, but for automatic ringing and busy signals as well as for secrecy. The junctions of the various parts and circuits are quite similar to those of the earlier patent in connection with which they were described at length. It does not, therefore, seem advisable to go into great detail here. Suffice it to say, that the switching member, in making a call, travels vertically in front of and some distance away from the multiple line contacts until over the one desired. This vertical movement takes place in response to the subscriber's selective switch. When the receiver of the calling party is removed from the switch hook, the metallic circuit being completed, the central office switch contact is thrown into contact with the desired subscriber's terminal and line if he be not busy. His bell is then rung. If he be busy, a busy signal or hum is returned to the caller.

A RINGING DEVICE.

A rather novel ringing device is that included in a patent for a telephone exchange system just issued to J. C. F. Multhauer, of Minneapolis. This device renders the use of a steady source of ringing current unnecessary by bringing a pole changer within the connecting cord circuits in such a way that the generation of alternating current is controlled directly by the ringing keys. The circuit is well shown in Fig. 3, wherein a pair of connecting cords is drawn completing a connection between two subscribers' lines. One coil of the transformer, 21, is connected to the ringing keys, while the other two coils are so associated with the ringing battery, 25, the pole changer, 20, and the wiring, that the depression of the ringing key closes the vibrator circuit, causing the generation of the ringing current. The circuit for the first primary current impulse is from 25 through armature 24, coil 22, winding 29, wires 28 and 10 and key 17, back to battery 25, whereupon the armature, 24, makes its forward movement to the front contact. This establishes the reverse circuit through coil 23, which may be similarly traced. The Stromberg-Carlson Company has also obtained this patent.

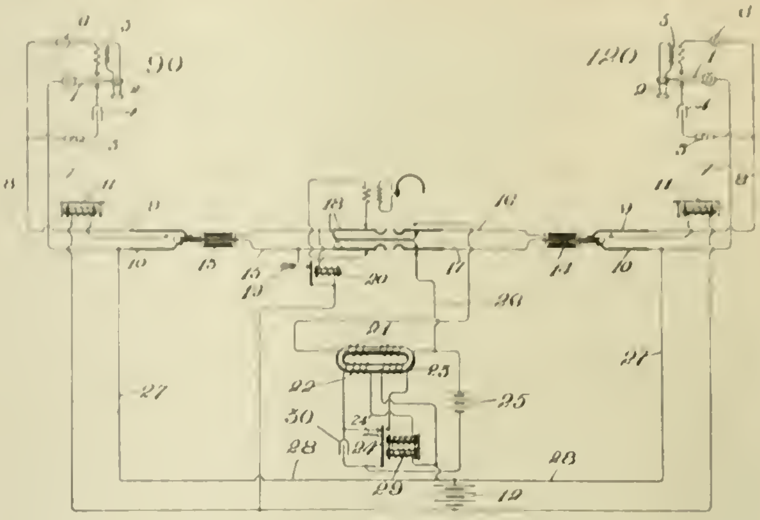


FIG. 3.—MULTHAUER TELEPHONE SYSTEM.

SELECTIVE SYSTEM.

Another signalling patent is that granted to Messrs. C. M. Jacobs and A. H. Nicholson, of England. This provides for the selection at will of any of twelve subscribers' stations on a party line by the use of polarized relays and the various possible combinations of direct currents and the two line wires and earth. In fact, the only difference between this and the well-known B.W.C. system seems to lie in the association of a separate relay with each of the three fundamental circuits instead of combining these in one or two compound-wound relays as in the earlier system.

A REPEATER AND AN ANTISEPTIC DEVICE.

The last two patents for consideration show "old friends in new garb," covering respectively a telephone-microphone repeater, using a compound or three-section induction coil and a sheet-of-paper type sanitary device. For details the reader, if interested, is referred to the patents, granted respectively to G. E. Sundquist, of Cleveland, and Abraham Levi, of Baltimore.

Meeting of Philadelphia Institute Chapter.

A meeting of the Philadelphia Branch of the American Institute of Electrical Engineers was held Tuesday evening, November 10 at the Engineers' Club. A business meeting preceded the reading of the papers, during which a set of by-laws were adopted and new officers elected as follows: Chairman, Mr. Charles E. Hewitt; secretary-treasurer, Mr. H. F. Sanville. Managers—Messrs. W. C. L. Eglin, Horatio A. Foster, J. Franklin Stevens, W. L. Hodges, G. W. Pike, A. J. Rowland.

Mr. C. B. Voynow, assistant engineer of the Philadelphia Rapid Transit Company, presented a paper on "A Method of Track Laying and Bonding." The paper was very instructive and interesting, describing as it did the Nichols-Voynow rail joint, which is in use throughout Philadelphia, and which is a new departure in methods of track laying. There was a spirited discussion in which Messrs. Pike, Hering, Hodges and Hewitt took part.

Mr. Horatio A. Foster gave to the meeting reminiscences of his experiences in the early eighties, when installing and trying to operate the first electric railway in the city of Baltimore, for the old Daft Company. The talk was very interesting, and, in the light of modern practice, decidedly humorous.

Mr. Charles E. Hewitt, with the assistance of some lantern slides, showed the development of the railway motor from its beginning to the present time.

The Albert & J. M. Anderson Manufacturing Company sent for exhibition at the meeting its collection of relics of early practice in overhead construction. Some of these were very interesting, and, placed alongside of the elaborate new devices, which were also on exhibition, told better than words of the enormous development in electric traction in the last twenty years.

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The Chatel St. Denis-Palezieux Railway.

The latest Swiss railway is a line recently opened which serves to connect the trunk line, known as Jura-Simplon, at Palezieux, with the small city of Châtel St. Denis.

The track is one metre gauge and the line has grades of a maximum of 3.2 per cent. Electrical energy is brought from the hydroelectric plant of Châtel St. Denis by the holder of the concession, and the current, which is received at 4,000 volts, three-phase, is transformed to 750 volts in a sub-station situated at St. Denis. The transformation is made by means of motor-generators, the motors of which are of the asynchronous or induction type wound for 4,000 volts, 50 cycles, three-phase. The frequency of 50 cycles has been somewhat a determinative factor in the choice of motor-generators instead of rotary converters. There are, however, some examples of rotary converter stations operating at a frequency of 50 cycles in the same district.

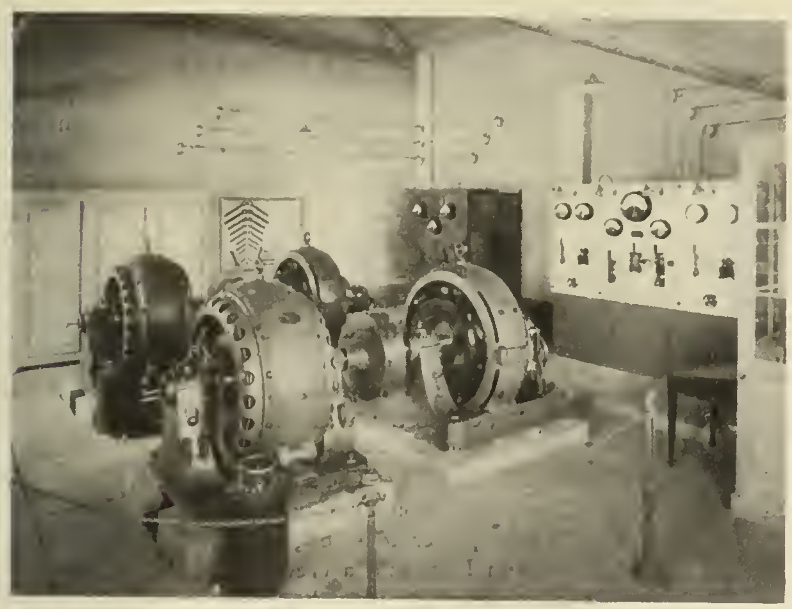

FIG. 1.—MOTOR-GENERATORS, SWITCHBOARD, ETC.

The power generated by the motor-generators is 53 kw under 750 volts. Multipolar dynamos connected to the induction motor are shown on the illustration. Near the motor is to be seen the three-phase starting resistances. It connects by three wires to the three brushes resting on the armature rings of the motor. When after starting the resistance has been gradually lowered by the rheostat and short-circuited, a final short-circuit is substituted on the armature itself directly by means of brushes, the operating rod through the end of the shaft being clearly illustrated. The brushes are finally removed from the rings by an arrangement for that purpose. The switchboard is fitted with Hartmann & Braun instruments, which are much used on the continent. The direct-current apparatus is shown on the right and the alternating current on the left hand.

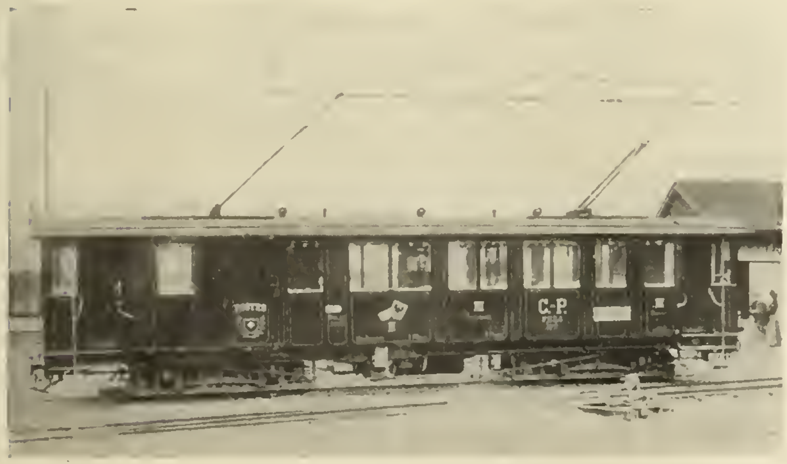

FIG. 2.—TYPICAL CAR.

A storage battery works as a buffer battery in parallel with the machines and is charged by means of a booster, which permits of the pressure being raised as high as 1,000 volts. The traction line is operated at 750 volts and current is collected by the cars by means of two bows as represented in the accompanying illustration.

The cars, which are each supplied with a 30-hp motor, are mixed cars of second and third class, having eight seats for second and 30 for third-class passengers. There is also a baggage compartment. The maximum speed of the trains approaches 24 miles an hour. Good operation has been the rule throughout, due to the good management and excellence of material and rolling stock. The builders of the latter are Messrs. Alioth et Cie, of Bâle.

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A Riedler Steam Turbine.

Prof. A. Riedler, the well-known mechanical engineer of Berlin, Germany, gave recently a lecture on steam turbines before the Österr. Ing. Arch. Ver., in Vienna, Austria. The paper contained some highly interesting details upon the new turbine developed by Riedler in connection with Prof. Stumpf and built by the General Electric Company, of Berlin.

The new turbine is in action and type similar to the turbine of De Laval. There is a series of blades cut in a solid steel disc by special cutters, which finish a wheel per day. The diameter of the disc is approximately 3 metres—smaller, for higher speeds, and larger if lower speeds are desired. The De Laval turbine has, according to Riedler, several drawbacks, which are avoided in the new type. There are not merely a few nozzles of elliptical section, but a whole belt of nozzles is formed, and by means of the closed steam belt the "resistance of ventilation" is reduced to zero. The friction between the disc and the steam is negligible, when the disc is well polished. For instance, the disc of a 2,000-kw Stumpf-Riedler turbine running in steam did not come to rest until after two hours. The principal source of loss in steam turbines is the resistance of ventilation produced by buckets running empty. This loss may be avoided in applying a closed steam belt, which is produced by nozzles of quadratic section partly superposed. The buckets of the Riedler turbine resemble those of the well-known Pelton type. The steam jet is divided by a central "slipper" in two parts. The Riedler turbine is much simpler in construction than other steam turbines, including the Parsons and Curtis types. There are only two parts: a solid steel disc running at a peripheral velocity of 340 metres per second and a fixed nozzle ring connected with the case. At this extraordinary high velocity the disc is not overstrained, but a factor of security = 5 is obtained. The form of the buckets and nozzles has been chosen after careful experiments. In this special form the effect of the centrifugal force of the mass of the steam, which produces differences in pressure of 0.1 — 0.2 kg. per sq. cm., has been taken into account. The diameter of the slots of a 2,000-kw turbine is so small compared with the corresponding dynamo shaft that the turbine disc may be disposed flying; that is, with only one bearing. The air-gap is 3 mm. That is much higher than the air-gaps common with Parsons and Curtis turbines. The oil consumption is extremely low. It was impossible to detect any oil consumption after a two months' operation of a 200-kw turbine. Of course, there is only one bearing to lubricate. The steam consumption is dependent of the size of the turbine. The first turbine showed a consumption of 14 kg. per brake hp, working without condensation. The 200-kw turbine gave a consumption of 6.7 kilos per brake hp, and the 2,000-kw turbine a consumption of 7.6 kilos per kilowatt. In fact, the turbine has the same efficiency as the very best reciprocating engines. As to cost, Riedler estimated that of smaller turbines at 1/5 to 1/6 of the cost of a piston engine of the same output. With turbines of large sizes, this figure is reduced to 1/10. The 2,000-kw turbine was not anchored with bolts, but stood immediately on the floor. Riedler has also developed entirely new types of compressors, condensers and pumps for direct coupling with steam turbines of 3,000 r.p.m. and more. He also has designed new means for the regulation of speed and reversing of turbines.

Power Transmission in Washington State.

The longest transmission line in the Northwest is that of the Washington Water Power Company, of Spokane. The line is about 110 miles long all told, between generator and consumer of current. A portion of it runs through swampy country where considerable trouble was experienced last winter on account of ice forming around the pole butt and finally lifting the pole out of the hole. This difficulty was overcome by putting horizontal cross pieces on the butts underground. The line consists of three No. 2 solid copper wires, with 60,000 volt Locke insulators and pins, made of about three inch wrought iron with cast-iron shanks.

At the generating plant two 2,250 kw, 4,000 volt, revolving field alternators, each direct connected to a Victor turbine, operating under a head of 70 ft., have been installed. The electrical apparatus, including generators, transformers, switches, lightning arresters, etc., was built by the General Electric Company. The switchboards are installed on a gallery overlooking the whole power house and all main bus-bars are in separate pottery cells under the gallery. Two sets of bars permit the city service and the transmission system to be separated when necessary. The generator switches are of the motor operated, remote-control type. The exciter is direct connected to a separate water wheel without governor. A Lombard governor is installed to operate each of the larger generators; only one of these governors, however, will be used at a time, as a practically constant gate opening on one wheel will be used, allowing the governor on another wheel to regulate for the whole station. Three water-cooled transformers (with one spare) step the voltage up from 4,000 to either 45,000 or 60,000 volts, the latter having been in experimental use successfully on the line for some time. There are no high-tension switches other than disconnecting switches installed between the line and the transformer primaries. Lightning arresters are installed, each single-pole arrester being in a separate brick compartment extending from the lower floor of the building to the high-tension wires.

Current is delivered to six sub-stations, each equipped with three-phase, step-down, water-cooled transformers, varying from 100 kw to 750 kw, with primary taps for 60,000 or 40,000 volts. Each sub-station is equipped with an automatic high-tension oil switch mounted in a separate brick cell above the panel and connected between the transformer primary and line. The current will be used almost exclusively for mining purposes. At the Standard and Hecla mines four General Electric, 300-hp induction motors will be used to drive compressors, hoists, etc. One of these motors will be geared direct to a hoist. There is upwards of 800 hp in synchronous motors and the remainder is in induction motors. The synchronous motors are started direct from the line through low-voltage taps on the transformers.

Electricity at the National Capital.

Mr. Walter C. Allen, the District electrical engineer, has filed with the Commissioners of the District of Columbia his report regarding the operations of his department for the fiscal year ended June 30. The work of changing the system of arc lighting from the old open series lamps to enclosed has been completed. The number of such lamps in operation at the close of the year was 584 enclosed series lamps and 381 enclosed multiple lamps. The service has been greatly improved by this change. Mr. Allen states that three signal circuits were added to the 21 in service on July 1, 1902. Fifty fire alarm boxes were purchased with the special appropriation made for that purpose, and 24 of them placed in service. Eight fire alarm boxes were purchased and installed at cost for private parties. The electric wiring and devices in each of the seven theatres were inspected during the summer.

Tree Felling by Electricity.

The strenuous exertions of President Roosevelt with the axe in tree felling are no longer necessary. M. R. Guenther, United States Consul General at Frankfort, Germany, hears that successful experiments have been made in various forests of France in cutting trees by means of electricity. A platinum wire is heated to a white heat by an electric current and used like a saw. In this manner the tree is felled much easier and quicker than in the old way; no sawdust is produced, and the slight carbonization caused by the hot wire acts as a preservative of the wood. The new method is said to require only one-eighth of the time consumed by the old sawing process.

CURRENT NEWS AND NOTES.

A DREARY SPOT.—A Canadian correspondent informs us that a Dominion Government steamer has just taken to Belle Isle some insulated copper wire for the purpose of establishing telephonic communication between the two ends of that island. The land is nothing but a mass of rock partially covered with moss and producing no wood of any kind. As there are no poles upon which to string the wire, and the character of the land precludes the possibility of erecting them, the wire will be laid along the surface of the rocks.

FAROE ISLAND LIGHTING.—It is suggested that Thorshavn, in the Faroe Islands, should be provided with electric lights. The water power is abundant for nine months of the year and during that period it is so dark that artificial light is necessary. Petroleum lamps are generally used in the shops and houses and for street lighting; this could all be advantageously replaced by electric lighting during the season that lights are most needed. During the months of May, June and July, when the streams are the lowest, no lights would be needed, as it is daylight constantly.

WIRELESS TELEGRAPHY IN THE ARMY.—In his annual report, General Greely, Chief Signal Officer of the Army, says that the system of wireless telegraph devised by the Signal Corps in 1899 has been improved in details, but its range of operation is limited, and experimental work has stopped pending the development of this science by experts in civil life. Commercial concerns having failed to install a wireless system in Alaska, he says, the Signal Corps is engaged in an effort to install a system that shall work from St. Michael to Safety Harbor, near Nome, a distance of 105 miles. The connection by submarine cable of the detached system in southeastern Alaska, of 1,400 miles, with that of the Yukon district, 1,619 miles, is strongly recommended as in the public interests, not only as of strategic value, but also in connection with the development of Alaska.

SUBMARINE BOAT TESTS.—The submarine torpedo boat *Protector,* the first built of the Simon Lake type, left Bridgeport, Conn., last week under her own power for Newport. The *Protector* is in charge of Captain Simon Lake and a crew of six, in readiness for the competitive trial this week between herself and the *Fulton,* constructed by the Holland Torpedo Boat Company. The tests will take more than a week, and the weather conditions may continue the trials still longer. The tests will be conducted by a trial board of naval officers. The tests will be really for supremacy as to which type will be selected by the United States Navy. The tests will include three speed trials over a mile course, light, awash and in a submerged condition, manœuvering ability, speed of diving, torpedo firing, radius of service under the boat's own power, habitability and seaworthiness. There is patent litigation between the two interests.

WHY STRIKES HAPPEN.—An interesting article in the *New York Sun* tells for what trivial reasons strikes are sometimes called. A dispute running over several years and resulting in many strikes took place between the Electrical Workers' Union and the Elevator Constructors' Union as to which should do the electric wiring in elevators. Both unions were in the Board of Delegates. The Elevator Constructors refused to arbitrate and were suspended by the board. The matter was finally referred to an unofficial umpire, who decided in favor of the Electrical Workers. The Elevator Constructors then applied for and got reinstatement in the board. At present the members of a special arbitration committee appointed by the Building Trades Employers' Association are trying to solve the problem whether the Bricklayers or Electrical Workers shall punch the holes in the walls of buildings through which electric wires are to pass. The committee has had several meetings and heard enough evidence to fill a big volume. Hitherto bricklayers have punched the holes, with the result that every year the Electrical Workers have been ordering strikes whenever a walking delegate found a bricklayer punching a hole. The Electrical Workers' Union ran a series of strikes some years ago against the Gas and Electrical Fixtures Union over which union should run the electric wires through gas fixtures. The matter was finally left to an umpire, who decided in favor of the Electrical Workers' Union. The defeated union was placed at such a disadvantage by this decision that it disbanded and its members joined the Electrical Workers' Union.

TOOL BUILDERS' ASSOCIATION.—A very successful and representative meeting of machine tool builders was held in this city last week on the occasion of the second annual convention of the National Machine Tool Builders' Association. The leading concerns were thoroughly well represented and the proceedings were of a most interesting character. As bearing upon the present feeling of depression in the country due to the recent slumps in Wall Street, it may be noted that the association adopted a resolution for the maintenance of prices, declaring that there is nothing in existing conditions to warrant a reduction and resolving to maintain the preset schedule of prices on all machine tools. Mr. William Lodge, of the Lodge-Shipley Machine Tool Company, Cincinnati, Ohio, was elected president; Mr. W. P. Davis, of the firm of that name, Rochester, N. Y., first vice-president; F. E. Reed, of the firm of that name, Worcester, Mass., second vice-president; Enoch Earle, of P. Blaisdell & Co., Worcester, Mass., treasurer, and Mr. P. E. Montanus, of the Springfield (Ohio) Machine Tool Company, secretary. The next annual convention is to be held in Cincinnati.

WIRELESS FOR CATCHING SMUGGLERS.—It is said that for thirty years Puget Sound has been the seat of the greatest opium and Chinese smuggling operations in the country, and the government has spent hundreds of thousands of dollars in attempting to stop smugglers from racing across the Straits of Fucia in small sloops from Victoria or other British Columbia ports with opium and contraband Chinese. They have every opportunity to escape among dozens of islands, and an immense fleet of revenue cutters would be necessary to thoroughly patrol every passage and island coast. The problem of stopping smuggling is now to be dealt with by means of wireless telegraphy. The revenue cutter *Grant* has been fitted with receiving apparatus enabling her to communicate regularly with the wireless telegraph station at Porf Townsend. Numerous other stations are to be established at strategic points where operations of smugglers can be reported. The *Grant* and other cutters will thus be enabled to go quickly to the scene of action whenever a suspicious sloop is reported. Captain Tozier, who has chased smugglers for years, declared wireless telegraphy will stop smuggling.

WORDS OF LIFE.—The following, purporting to come from Honolulu, Hawaii, is too good to be wasted in obscurity: "News of an ingenious escape from drowning comes from the Midway cable station. S. McMichael, one of the operators, left Honolulu on the schooner *Julia E. Whale*, for Midway station. The schooner encountered bad weather off the island and was driven on the reef last Wednesday night, October 21. Fears for the safety of all on board were entertained. With remarkable presence of mind, McMichael is reported to have devised a novel life belt. Cylinder records for a phonograph had been placed in his care for the station. When he found the vessel pounding on the reef and likely to go pieces McMichael thought of the records. He plugged up the ends of the cylinders, making them completely air-tight. Stringing them on ropes, he constructed several life belts. He took to the water and floated ashore with the aid of the belts. The remainder of the crew would have been glad of the opportunity to have had similar life belts, but McMichael had used up all of the records. Members of the crew finally were saved by getting their lifeboat launched before the vessel broke up." This is certainly a record-breaker, but it is not explained how the fragile records did not break, nor how they were air-tight, while strung on ropes.

COMPENSATING SYSTEM.—A patent has been secured by Mr. E. E. F. Creighton on a compensating system for alternating-current generators in which means are supplied to increase the voltage of the generator when the current lags due to the presence of an inductive load or when the current increases in the circuit. In these systems it has been proposed to provide a local circuit in which a current is produced bearing a substantially constant volume relation to the current in the main circuit produced by the generator. The current in this local circuit is an alternating current, and means have been provided or suggested to cause this alternating current to act directly or indirectly upon a magnet, such magnet being connected and arranged so that its magnetism affects the voltage of the main circuit. The lag is compensated for by providing a switch or commutator that will divide each cycle of the current in the local circuit in such a way that the magnet winding will receive a nearly equal volume of current in each direction when no lag is on the line, while the presence of a lag automatically provides an excess of current in one direction over that of the other, producing magnetism in said magnet and increasing the voltage of the main line The greater the lag the greater this excess. Hitherto it has either been necessary to provide a commutator, which gives considerable trouble, or it has been necessary to utilize only half the current produced in the local circuit. It is one of the objects of the present invention to utilize all of the current of the local circuit and yet avoid commutation of such current, thus eliminating the commutator and its troubles. To this end Mr. Creighton provides a switch, which shifts the current in the local circuit periodically first into one and then into another branch circuit or sub-circuit. These sub-circuits comprise the two ends of an energizing coil, or, in other words, two energizing coils, and the switch directs the current of the local circuit alternately into these two coils and in relatively opposite directions therethrough. We thus have what may be broadly referred to as a "magnetism" commutator rather than an "electrical" commutator. By the provision of this apparatus operating on this principle the apparatus of compensating systems and their operation is made more efficient and certain and more regulatable. A further improvement is to shunt the switch referred to, as well as the magnet coils, with one or more condensers, thus obviating the sparking and the inductive effects on the magnet windings and also increasing the efficiency of the system. Mr. Creighton has also in developing his method for a three-phase system provided a novel switch, combining in one structure of a simple character the switching mechanism for all three phases and obviating the necessity of supplying three separate switches. Another patent deals with the method and the adjustment of the elements.

REVERSE-CURRENT INDICATOR.—A patent has been issued to Mr. Leonard Andrews, of Hastings, England, for a new reverse-current indicator for alternating current. An apparatus according thereto comprises a transformer core forming two magnetic circuits magnetically connected together, two secondaries arranged to be energized by said two circuits, respectively, a primary arranged to produce fluxes in both of said circuits simultaneously, and a primary arranged to influence said fluxes, so as to oppose one and assist the other. The circuits of the two secondaries may be either provided with means for producing separate indications or be adapted to produce a single indication resulting from their mutual co-operation. The transformer has a core with a central member which carries one primary winding and which has at its ends two cross members which extend in opposite directions from the central member and are magnetically connected together at their ends and of which one carries equally on its parts projecting on opposite sides of the central member a winding for the other primary, while the other cross member carries the two secondaries disposed one on each side of the central member. Such a transformer comprises two magnetic circuits united for a portion of their length and adapted to be mutually energized by the primary winding surrounding their united portions and other windings, of which one (a primary) is divided between and adapted to influence the two magnetic circuits on their ununited portions, while the remaining windings are respectively located upon the ununited portions of the two magnetic circuits and adapted to supply indicating currents. It will be clear from this that the conductors on the ununited portions of the magnetic circuits may be severally located in any desired positions and are not restricted to the positions previously indicated. The directions and situations of the windings are such that one of the primaries will tend to induce in the two magnetic circuits fluxes to produce equal indicating currents in the conductors therefor, while the other primary will tend to increase the flux in one magnetic circuit and decrease it in the other, the magnetic circuit having the greater flux and producing the controlling or the greater indicating current being liable to change with change in the relative directions of the currents in the primaries. The indications are furnished in various ways. According to one arrangement separate windings are connected to lamps colored red and green, respectively, the arrangement being such that unless currents flow in both of the primaries neither of the lamps will be lighted; but that if currents flow in both in the proper relative directions the green lamp will light, while if one of them flows in the wrong direction in relation to the other then the red lamp will become luminous. It is obvious that the only function of the lamps is to indicate the presence of current in the secondaries, and that consequently any well-known electroresponsive device, such as a voltmeter, may be substituted for the lamps.

BEDS TO BREAK A FALL.—In St. Louis recently a repair lineman working on an alternating current circuit received a bad shock and became unconscious on a cross arm. Merchants along the street, seeing his predicament, brought out mattresses, etc., and piled them up underneath him so as to break his fall. He was, however, carried to the ground in safety.

RAILWAY SIGNAL APPARATUS.—To dispense with pneumatic and electric motor railway signals, Mr. Clyde J. Coleman, of New York, has just patented a system wherein a supply of liquefied gas is depended upon to furnish the means to operate the signals, in combination with electrical circuits. Carbonic acid gas is specifically referred to in the claims which number no fewer than 112. It is stated that a portable storage tank containing fifty pounds avoirdupois of such gas is capable of operating an ordinary semaphore signal over 12,000 times. Great economy of installation, maintenance and operation is predicated on the new departure.

COATING GLASS GLOBES.—Mr. Henry Keppler, of Brooklyn, N. Y., has patented what seems to be a simple system of coating bulbs, etc. He first mixes medium bronze lacquer with luminous powder and applies the same evenly over the surface of the glass. This gives the surface a frosted appearance, and by reason of the illuminating properties of the composition thus formed when applied to one-half of a light globe, acts as a reflector. The lacquer, of course, serves to form an adhesive base for the powder. Where the reflective characteristics are undesirable simply the lacquer is applied and the illuminous powder omitted. This would especially be true in coating fabrics. The second step is to mercerize white rubbing varnish and apply the same evenly over the first mixture after the latter has thoroughly dried. The third step is to dust this surface before drying with gold-bronze powder. The surface is then dried. The final step is to subject the article thus coated to a copper bath, after which it may be painted or enameled.

WINDING ELECTROMAGNETIC COILS has long been a study with Mr. Richard Varley, of Providence, R. I., who has recently secured a patent on some further developments in that direction. In machines for winding coils, especially those adapted to wind a number of coils simultaneously and known as "automatic multiple winding machines," it is desirable for various reasons to allow the strand guide which forms the layers to be located quite near the surface of the winding, and as the strand guide is usually a pulley and occupies considerable space it cannot be used between the flanges of a spool, because its motion is interrupted by the flanges at each end of a layer, with the result that the layers are not finished or at least are roughly finished. To dispense with the flanges and still preserve the integrity of the coil during its winding and after, the practice has been introduced of inserting a sheet of paper between every two layers of the winding, allowing it to extend laterally beyond the end convolutions of the layers and then winding a given number of turns in each layer, while in the multiple machines each sheet of paper thus inserted is wide enough to extend throughout all of the coils on the spindle. The coils thus build up more or less solidly; but it is still found, especially in winding the coils of larger diameter, that the tension of the wire or the jarring of the machine or handling after the coil is finished will cause the end turns of the layers of wire to break or bend down the unsupported projecting portions of the paper, and so loosen from the main body of the coil. The object of Mr. Varley's invention is to introduce a process of winding coils either singly or in multiple and involving the introduction of paper between the layers wherein the end convolutions of each layer will be securely confined and the integrity of the coil maintained throughout the winding operation and afterward when the coil is in use. This is done by building up end flanges for the coil as the diameter of the coil increases by providing each sheet of paper introduced between the layers with thickened or reinforced bands, which form stops for the end turns of the layer wound directly upon the sheet. The thickened bands are obtained by pasting strips or ribbons of paper upon the face of the sheet at a distance apart equal to the width of the layer. In multiple winding each sheet will have a number of the bands, depending upon the number of coils wound at once, and preferably one band between any two coils will serve for both; but it will be of sufficient width to be divided along the middle when the coils are removed from the winding spindle, allowing one-half to each.

LETTERS TO THE EDITORS.

Hydraulic Units.

To the Editors of Electrical World and Engineer:

SIRS:—Referring to the paper by Mr. Montagu, "A Suggested Hydraulic Unit," I beg to give you a simple old rule which has been used for decades in continental Europe for the calculation of water power. This rule is especially fitted for illustrating the advantages gotten by the use of the metric system.

Let Q be the flow of the stream in cubic metres per second, H the height of the fall in metres. The available power of the fall in kilogram metres per second is, then, 1,000 $Q\,H$, since one cubic metre of water weighs 1,000 kg. The available power in horse-power is 1,000 $Q\,H \div 75$, since 75 kilogram-metres per second are equal to one (continental) horse-power.

The effective power of the fall, measured on the turbine shaft is found by multiplying the available power with the efficiency. Now, the efficiency may be assumed for a first calculation as equal to 0.75. In this way the effective power of the fall, W, measured in horse-power, is

$$W = .75 \frac{1{,}000\,Q\,H}{75} = 10 \times Q \times H$$

The value of 0.75 for the efficiency holds good for many cases. With Pelton wheels and other types of very high efficiency, 0.75 may be taken as the combined efficiency of the turbine and the electric generator

VIENNA, AUSTRIA. E. ADLER.

Barbed Wire for Lightning Protection.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of July 18th last, there appeared some comments on Mr. Ralph D. Mershon's paper on "The grounded wire as a protection against lightning" at the Niagara Falls convention of the American Institute of Electrical Engineers.

As the public here generally lay it to deficient apparatus, not to say carelessness, when there is any accident due to lightning, it occurred to me to translate your comments and publish them in a local newspaper with an obvious object. The publication at once called forth an answer from a local "expert," and thinking that you, as well as Mr. Mershon, would probably be surprised to learn how little you know about the matter in hand, and how much is known of which you have no knowledge, I have also translated the aforesaid answer and sent it to you herewith. I trust you will find it instructive. It is at least evident that you are not aware of your "total ignorance of the most ordinary phenomena relating to electricity."

SANTA ANA, REPUBLIC OF SALVADOR. W. C. MCENTEE.

(The enclosure is as follows:

"To doubt the superiority which a grounded barbed wire has over a plain wire as a protection for loaded aerial conductors would be to admit a total ignorance of the most ordinary phenomena relating to electricity. Ignoring the theories of the physicists, in practice it is constantly observed that the electric fluid concentrates at the points of bodies in which it circulates, each one of these becoming a kind of squib which expels if the charge is positive or absorbs if it is negative. The charge of a wire in connection with the earth is negative and the deeper the ground connection the stronger the charge, and its radius of protection increases with its elevation above the other conductors charged with the opposite electricity. This wire, then, being barbed, each of its points is a small open mouth through which the lightning passes to the ground, leaving unaffected, or at least weakly influenced, all objects within the circle of protection. A plain wire receives, it is true, the inductive force of lightning, but with a difference with respect to the barbed wire of about four to one in favor of the latter.

"A simple experiment will better convince: Carry into a dark place, a room for instance, the extremity of a bare aerial conductor charged positively, and three or four kilometres long, which in most of its length runs through country where there is little high vegetation, so that it may receive the full charge that the lightning induces in it. Three millimetres from this and parallel to it, place another conductor about two metres long, having connected in the middle of it a piece of barbed wire half a metre long, grounded at both ends by burying six or eight metres in moist earth. When lightning occurs it will be observed that all the points of the barbed wire which are presented to the conductor which come from outside will be illuminated, producing at the same time a loud crackling sound; but no alteration whatever will be noticed in the plain part of the same conductor. It is not to be for a moment doubted that this phenomenon is owing to the resistance that the neighboring points oppose to the free circulation of the excess of electricity induced in the rural conductor, and to the avidity with which these absorb the excess referred to. And then let a Mr. Mershon come, electrical engineer, forsooth, and say that the barbed wire offers no advantage over the plain wire as a protector of aerial electrical networks.

"As a further proof I will refer the following case: Once on a time it happened that some perverse person broke a telegraph line, taking away a piece of the wire; the lineman in charge, on arriving at the break, found he had not with him sufficient wire to supply the missing length, so he cut a piece out of a barbed-wire fence in the neighborhood and joined up the line with it, innocently believing that his *industry*, the secret of which he guarded, deserved a prize. During four days communication was impossible over that line, after which, having exhausted every means of re-establishing it, I decided to go myself over the line, and like the Roman I arrived, I saw and I took away that which they say is only good for protection against cattle. Communication was at once perfectly re-established; the points had played their part marvelously; connected as they were, in series, with a wire of positive currents, they had become so many doors of exit."—*Santa Ana Democrat*, September 30, 1903.)

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Diagram of the Repulsion Motor.—Osnos.—A long mathematical article, illustrated by diagrams, in which the author shows that for the repulsion motor the relations between current, phase difference and torque, etc., may be represented simply in form of a diagram. In the same the locus of a point which determines the whole behavior of the motor is a circle, in a way quite similar to the case of the induction motor. (Concerning the latter see, for instance, Steinmetz, "Alternating Current Phenomena," third edition, pages 244-246, and the very elaborate discussion of this problem in Behrend, "Induction Motor.") The author first discusses the problem of the repulsion motor by the graphical method and afterwards develops the same and some additional results by purely analytical means. Fig. 1 represents an ordinary two-pole repulsion motor, the current being supplied to the stator winding, *s*, at the points 1 and 2. A line which connects the two brushes is generally inclined against the direction 1 2 by an angle α. In this figure the stator winding is shown as closed in itself, but this is no supposition for the following results, since the stator winding may consist of parts connected in series, so that the field has the direction 1 2. It is of no account whether the winding is of the ring or drum type, and the only supposition is that the motor has a case like ordinary induction motors; that is, with uniformly-distributed iron and a uniform air space over the whole circumference. Fig. 2 gives the diagram of the repulsion motor. *A C* is the resulting stator field, so that the direction perpendicular to it is the voltage at the terminals, *e*, and the angle *F A B* gives the primary phase difference. *A B* is the primary current, *B C* is the secondary current divided by $v_1 \cos \alpha$, where α is the angle shown in Fig. 1, while v_1 is the primary coefficient of stray field ("primärer Streuungsfaktor"), that is equal to the ratio of the magnetic reluctance of the primary field to the magnetic reluctance of the field common to the primary and secondary. The speed is indicated by the ratio *B H* to *H C*, and the torque by the product of *A B* by *J B*. The locus of the point *B* is a circle, the angle *A B D* being constant. The point B_k represents the condition of the motor, braked to be at rest, so that $A B_k$ is the short-circuit current. *J B* measures the torque for the unit of primary current. From the diagram it is seen that the relatively large decrease of the torque with the increase of the speed of the repulsion motor is not so much due to a decrease of the armature current (as was assumed heretofore), but mainly to the decrease of its phase difference against the primary current. At the point B_m the torque is zero, so that this point represents the maximum speed which the motor approaches when not loaded. In the ordinary series motor the maximum speed has theoretically an infinite value. This is not the case with the repulsion motor, so that the danger of the repulsion motor running up to a prohibitive speed is smaller than with the series motor. By analytical means the author shows that the displacement of the brushes of the repulsion motor may be used as well for braking as for regulating the speed.—*Elek. Zeit.*, October 29.

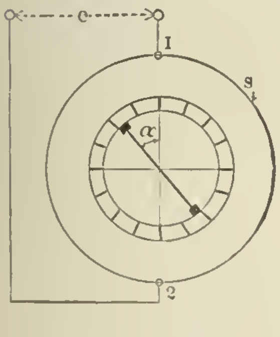


FIG. 1.—TWO-POLE REPULSION MOTOR

Compensated and Compound Alternators.—Meyer.—A reply to the letters of Heyland and Fynn, noticed in the Digest November 14. He knew that Heyland machines are being built and that some have even been tested, but what he contests is the claim of commercial superiority, or even equality with the standard revolving field type of modern design, special cases excepted. The use by Fynn of a relay which, by means of magnetic clutches, acts mechanically on the rheostat of the exciter field, is, indeed, an old scheme, the drawback being the considerable time lag and its consequences. Concerning the new British Thomson-Houston device, he gives the following information: A constant resistance is put into the field circuit of the exciter, so that the voltage of the latter is reduced to about 40 per cent. of its normal value. In parallel with this resistance is a circuit containing a contact device which short-circuits and open-circuits the exciter resistance in rapid succession, thereby changing the exciting current to a more or less pulsating current. The frequency of the make and break of this current is controlled by the voltage and the current of the generator and varies from about 1 to 20 per second. The smallest drop in the voltage will cause the rheostat to be short-circuited for a longer period, thus raising at once the voltage of the exciter and of the main generator. The rapidity of action and reaction is such as to keep the voltage practically constant for all such changes in load, power factor and speed of the engine as are experienced in modern plants.—Lond. *Elec.*, October 30.

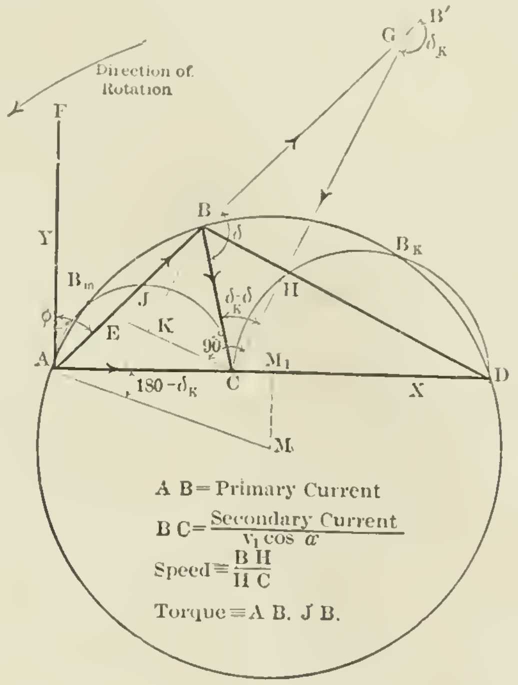


FIG. 2.—DIAGRAM OF REPULSION MOTOR.

Latour.—This author now also takes a hand in the discussion between Heyland and Meyer. He justifies his interference by saying that he has never ceased to claim complete priority of invention of the commutated machinery under discussion. He thinks that Meyer is mistaken in comparing the compensated motor with an ordinary induction motor. On the contrary, the compensated motor should be compared with the synchronous motor, over which it has the following advantages: First, unity power factor obtained automatreally at all loads; second, the rotor may be made much lighter (less copper and iron) in the compensated motor, and this without risk of its getting out of step under serious overloads; third, the compensated motor is not subject to hunting. He agrees with Meyer that the commutator alternator is suited only to the construction of high-speed machines with few poles. He claims that the compounded commutator type of high speed alternator is a cheaper machine than the present type of machine with separate exciters. In fact, in this type of machine the commutator and connections of the exciter are simply transferred to the rotor of the alternator, where they take the place of the collector rings. The voltage regulation is instantaneous and is obtained for each phase separately, thereby compensating for all dissymmetric loads on the circuit of any power factor whatsoever. The copper on the rotor of this type of machine does not sensibly exceed in weight the copper on the stator, which condition corresponds to the best possible economy. He concludes as follows: "The commutated alternating current machinery forming the subject matter of my patents is not intended to bring about a revolution in electrical construction, as may be inferred from the large publicity given to the subject by others; but I am convinced that my machines are superior to the present type of high-speed alternating-current generators."—Lond. *Elec.*, October 30.

Asynchronous Generators.—McAllister.—An illustrated discussion on the Heyland asynchronous generator. The author points out that as in the case of the induction motor, the current which produces the m.m.f. for field excitation lags 90° behind the e.m.f. of the circuit and must be supplied from some source external to the machine. If this source be a synchronous alternator, the effect of the presence of the exciting current for the asynchronous machine may be eliminated by placing across the generator circuit condensers adjusted in capacity, so as to take an amount of leading current equal to the lagging current on the asynchronous generator. If this adjustment be exact, and there are no fluctuations in the load, no current will pass from the synchronous to the asynchronous machine, and the circuit between them may be opened without producing any effect whatever upon the operation of either machine. If additional load be placed on the generator, the e.m.f. will decrease, while if the load be decreased or removed the e.m.f. will only increase, the performance being similar in many respects to the direct-current, shunt-wound generator. Investigating the effect of varying the condenser capacity in the circuit, the author shows that assuming the asynchronous generator to run without load and with condensers adjusted in capacity to give normal e.m.f., if the capacity be increased, more leading current will flow through the condenser circuit, and this will increase the field magnetization and consequently augment the e.m.f. generated. This augmented e.m.f. will further increase the condenser circuit current, etc., and if the reluctance of the path of the magnetic flux remained constant this increase would continue indefinitely and the operation of the generator would be impossible. He gives a magnetization curve which shows the relation between the exciting current of an asynchronous generator and the e.m.f. at its terminals. This curve is similar in form to a mean "hysteresis loop" for iron with an air-gap in the magnetic circuit. Each point, however, represents the relation between the virtual value of the alternating current for excitation and the alternating e.m.f. produced at constant frequency. He shows that the asynchronous generator refuses to be excited when the condensance is below a certain value, and that only above the initial bend of the magnetic saturation curve does the operation become stable. The operation of an asynchronous generator with commutator excitation is quite similar to that of one excited by means of condensers. With a commutator generator, however, it is possible to use compound excitation, which consists in passing the load current by means of a set of auxiliary brushes on the commutator, through the secondary conductors, and thus to increase the field strength with the load and to counteract the effect of any lagging current upon the field magnetism and the circuit e.m.f.—*Am. Elec.*, November.

Electric Standardization.—A reprint of the resolutions of the British Engineering Standards Committee on standard direct-current pressures and frequencies. The matter had been considered by a special sub-committee on generators, motors and transformers. It was resolved, first, for lighting, that the standard direct-current pressures, measured at the consumers' terminals, shall be 110, 220, 440 and 500 volts; second, for traction, that the standard pressures, measured at the terminals of the motors, be, for tramways, 500 volts, and for railways, 600 volts. Concerning frequencies, there was some discussion whether, besides two standard frequencies of 25 and 50, there should be adopted a third one of 40 or 42, to enable synchronous converters to be used to the fullest advantage. All the arguments in favor of this third frequency were fully discussed; but after carefully weighing the pros and cons, the sub-committee decided not to recommend the adoption of more than two frequencies, namely, 25 and 50. A frequency of 25 periods per second was adopted for (1) systems involving conversion to direct current by means of synchronous converters; (2) large power schemes over long distances; (3) three phase railway work, where motor gearing and the induction drop on the track rail have to be considered. A frequency of 50 was adopted for (1) mixed power and lighting on town supply mains; (2) ordinary factory power plant; (3) all medium sized power plants, where rotary converters are not employed. These recommendations of the sub-committee were submitted to the Electric Plant Committee, the Publication Committee, the Main Committee and the Board of Trade for approval. This has now been obtained.—Lond. *Elec.* and *Elec. Rev.*, October 30.

Editorial Notes.—While no recommendation is yet made by the committee for standard alternating-current voltages, yet it would greatly be advantageous to make these the same as the direct-current pressures, as the manufacture of lamps and various fittings would be simplified and cheapened thereby. The standard frequencies adopted are those put forward by the British Institution of Electrical Engineers a few years ago. Although they are certainly good standard practice for general use, it may not always be advisable to adopt them in particular cases. For instance, it seems that frequencies of 30 and 60 frequently make the design of turbine-driven sets easier.—Lond. *Elec.*, October 30.

The Inventor of the Dynamo.—An account of recent court proceedings in London and an editorial on the subject. Dr. H. Wilde had brought an action to restrain Prof. S. P. Thompson from referring, in books of which he is the author, to certain electrical machinery as being "dynamo-electric machinery," Dr. Wilde himself claiming the distinction of being the inventor of the dynamo and dynamo-electric machinery, and objecting to the invention being accredited to any one but himself. The lower court and the appeal court decided in favor of Thompson. The same issue contains a long letter by S. P. Thompson on the definition of a dynamo. The word is used by authoritative writers in two different senses, either in the narrow sense of the self-exciting machine or in the wide sense, including all machines in which mechanical movement is used to generate an electric current, only the electrostatic class being excluded by common consent. On the other hand, what Dr. Wilde had in effect sought by his libel suit, was to force everybody to employ the term dynamo only for separately-excited machines.—Lond. *Elec.*, October 30.

REFERENCES.

Induction Motor.—Hoxie.—The conclusion of his paper on the induction motor and its engineering capabilities. In this last installment he discusses its general capabilities and says that for any service requiring a nearly constant speed the induction motor is suitable. For a large starting torque, together with good speed regulation, special devices may be added. For services requiring variable speed and a torque varying inversely with the speed, the induction motor is not primarily well suited, and it is only with difficulty that it can be adapted to such service. He discusses in detail the use of the induction motor in cotton mills, machine shops, for operating pumps and fans, for use as a frequency changer, for operating elevators, and finally for traction. The author is careful not to express any definite opinion concerning the suitability of the induction motor for traction. He compares the theoretical advantages of the induction motor and of the direct-current motor for traction concerning initial cost, method of control, maintenance of schedule, operating convenience and efficiency. He thinks it is possible that the induction motor may ultimately be used for traction purposes upon the large trunk lines of this country.—*Jour. Franklin Inst.*, November.

Construction of a Small Variable Voltage Transformer.—Roberts.—An illustrated article on the design of a small transformer having a maximum capacity of about 80 watts and capable of furnishing a secondary pressure that can be varied from zero to about 5 volts. The illustrations are all dimensional drawings and the constructional details are fully explained in the text.—*Am. Elec.*, November.

Alternators.—An illustrated description of the construction of alternating-current generators by a British manufacturing company. It is said that the time is now over when engineers of English tramway and lighting systems were compelled to obtain their alternating-current machinery from abroad.—Lond. *Elec. Rev.*, October 30.

Lights and Lighting.

Osmium Lamp.—Some additional notes supplementing those given in the Digest November 14. The range of voltages for which the lamps may be used has recently been increased and lamps for 55 volts are now supplied by the Austrian Gasgluehlicht und Elek. Ges., of Vienna. From a report of Wedding it appears that two groups, each consisting of six lamps, of 37 volts, were connected in series across 220-volt supply mains. In one of the groups, for the first 3,132 hours, the average life of the six lamps was 2,853 hours, and the average candle-power fell from 30.1 to 23.7, the mean consumption in watts per candle-power rising from 1.46 to 1.78. After 520 hours the first lamp collapsed, and after 3,724 and 3,940 hours, respectively, two others gave way, the remaining three still burning after 3,973 hours. For the second group, which consisted of six 25-cp lamps, the average life was 1,479 hours, the candle-power dropping in 2,198 hours from 25.1 to 19.9 and the energy consumption increasing from 1.37 to 1.75 watts per candle-power. The filament of the lamps is made up of two loops, which are held apart by insulating stays attached to the interior of the glass bulb.—Lond. *Elec.*, October 30.

Power.

REFERENCES.

Electric Pumps for Water Works.—Oelwein.—A very long and profusely-illustrated article on the electric pumping installation of the water works of the city of Urfahr, in Austria. It was found that electric pumps would be cheaper than steam pumps.—*Zeit. d. Oesterr. Ing. u. Arch. Ver.*, October 30.

Blast Furnace Gas Engines.—Perkins.—An illustrated description of a 1,600-hp gas engine and three-phase alternator at the Laar power plant in a mining district in Germany, and of other high-power blast furnace gas engines installed abroad.—*Elec. Rev.*, November 7.

TRACTION.

Underground Railway Accident in Paris.—A summary of the disclosures made at the official investigation of the recent accident on the Metropolitan Underground Railway, of Paris, which resulted in a large loss of life. The interesting fact was established that the motorman on the disabled train discharged his passengers at a station and had his train pushed by the following train, which had also discharged its passengers at the same station. However, the motorman on the disabled train neglected to raise the third-rail shoes and open the motor cut-out switches in the controller. When the explosion occurred which brought the train to a standstill, it was seen that the head motor car and the first trail car were on fire. As the third-rail shoes on the motor car had not been raised an arc was maintained under the car which prevented the employees from extinguishing the fire, and soon the entire train was in flames. The bodies of the cars were made of pitch pine and no effort had been made, evidently, to fire-proof them. The heat caused by the fire destroyed the lighting and telephone cables and the tunnel was enveloped in disastrous darkness.—*St. R'y Jour.*, October 24.

Resistance of Road Vehicles to Traction.—An illustrated reprint in abstract of a report of a committee of the British Association. The first experiments were made with iron-shod wheels. The tractive effort increases with the velocity, but the curves representing the tractive effort as function of the velocity are concave downwards, showing that the rate of increase of the tractive effort diminishes with the velocity. This may be due to the fact that as the wheel travels faster, it has less time to fall into the little holes in the roadway, merely skimming along the tops of the ridges. Well-laid setts under these circumstances, even with wide, deep gaps, form a perfectly smooth track at high speeds. In some tests it was even found that the tractive effort was smaller for setts than for macadam. Further tests were made with pneumatic-tired wheels, and it was found that the ratio of tractive effort to load is very nearly constant and that the tractive effort increases slightly with the velocity. Under similar conditions as to road surface and speed, the tractive effort is less for tires of smaller cross-section than for those of larger cross-section. The rolling friction may be expressed by the formula $f P \div D$, in which f is a coefficient expressed in kilograms, varying with the nature of the road and the width of the tire, its value for a smooth, dry road being about 0.01. P is the total load on the vehicle in tons and D is the diameter of the wheel. The axle friction may be expressed by the formula $s d \div D p$, in which s is a coefficient expressed in kilograms, varying with the mode of lubrication and the nature of the rubbing surfaces, and being about 0.015. d is the diameter of the axle and p the weight of the car without the wheels. The tractive effort on the road covered with thick mud was found quite double that on a dry road. When pneumatic tires are used it must not be thought that springs can be dispensed with. The method of attaching plate springs to the frame is also a matter of considerable importance. The tractional resistance is reduced from 15 to 30 per cent., according to the nature of the road, by the use of pneumatic in place of metal tires. On good roads the width of tire has little effect on the resistance, and even on bad roads the advantage lies sometimes with the wide tires and sometimes with the narrow ones, according to circumstances. The best-known formula for the air resistance is $K S V^2$, in which R equals resistance in kilograms, S the projected area in square metres of total surface of vehicle on a plane normal to the direction of the motion, V the velocity on metres per second and K is a numeral coefficient which varies between very wide limits, according to the form and speed of the vehicle. The value of K is given as 0.0288, 0.0648 and 0.116 by Forestier, Bourlet and Tribault, respectively. The front of the car ought to taper and the back be yet more pointed, resembling the shape of a fish.—Lond. *Elec.*, October 23.

REFERENCE.

Railway Circuit-Breakers.—A description of an automatic oil circuit-breaker designed to take the place of the fuse block and hood switch, commonly employed on electric cars, also of a circuit-breaker designed for switchboard use and adapted specially for the protection of railway feeders.—*St. R'y Jour.*, October 24.

Installations, Systems and Appliances.

Modernized District Central Station.—An illustrated article describing the power plant of the Bronx Gas & Electric Company at Westchester, N. Y. The company supplies all of the street and commercial lighting of the annexed district of Greater New York north of the Bronx River, with the exception of the district known as Williamsbridge. Two generators take the place of eight 125-light Brush machines and one 75-kw alternator, and they require but ⅓ of the space occupied by the nine old machines. The power house is located in a central situation convenient for the lines of the whole system, and stands upon the west bank of Westchester Creek, so that ample supplies of water are available for condensing purposes. Two 300-kw, two-phase, 2,300-volt machines, direct-connected to cross-compound engines of the vertical type, and a belt-driven, 150-kw, 2,300-volt machine constitute the generating equipment. The smaller machine takes care of the all-day load, the large machines only being used at night. Enclosed arcs are used for street lighting and these are fed through constant-current transformers.—*Am. Elec.*, November.

Wires, Wiring and Conduits.

Dielectric Losses in High-Tension Cables.—Apt and Mauritius.—A long article in which the authors give the results of an extended investigation of the dielectric losses in cables made for use at 20 to 30,000 volts. All cables tested were three-core cables, the insulating material being either rubber, impregnated jute, paper or a combination of these different substances. They determined the loss in the dielectric of the cable, which is the sum of two items, the loss due to direct passage of the current through the dielectric, and the loss due to dielectric hysteresis. The researches confirm what was to be expected from former investigations, made especially by Steinmetz with condensers, namely, that the energy loss in the dielectric is proportionate to the square of the e.m.f. This loss for a cable length of 1 metre is, therefore, equal to $c e^2$, where c is a characteristic constant of every type of cable, and the value of c determines the quality of the cable with respect to the dielectric losses in it. This value is small, so that instead of the value c it is more convenient to use the value C equal to 1,000,000 c, the loss figure ("Verlustziffer"). C, representing the loss in watts in the dielectric of the cable for a length of cable for 1,000 metres and a voltage of 1,000. While in Steinmetz's investigations voltages up to 950 only were used, the authors experimented with voltages up to about 30,000 and found the above quadratic law almost absolutely correct, as long as the insulation was of a strength that the safety limit of voltage was not approached in the experiments. Each of the three cores of the various cables used had a cross-section between 10 and 35 sq. mm., while the thickness of insulation varied between 3 and 7.5 mm. For these cables the loss figure, *C*, as above defined, varies between 0.42 and 14.3. Cables with pure rubber insulation have the highest loss figure. The Allgem. Elek. Ges., of Berlin, uses for high-tension cables a combined insulation, consisting of a layer of a non-vulcanized special rubber compound (the trade name of which is "red rubber," or "Rotgummi," around which a layer of impregnated jute is provided. The loss figure for these cables is in the average 0.67. The authors finally give an example showing the cable loss in a transmission line. If the loss figure is 0.7 and the voltage of operation is 20,000, the loss per kilometre of cable length is $0.7 \times 400 = 280$ watts. If the total high-tension cable line has a length of 100 km (about 60 miles), the total loss in the dielectric of the cable is 28 kw. This may be compared with the iron loss in transformers, which is also independent of the load. If the installation has a capacity of 10,000 kw in transformers, the loss will be about 2 per cent.—that is, 200 kw. The dielectric loss in the cables will, therefore, be only about 1/7 of the no-load loss of transformers. The greater the value of the transmitted energy compared with the cable length, the smaller becomes the dielectric loss in the cables compared with the no-load loss of the transformers.—*Elek. Zeit.*, October 22.

Electro-Physics and Magnetism.

Dark Cathode Space.—G. C. Schmidt.—A paper in which the author develops a theory of the dark cathode space in analogy with the ionic theory of the electrolysis of aqueous solutions. If in an ionized gas a high current density is used, the regions near the electrodes will be deprived of ions since they are not re-formed immediately, nor does diffusion bring them back quickly enough to the impoverished regions. Since the positive ions very probably move more slowly than the negative ions, it is natural that the impoverishment should be greatest at the cathode towards which the positive ions migrate. The dark cathode space represents the region of impoverishment. This view is confirmed by the following experiment: On introducing into the dark space the terminal of an electrometer connected with a capacity, it takes a long time to get charged. It charges itself all the quicker, the more the electrode or probe is approached to the glowlight, and thus brought into a region of greater ionization. Anything that increases the number of ions in the dark cathode space, reduces the cathode fall of potential. Cathode rays and canal rays, when made to fall upon the dark cathode space, have that effect, but cathode rays are the more effective of the two. The cathode rays belonging to the cathode itself, if thrown back upon it by a metallic mirror, have the effect of reducing the dark space and the cathode fall of potential. The author traces some striking analogies between these phenomena and the phenomena in the electrolysis of copper sulphate.—From *Ann. d. Phys.*, No 11; in Lond. *Elec.*, October 23.

Radioactivity.—Soddy.—The first of a series of lectures delivered at University College, London, on the subject of radioactivity. These lectures are afterwards to be published in book form. In the present lecture the author prefaces the study of Becquerel rays by the consideration of Röntgen rays, and traces the historical connection between the two discoveries. He gives a short account of the researches of Becquerel and the Curies. The most remarkable feature of Mme. Curie's work is considered to be her recognition of radioactivity as an atomic property. For if inertia is excepted, there is, strictly speaking, only one other atomic property, and that is weight, which alone is an additive property of the atoms. Radioactivity is in every respect a property upon which a method of quantitative chemical analysis can be based. It also furnishes a means of quantitative analysis. There are certain peculiarities which enable us to instantly recognize thorium or radium from uranium without performing a single chemical or spectroscopic test with the substance.—Lond. *Elec.*, October 23.

Thermo-Electricity.—McClellan.—A paper on the thermo-electric behavior of nickel nitrate.—*Phys. Rev.*, October.

Electro-Chemistry and Batteries.

Manufacture of Ferro-Alloys in the Electric Furnace.—Rossi.—An account of the extended researches of the author on the manufacture of ferro-alloys in general and of ferro-titanium in particular in the electric furnace. His method of reducing metallic oxides is based on the same principles as Goldschmidt's aluminothermic reaction. But while the latter uses aluminum in powdered form and mixes it intimately with the oxide to be reduced, Rossi carries the operation on in an electric furnace in a bath of aluminum. Aluminum in ingots, scrap or the like, is first charged in the electric furnace and the current started. It melts in a few minutes and in this molten bath he then shovels the metallic oxides. The reaction sets in at once and aluminum oxidizes with incandescence. As applied to ferro titanium, the method consists in charging in the bath of aluminum the titaniferous iron ores; that is, titanic oxide associated with iron oxide. The iron is reduced first, forming a bath in which titanium reduced by the aluminum dissolves, yielding ferro-titanium. If rutile is used (titanic oxide practically free from iron oxide), and if a ferro-titanium of a certain percentage is desired, there is charged in the furnace, after or before the aluminum, the proper quantity of good scrap iron. This diminishes the expense of aluminum, as no aluminum is here required for reducing the iron oxide. He has made alloys practically free from carbon, containing from 0.12 per cent. to 0.75 per cent. carbon and from 10 to 75 per cent. titanium by the ton. Such alloys are very well adapted for the treatment of steel, but for seasoning cast iron he uses ferros containing carbon, from 6 to 8 per cent. and more, and obtained with carbon as reducing agent, since in this case the presence of carbon is of no consequence. The properties and applications of ferro-titanium are discussed in detail.—*Electrochem. Ind.*, November.

Units, Measurements and Instruments.

Measuring the Resistance of Highly Insulated Substances to Perforation.—Holitscher.—A communication criticising the method of Walter, which was described in the Digest on October 17. The writer claims that this method gives no definite indication of the resistance of the tested substances, for the reason that the results depend on the good condition of the drop of wax used and on the way in which the perforation of the wax is made with the fine needle. He therefore claims that this method is not suitable for general use because it greatly depends upon the skill of the operator. He proposes to continue to consider as the figure for the perforation voltage that value of the e.m.f. of a sinusoidal alternating current, for which the material is perforated without any drop of wax on it. In practice this value should be referred to a thickness of 1 cm. of the material. He suggests not to use metallic points, but plates of 10 sq. cm. In all researches of this kind it has been found that the perforation voltage is not absolutely proportional to the thickness of the substance, but for increasing thickness it is somewhat smaller than would correspond to the law of proportionality. The difference, however, is negligible in practice up to the certain thickness and voltage. —*Elek. Zeit.*, October 22.

Telegraphy, Telephony and Signals.

Transmission of Signals on Ships.—An illustrated article in which reference is first made to the use of electrical methods of communication on American warships. Much of the signalling is done by placing a series of lamps behind a number of translucent signals and illuminating the lamp corresponding to the signal which it is desired to give. It is thought that this method is rather primitive and entails running a separate wire for every signal, and it is difficult to see the

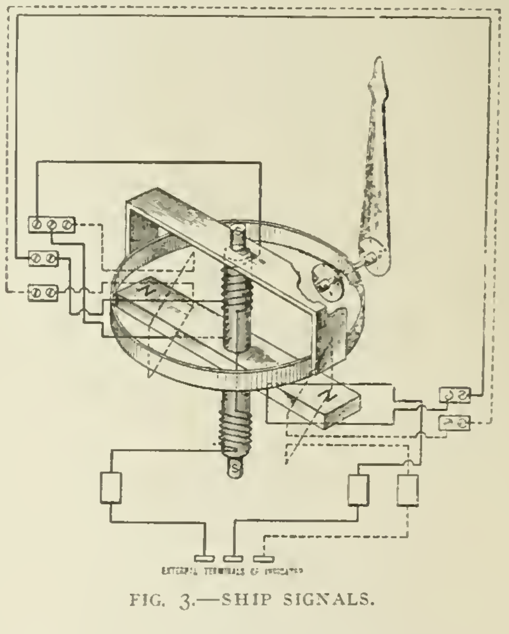


FIG. 3.—SHIP SIGNALS.

signal in a bright light. A description is then given of the Richards-Evershed ships' telegraph which has been in use in the British navy for many years for the purpose of indicating to the officer in charge of the ship the angle to which the helm has been put over. The system consists essentially of an indicator constructed on the ohmmeter principle, in which the position of a needle is determined by the ratio of the currents in two coils placed at right angles to one another, while the transmitter consists essentially of a series of resistances provided with contacts over which a switch can be moved. If one of the ohmmeter coils be connected to one end of this series of resistances and the second to the other end, while the current is led in through the movable switch and taken out at the other end of the ratio coils, which are joined together, it follows that the position of the needle in the ohmmeter coils will depend upon the position of the switch. The arrangement can be clearly seen in Figs. 3 and 4, which give a perspective sketch of the needle index and gear connecting them, together with a diagram of the connections of the coils by which the needle is magnetized, and by which its position is determined. In the helm indicator the transmitter contains the resistances and a switch arm, the latter being moved by two parallel coupling rods by which it is attached to the rudder stock. The position of the switch automatically determines the position of the needle of the indicator, and any one of several indicators can be switched into circuit with the transmitter. In this manner it is possible for the officer in charge to obtain automatic signals from the helm either on the bridge or at any other steering station to which it may be desired to make connection. In no case is it necessary to use more than three wires, and it is customary to use three-core cable having three wires covered in distinctive colors, so as to facilitate the operation of connecting up on board. A second application of the system is the use of the apparatus as steering telegraph, which is also described.—Lond. *Elec.*, October 30.

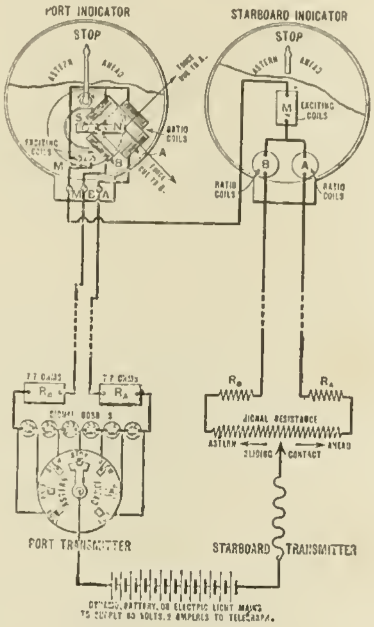


FIG. 4.—SHIP SIGNALS.

REFERENCES.

Secrecy of Telephone Messages.—Salzer.—An article illustrated by diagrams on telephone systems in which one party may call up and speak with another party independently of a third party (exchange). Such systems have generally the disadvantage that secrecy is not guaranteed, for the reason that on account of inductive actions and of current distribution, simultaneous messages are impressed on the whole network, so that the clearness of speech is diminished and there is no secrecy. The author discusses the reasons of this disadvantage and shows how it may be counteracted.—*Elek. Zeit.*, October 22.

Wireless Telegraphy.—Prasch.—The first part of an illustrated article in which the author explains with the aid of diagrams the essential distinguishing features of the various systems of wireless telegraphy.—*Zeit. f. Elek.* (Vienna), October 18.

Fire Alarms.—An illustrated description of an automatic fire alarm for use in buildings, made by a German company.—*Elek. Anz.*, October 18.

New Books.

Koniglichen Technischen Hochschule zu Aachen. By Dr. Wilhelm Borchers. Halle: Wilhelm Knapp. 62 pages, 89 illustrations. Price, 6 marks.

This book describes the new Laboratory of Mining and Metallurgy of the Institute of Technology of Aachen, with an account of the author's and his students' work in his old laboratory. The new laboratory appears to be well equipped for electric furnace experiments, various types of furnaces being described and illustrated. A chapter of the book dealing with measuring instruments has been written by Dr. Danneel.

Einrichtungen von Elektrolytischen Laboratorien. By H. Nissenson. Halle: Wilhelm Knapp. 51 pages, 32 illustrations. Price, 2.40 marks.

This volume is another one of the series of monographs on applied electrochemistry, edited by Victor Engelhardt. The reviewer looked forward with pleasure to reading the little book, as he realized that it promised to fill a gap in the literature on electro-analysis. Electro-analytical methods, on account of their simplicity and quickness, are becoming more and more used in practice. The text-books on electro-analysis, however, do not contain the data required to enable the chemist in practice—especially if he belongs to the old school and does not know very much about electricity—to put up an electro-analytical installation to the best advantage. The author of the little volume under consideration is an authority on the subject of electro-analysis and a pioneer in the application of electro-analytical methods in practice, in the large industrial laboratory, of which he has been the director for many years. He is, therefore, eminently qualified to write on the subject and it was hoped that he would embody the results of his experience in this book for the benefit of the man in practice. These hopes are, however, doomed to disappointment, for after a few pages of general matter he contents himself with a mere description of a dozen or more installations, the great majority of them being University laboratories. Included among the latter is that of the University of Pennsylvania, built by Dr. Edgar F. Smith, the foremost authority on this subject in America. On the last few pages the author describes and illustrates his own installation in its historical development. He concludes with the following sentence: "As the result of a more than two years' use of my installation and a thorough observation of other installations, a number of changes have again been found desirable, in order to cheapen the running, simplify the manipulation and increase the accuracy of the results obtained. I will discuss sure roads (sichere Wege), which lead to this end, in a later publication, entitled, 'Most Suitable Installation of Laboratories for Electrolysis in Metallurgical Works.'" It is to be regretted that, as he was writing the book under consideration, which covers the same subject, he omitted to avail himself of this opportunity.

The Practical Physics of the Modern Steam Boiler. By Frederick J. Rowan. Introduction by Dr. R. H. Thurston. New York: D. Van Nostrand Company. 638 pages, with 314 diagrams and plates.

The purpose which the author of this work has consistently held in view throughout seems to have been the development and presentation in detail of the broad underlying principles upon which boiler design and construction, and especially improvement, must be based. We find accordingly a historical sketch of the development of the modern steam generator, and in particular a full presentation of the characteristics of the modern boiler of the water tube type. We find further a large amount of descriptive matter relating to modern forms of boiler, particularly of the water tube variety. This portion of the book constitutes the descriptive part and represents the matter intended to provide for the general acquaintance of the reader with the subject in hand. Next, coming closer to the purpose of the book, is a full discussion of the physical laws relating to the combustion of fuel, the transmission of heat, the circulation of water, the action of changes of temperature on the structure, the general relation of the structure to the stresses it is called on to bear, the corrosive influence and prevention of scale deposits. On all these topics a large amount of information based on actual experience, is furnished, together with a clear, careful and full statement of the physical laws involved. A further chapter contains a large amount of information drawn from boiler tests of various types, and especially such as have special value by reason of their extent or the care with which they have been carried out.

Throughout the work the author is more concerned with physical principles and laws, and their application in particular to the improvement of the boiler, than he is with present-day practice in minor particulars or with constructive details. The keynote of the work is "improvement," and the various physical laws are presented and discussed with this particular end in view. The prominence of the author in the engineering world would lead us to expect a treatment of the subject which will be clear in style, ample in scope, having in view his expressed purpose, and authoritative in character. In these expectations we are not disappointed, and the book must certainly take a leading rank in the standard literature of the subject. It will be found a most acceptable addition to the working library of all those who are concerned with the great problem of the betterment of the steam boiler as a factor in our modern industrial civilization.

BOOKS RECEIVED.

Opere di Galileo Ferraris. Vol. II. Milan: Ulrico Hoepli. 478 pages. Price, 12 lire.

La Telegraphie Sans Fil. By E. Guarini. Bruxelles: Ramlot Freres et Soeurs. 64 pages, 88 illustrations. Price, 2.50 francs.

La Tecnica Delle Correnti Alternate. By Giuseppe Sartori. Milan: Ulrico Hoepli. Vol. II, 480 pages, 290 illustrations. Price, 8 lire.

Fowler's Mechanical Engineer's Pocket Book, 1904. Manchester: Scientific Publishing Company. 441 pages. Price, 2 shillings, sixpence.

Electric Railway Commission for St. Louis Exposition.

In view of the growing importance of the electric railway interests of this country, plans are being carried into effect which contemplate a very prominent recognition of the electric railway and electric railway problems at the St. Louis Exposition. The appointment of an Advisory Commission on Electric Railway Tests of the Louisiana Purchase Exposition has just been announced. The Commission is thoroughly representative of each branch of electric railway activity and will, undoubtedly, receive the support of the entire electrical industry in any plans for the promotion of electric transportation which the Commission shall devise.

The personnel of the Commission is as follows: Mr. J. G. White, president, J. G. White & Co., New York City, chairman; Mr. H. H. Vreeland, president Interurban Street Railway, New York City; Mr. W. J. Wilgus, vice-president New York Central & Hudson River Railway, New York City; Mr. George McCulloch, president Union Traction Company of Indiana, Indianapolis, Ind.; Mr. James H. McGraw, president McGraw Publishing Company, New York City.

The Commission will act in an advisory capacity in connection with a series of tests on electric railway apparatus to be conducted at the Exposition under the auspices of the Department of Electricity.

From Mr. W. E. Goldsborough, chief of the Department of Electricity, we learn that the electric railway test tracks have been laid north of the Transportation Building on the Exposition Grounds, and represent a practically level clear double track, 1,400 ft. in length. These tracks will connect with the Intramural Railroad and also the steam railway system serving the grounds. It is said that several important manufacturers have already promised complete equipments for exhibition and test, and the present outlook indicates that all of the new systems of alternating-current propulsion, as well as the old direct-current system, will be offered for inspection and operation.

It is not so much the intention to conduct these tests in a competitive sense as it is to arrange for the accumulation of data which will be valuable in promoting further electric railway undertakings from an engineering standpoint. A very complete equipment for testing apparatus will be provided, and all of the work will be done in a thoroughly engineering and scientific manner.

Dr. Hans Goldschmidt on Aluminothermics.

Aluminothermics is the name of a new branch of engineering, all applications of which are based on the fact that the combination of aluminum with oxygen evolves a very large amount of heat, and that this reaction, when started at one point of a mixture of powdered aluminum with a metallic oxide, goes on with great rapidity and produces a very high temperature. Such a mixture is called thermit, but what is mostly understood under this name is the special mixture of powdered aluminum and iron oxide. The vehemence of this reaction has been known for many years, but just for this reason the only use this reaction was put to was to make an interesting and showy laboratory experiment. Although Messrs. Green and Wahl succeeded many years ago in applying this reaction for reduction of metallic oxides, it was left to Dr. Hans Goldschmidt, of Essen, Germany, to make the reaction a controllable one, applicable with ease and certainty to a great many engineering purposes in which production of an extremely high temperature is required.

The development of this process has required a great many years, as is known to our readers from the Digest abstracts of papers which Dr. Goldschmidt had published from time to time. While the process is extensively used abroad, especially for rail welding in continental Europe and England, for repairing broken mining machinery, especially in the Transvaal, and for repairing broken stern-posts of ships, etc., in various countries, the process is practically untried on a larger scale in this country.

To introduce the various applications of his process in this country Dr. Hans Goldschmidt delivered an experimental lecture on November 13, before the Columbia University Chemical Society and many invited guests, in Havemeyer Hall, Columbia University. The large lecture room was crowded and the experiments of Dr. Goldschmidt were extremely successful.

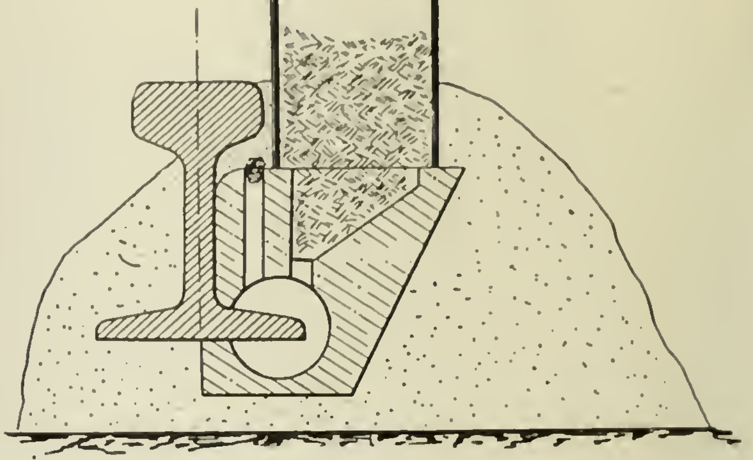


FIG. 1.—WELDING A THIRD RAIL.

The greater part of the paper dealt with the process of rail welding with or without clamps. It seems that the use of clamps has recently been found more and more superfluous, so that in many of the recent installations rail clamps were dispensed with. Even a butt weld can be obtained without clamps, particularly with rails already embedded. At Barmen, Germany, this was done very successfully about a year and a half ago. The old fish-plates were taken off, the ends of the rails were raised slightly by means of a crowbar and a shim was firmly wedged in between. In this case the shim was welded into the head of the rail.

When welding new rails not yet embedded, the use of rail clamps can be obviated by firmly wedging up the rail from the next succeeding joint.

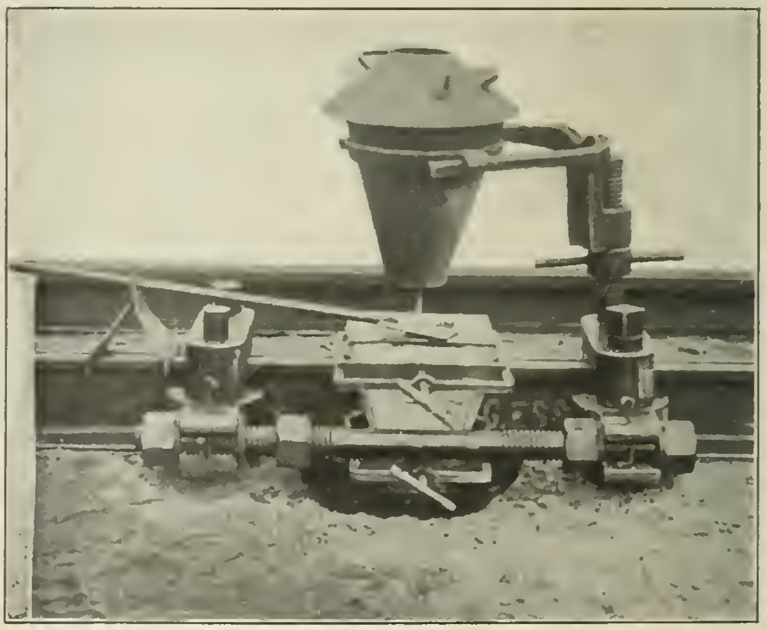


FIG. 2.—WELDING OUTFIT COMPLETE.

When working without clamps, the time consumed per joint equals three-quarters of an hour for one man. Squads of four men, including foreman, do not use nearly so much time. At $1.50 per day the wages item of cost is 10 cents per joint. The use of the clamps doubles this amount. The other labor connected with welding remains the same whether clamps are used or not.

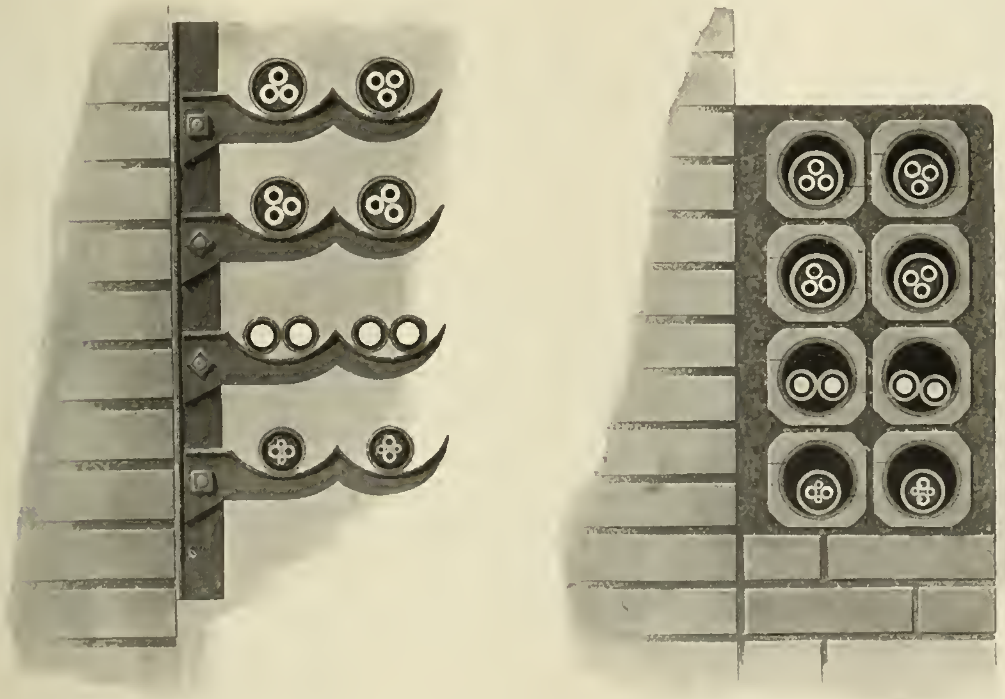
The moulds are in two parts and are sometimes made by the trolley companies themselves. The mould is screwed on to the rail and the rims are carefully smeared with clay where they touch the rail. Prior to this the rail ends are cleaned of dirt and dust with a wire brush and are slightly warmed, no sand-blast being required. In case the tops of the rails are to be butt-welded, the section has to be filled. This is all that is required in the way of preparatory work. A true alignment of the rail is, of course, necessary.

Each joint requires a distinct amount of thermit, according to the dimensions of the rail, and to avoid any mistake of the workingmen the amount of thermit required for one joint is given to the workingmen in a sealed bag. Since the trolley companies may make their own crucibles and moulds they will have to pay freight only on these "welding portions" which they buy from the manufacturer. The welding portion is filled into the crucible and about a thimbleful of ignition powder is added and ignited by a match. The reaction then goes on and the molten thermit iron flows into the mould and the weld is made. Recently the same method has been used successfully for welding third rail.

Other applications described by Dr. Goldschmidt were the production of pure refractory metals free from carbon, the repairs of broken machinery, the improving of iron and steel castings by means of anti-piping thermit and the welding together of wrought-iron tubes. His experiments in which two tubes were welded together was certainly one of the most beautiful ever shown in a scientific lecture. Recently the thermit process has been applied repeatedly to the repair of broken stern-posts of steamers and the time of the repair has been reduced from several weeks to a few hours, with a corresponding reduction of cost.

A New Divided Tile for Underground Work.

Considerable time and attention has been given to improvements in the underground installations of electric power plant conductors. Both the conductors and their insulating walls or the conduit proper have been considered. Various types of cables for the different classes of work have been developed. An improvement in the lead sheath and the insulation has taken place. The conduit proper, the method of laying the same, and the construction of the manholes have also been undergoing changes. All of these modifications have resulted in making as nearly a perfect underground system as possible.



FIGS. 1 AND 2.—DIVIDED TILE.

It therefore seems somewhat strange that any item whatever has been neglected, but such is the case, as an inspection of such a system will show. In manholes and especially at stations iron racks have been constructed to carry the cables, which has proved very unsatisfactory. Such a point will prove a very good ground which will permit electrolysis and other destructive agents the more readily to proceed with their disintegrating work. When the insulation is once broken down, a destructive arc will ensue which may prove disastrous in its results. The lack of proper mechanical protection also in many cases is quite evident. This, in a great many cases, has been due to the fact that a suitable protective covering could not be applied, as the cables were already in position.

To overcome this difficulty and provide a covering as effective as at any other point in the system, a split tile has been designed by Mr. Ed. N. Lake, of the Chicago Edison Company. This is divided in such a manner that the joints in the opposite walls are offset. The advantage of this, from a mechanical standpoint, is readily appreciated. From an electrical standpoint it will be seen that it is impossible for an arc in any one duct to be communicated to an adjacent one, a most desirable and necessary feature. For should an arc once be started, most serious results would follow where a large amount of power is concentrated in a small space, as is the case in many large power installations. The conduit, as will be seen from the cuts, Figs. 1, 2, 3 and 4, readily adapts itself to any and all conditions, and with the use of curved ducts can be employed for the most complicated cable run. The Lake divided camp tile is being made by the H. B. Camp Company.

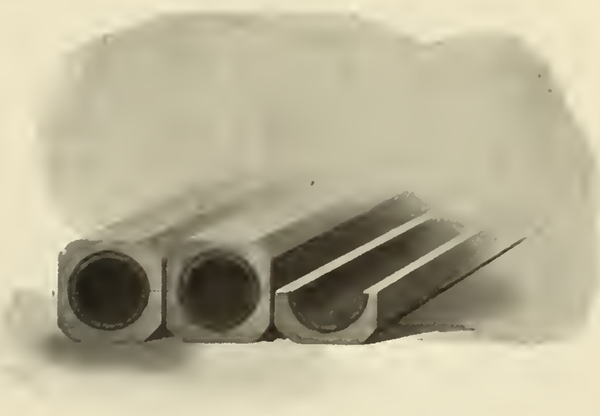


FIG. 3.—DIVIDED TILE.

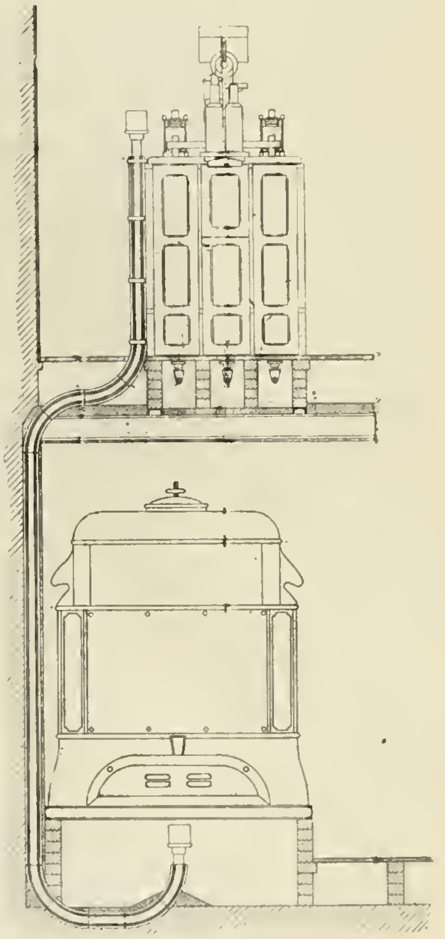


FIG. 4.—TYPICAL APPLICATION OF DIVIDED TILE TO HIGH-TENSION LINES IN SUB-STATIONS.

New Electric Lighting Specialties.

The steady trend of improvement in the field of electric light and power brings with it demands for specialties of one kind and another, which shall more strictly answer the insurance requirements, as well as be more handy for installation and be of greater general efficiency and economy. Work done in this respect may not seem sometimes as important as that connected with the larger developments, but in the aggregate it has probably just as much to do with the satisfaction given to the public and with the general safety and security of electrical methods.

A concern which has recently been putting forward some new specialties of unusual interest is the Banner Electric Company, of Youngstown, Ohio. A few of these are illustrated herewith, including its weather-proof, double-pole fuse cut-out, its entrance switch and plug cut-out, and its floor boxes. A form of the entrance plug cut-out is shown in Fig. 1. One of the advantages of this is that combinations of these blocks may be used in the place of panel or tablet boards, so that what is virtually a switchboard can be built up from these units. They can be so arranged as to take off branches from one or both sides of the mains, each branch being supplied with switchboard and fuse connections. They are made for standard fuse plugs. The base is of glazed porcelain and the copper and brass parts are highly finished, the whole being approved by the Board of Underwriters.

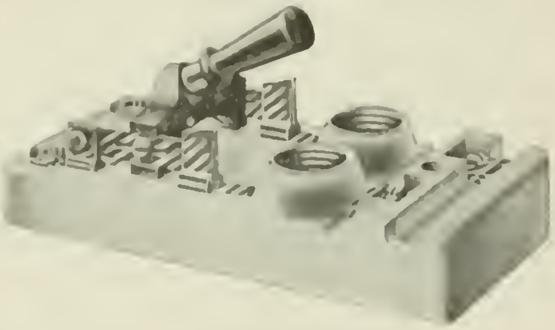


FIG. 1.—CUT-OUT.

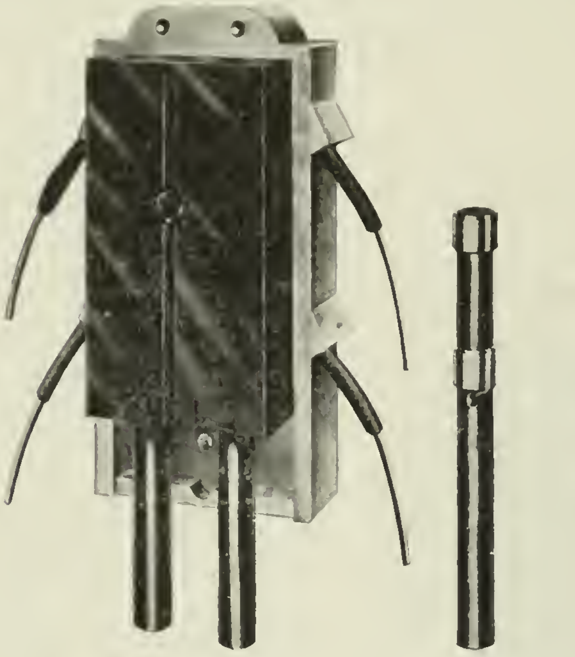


FIG. 2.—WEATHER-PROOF CUT-OUT.

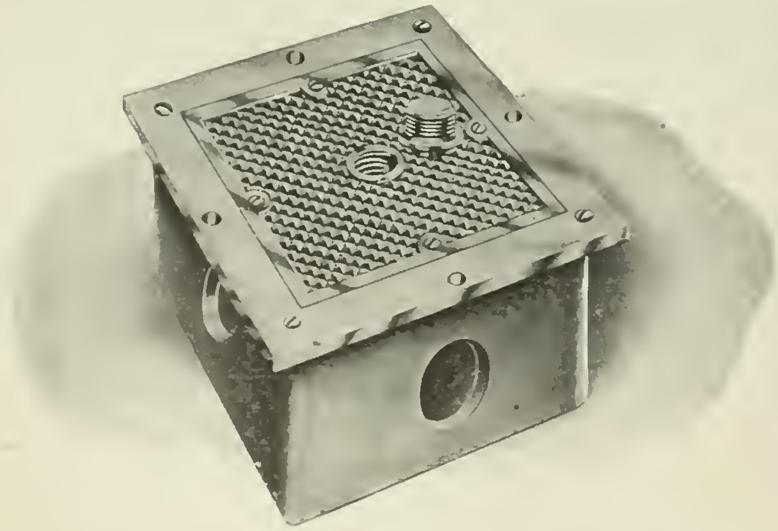


FIG. 3.—FLOOR BOX.

The weather-proof, double-pole fuse cut-out shown in Fig. 2 is an interesting device used principally in connection with alternating arc lamp service. The contact points cannot possibly be reached except by means of the fuse tubes shown in the cut, so that a heavier fuse than should be used cannot be connected. In this way the lamp is protected from excessive current, and the device can, of course, be used in many other ways where some protection is needed and can be afforded by using fuses of fixed capacity. The base of this is of glazed porcelain, and the contact points are round spring clips. The fuse tubes are of heavy hard fibre, carrying copper ferules, to which the fuses are soldered, the fuse passing through the side of the tube from one ferule to another. The arrangement is such that the tube cannot possibly jar loose or drop out when inserted in the clips, and a good contact is always insured. They are designed for 250 volts and any required capacity up to 30 amp. The positive and negative poles are separated by a thick wall of porcelain, minimizing the possibility of short circuit. The cover is of enamelled galvanized iron bolted to the porcelain and cemented securely around the edges so as to be water-proof. The inleading wires are soldered to the spring clips.

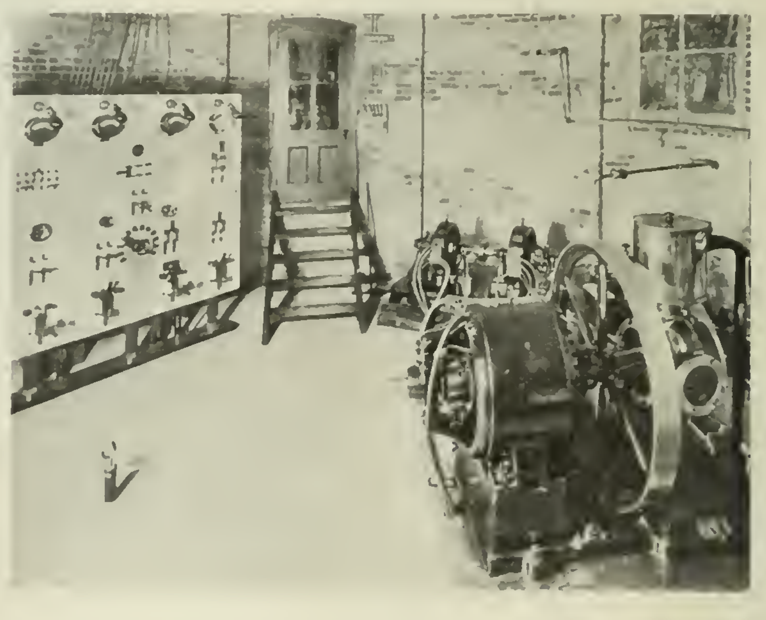
Fig. 3 shows a new form of floor box for conduit work and the type illustrated is that which has been designed for and is to be used by the new Government Bureau of Standards and laboratory which has recently been built at Washington. The lower part of the box is of cast iron, while the cover is of polished brass, the center field being finished in small raised diamonds sharply cut. The center plug screws in from the bottom of the plate and when in place comes flush with the top side. A rubber gasket is used between the brass cover and the iron box body so as to make it perfectly water-tight.

Among other supplies of the concern may be mentioned the automatic time switch and the heavy stamped copper terminal lugs. The Banner incandescent lamps are already familiar to our readers.

A Small Domestic Lighting Plant on Long Island.

An interesting example of a small electric lighting plant for domestic use is that of a private residence at Bayville, L. I., where current is generated by a 6½-kw generator direct-connected to a kerosene engine. It is stated that a current of 50 amp. at 110 volts (5½ kw) is generated on a consumption of 10 pints of oil per hour, the engine running at 350 r.p.m.

The connections of the generator are such that current may be furnished either directly to the main circuit or to a storage battery having a capacity of 240 amp.-hours. The regulation of the unit is stated to be within 2 per cent. from no load to full load, and less for intermediate changes of frictional loads. This outfit requires practically no attention beyond that of providing the proper supply of oil for fuel and lubrication. A small pump furnishes the exact amount of kerosene to the cylinder, and this is regulated by a centrifugal fly-wheel governor.


SMALL PRIVATE ELECTRIC LIGHTING PLANT.

On the basis of the above figures, with oil at 10 cents a gallon, it is calculated that the cost of current for 100 16-cp lamps per hour is 10 cents, or .001 cp for one lamp.

The engine is of the Mietz & Weiss make, and the generator was furnished by the Bullock Electric Manufacturing Company. A Gould storage battery is used.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—During the early part of the week depression prevailed in the market, which, however, was followed by a rally. The United States Steel securities reached new low record prices, due to further reductions in quotations for some classes of steel products. These shares became steadier and rallied when it was announced that no cuts would be made in the price of rails or structural steel. This improvement, however, failed to help the general market. There was considerable foreign selling here, particularly in Pennsylvania Railroad, which in this market declined to the lowest figure since 1898. The entire railroad list was influenced more or less by the action of the leading stocks in this class. On Friday the market rallied on extensive covering by the short interest. Electric and traction stocks were not affected to any appreciable extent. Brooklyn Rapid Transit, on sales of 82,600 shares, gained 1 point, net, closing at 36¾, and Metropolitan Street Railway gained 3 points, closing at 112, the sales aggregating 25,700 shares. General Electric was weak, closing at the lowest price of the week, namely, 146¼, this being a net loss of ¾ point. The highest point reached by this stock was 149. Westinghouse common closed at the highest point of the week—138—thus gaining 3 points net. Western Union was steady, closing at 83. Following are the closing quotations of November 17:

NEW YORK.

	Nov. 10	Nov. 17		Nov. 10	Nov. 17
American Tel. & Cable	78	78	General Electric	148	149⅛
American Tel. & Tel	125	125	Hudson River Tel	..	..
American Dist. Tel	23	23	Metropolitan St. Ry	111½	114
Brooklyn Rapid Transit	37	38¼	N. E. Elec. Veh. Trns	..	..
Commercial Cable	140	..	N. Y. & N. J. Tel	140	..
Electric Boat	19	22	Marconi Tel	..	..
Electric Boat pfd	42	48	Western Union Tel	82½	83⅛
Electric Lead Reduction	⅞	*1	Westinghouse com	134½	136
Electric Vehicle	5½	6	Westinghouse pfd	162½	165
Electric Vehicle pfd	8½	8			

BOSTON.

	Nov. 10	Nov. 17		Nov. 10	Nov. 17
American Tel. & Tel	126¼	124¾	Western Tel. & Tel. pfd	75	75
Cumberland Telephone	*115	*115	Mexican Telephone	1⅛	1⅛
Edison Elec. Illum	240	*242⅛	New England Telephone	123	120
General Electric	146	149	Mass. Elec. Ry	18⅛	18
Western Tel. & Tel	8	7⅛	Mass. Elec. Ry. pfd	76	76

PHILADELPHIA.

	Nov. 10	Nov. 17		Nov. 10	Nov. 17
American Railways	42	..	Phila. Traction	95½	..
Elec. Storage Battery	45	46	Phila. Electric	6	5¾
Elec. Storage Battery pfd.	45	..	Phila. Rapid Trans	11¾	11⅛
Elec. Co. of America	7⅜	7¼			

CHICAGO.

	Nov. 10	Nov. 17		Nov. 10	Nov. 17
Central Union Tel.	..	..	National Carbon pfd	86	85
Chicago Edison	140	..	Metropolitan Elev. com	17	..
Chicago City Ry	165	..	Union Traction	5½	5⅛
Chicago Tel. Co	120	..	Union Traction pfd	29	25½
National Carbon	20	19			

*Asked

WESTINGHOUSE BRAKES.—The Westinghouse Air Brake Company, of Pittsburg, has been granted a charter with a capital of $11,000,000. The new company is a merger of the Westinghouse Air Brake Company, organized in 1863, and the Electro-Magnetic Brake Company, organized about two years ago with a capital of $5,000,000. The officers of the new company are: George Westinghouse, president; Robert Pitcairn, first vice-president; H. H. Westinghouse, second-vice-president; E. M. Herr, third vice-president; John Miller, secretary, and John Caldwell, treasurer. The Electro-Magnetic Brake Company manufactures electric brakes for street car service, and these will continue to be manufactured by the Westinghouse Air Brake Company.

HITCH IN MICHIGAN TELEPHONE.—An order staying confirmation of the Michigan Telephone sale until further orders has been granted by Judge Swan in the United States Circuit Court, Detroit. The order to show cause why the sale to the Old Colony Trust Company and N. W. Harris should not be set aside, is returnable this week. A bill of complaint against the Old Colony Trust Company, the Michigan Telephone Company and N. W. Harris has been filed. George W. R. Harriman is complainant and petitions alleging frauds. He asked leave to intervene and for a bill of review.

ELECTRIC STORAGE BATTERY.—In an interview in Philadelphia as to the outlook for Electric Storage Battery Company, President Herbert Lloyd says: "We are doing very well and the outlook is good. We will show considerably more gross earnings for the fiscal year ending December 31, 1903, than for 1902. The January dividend will certainly not be less than the last one. Out of the 50,000 shares of preferred stock I understand that now all but 3,000 or 4,000 have been converted into common."

TYRONE TROLLEY MORTGAGE.—The Tyrone Electric Railway Company, of Tyrone; the City Passenger Company, of Altoona, and the Altoona & Logan Valley Electric Railway Company (all subsidiary to the American Railways Company) have been merged under the name of the latter and a mortgage for $4,000,000 on their properties entered in favor of the Equitable Trust Company, of Philadelphia.

DIVIDENDS.—Niles-Bement-Pond Company has declared a quarterly dividend on the preferred stock of 1½ per cent. Pratt & Whitney Company has declared a quarterly dividend of 1½ per cent. on the preferred stock. American Railways directors have declared a dividend of 1½ per cent. (75 cents) a share, payable December 15, to stockholders of record November 30.

NEW YORK TRACTIONS.—When asked about the rumored plans for a consolidation of all the local traction companies, Vice-President Thomas F. Ryan, of the Metropolitan Street Railroad Company, said: "As far as the Metropolitan Street Railroad Company is concerned, there is absolutely no truth in the rumor."

UTICA LIGHTING BONDS.—The Utica Electric Light & Power Company has applied to the Stock Exchange to list $500,000 additional first mortgage 5 per cent. sinking fund bonds of 1950.

Commercial Intelligence.

THE WEEK IN TRADE.—A larger business was reported last week, due to the expansion of retail trade at the Northwest, which was favored by cooler weather, and at the South, where an enormous quantity of cotton is being marketed at good prices. On the whole, wholesale trade is still quiet, waiting developments in price and demand. There appears to be an excellent expansion in export trade. The October cotton reports were equal to the best recorded in any month, and wheat and corn are selling more freely and moving abroad in response to concessions forced by larger receipts, increasing visible supplies, liquidation and fear of foreign competition later. The exports of leading products aggregate the second largest total ever recorded for October. While the general outlook is favorable, there were some depressing features in the situation, chief among which were the reports that finished steel products had been cut; that wages of iron and steel and cotton mill employees must be reduced, and that among new strikes a general shut-down of Colorado coal mines menaces far Western manufacturing and railway activity. The gross railway earnings in October show a cheering gain of 5 per cent. over the progressive increases reported in that month for at least 6 years past. The reduction in the pig-iron output in the Pittsburg district alone is placed at 500,000 tons per month. On the other hand, high prices have checked demand. A favorable industrial development is the resumption of work by copper mines employing 30,000 men. A reduction of freight rates on steel from Pittsburg for export has been granted by the railroads. Sales of material in Europe by the leading American concerns are placed at 150,000 tons. Other metals show downward tendencies. Domestic purchasers of copper are still buying on a most conservative scale, and the aggregate of transactions has been extremely light. With the report of the reopening of the Montana mines, a heavy break in prices occurred here and in London. The closing quotations are 13½c. for Lake, 13¼c. for electrolytic, and 13c. for casting stock, these prices being nominal. The lumber market is irregular, but building activity is favored by the late favorable fall weather. *Bradstreet's* reports the number of business failures for the week ending November 12 as 250, against 216 the week previous, and 205 the corresponding week of last year.

HUGE NEW WORTHINGTON PLANT.—The International Steam Pump Company is building a huge plant at Harrison, N. J., which will be devoted to the manufacture of the Henry R. Worthington water works machinery, water meters, cooling towers, condensers, feed water heaters, centrifugal pumps, etc. It will be electrically equipped and will be the largest plant of its description in this country, if not in the world. There will be eight acres of roofing and double that extent of floor space. The new works will accommodate from 4,000 to 5,000 men and will cost in the neighborhood of $2,000,000. There will be nine large buildings, including a main machine shop, with wide galleries, over 1,000 ft. long; an erecting shop 592 ft. in length of the same section as the machine shop, a high erecting shop 210 ft. long, four galleries in height, in the side bay, connecting the two shops. The main foundry will measure 600 ft. in length and there will also be a special foundry for small work, 410 ft. long, with a building 200 ft. by 60 ft. for cleaning castings connecting the two. The pattern building will be four stories high and 550 ft. long, and is to be divided by fire walls into four sections. The power house will be 172 by 102 ft. Electric power distribution is to be employed throughout and the grounds will be illuminated by electric arcs. The initial capacity of the power plant will be 1,000 kw. The General Electric Company has been awarded the contract for the generators. There will be special machines of 500-kw capacity each. The direct current to be taken off the commutator will be 250 volts. A third or neutral wire is to be connected to collector rings on the opposite side of the armature, so that a voltage of 125 can be taken off between either of the main wires, the neutral wire thus making a third-wire system in the one machine. The engines will be of cross-compound condensing build of 1,000-hp capacity each. The boilers—five units of 300 hp each—will be manufactured by Babcock & Wilcox. A steam turbine of 200-kw capacity will be installed for night run and lighting purposes. The plant has been designed so as to permit of the installation of a further capacity of 800 kw. Orders for a substantial number of machine tools have been allotted to the Niles-Bement-Pond Company and Manning, Maxwell & Moore. The plant is expected to be in active operation next fall.

THE GREGORY ELECTRIC COMPANY, of Chicago, reports a remarkable increase in the business brought about by the increasing of its facilities through the addition of its new warehouse and works at Sixteenth and Lincoln Streets. The cost of handling and overhauling the second-hand apparatus which it handles has been largely reduced thereby, and the company reports that September and October shipments are by far the largest in its history and enough orders have been booked to have November and December shipments as large or even larger. Among the recent shipments it reports the following: 25-hp Eddy motor, Electric Light & Street Railway Company, Sheboygan, Wis.; 33-kw Wood alternator, Albion, Ind.; 125-kw Thompson-Ryan generator, Grand Rapids Edison Company, Grand Rapids, Mich.; 15-hp Wagner alternating motor and a 10-hp General Electric alternating motor, Mayfield Manufacturing Company, Mayfield, Ky.; 15-kw Crocker-Wheeler generator direct-connected to Nash gas engine, A. Everett, Chicago; one General Electric 60-kw alternator, to the City Electric Light Company, Corry, Pa.

MEXICAN WATER POWER SCHEMES.—The construction of further large hydraulic plants in Mexico is contemplated by Andres Lefebre, of Vera Cruz. He has just secured a concession from the Mexican authorities permitting the utilization of 15,000 litres of water per second in the dry season and double that quantity during the wet period from the Zoacinco de Altotongo River, Jalacingo, State of Vera Cruz. Mr. Lefebre is also interested in a project to construct a water power plant on the River Maria de la Torre, State of Puebla. The franchise has been granted for the use of 10,000 litres per second in the dry season and 20,000 litres in the wet season. Other new Mexican projects of a similar nature include the using of 70,000 litres of water per second from the River Yaqui, State of Sonora, in which proposition Carlos Garza Cortina is the leading spirit. Carlos Castenada will also build a fair-sized plant on the River Lerma, State of Michoacan. All the plants are to generate current for lighting purposes principally.

FIGURES OF FOREIGN TRADE.—The month of October was not at all a bad one in foreign trade for the United States. The imports of merchandise in October amounted to $81,931,005, as against $87,424,070 in the same month last year. The decrease was entirely in dutiable goods, there being a considerable gain in the imports of those classes of merchandise which are admitted free of duty. The exports of the United States in October reached the grand total of $160,370,095. The exports in the same month last year were $144,327,428. The exports last month were larger than in any October since 1899. The balance in favor of this country was $78,439,000, or nearly $22,000,000 more than in 1902.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, of Chicago, reports an unprecedented number of switchboard shipments for the past two weeks of November. The shipments reached over 2,500 lines capacity, and consisted mostly of the well-known express switchboard equipments. A partial list of the equipments shipped includes: Richland, Mo., 200-line express; Herkimer, N. Y., 105-line express; Murray, Iowa, 200-line express; Germantown, Ohio, 100-line express; Palmyra, Ill., 200-line express; Richmond, Ind., 100-line express; Ozark, Ark., 100-line express; Wabasha, Minn., 100-line express; Fort Bayard, N. M. (United States Signal Officer), 50-line express.

SOME HEINE BOILER ORDERS.—The Heine Safety Boiler Company, of St. Louis, has secured a contract for two boilers of 200-hp capacity each for installation in the plant of the Edison Electric Illuminating Company at Pottsville, Pa. Two 300-hp units for an extension to the Electric Company of America's plant, of Rockford, Ill. The Citizens' Light, Heat & Power Company, of Montgomery, Ala., has requisitioned for two 300-hp boilers. The City Railway Company, of Wheeling, W. Va., has ordered three units of 300-hp capacity each. A 350-hp one is to be shipped the Denver (Colorado) Gas & Electric Company.

WESTINGHOUSE EQUIPMENT FOR CHILIAN NITRATE PLANTS.—In addition to securing the contract for the complete electrical equipment of the Victoria nitrate plant at Junin, the largest in Chili, the Westinghouse interests have secured substantial orders for machinery to be installed in two plants located in the vicinity of Iquique. Westinghouse generators will also be utilized for railway work at Antofagasta. These contracts were secured through J. K. Robinson, of Iquique, who is now at the offices of the William E. Peck Company, 116 Broad Street.

EQUIPMENT FOR NEW JERSEY STEEL PLANT.—The New Jersey Steel Company is to utilize electric power for the purpose of operating its plant at Rahway, N. J. The engineering and contracting firm of Mackenzie, Quarrier & Ferguson, 114 Liberty Street, have been allotted the contract for the complete plant. There will be a 300-hp Harrisburg tandem compound engine direct-connected to a Sprague generator of 200-kw capacity. The boilers, two units of 200-hp, will be of Heine build. The necessary motors will be purchased later on.

LIGHTING EQUIPMENT FOR MOST SOUTHERLY PORT IN THE WORLD.—Additional American equipment has been ordered for installation in the lighting plant at Puenta Arenas, Patagonia, the most southerly port in the world. The existing plant has a capacity of 50 kw, consisting of a Westinghouse engine and generator and a Bigelow boiler. The contract just placed by J. K. Robinson calls for a 150-kw Westinghouse generator direct-connected to a 250-hp Westinghouse engine. The boiler will also be of Bigelow build.

BOSTON ELEVATED CONTRACT.—The Boston Elevated Company has awarded a contract to the General Electric Company for the equipment with motors and controllers of 24 new elevated cars and 62 surface cars, the contract involving between $150,000 and $200,000. Under this contract the Boston Elevated people reserve the right to equip their present 150 "L" cars with the new General Electric-Sprague controllers, should the new controllers turn out as successful as the General Electric and Boston Elevated officials expect.

THE ALBERT DICKINSON COMPANY, Minneapolis, Minn., is building a new power house for its plant. As all the machinery is to be motor-driven, sufficient generator capacity for both power and light is being installed in the power house, complete in every detail, with ample provision made in the layout of the plant for any needed future extension. The Arnold Electric Power Station Company, of Chicago, is consulting engineer, and Barnett & Record, of Minneapolis, are the general contractors.

LIGHTING PLANT WANTED.—The light commissioners of Rushville, Ind., are asking bids until November 19 for one 100-kw and one 250-kw generators, direct-connected to engines, switchboards, piping, transformers, lights, etc.; also on one 250-kw, belted type, single-phase generator, one belted engine, belting, switchboard, piping, lights, etc. Mr. A. L. Stewart is engineer and Mr. Harry Larkin is the city clerk.

ELECTRIC BUSSES FOR AUSTRALIA.—The export commission house of Muller, MacLean & Co., 116 Broad Street, New York, has inquiries in hand for ten electric busses to be employed in Freemantle, Western Australia. The same concern is also figuring on electric elevators, both passenger and freight, for shipment to South Africa.

ANDERSON MATERIAL FOR ABROAD.—The Albert & J. M. Anderson Manufacturing Company, of Boston, Mass., has some substantial orders on hand from the British firm of Robert W. Blackwell & Co. A fair-sized order for wire has also been received from Buenos Ayres, Argentine Republic.

MORE EQUIPMENT FOR ELIZABETHPORT PLANT.—The A. & F. Brown Company, New York, is to extend the capacity of the electrical equipment of its Elizabethport (N. J.) plant. A 100-kw generator (belted) and a switchboard have been ordered from the C. & C. Electric Company.

ELECTRICAL SUPPLIES FOR AUSTRALASIA.—E. B. Latham & Co., 39 Vesey Street, New York, have recently secured fair-sized orders for electrical supplies through Muller, MacLean & Co., 116 Broad Street, for shipment to Australia and New Zealand.

C. & C. EQUIPMENT FOR CUBA.—The C. & C. Electric Company has a fair sized order in hand for lighting equipment for Cuba.

General News.

THE TELEPHONE.

LOS ANGELES, CAL.—Architect Frain, of this city, is preparing plans and specifications for a new building for the Home Telephone Company at Santa Barbara, to be located on Carrillo Street.

ALTON, ILL.—Announcement has been made in Alton that the Central Union Telephone Company will rebuild its lines in Alton at a cost of $30,000.

RICHVIEW, ILL.—William Rixman, proprietor of the Rixman telephone line, has completed arrangements to run his line into Nashville, Ill., and work has been commenced. This will put Richview, Ashley, Irvington, Walnut Hill, Centralia, Hoyleton and Nashville on a free telephone system, with free connection to local points on the Bell line.

ALEXANDRIA, IND.—The Alexandria Telephone Company has been organized by J. M. Walker, G. W. Kelly and O. W. Willits. The capital stock is $850,000.

INDIANAPOLIS, IND.—The Star City Telephone Company has been organized to operate exchanges in Pulaski, Fulton, Cass and White counties. The capital stock is $10,000.

SOUTH BEND, IND.—At a recent meeting of the board of directors of the South Bend Telephone Company, a semi-annual dividend of 2½ per cent on $200,000 capital stock was declared.

SHELBYVILLE, IND.—The exchange of the Mutual Telephone Company, of this city, has been closed for a week to make repairs. On examination it was found that mice had cut the tapes and destroyed many other parts of the apparatus.

RICHMOND, IND.—There are indications of a war between the telephone and telegraph companies on the one side and the city on the other because of the attempt by the city to remove poles and place wires underground. The Central Union Telephone Company, the Western Union and the Postal Telegraph Companies will fight the matter through the courts.

GREENSBURG, IND.—The Westport and Sardinia Telephone Company has been absorbed by the Decatur County Independent Telephone Company and will be operated through the local exchange in this city. This will increase the number of instruments operated by the Independent Company to 1350 and will give all subscribers access to the extreme southern part of the county.

INDIANAPOLIS, IND.—The case of the Cumberland Telephone Company vs. the City of Evansville was argued before Judge Anderson, of the United States District Court in this city on Nov. 5. The company asks an injunction restraining the city of Evansville from removing its poles and wires from the streets and alleys and from otherwise interfering with its rights in the city.

MILFORD, IND.—The Royal Independent Telephone Company established an exchange in this city last January. The company has extended its lines to New Paris, Syracuse, Millersburg, Oswego, Hastings and Warsaw. The rapid growth of this company is attributed to the support of the farmers which was secured by special inducements. The charges for telephones is $1 per month, but to every one taking one share of stock ($50) a 50 cents per month rate was allowed. This plan has afforded ample capital for the company to build five toll lines and secure long distance connections in many directions. The company is now building a toll line from Milford through North Webster, Oswego and Leesburg.

HURON, IA.—The Gimmell Telephone & Manufacturing Company, of Huron, has been incorporated with a capital stock of $200,000.

DES MOINES, IA.—The Boone County Telephone Company will install a modern switchboard to cost $20,000, and will expend as much more on new lines.

PIERSON, IA.—The Pierson Independent Telephone Company has been incorporated by John F. Brooks, J. C. Pierson, E. J. Raw, F. F. Nicholls, L. E. Heaton and J. H. Benson.

DES MOINES, IA.—The Douds-Leando Southwestern Telephone Company of Van Buren County has been incorporated with a capital stock of $500. The officers are: President, C. R. Dyer; vice-president, J. O. Boyer; secretary, W. E. Russell; treasurer, J. W. Wainscott.

TOPEKA, KAN.—The Linn Rural Telephone Company, of Linn, has been incorporated with a capital stock of $5000.

DETROIT, MICH.—The Monroe County Telephone Company, of Dundee, has applied for a franchise at Milan.

HART, MICH.—The business of the Mason County Telephone Company has been merged with that of the Oceana County Bell Telephone Company and the exchanges are to be consolidated.

YPSILANTI, MICH.—Mr. Garry Densmore has applied to the city council for a franchise for a telephone system. The maximum rates proposed are $24 per year for business instruments and $18 for residences, on a three-year contract basis. With no contract the proposed rates are $26 and $20. At the end of ten years the city shall have the right to purchase the plant.

MONROE, N. C.—The stockholders of the new Union Telephone Company met recently at Monroe and elected J. A. Justin, general manager. Work on the plant will soon be commenced.

WINSTON, N. C.—The Bell Telephone Company has recently added 80 drops to the system at Winston. A long distance line is also being built from Winston to Mt. Airy, N. C.

ASHEVILLE, N. C.—The complete merger of the telephone interests at Asheville with the Bell Company as sole owner has been completed. The Bell Company will take down most of its wires and will reorganize the plant of the absorbed independent company.

CLEVELAND, OHIO.—At the recent meeting of the Board of Directors of the Federal Telephone Company all of the present officers were re-elected.

HOPKINSVILLE, OHIO.—Arthur A. Hoge, of Lima, Ohio, was the successful bidder for a telephone franchise here and he will erect an exchange.

WEST MANCHESTER, OHIO.—The West Manchester Telephone Company has been organized and is preparing to install a new switchboard and connect up a number of subscribers in the rural districts.

FARMER, OHIO.—The Farmer Telephone Company, of Farmer, capital stock $10,000, has been incorporated by John Norway, P. C. Bigelow, D. C Lord and V. E. Cunningham.

CLEVELAND, OHIO.—The United States Telephone Company aided greatly in disseminating the reports of the Ohio election Nov. 4. The company has connection with 457 exchanges in Ohio and the reports from the various towns were telephoned to the headquarters in Cleveland.

MANSFIELD, OHIO.- Prominent business men of Mansfield who own a minority interest in the stock of the Mansfield Telephone Company are considering a proposition to buy out the interest controlled by the Federal Telephone Company of Cleveland, and thus place the entire ownership of the property in Mansfield. It is probable that the deal will go through.

CLEVELAND, OHIO.—The Federal Telephone Company has sold its interest in the Lima Telephone Company to the Ideal Construction Company, of which A. W. Hoge, of Lima, is president. The company has $100,000 of preferred stock, $150,000 common stock and $118,000 of 5 per cent. bonds. The Federal owned $40,000 par value of preferred stock and $80,000 of common stock.

MARKHAM, TEX.—The Northern Irrigation Company is constructing a private telephone company between this place and its large rice plantation.

DEPORT, TEX.—A contemplated increase from 80 to 100 subscribers is looked for by the Deport Telephone Company. The charges are $1.25 and $2 per month.

BEAUMONT, TEX.—It is announced that the Southwestern Telegraph & Telephone Company will expend about $150,000 in the erection of a new exchange building here and in putting its wires underground. New equipment will be installed.

OGDEN, UTAH.—The Rocky Mountain Bell Telephone Company has placed an order with the Western Electric Company for underground cables, which will take the place of the overhead wires.

FREDERICKSBURG, VA.—The Southern Bell Telephone Company has recently purchased the local company at Fredericksburg and a new plant will be installed. W. T. Jones has been appointed manager of the Bell Company at Fredericksburg.

COLFAX, WASH.—The Crumbaker Telephone Company has been incorporated by M. A. Crumbaker, Thomas Neill and Bert Ray. The capital stock is $10,000. The organized property was formerly conducted by Mr. Crumbaker, and the lines extend to the most thickly settled part of Whitman County.

KEYSER, W. VA.—The Piedmont & Keyser Telephone Company took up by purchase the Piedmont Telephone Company, Keyser & Petersburg Telephone Company, Keyser & Headsville lines, Mims Telephone lines, Burlington & Moorefield Telephone Company, Gordon Telephone Company, and Romney & Moorefield telephone lines. Three switchboards are operated, Stromberg-Carlson apparatus being used. The subscribers number about 300.

PARKERSBURG, W. VA.—The plant of the West Virginia Western Telephone Company has recently been rebuilt and 800 connections have been added within a year. Additional subscribers at the rate of 100 a month are asking for service. The demand for rural service is greater than the company's ability to supply. Mr. A. C. Davis, general superintendent and office manager, says that the business is increasing throughout the entire system both in extensions and new work. It is proposed to build 75 miles of toll line before long. In Parkersburg there are 1600 subscribers; outside of the city 1200 people are supplied with service. The charges are $18 and $24.

BELOIT, WIS.—The Beloit Telephone Company has at present 700 subscribers. An increase of 100 telephones during the coming year is looked for.

BRISTOL, WIS.—One hundred and fifteen subscribers are furnished with service through the Bristol Telephone Company, which operates 60 miles of toll line.

SUNNYSIDE, WIS.—The Christian Co-operative Telephone Association has 170 subscribers, and has 75 miles of toll line. Eureka and Stromberg-Carlson apparatus are used.

ALMOND, WIS.—The Almond Telephone Company, numbering 43 subscribers in the village and a total of 160 in the surrounding farming country, reports a steady increase. The company contemplates running party lines into the country.

MADISON, WIS.—The Waldwich, Jonesdale & Hollandale Farmers' Telephone Company, of Jonesdale, Iowa County, has been incorporated with a capital stock of $4000. The incorporators are Richard Jackson, William N. Uren and Peter Walsh.

DURAND, WIS.—The telephone service at this place is supplied by the Durand Light & Power Company, using a Stromberg-Carlson 160-drop switchboard and numbering 175 subscribers. The company recently built a 12-mile pole line of its own, having previously rented the poles of the Bell Company.

BLACK RIVER FALLS, WIS.—The Central Wisconsin Telephone Company, which recently added 25 miles of toll line, has the construction of 25 miles more in view. Four hundred patrons subscribe for the service. The company reports a most encouraging outlook and states that many farmers' lines are being constructed and that the local demand is greater than ever. Kellogg apparatus is used.

AMERY, WIS.—A telephone extension to Clear Lake has recently been completed by the Amery Electric Company. It is planned to install new switchboards at Amery and Clear Lake in the future. There are 47 subscribers at Clear Lake, 76 at Amery and 102 party lines. There has recently been a slight increase in the rate charges and still the system grows. Mr. George F. Guthn is president.

ARCADIA, WIS.—The Western Wisconsin Telephone Company, using Stromberg-Carlson and American Electric apparatus, operates seven exchanges at the following places: Arcadia, 100 drops; Independence, 50 drops; Whitehall, 60 drops; Blair, 50 drops; Ettrick, 50 drops; Galesville, 100 drops, Centerville, [illegible]0 drops, Trempealeau, 50 drops. There are 500 subscribers and 400 miles of toll lines in this system. The rates charged are $12 for residence, and $25 per annum for business service.

DELEVAN, WIS.—The Walworth County Telephone Company controls the exchanges at this place and at Elkhorn, the former having 260 subscribers and the latter 108. Standard Telephone & Electric Company instruments are used in these exchanges. Mr. H. C. Hackney, the president, states that the company controls another company which is doing nothing but farm and toll line work. At least 100 farm telephones and 50 miles of toll line will be installed and built during the next six months.

WINNIPEG, MAN.—The Bell Telephone Company will probably erect a new exchange building in this city next season.

ELECTRIC LIGHT AND POWER.

JUNEAU, ALASKA.—A landslide from Mount Juneau recently wrecked a large section of the flume which conducts power water to the electric light station supplying Juneau with light. Repairs were commenced at once.

HOLTON, CAL.—Bids are wanted Jan. 1 for erecting the $75,000 electric plant of the Holton Power Company. W. F. Holt, of Redlands, is president.

SANTA CLARA, CAL.—This town has come into control of the incandescent lighting system of the United Gas & Electric Company. The contract is limited to a period of five years, and during that time the United Gas & Electric Company will refrain from supplying current for light or for stationary motors in the town. Payment is to be made by the town at the rate of 2½ cents per kw-hour for energy under 25,000 kw. Over 25,000 kw the rate is 2 cents, and 35,000 kw or more 1¾ cents.

SAN FRANCISCO, CAL.—After considerable delay while the advisability of joining the merger of San Francisco lighting companies was being discussed, the Mutual Electric Light Company is taking steps to proceed with the construction of its new electric power house on the site at the corner of Folsom and Steuart Streets. The two 1500-kw Bullock 2-phase generators for the new station are now on the way to San Francisco. Each of these 2200-volt, 60-cycle, revolving field machines will be direct connected to a Pennsylvania Iron Works Corliss horizontal engine operating at 80 r.p.m. The new plant will be thoroughly up-to-date with a salt-water supply for condensing purposes. A simple and effective conduit system will be installed for distribution throughout the underground district. The company recently arranged for a bond issue of $400,000 to provide for the new construction work.

DENVER, COL.—Chas. B. Haskell, secretary of the Routt County Electric Light & Power Company, states that bids for the work on the proposed electric light plant will be received about Jan. 1. The probable cost will be $60,000.

WATERBURY, CONN.—The question of installing an electric light plant in the city hall, to light the public buildings, is under consideration. R. A. Cairns is City Engineer.

WASHINGTON, D. C.—According to the annual report of Walter C. Allen, electrical engineer for the District of Columbia, for the fiscal year ended June 30, 1903, the work of changing the system of arc lighting from the old-style, open-series lamps to those of the enclosed type was completed during the year. The number of such lamps in operation, June 30, 1903, was 584 enclosed-multiple lamps. The service, it is stated, has been greatly improved by this change, the number of lamps reported out being considerably reduced. According to the report, 9.4 miles of underground cable, containing 282.85 miles of wire was laid during the year. The total number of miles of underground cable now laid in the District is 21.58 aggregating 1,046.20 miles of conductor.

WASHINGTON, D. C.—The Universal Light & Power Company has been incorporated here with a capital stock of $750,000. The incorporators are Robert K. Van Mater, Ralph Wormelle, Edwin L. Bradford and Leonard A. White.

SANDERSVILLE, GA.—Nisbet Wingfield, of Augusta, will prepare plans for water works and an electric light plant for Sandersville. Bonds have been sold, and bids for construction will soon be asked.

JOLIET, ILL.—It is reported that the Gaylor Syndicate is about to start work to develop water power south of Joliet on Des Plaines River and Drainage Canal. Major Siddons, of Chicago, is chief engineer.

QUINCY, ILL.—There is a lighting war on at present between the Quincy Gas and Electric Light Company and the Independent Light and Power Company. The former announces that it has cut its rates to the extent of 60 per cent.

COLUMBUS, IND.—The city council has decided to install a new electric light plant to take the place of the present one which is obsolete and worn out.

TELL CITY, IND.—The Tell City Electric Company has turned over all its property, including the electric light plant and entire system, to the city. The plant is being moved to the water works plant at the outskirts of the city The electric lights will hereafter be furnished by the city.

MARION, IND.—The Citizens' Light & Heating Company, which was recently granted a franchise in this city, has, we are informed, refused the same on account of the unreasonable restrictions imposed by the City Council. The company is not yet in existence, but will probably be organized after the election of the new council.

NEVADA, IA.—About $7000 will be expended in improvements to the electric light plant. W. A. Curtis is the manager.

HAMBURG, IA.—It is reported that John Gotsche and others propose constructing an electric light system along country roads. It will be necessary to enlarge the local light plant.

GIRARD, KAN.—W. H. Ryan, mayor, writes that it is proposed to construct a municipal electric light plant to cost about $20,000.

HARRODS, KY.—Seasongood & Mayer have purchased an issue of $12,000 worth of bonds to insure the building of a municipal lighting plant.

WAKEFIELD, MASS.—It was voted Nov. 9 to appropriate $2600 to extend the electric light plant.

WARE, MASS.—The Ware Electric Light Company has appropriated $20,000 to be expended in enlarging its power plant.

BELZONI, MISS.—The citizens have voted to issue $20,000 bonds for water works and an electric light plant.

WHITEFIELD, N. H.—P. T. Kellogg, of Whitefield, is interested in developing the power at the plant of the Molly Falls Light & Power Company.

MILFORD, N. H.—The Milford Electric Light Company's plant was sold at auction recently and bid in by an agent of the bondholders for $53,800. The plant furnishes current for both Milford and Wilton.

JAMESTOWN, N. Y.—It was voted Nov. 3 to raise $15,000 by direct tax for enlarging the lighting plant.

SIDNEY, OHIO.—An ordinance is under consideration in Council granting H. Bailey and associates, of Piqua, a franchise for an electric light plant.

TROY, OHIO. The contract for an electric light plant for the court house has been awarded to the Hobart Electric Mfg. Company, of Troy, for $5047.

MANSFIELD, OHIO.—D. S. Koontz, Clerk of Council, writes that the citizens have voted to grant a franchise to the Mansfield Railway, Light & Power Company.

TOLEDO, OHIO.—The Toledo Railway & Light Company is proposing to build an addition to its plant. The new equipment will include boilers, engines, generators, etc.

GENEVA, OHIO.—The Geneva Electric Illuminating Company, capital stock $1000, has been incorporated by Elmer G. Derr, Alonzo M. Snyder, F. A. Henry, H. B. Graw and others of Geneva.

COLUMBUS, OHIO.—It is stated that the Board of Service plans to construct a dam in Olentangy River at the new municipal light plant to supply the same with water independently of the present water works. The cost will be about $7000.

MT. VICTORY, OHIO.—The Mt. Victory Electric Light Company, of Hardin County, has been incorporated with $10,000 capital stock by J. J. Boone, H. E. Dickinson, W. F. Witcraft, A. L. Boyd, T. J. Boyd and J. N. Richardson.

BARBERTON, OHIO.—The village council has granted a lighting franchise to O. C. Barber, J. K. Robinson and M. J. Alexander who own the Barberton Inn. They propose to install a lighting plant and will furnish current to business houses.

CLEVELAND, OHIO.—Mayor Tom L. Johnson's cherished plan to bond the city for the purpose of erecting a municipal lighting plant to supply the city with current for lighting and to enter into direct competition with the Cleveland Electric Illuminating Company, was defeated at the election on Nov. 4.

STEELTON, PA.—The Steelton Heat, Power & Light Company is stated to have secured the contract for lighting the city for five years, at $53 per light per year.

JEANNETTE, PA.—The Jeannette Light Company has just completed the installation of 60 enclosed arc lamps in the streets of this place.

JOHNSTOWN, PA.—The Johnstown Light, Heat & Power Company and the Citizens' Light, Heat & Power Company, of this city, are to be consolidated. The new company will install some new equipment which has already been purchased. The latter includes three 400-kw turbine sets installed by Westinghouse, Church, Kerr & Company, boilers, pumps, etc.

NEWPORT NEWS, VA.—The City of Newport News is considering the advisability of establishing a city electric light plant and the city electrician has been instructed to submit estimates.

SEATTLE, WASH.—The Wagner-Bullock Electric Company, of San Francisco, Cal., has secured the contract for the generator equipment of the municipal electric light plant for $17,686.

REPUBLIC, WASH.—Extensive improvements are being made in the plant of the Republic Light & Power Company. A flume has just been completed, and the new equipment will include a revolving field, General Electric 150-kw generator.

PLAINFIELD, WIS.—The city electric light plant was inaugurated recently, the event being marked with a dinner and a general holiday.

GUANAJUATO, MEX.—The formal inauguration of the great electric light and power plant of the Guanajuato Electric Light & Power Company which took place here on Oct. 29 was made the occasion of festivities and celebrations lasting several days. The importance of the project led to the presence of President Porfirio Diaz and members of his cabinet and many other federal and state officials. The company is composed of Americans. Henry Hine, of Colorado Springs, Colo., is president; John Hays Hammond, vice-president; Leonard E. Curtis, treasurer; Irving W. Bonbright, secretary; H. H. Filley, resident manager and chief engineer; Robert F. Doble, of San Francisco, consulting engineer. The horse power already installed is 4000 while the capacity of the water head and the transmission lines is 8000-hp. The cost of the work up to this time is about $500,000, Mexican money. The construction of the plant began fourteen months ago. Details of this plant have already been printed in these columns.

The Electric Railway.

LOS ANGELES, CAL.—It is announced that the Pacific Electric Railway Company will abolish its steam power plant at Pasadena and install a substation there. The central station at Los Angeles is to furnish all power for the company's suburban lines.

HARTFORD, CONN.—At the annual meeting of the Farmington Street Railway Company in Hartford the directors elected Mr. James, president; Mr. Barney, vice-president, and Mr. Robbins, secretary, treasurer and general manager.

DANBURY, CONN.—The United Gas Improvement Company, of Philadelphia, which controls the Connecticut Railway & Lighting Company, has voted to proceed at once with the building of its trolley extension from Cheshire to Waterbury. An engineer is now engaged in buying the right of way for the extension.

LEWISTON, IDAHO.—It is said that articles of incorporation will soon be taken out for the Lewiston & Southeastern Electric Railway Company. Back of the company is Col. Judon Spofford. The plan is to build an electric railway from Lewiston to Grangeville.

CHICAGO, ILL.—Judge Grosscup decided that the receivers of the Chicago Union Traction Company shall increase the wages of the power house and shop men of the Chicago Union Traction Company 10 per cent.

DECATUR, ILL.—The street railway, gas, electric light and steam heating properties of Decatur, all owned by the McKinley syndicate, are to be consolidated with the Decatur, Springfield & St. Louis Railway, which is now under construction.

CHICAGO, ILL.—The Sanitary District of Chicago has decided to permit the South Side Elevated R.R. Company to draw water from the 39th Street conduit for use for condensing purposes in its new power house. The company is to pay the Sanitary District $1.00 per rated horse power a year as compensation. This will yield the District about $6000 a year in revenue.

GRANITE CITY, ILL.—The power house and car sheds of the Granite City & St. Louis Electric Railway Company, now located in Venice, are to be removed to Granite City. The change of location is mostly due to the fact that in the near future the line will be extended to several large cities in the county, and the location selected in Granite City is more central. The erection of the buildings will be commenced this winter.

FREEPORT, ILL.—The Freeport-Dixon Electric Company has been incorporated, capital stock $50,000. The incorporators and first board of directors are O. T. Smith, F. W. Siecke, W. A. Hance, Boyd P. Hill, C. J. Hildreth, R. P. Eckert and F. A. Reed, all of Freeport. It is proposed to construct a line from Freeport, Stevenson County, Ill., to South Freeport station, thence to Forreston and Polo, in Ogle County, and thence to Dixon, in Lee County.

CHICAGO, ILL.—Three thousand employees of the Chicago City Railway went out on strike on the morning of Nov. 12. The company made a few attempts to run cable and electric cars during the forenoon, but violence immediately began on the part of the sympathizers of the strikers. Crews of non-union men were assaulted and several were severely injured. Car windows were smashed; slots plugged and other acts of violence committed. The assurances of a peaceable strike were openly violated on every hand. The public was greatly inconvenienced and all sorts of vehicles were pressed into service for public transportation. The men struck when the company refused to increase wages from 24 to 28 cents an hour for motormen and conductors. They also demanded a "closed shop" policy, none but union men to be employed, and that their demands be submitted to arbitration. The company was willing to arbitrate the wage question, but would not agree to the "closed shop" policy. At the present writing the Wentworth Ave. electric line is being operated under the protection of 1000 policemen and the company is preparing to establish service on other lines in a like manner. There is still more or less violence on the part of the sympathizers of the strikers. General Manager McCulloch stated that no one connected with the company "is thinking about arbitration." On Monday of this week 150 lineman, repair men and dynamo men joined the strike.

COLUMBUS, IND.—An interurban electric railway to connect Columbus, Hope, Norristown and Shelbyville is projected. The line will be 26 miles in length.

VALPARAISO, IND.—The Northern Indiana Traction Company will ask Valparaiso for a franchise for the new South Bend-Chicago line. Franchises have been granted by South Bend, New Carlisle, Laporte and Westville.

JEFFERSONVILLE, IND.—The Ohio Valley Traction Company has been organized to construct an electric railway from this city to the State forest preserve near Henryville, and to erect a modern hotel at Blue Lick Springs, George H. Holzbog, E. C. Eaken and G. H. Voight are interested.

RICHMOND, IND.—Contracts have been let for enlarging the power house of the Dayton & Western Traction Company at West Alexandria, and for equipping it with additional machinery. This addition to the power facilities of the company is made necessary by the large increase in traffic.

SEYMOUR, IND.—At a recent meeting in this city of the stockholders of the Central Indiana Electric Railway Company the following directors were elected: J. T. Stout, John Stratton, J. B. Burrell, G. A. Robertson, H. C. Johnson and G. W. Caldwell. Chief Engineer Cranshaw announced that the survey of the line from Columbus to French Lick had been completed. Construction work on this line will begin early next year.

TOPEKA, KAN.—Senator J. K. Codding, of Westmoreland, and L. G. Beal, of Topeka, are interested in a plan to construct an electric railway from Topeka west along the Kaw Valley to Manhattan.

FRANKFORT, KY.—Articles of incorporation have been filed with the Secretary of State for the incorporation of the Frankfort and Versailles Traction Company; capital $300,000. The new company will operate the recently acquired Frankfort & Suburban Street Railway and extend the line to Versailles. Albert Norvali, of Cincinnati, Jno. T. Buckley, of Frankfort, and others are interested.

KEYSER, MD.—An electric railway will be built between Keyser and Westernport, Md., making a continuous line from Cumberland to Keyser.

MILFORD, MASS.—At the annual meeting of the Milford & Uxbridge Street Railway Company the following officers were elected: John T. Manson, of New Haven, president; Sydney Harwood, of Boston, vice-president; J. E. Walker, of Milford, Mass., treasurer.

TEMPLETON, MASS.—After failing to get authority from the Railroad Commission to issue a large amount of bonds, it is said that William E. Barrett, who practically owns the Templeton Street Railway Company, will put the affairs of the company into the hands of a receiver.

FLINT, MICH.—A franchise has been granted for the Flint-Flushing-Fenton electric line. E. O. Wood, of Flint; Clarence Tinker, of Fenton, and Franklin P. Sayre, of Flushing, are the promoters.

NILES, MICH.—S. G. McMichael, of Chicago, who heads a project to build an electric railway from Benton Harbor to Dowagiac via Eau Claire, has been in Niles in quest of a franchise. It is the intention to build the line from Eau Claire to Niles.

GRAND RAPIDS, MICH.—It is announced that the power house for the proposed Grand Rapids & Iona Railway will be located at Lowell. Among those interested in the enterprise are Gov. A. T. Bliss, of Saginaw; E. M. Hopkins, of Dayton; ex-Gov. J. T. Rich, of Detroit; J. L. Hudson, of Detroit; C. H. Pomeroy, of Saginaw; Robert Graham, of Saginaw.

VIRGINIA CITY, MONT.—The Bismarck-Nugget Mining Company has secured a franchise for an electric railway from Sheridan to Brandon.

RENO, NEV.—The City Council has granted a street railway franchise to J. B. O'Sullivan, John Saunderland and Oscar Smith.

TRENTON, N. J.—The Trenton Terminal Railroad Company has been incorporated in this city for the purpose of building a connecting line between the Camden & Trenton Railway and the Trenton & New Brunswick Railroad. The capital of the company is $100,000, and the road, as at present planned, will be 2900 ft. long. The incorporators are Henry V. Massey, of Merion, Pa.; Mitchell B. Perkins, of Beverly, N. J.; James S. Gilbert, of Bordentown, N. J.; R. W. D. Alboury, of Beverly, N. J.; Linton Satterthwaite, Stephen A. Cook and A. V. Robinson, of Trenton.

PORT CHESTER, N. Y.—The New York State Court of Appeals sustained the State Railroad Commission in its grant of the certificate of public convenience under Section 59 of the railroad law to the New York & Port Chester Railway Company. The case is a proceeding in certiorari brought by the New York City and Westchester Railroad against the Railroad Commission. The Port Chester road thus wins in all courts. The New York aldermen still hold aloof, however, from a favorable vote or any action at all.

AKRON, OHIO.—The Northern Ohio Traction & Light Company has placed a contract with the General Electric Company for a 700-hp Curtis turbo-generator unit, to be installed at the main power house in Akron.

PAINESVILLE, OHIO.—The Cleveland, Painesville & Eastern Railway is extending its line in Painesville to connect with the tracks of the Cleveland, Painesville & Ashtabula Railway now operating to the outskirts of the town.

TOLEDO, OHIO.—It has developed that parties independent of the Detroit, Monroe & Toledo Short Line Railway are securing a right of way for a line from Toledo to Detroit. The proposed route taps territory to the west of the present line.

MARIETTA, OHIO.—The Parkersburg, Marietta & Interurban Railway is making surveys for a line from a point opposite Marietta to Sistersville, on the West Virginia side, a distance of 35 miles. Eventually this will be extended to Wheeling, forming an unbroken line of electric roads from Parkersburg to Pittsburg.

CONNEAUT, OHIO.—The Conneaut & Erie Traction Company has completed its line, and the first car was run from Erie to Conneaut a few days ago. There is now an unbroken line of electric roads from Erie to Toledo, and links which will complete communication between Buffalo and Chicago are under actual construction.

CINCINNATI, OHIO.—The Cincinnati Rapid Transit Railroad Company has elected the following officials: J. G. Schmidlapp, August Herrmann, H. H. Hoffman, W. H. Alms, M. E. Ingalls, C. H. Rowe and L. Ault, directors. J. G. Schmidlapp was elected president; August Herrmann, vice-president, and H. H. Hoffman, secretary. The company will shortly place $250,000 stock on the market.

LAWTON, O. T.—The Lawton, Wichita Mountain and Western Electric Railway Company has been organized for the purpose of building an interurban electric railway 75 miles long to run from Lawton to Fort Sill and from Lawton to Lone Wolf. The company has its principal office at Lawton. Its capital stock is $200,000. The financial arrangements for building the road are said to have been made. Among the incorporators are C. W. Johnson, of Montgomery, Ala.; S. P. Brundage, of St. Louis, Mo.; J. R. Brattan, of Carthage, Mo.; Edward F. Mitchell, of El Reno, Okla.

SUMPTER, ORE.—From present indications the construction of an electric road between Sumpter and Bourne, Ore., will be under way within the next few months. Henry Hewett, a wealthy lumberman of Tacoma, has agreed to furnish 75 per cent. of the capital. The cost of constructing the road is estimated at from $75,000 to $100,000.

CHAMBERSBURG, PA.—The Chambersburg, St. Thomas & Fort Loudon Electric Railway Company has been organized to build an electric railway from Chambersburg to St. Thomas and Fort Loudon. The officers of the company are John R. Eberly, president; Frisby Miller, secretary; Dr. F. G. Strock, treasurer.

BANGOR, PA.—The Bangor, East Bangor & Portland Street Railway Company has purchased the large plant of the Bangor Electric Light, Heat

& Power Company. The trolley company intends making some alterations, after which it will extend the line from the present terminus at Portland to the Delaware Water Gap and Stroudsburg.

WEST CHESTER, PA.—The West Chester & Pottstown Improvement Company, recently incorporated, has organized as follows: Bayard A. Conrad, of Font, president; Frank Green, of East Goshen, vice-president, Horace A. Felters, of Upper Uwchlan, secretary. The plan of the company is to build an electric railway through Oaklands, Whitford, Lionville, Eagle, Font, Ludwig's Corner, Nantmeal Village and Pughtown.

ALTOONA, PA.—The Altoona City Passenger Railway Company, the Tyrone Electric Railway Company, and the Altoona & Logan Valley Electric Railway Company have been recently consolidated under the name of the Altoona & Logan Valley Electric Railway Company. This property is one of the more important properties owned by The American Railways Company, which, four years since, acquired practically all of the stock of the Altoona & Logan Valley Electric Railway Company, and through the said company most of the stock of the Altoona City Passenger Railway Company. All of the remaining shares of these companies have since been purchased by The American Railways Company, which has also taken over the stock and bonds of the Tyrone Electric Railway Company.

NASHVILLE, TENN.—F. P. Pond, local solicitor of the Interurban Electric Railway, has been notified that a deal has been closed, which assures the building of the interurban roads to Gallatin and Mt. Pleasant. C. W. Ruth, of Pittsburg, is president of the company.

MEMPHIS, TENN.—The Westinghouse Electric & Manufacturing Company is preparing plans and specifications for the 25-mile electric railway to be built between Memphis and Colliersville, Tenn. The line will cost, it is said, $100,000 and is being projected by the Shelby Traction Company.

DENISON, TEX.—The capital stock of the Denison & Sherman Railway Company has been increased from $100,000 to $200,000. It is stated that the company will make extensive improvements.

EL PASO, TEX.—J. H. Nations, J. S. Dodge and others of this city have applied to the city council for a franchise for the construction and operation of a street railway to run to the Highland Park addition.

TAYLOR, TEX.—Henry Wisden, of Columbus, Ohio, has been investigating the situation with the view of building and operating an interurban electric railway between this place and Austin. It is reported that the project contemplates the establishment of a large power plant on the Colorado River.

WHEELING, W. VA.—The Wheeling Traction Company may extend its line from Barton to St. Clairsville.

FOND DU LAC, WIS.—The Wisconsin Central Railway Company has filed an amendment to its articles of organization providing for the building of two extensions, one from Park Falls, Price County, 10 miles northeast into Ashland County; the other, from Glidden, Ashland County, 8 miles southwest.

MONTREAL, QUE.—The Montreal Terminal Company has applied to the City Council to construct lines on a large number of the city streets.

GUELPH, ONT.—The by-law voted on recently by the citizens of Guelph for taking over the Guelph Radial Railway by the city was carried. The cost will be $78,000.

PORT ARTHUR, ONT.—Port Arthur is about to increase its electric power for running its municipal lighting plant and the street railway between Port Arthur and Fort William. The additional power will be secured from the Current River.

LEGAL.

TELEPHONE RIGHT OF WAY.—A Supreme Court decision at Topeka, Kan., requiring telephone companies to secure rights of way from owners of land along public highways will cause much vexation to telephone companies in Kansas. Telephone lines are being built all over the state, and thousand of instruments have been placed in farmers' houses. Now these companies will have to secure rights of way and pay concessions to many farmers.

NEW INDUSTRIAL COMPANIES.

THE THOMPSON ELECTRIC COMPANY, of St. Paul, Minn., has changed its name to Northwestern Electrical Supply Company.

WILLIAMS ELECTRIC & MANUFACTURING COMPANY, of Jersey City, has been incorporated; capital, $10,000. Incorporators: J. Edgar Tackaberry, James T. Clark and George A. Williams.

MARCELLUS & WALTON, New York, have been incorporated to manufacture motors and electrical machinery; capital, $10,000. Directors: H. L. Marcellus and F. W. Walton, New York, and H. L. Hull, Brooklyn.

THE MOLINE INCANDESCENT LAMP COMPANY, of Moline, Ill., has been incorporated to manufacture electrical apparatus; capital, $30,000. Incorporators: Albert H. Kreitler, Conrad F. Gratz, Sr., Elmer E. Morgan.

BROWN ELECTRICAL CONSTRUCTION COMPANY, Chicago, has been formed with a capital of $50,000, for manufacturing electrical and mechanical supplies. Incorporators: William E. Church, Roger Sherman, David O. Dundar.

THE GENERAL STORAGE BATTERY COMPANY, of New York City, has been incorporated with a capital of $1,000,000 to manufacture electric storage and primary batteries. The directors are Julius H. Susmann, John G. Greenburgh, Adolph Procbownick and Joseph Rijur, of New York City.

THE AMERICAN AUTOMATIC SWITCH COMPANY has been incorporated at Pueblo, Col., with a capital stock of $100,000, to manufacture a patented automatic street car switch. T. G. McCarthy is president, W. K. Smith, secretary and general manager, and George H. Williams, treasurer.

THE BALDWIN ROWLAND ELECTRIC SWITCH COMPANY has been incorporated at New Haven, Conn., to manufacture a street railway switch. The company is capitalized at $125,000. The officers are: President, R. S. Woodruff, vice-president, H. L. Rowland; treasurer, N. W. Kendall; secretary and general manager, F. W. Raymond.

PERSONAL.

MR. RALPH D. MERSHON, E. E., has returned from a trip to England and the Continent made for consultation work.

MR. JOHN M. ANDERSON, treasurer of the Albert & J. M. Anderson Manufacturing Company, of Boston, Mass., was a visitor in New York last week.

MR. A. FREDERICK COLLINS has taken space in the Electricity Building at the St. Louis Fair, to exhibit his apparatus for wireless telephony, etc., which has aroused a good deal of public interest.

MR. R. PERCY SELLON, E. E., who is prominently identified with electrical affairs in England and is connected with the Otis Elevator interests there, is visiting this country for a few weeks. Mr. Sellon was last over here in the Spring of 1902.

MR. W. KELSEY SCHOEPF, president of the Cincinnati Traction Company, confirms the story that the Elkins-Widener Syndicate will spend $10,000,000 developing 200,000 horse power on the Ohio Falls, and supply current to Indianapolis and Cincinnati traction lines.

DR. F. A. C. PERRINE, president of the Stanley Electric Manufacturing Company, and formerly professor of electrical engineering at Leland Stanford, Jr., University, will deliver the Founder's Day address, Nov. 30, at the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y.

MR. CHARLES T. YERKES arrived from London last week. As to work in the British metropolis he said: "We have enough money and are satisfied to carry out what we have started. The work in London on the new electric underground is well under way, and about one-half of it, the part from Baker Street to Waterloo, will be finished in about one year. The rest will be completed within five years."

MR. FRANK MARTIN, who for some three years past has held a position under the U. S. Navy Department, in charge of the light, heat and power plant at the Brooklyn Navy Yard, has resigned in order to assume charge of the electrical department of the University Power Company, Princeton, N. J., which will furnish light, heat and power to Princeton University, campus, etc., and in the town. The plant is just about starting up.

MR. W. D'A. RYAN.—At the 238th meeting of the New York Electrical Society, which will be held Nov. 30, in this city, Mr. W. D'A. Ryan will lecture on "Practical Problems in Lighting and Illumination." This lecture will be full of interest, and will be illustrated by numerous experiments. Mr. Ryan has long given special attention to the engineering aspects of illumination, and his lecture will have a decidedly practical value.

MR. FREDERIC J. NICHOLLS, the well-known Canadian electrical manufacturer and general manager of the Canada Foundry Company and Canadian General Electric and Dominion Iron, states that he considers that the present depression in the iron and steel markets is purely temporary, and that better prices will be seen in the near future. In expectation of better prices Mr. Nicholls has advised the Dominion Iron & Steel Company to proceed with the erection of new mills.

MR. ARTHUR W. FIELD has retired from the position of secretary and general manager of the Edison Electric Light Company of Columbus. His retirement is the result of the merger of the Edison Company with the Columbus Railway Company, the new company being a leasing company known as the Columbus Railway & Light Company. Mr. Field has been identified with the Edison interests for a number of years. He was one of the organizers of the Ohio Electric Association and was twice president of that organization.

MR. J. B. HOGE, secretary of the Federal Telephone Company, Cleveland, Ohio, has been made general manager of the entire Federal properties and will succeed Mr. Maxime Reber who will enter business in St. Louis. Mr. C. Y. McVey, at present manager at Youngstown, will become assistant general manager of the Federal Company. Mr. W. F. Crossley, superintendent of the Columbiana County system, will also have charge of the Youngstown system. Mr. O. F. French, for some time acting manager of the Cuyahoga Telephone Company has been made general manager of that company.

DR. W. J. MORTON writes us to say that the newspaper reports of his remarks before the Society of Medical Jurisprudence are not quite correct, as noted in our issue of November 14. "As to what kind of cancer could be cured or could not be cured, I didn't draw the distinction as it appears, and as to the remark that 'I have a patient whom I have been trying to burn for a year and he simply won't burn,' this was made by another speaker, and is so utterly at variance with the physical facts, that it would be most painful to me to father it."

MR. C. H. HINES.—Official announcement is made of the appoinfment of Mr. C. H. Hines as electrical engineer of the Canadian Pacific Railway, with headquarters at Montreal. He reports to Mr. E. A. Williams, the superintendent of rolling stock. His duties are thus defined: He will have general supervision over all electrical matters, including power and lighting circuits, generators, motors, arc and incandescent lamps, and other electric machinery and apparatus as directed. He will prepare standard and special plans and estimates as required, and it shall be his duty to supervise the construction, operation and maintenance of electric installations and circuits in order to insure compliance with plans, rules and specifications pertaining to same. In the execution of new work, general and special repairs and maintenance of electric plants, divisional employees will act under his instructions as directed and limited by the general superintendents of their respective divisions.

MR. JOHN CALDER, who has been with the C. W. Hunt Company as its executive engineer, left on Nov. 14, for Ilion, N. Y., where he will be connected with the management of the Remington Typewriter Company. Before leaving, he was treated to a pleasant surprise. A few minutes before the noon hour, members and employees of the company gathered around his desk to participate in the presentation of a handsome silver loving cup suitably inscribed. Mr. George S. Humphrey presented the token to him, with a few appropriate remarks, expressing the esteem in which he was held both professionally and personally by the donors. Mr. Calder made a brief impromptu reply, expressing his thanks for the gift and his regret at severing the pleasant associations he had formed while in the employ of the C. W. Hunt Company. While this company loses an efficient officer, the Remington Typewriter Company is to be congratulated on the acquisition of a man of Mr. Calder's ability and standing.

MR. ARTHUR A. HAMERSCHLAG has been nominated by the trustees of the Carnegie Institute as president of the Carnegie Technical Schools of Pittsburg. The salary is $8000 a year. He was born in Nebraska, 36 years ago, graduated from the Hebrew Technical Institute, New York, in 1889, taking afterwards special courses in physics and mining at Columbia University. Mr. Hamerschlag was for twelve years superintendent of St. George's Evening Trade School and for eight years consulting engineer, lecturer and organizer for the New York Trade School. He is consulting engineer for Highland Falls Trade School at Highland Falls, N. Y.; Boys' Preparatory Trade School, New York City; Manual Training School of the Church of the Good Shepherd; Philips Memorial Industrial School, New York; Home Garden School, New York; Industrial School of Lynhurst, Tarrytown; McAlpin Trade School, New York, and about half a dozen other similar institutions. He is a member of the National Educational Association, the Society for the Promotion of Engineering Education, the New York Association for Organized Work Among Boys, the American Institute of Electrical Engineers, the New York Electrical Society, and he has written several papers on trade and technical education and text-books and courses of instruction for his schools.

Trade Notes.

THE MERWARTH METALLIC GASKET COMPANY has removed from 120 Liberty Street, New York, to 32 Broadway, where it has larger quarters which will give it more room for handling its increasing business.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is selling agents for Packard lamps and transformers. It is sending out advertising matter telling of the new "Salus" compound with which the Packard transformer is insulated.

MORRIS ARC LAMP COMPANY.—The trustee in bankruptcy announces that patent No. 569,881 for an electric arc lamp, which was owned by the Morris Arc Lamp Company, will be sold at the office of A. B. Geary, Chester, Pa., on Nov. 19.

MR. JACOB CLOOS, of Milwaukee, will represent the Downward Light Electric Company in that city. He will carry a full stock of the well-known incandescent lamps made by this company. The Milwaukee headquarters will be in the Matthews Building.

NATIONAL WIRE CORPORATION, New Haven, Conn., has issued under date of Nov. 1, a new telephone and telegraph wire price list, which combines the latest figures for this class of wire and the latest trade prices. Copies can be had on application by any one interested.

MARCELLUS & WALTON, the continuation of an old concern, has been formed at 16 Dutch Street, New York, with a capital stock of $10,000. Mr. H. L. Marcellus is president and Mr. F. W. Walton is secretary and treasurer. They will build electric motors of 2 to 5-hp, etc and make installations.

THE H. O. S. ENGINEERING COMPANY, 88 Warren Street, New York, recently issued Bulletin No. 40, devoted to the illustration and description of its spool handle baby knife switches in full detail. Bulletin No. 39 in similar manner deals with its "all copper panel board." There is a good demand for both of these lines of Swoboda specialties.

CROCKER WHEELER COMPANY, of Ampere, N. J., has issued in Bulletin No. 3, for October, an interesting account of a plant for lighting and motors installed by it in the Orange Brewery, with a capacity of 80,000 barrels a year. There is a 60-kw Crocker-Wheeler generator, and in addition to the lights the plant includes 13 motors of a total of 123-hp.

THE ENORMOUS STEAMING CAPACITY required in boilers on the large ocean steamships can only be attained by means of artificial draft. The fan blower may be found in all these steamships supplying air to the boilers as "forced draft." The International Navigation Company's steamship *St. Louis* has eight new Sturtevant fans for this purpose, each one of which is driven by a Sturtevant compound engine.

A CENTRIFUGAL PUMP of novel design and unprecedented capabilities will be exhibited at the St. Louis Exposition by Henry R. Worthington, of New York City. That this pump marks a distinct departure from the usual centrifugal practice will be appreciated when it is stated that it will be capable of delivering about 500 gallons of water per minute against a head of 250 lbs. per square inch, and with high efficiency. This pump is of the type known as the multi-stage, turbine centrifugal, and differs in a great many respects from the centrifugal pumps with which engineers have been familiar.

STURTEVANT SOUVENIR.—An interesting and instructive souvenir was presented to the members of the New England Foundrymen's Association on the occasion of their recent visit to the new foundry and pattern departments of the B. F. Sturtevant Company, at Hyde Park, Mass. This has been republished as Bulletin 54, a sixteen-page pamphlet, describing and illustrating these departments and particularly their industrial equipments. The removal of the foundry and pattern departments is the first step towards the removal of the entire plant from Jamaica Plain, Mass., to the extensive new works at Hyde Park, to which general attention has been recently called.

BALL CORLISS ENGINE.—The success of the new medium speed Corliss engine recently brought out by the Ball Engine Company, Erie, Pa., has been so great that it was found necessary to greatly increase the capacity of its works. Entirely new works were determined upon and an ideal location was selected. These works have been under construction during the past year, and the company has just moved into them. Although this was a large undertaking, it was accomplished without accident or any appreciable interruption of product. The new works are among the most modern in the country, well lighted and finely equipped, giving the Ball Engine Company unsurpassed facilities and a very large capacity.

HIGH GRADE TURBINES.—The Trump Manufacturing Company, of Springfield, Ohio, has issued a very handsome oblong pamphlet with regard to its water turbine, illustrating and describing a large number of the plants which it has installed, as well as showing details of the apparatus. The catalogue includes a number of foreign plants and the text is printed in English, Italian and Spanish. The Trump turbines are now to be found all over the world, being an excellent illustration of the manner in which American apparatus of high standard is patronized in various countries strictly on its merits. The catalogue is one of the most interesting and handsome that we have seen in some time.

SMITH & HEMENWAY COMPANY, of 296 Broadway, N. Y., has added to its line of hardware specialties catalogued in its well-known Green Book, the Bay State taps and dies, the entire marketing of which the above company controls. These tools are made of the finest steel procurable—are nicely finished—of excellent wearing quality and superior workmanship—especial attention having been paid to the pitch of the thread, which is absolutely correct. The U. S. V. or Whitworth thread will be made on any style tap or die. Each and every tap and die is sold under rigid guarantee, and should any defective tool be found, it will be exchanged for a perfect one. The Smith & Hemenway Company has the entire marketing of the products of the following companies: Utica Drop Forge & Tool Company, mfr. of nippers and pliers; Acme Ball Bearing Caster Company, mfr. of casters and jacks; Bay State Tap & Die Company, mfr. of taps and dies; Vandegrift Mfg. Company, mfr. of wrenches; Page-Storm Company, mfr. of drop forges; Champion Mfg. Company, mfr. of hammers, hatchets and ice picks.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 10, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

743,410. ELECTRODE AND CONDUCTOR; Charles Ernest Acker, Niagara Falls, N. Y. App. filed June 5, 1902. (See page 841.)

743,417. REVERSE-CURRENT INDICATOR; Leonard Andrews, Hastings, England. App. filed March 30, 1903. (See Current News and Notes.)

743,421. TELEPHONE SYSTEM; Garrison Babcock, Chicago, Ill. App. filed April 27, 1903. (See page 843.)

743,423. SYSTEM OF MOTOR CONTROL; Thomas E. Barnum, Milwaukee, Wis. App. filed March 31, 1902. Wherein a large motor and a small motor are arranged to drive a printing press or similar machine, a controlling resistance is provided having a movable element adapted at first to include all of the resistance with the small motor and afterwards to exclude all of the resistance and the small motor and include the large motor. The invention also includes switches and devices for preventing the operation of the same after the motor circuits are opened until the rheostat arm is returned to its initial position.

743,426. SYSTEM FOR OPERATING ELECTRIC ELEVATORS; William Baxter, Jr., Jersey City, N. Y. App. filed Jan. 17, 1899. A motor having sectional field coil, a manually operated controller for regulating the speed of the motor by cutting in and out the sections of the field coil and an automatically operating switch also cutting in and out the sections of the field coil.

743,431. METHOD OF CONVERTING OXYGEN INTO OZONE; Frederick S. Blackmarr and Joseph L. Willford, Minneapolis, Minn. App. filed April 26, 1902. (See page 841.)

743,432. APPARATUS FOR CONVERTING OXYGEN INTO OZONE; Frederick S. Blackmarr and Joseph L. Willford, Minneapolis, Minn. App. filed April 26, 1902. (See page 841.)

743,433. APPARATUS FOR CONVERTING OXYGEN INTO OZONE; Frederick S. Blackmarr and Joseph L. Willford, Minneapolis, Minn. App. filed October 27, 1902. (See page 841.)

743,435. APPARATUS FOR CONTROLLING TROLLEY POLES; Judson L. Bogue and David M. Jennings, Denison, Tex. App. filed May 2, 1903. Means for automatically throwing the trolley pole into position to engage the wire after it has accidentally left it, said means not interfering with the manipulation of the pole, through the cord, by the motorman.

743,441. ELECTRIC TERMINAL; Howard Brooks, Wheaton, Ill. App. filed June 20, 1902. A thimble intended to insure perfect insulation and sealing of the end of a main cable or conductor.

743,444. MEANS FOR REGULATING SELF INDUCTANCE IN ELECTRIC CIRCUITS; Charles F. Burgess, Madison, Wis., and Budd Frankenfield, Pittsburg, Pa. App. filed Jan. 27, 1903. As a means for regulating self-inductance in electric circuits, a core of magnetic material and two independent electric circuits in magnetic inductive relation to the core and in non-inductive relation to each other, the current in one circuit being varied at will.

743,457. TELEPHONE-EXCHANGE SYSTEM; George L. Cragg, Chicago, Ill. App. filed May 9, 1902. (See page 844.)

743,458. COMPENSATING SYSTEM; Elmer E. F. Creighton, Pittsfield, Mass. App. filed Dec. 29, 1902. (See Current News and Notes.)

743,459. COMPENSATING SYSTEM; Elmer E. F. Creighton, Pittsfield, Mass. App. filed Jan. 31, 1903. (See Current News and Notes.)

743,461. CONTROLLER FOR ELECTRIC MOTORS; Henry H. Cutler, Milwaukee, Wis. App. filed Dec. 30, 1901. The speed of the armature controls the continuity of a shunt circuit around the armature.

743,471. FUSE CASING AND SWITCH; Louis W. Downes, Providence, R. I. App. filed Jan. 12, 1903. The casing has a number of covers to each of which an inclosed fuse is attached, the fuse being carried into the clips by the closing of the cover.

743,493. ALARM SIGNAL FOR ELEVATORS; Edward L. Hall and George Hall, Providence, R. I. App. filed May 1, 1902. An alarm is sounded as the elevator moves along to give notice that it is in motion.

743,512. APPARATUS FOR TRANSMITTING ELECTRICAL COMMUNICATIONS, Charles M. Jacobs, Maidenhead, and Arthur H. Nicholson, Wendover, England. App. filed Aug. 2, 1902. (See page 844.)

743,514. MAGNETIC CLUTCH; Camaille Jenatzy, Fils, Brussels, Belgium. App. filed June 27, 1903. A magnetic fly wheel having a friction surface composed of anti-friction metal and steel for preventing gripping of the plate during sliding action.

743,521. TROLLEY STAND; Frederick Kennington and David L. Fawcett, Leeds, England. App. filed Jan. 14, 1903. The pole is mounted to swing on horizontal and vertical pivots, a spring being interposed between a lug on the pole and the vertical socket.

743,522. COATING GLASS OR FABRICS; Henry Keppler, Brooklyn, N. Y. App. filed Feb. 21, 1903. (See Current News and Notes.)

743,532. TELEPHONE EXCHANGE; John C. Fred Malthauer, Minneapolis, Minn. App. filed June 23, 1902. (See page 844.)

743,534. ELECTROTHERMAL DIFFUSER; Frederic de Mare, Brussels, Belgium. App. filed June 27, 1902. (See page 842.)

743,540. ELECTRIC CUT OUT; Louis W. Miller, Rochester, N. Y. App. filed Feb. 26, 1903. Details.

743,542. TROLLEY SIGNAL; Charles H. Morse, Cambridge, Mass. App. filed June 25, 1901. Safety and danger signals at each end of the block are controlled by electro-magnets through which current is directed by the passing cars.

743,555. SNAP SWITCH OPERATING MECHANISM; Charles G. Perkins, Hartford, Conn. App. filed Aug. 1, 1903. Details.

743,564. AUTOMATIC TELEPHONE-EXCHANGE; Malcolm C. Rorty, Dedham, and Albert M. Bullard, Somerville, Mass. App. filed Aug. 9, 1900. (See page 844.)

743,580. TELEPHONE RELAY OR STEP-UP; Gustavus E. Sundquist, Cleveland, Ohio. App. filed May 14, 1902. (See page 844.)

743,594. TELEPHONE CIRCUITS AND APPARATUS; George K. Thompson, Newton, Mass. App. filed March 31, 1903. (See page 843.)

743,598. ELECTRIC BATTERY; Edmund Tweedy, New York, N. Y. App. filed Dec. 31, 1902. (See page 842.)

743,600. ELECTRIC FIRE ALARM; Johannes W. H. Uytenbogaart, Utrecht, Netherlands. App. filed May 6, 1903. When the glass front of the instrument is broken, a pendulum contact is released and automatically makes and breaks contact with the alarm terminals until it ceases to swing; the size of the pendulum being varied for different instruments to give alarms of different periods.

743,601. MEANS FOR CONTROLLING THE SPEED OF ELECTRIC MOTORS; Arthur P. Warner, Chicago, Ill. App. filed March 20, 1903. A plurality of electric motors mechanically connected to rotate at the same relative speed, the armatures of the motors being connected in series and the fields in parallel with the source of current and means for controlling the field strength of all of the motors independently of each other.

743,603. ELECTRICAL VIBRATORY MOTOR; Charles S. Whitney, Springfield, Ill. App. filed Feb. 25, 1903. A massaging vibrator operating by alternating currents.

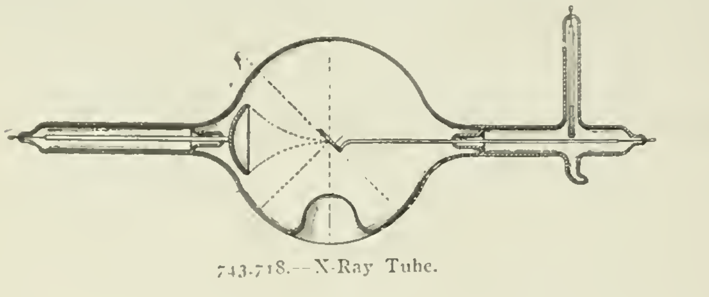
743,607. RESISTANCE FOR ELECTRIC CIRCUITS; Gilbert Wright, Pittsfield, Mass. App. filed July 15, 1902. A series of cast grids arranged in radial planes and held in position by lugs cast at intermediate points on the grids engaging with a ring frame.

743,654. ELECTRIC CAR HEATER; James F. McElroy, Albany, N. Y. App. filed Sept. 2, 1903. The heater in the motorman's compartment is automatically thrown into and out of circuit by the movement of the door of the compartment.

743,668. EXTRACTING CHROMIUM FROM CHROME-IRON ORE; Robert Suchy and Heinrich Speckecter, Griesheim-on-the-Main, Germany. App. filed Feb. 6, 1903. (See page 841.)

743,718. X-RAY TUBE; John O. Heinze, Jr., Lowell, Mass. App. filed July 9, 1903. The tube has a dome shaped re-entering portion of its radiating walls projecting into the field of bombardment of the anode, the thickness of the dome portion being thinner than the radiating wall.

743,724. ELECTRIC LIGHTER; Conrad Hubert, New York, N. Y. App. filed March 17, 1903. Details of a cigar lighter.



743,718.—X-Ray Tube.

743,779. PROCESS OF WINDING ELECTRICAL COILS; Richard Varley, Providence, R. I. App. filed May 15, 1903. The layers of wire are alternated with sheets of paper the edges of which project at each end and have reinforcing strips pasted thereto to retain the end turns of the wire in place.

743,789. RAILWAY STATION SIGNAL; John L. Wrenn, Washington, D. C. App. filed June 30, 1903. A prospective passenger can turn on a signal light to stop the car, the light being afterwards turned off by the car itself.

743,805. CABLE HOLDER FOR MANHOLES; Hugh C. Baker, Jr., New York, N. Y. App. filed April 20, 1903. An upright rod fixed in the wall of the manhole carries a vertically adjustable clamp for the cable.

743,836. ELECTRIC PUMP; Otto G. Dobert, New York, N. Y. App. filed July 17, 1903. An electric motor having a rocking armature drives the piston of the pump and at the same time reverses its own connections.

743,852. BLOCK SIGNAL SYSTEM; Israel H. Francisco, Rutland, Vt. App. filed May 20, 1902. Details.

743,878. ELECTRIC BLOCK SIGNAL; William S. Jackson, Hoboken, N. J. App. filed Macch 5, 1903. A shoe moved transversely to the semaphore by an electro-magnet, raises the semaphore, the withdrawal of the shoe permitting it to fall by gravity.

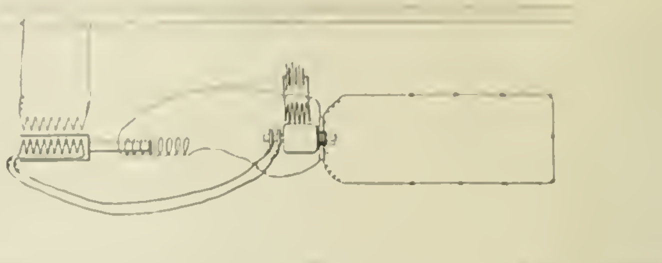
743,882. PROCESS OF MANUFACTURING PLATES OF INSULATING SUBSTANCES; Johanne Justus, Berlin-Halensee, Germany. App. filed March 9, 1903. An insulating substance is pressed into bars which are laid upon a foundation of wire network to which they are caused to adhere.

743,887. APPARATUS FOR REGULATING THE FLOW OF CURRENT IN ELECTRIC CIRCUITS; Isidor Kitsee, Philadelphia, Pa. App. filed March 1, 1901. An electro-magnetic device is connected in a shunt to the consuming circuit and adapted to move to and fro a metallic conductor placed between the primary and secondary of a converter.

743,888. ELECTRIC SAFETY APPLIANCE; Louis Klentschi, Richmond Hill, N. Y. App. filed Feb. 20, 1903. A cover for the third rail is raised and lowered by the flange of a car wheel operating upon a suitable leverage system.

743,893. HAIR SINGER; Conrad F. Lancaster, East Liverpool, Ohio. App. filed Oct. 20, 1902. The teeth which pass through the hair are electrically heated.

743,896. SANITARY ATTACHMENT FOR SOUND RECEIVERS OR TRANSMITTERS; Abraham Levi, Baltimore, Md. App. filed July 23, 1903. (See page 844.)



743,887. Apparatus for Regulating the Flow of Current in Electric Circuits.

743,906. INCANDESCENT LAMP SOCKET; Henry E. Meyers, Denver, Col. App. filed Feb. 13, 1903. Details.

743,925. INSULATING DRAW BAR ON DRAFT LINK FOR RAILWAY TRAINS; Henry E. Procunier, Oakpark, Ill. App. filed Sept. 22, 1902. The link is made in two parts connected by an insulated joint.

743,939. SAFETY ALARM DEVICE FOR MARINE VESSELS; Marshall Shepard, Edgartown, Mass. App. filed Dec. 9, 1902. An arm trailing from the bottom of the boat operates a circuit controller when it strikes bottom.

743,941. DISTRICT MESSENGER BOX; Aaron V. Siler and Justain H. Riley, Newark, Ohio. App. filed Sept. 8, 1902. Details.

743,948. PRINTING TELEGRAPH; Walter S. Steljes, London, Eng. App. filed May 12, 1903. A device for moving along its spindle and for holding in its required printing position, a type wheel having two or more rows of letters.

743,951. TELEPHONE-TRANSMITTER; Alfred Stromberg, Chicago, Ill. App. filed Nov. 17, 1902. (See page 843.)

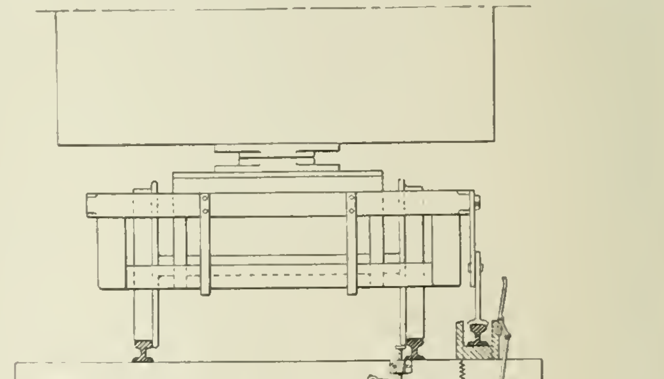
743,953. CENTRAL-ENERGY TELEPHONE SYSTEM; William A. Taylor, Chicago, Ill. App. filed Feb. 4, 1901. (See page 844.)

743,958. DYNAMOMETER FOR ELECTRIC CURRENT; Mathias E. Turner, Cleveland, Ohio. App. filed June 18, 1903. The instrument shows the maximum current used during any interval of time and is constructed not to be sensitive to temporary fluctuations.

743,970. ELECTRIC SWITCH; Christian F. Ziegler, Chicago, Ill. App. filed April 9, 1902. Details of construction of a drum having segments thereon adapted to move pivoted arms into contact with circuit terminals.

743,975. SIGNAL APPARATUS; Clyde J. Coleman, New York, N. Y. App. filed July 8, 1901. (See Current News and Notes.)

743,991. ELECTRIC FIXTURE; Kent Shaffer, Evanston, Ill. App. filed July 12, 1902. A group of sockets provided with two terminals common to all of the sockets and a plug substantially fixed with respect to the socket, the same terminals being common to the plug terminals also.



743,888. Electric Safety Appliance.

743,999. SYSTEM OF ELECTRIC COMMUNICATION; James T. Armstrong and Axel Orling, London, England. App. filed Feb. 5, 1902.

744,000. SYSTEM OF ELECTRIC COMMUNICATION; James Tarbottom Armstrong and Axel Orling, London, England. App. filed Feb. 5, 1902.

744,001. SYSTEM OF TELEPHONIC COMMUNICATION; James Tarbottom Armstrong and Axel Orling, London, England. App. filed Feb. 5, 1902.

744,012. ARMATURE COIL; Charles Knape, Pittsburg, Pa. App. filed July 9, 1903. The invention consists in flattening and widening the opposite sides of the portion of the strap which form the coil that extends beyond the ends of the armature core, thereby giving a more compact construction.

12,168. WIRELESS TELEGRAPHY; Reginald A. Fessenden, Washington, D. C. App. filed Aug. 12, 1902. (See page 842.)

12,169. WIRELESS TELEGRAPHY; Reginald A. Fessenden, Washington, D. C. App. filed Aug. 12, 1902. (See page 842.)

Electrical World and Engineer

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Thanksgiving.

This year, not less than other recent years, the country has a great deal to be thankful for, and the religious exercises of the week may well be approached in a spirit as cheerful as devout. In the domain of electricity, the workers have in general much cause for congratulation, for while quietness and dullness may have fallen upon other industries to some extent and temporarily, electrical applications of every kind have on the whole remained in exceedingly brisk demand. This is because the trend of the times is increasingly towards the adoption of electrical principles, ideas, inventions and apparatus; and such being the case, electrical arts may often remain busy during periods of prevalent slackness. But the nation has for some years now enjoyed great and substantial prosperity, which the future will see renewed and broadened, and he must, indeed, be a poor-spirited American who does not return hearty and fervent thanks for what we have received from a bountiful Providence.

Electricity for Trunk Railroads.

We feel sure that there is not a single reader of this journal who will take exception to the statement that in the contracts just awarded by the New York Central Railroad for the equipment of its system by electricity, is one of the most vital and epochal occurrences in electrical development of recent years. While in itself this step may probably be regarded as but one in a natural sequence running back to the very first effort to drive a car axle by adjusting a motor to it, it is an event of this kind which serves to mark the close of one era and the beginning of the next. The New York Central Railroad is one of the great trunk systems of America and of the world, and whatever action it may take of this sweeping character is destined to have not merely local effect, but to influence deeply the ideas and decisions of other leaders in the railroad field. Depending ever since its inception and up to the present time solely on steam as a means of locomotion, it has now put in force a resolve whose effects cannot cease until its very last steam locomotive has been banished from the tracks and relegated to the scrap heap.

There are a great many points of view from which this remarkable announcement of contracts may be considered. First of all, the magnitude of the order is very striking, for it includes no fewer than eight steam turbo-generator sets of 7,500 hp each, and 30 electric locomotives of 2,200 hp each, with of course the necessary and auxiliary boilers, condensers, etc., in the steam plant; and, it may be assumed, the electric lighting and electric heating of most of the passenger cars that are to be hauled. Furthermore, while the commission which has been deciding these points for the company may have started out more or less with the intention that it would carry out the law and the ordinances requiring the abolition of steam in the Park Avenue Tunnel, the members have found themselves carried onward by an influence greater than themselves, and making irresistibly for electricity, to decide that the new motive power shall be applied not merely in the tunnel, but on all the lines running out from the Grand Central Depot for at least 40 or 50 miles. Hence, it would appear that not only is the suburban traffic to be hauled in behind electric motors, but that at the edge of the electric zone the steam locomotives will be detached from the heaviest through trains and will also be brought down to the heart of the city by electric traction. This is something again which no railroad in the world has ever done before, and the New York

Central Company is to be congratulated not only upon the wisdom and foresight of its technical advisers, but on the courage and broadness of its management. We believe that this change will prove one of the best investments that the company has ever made; that its passenger traffic will grow by leaps and bounds within the suburban area, and that the New York Central will become more than ever a household word, less deserving of blame and more worthy of praise than ever before in its history.

It will, of course, be two or three years before even the first portions of this grand scheme can be carried through, but the die has been cast and forthwith the change is to be inaugurated, which at the end of a half decade will cause the whistle, the smoke and the fumes of that magnificent old servant of civilization, the steam locomotive, to be utterly unknown throughout this region. With such things happening we hardly think anybody ought to worry about the future of electricity.

It is significant to note that the direct-current system is to be employed rather than the alternating. We have a belief that at no distant date the alternating system of traction will have vindicated itself, but for the present it must be accepted that the arguments were overwhelming in favor of direct-current traction when adopted by such progressive men as Messrs. Sprague and Arnold, and the engineers associated with them on the commission. The adoption of the steam turbine in the power plant instead of the reciprocating engine is also an event fraught with great suggestiveness, for it may be taken as granted that in this battle royal of motive powers the standard type of engine was put on the very best plane of competition. Another striking feature is the fact that the multiple-unit system which upon its introduction was regarded as a more or less promising scheme for hitching up trolley cars, is now found applicable and desirable for tractors of the size of these immense locomotives, so that two of them working together can dally lightly with the biggest trains that the Central system has ever known. Other details are not yet forthcoming, such as those relative to the traveling contacts of the locomotives, the location and nature of the substations, the switching and signaling, and last but not least the terminal facilities, but they will be settled with equal care and deliberation.

TESTING ALTERNATORS UNDER FULL LOAD CONDITIONS.

In pursuance of a practically important subject recently discussed by Mr. Behrend, we print on page 873 an article by Mr. Waters, on modifications of the Mordey test of alternators. Mr. Waters points out that the method of opposing field coils and the method of opposing armatures, give results which are unreliable in regard to regulation, and are also apt to exaggerate the iron losses, to the prejudice of efficiency.

These criticisms apply particularly to the case where the opposition of coils or poles is not half against half, but a lesser against a greater part, so as to leave a working residual number. When, for example, 13 armature coils are opposed to 11, the voltage disturbance due to the distortion of magnetic flux in the machine at the points of reversal, must tell heavily upon a residual e.m.f. of two coils alone; and the regulation of the machine, as deduced in this manner, might be expected to be considerably affected thereby. A lesser discrepancy might be looked for by the opposition of say 16 coils against 10, and still less with 16 coils against 8; since the voltage disturbance would then be shared between 4 and 8 coils, respectively.

These conditions are interestingly expressed in Mr. Waters's diagrams, where, with 16 poles against 8, the deviation from the full series condition is about one quarter of that with 13 poles against 11. It is also instructive to observe that when the armature was divided against itself, the apparent regulation was better than the normal; whereas, when the field was divided against itself, the apparent regulation was worse than the normal, for the machine referred to. In this particular, the method previously suggested by Mr. Behrend on page 715, has the apparent advantage that by opposing the two halves of the field with a controlled excitation in each half, there is less general distortion of the magnetic flux, and the error of distortion is divided equally among all of the armature coils. It seems possible, therefore, that the regulation test would give somewhat better results by the Behrend method. At the same time it must be conceded that no method of field or armature opposition is likely to give accurate results in tests of pressure regulation, owing to the magnetic flux distortions at the points of reversal. As pointed out in the article, the greatest advantage derived at the present time from the opposition of armature halves is the test for temperature elevation by supplying the full-load *IR* losses, either from without or from within. If the factory regulation tests of large alternators ordinarily used could be agreed upon, and relied upon, with the same degree of security as the efficiency and heating tests, the art of testing large alternators under full-load conditions would be placed in a very satisfactory condition. Mr. Behrend has a letter on the subject in this issue.

HOW NOT TO HEAT THIRD RAILS.

There are times when it is well to contemplate the things which one cannot do electrically. Electricity possesses marvelous possibilities, but now and then it comes with the traditional sickening thud up against propositions undeniably out of its line. One of these seems to be melting sleet on a third rail by electrically-heating the same. In a note published in our last issue Mr. Del Mar grimly calculated the amount of energy necessary to accomplish the feat. The figures are somewhat startling. On very conservative assumptions as to the amount of heating required, the energy comes out of the calculation at 3,800 kw for a line having 50 miles of third rail merely for melting 1/100 inch of sleet, while more than double this amount additional would hardly maintain the rail at a temperature that would make melting possible.

The question of sleet is always with us, and each winter furnishes fresh material for thought. On Mr. Del Mar's showing we fancy that no one will have the temerity to try electrical heating as a remedy for sleet, and the scraper is likely to continue its pyrotechnic career at least for the present. Sleet on trolley wires is quite bad enough, but the conditions on the third rail are infinitely worse. As a matter of fact, scrapers give pretty good results when used assiduously, but the ice coating forms rapidly and if it once gets a good start it is likely to keep ahead of the game. The elevated roads with their constant succession of trains can keep the rail fairly clear, but woe betide the long road with infrequent stops when once the sleet gets down to business. The protected third rail strikes one as advantageous in dealing with sleet, as in many other respects, but it has not yet been thoroughly tried out on a large scale and sleet storms are happily too infrequent for experience to accumulate rapidly.

After all, it is still open to question whether the third rail is to have a permanent place in the art, save perhaps on elevated or underground lines of moderate length. There is much in its favor as a practical solution of immediate difficulties, and it has in some instances done extremely good service. But it does not lend itself readily to the delivery of energy at anything but very moderate voltages, and it may be regarded as altogether probable that the larger future work of the electric railway will demand high voltage working conductors. The Zossen experiments have shown how easily large amounts of energy can be supplied from overhead wires to a moving train with sliding contacts when high voltage is used; and when heavy and fast electric railroading is seriously undertaken supply at high voltage seems quite certain to be adopted. We should much like to know how the conductors on the Zossen line would stand up to their work in a really first-class sleet storm, but it is undeniable that at 10,000 volts an ice film is a less serious obstacle than at 500 or 600 volts. Fortunately, hereabouts, i. e., in New York City, most of the third-rail work will be underground where sleet cannot get at it, or overhead on elevated lines where the service is very frequent, and where the early troubles with sleet are hardly likely to be repeated. But lines operating with the third rail in open country have serious work confronting them. The hot water remedy for sleet referred to by Mr. Del Mar seems to us little more worthy of consideration than electrically-heating the rail, particularly on long lines, and the scraper in one form or another seems by all odds the best remedy at hand. In dealing practically with sleet, persistent application counts for more than anything else. As in fighting a snow storm on a street car line, the one thing needful is to begin work at the first intimation of trouble and to keep it up as long as the flakes fly. A very moderate storm suffices to stall the cars if it gets a start and begins to hold them up. The first car that stops blocks effective assistance and by the time the shovel brigade comes into action, the service is thoroughly demoralized. So, when the sleet comes on, the thing which counts is the equipment of every train for immediate action, and the initiation of a fight all along the line, day and night. Thus shall the passengers get home and peace reign over the system.

The Metric System and Foreign Trade.

On page 883 appears a communication from Mr. G. W. Colles, in which he cites the answers by prominent members of the French Society of Civil Engineers to certain anti-metric questions propounded by the American Chamber of Commerce. He employs these answers in support of an argument that it is better for us to keep to the customary British system of weights and measures than to change to the international metric system. We have no fault to find with the French replies to these American questions. The questions propounded, however, are clearly biassed antimetrically. We dissent only from Mr. Colles in the deductions he draws from the replies.

It is quite reasonable that when cargoes of goods are shipped to a metric country for distribution, it does not matter very much whether the goods appear on the bill of lading in cubic feet, cubic versts, cubic cubits or cubic Flemish ells, so long as a correct numerical relation is known between the foot, verst, cubit or Flemish ell, and the metre. The labor of the calculation once effected on a cargo of hundreds of tons does not appreciably alter the retail cost of a distributed kilogramme. Nor is it likely to be of much concern to a manufacturer in Great Britain or America that he makes goods by the yard or pound, when he has a competent agent abroad to make propositions to buyers abroad on the international metric basis. The agent merely has a little extra trouble with the computation and exchange. But where there is no agent, a would-be purchaser who has a catalogue of British or American commodities in pounds, avoirdupois; gallons, imperial or American; bushels, dry, liquid or otherwise, may be lost, and sometimes is lost, by the extra inconvenience of interpreting these crude and ambiguous units into international measure. The warning burden of the sermons preached for years by British foreign consuls to Britons, and by American foreign consuls to Americans, is found, in the consular literature, insisting on the importance of catalogues abroad with quotations in metric measures. The consensus of opinion of these trade experts abroad appears to be that England and America are handicapped, to some extent, in the markets of the rest of the world by their clinging to a ridiculous and mediæval system of units.

As regards the replies to the effect that non-metric American machinery can be used in metric Europe, we not only subscribe to that view, but we regard it as a strong argument in favor of the adoption of the metric system. Practically all fair-minded persons admit, after studying the question adequately, that it would be better if we had the metric system in this country, and in other English-speaking countries, with its three simple units—the gramme, metre and litre—instead of our antiquated old medley with its sixty odd and difficult units. But many oppose a change to the metric system because they say it would prevent our machinery from being used. They argue that a machine with inch parts will in some way be rendered useless to the community when the community measures in metres or decimals thereof. If such were, indeed, the case, it would be better not to have any metric system here, burdensome as our own system is, since the loss to the community in machinery, tools and mechanical products would be enormous and prohibitive. The clearest proof, however, that no such danger exists is found in the facts cited by Mr. Colles, that non-metric machines may be, and are, conveniently used in metric countries. Consequently, no machine manufacturer need fear loss of machinery, or of products, by reason of the national adoption of the metric system.

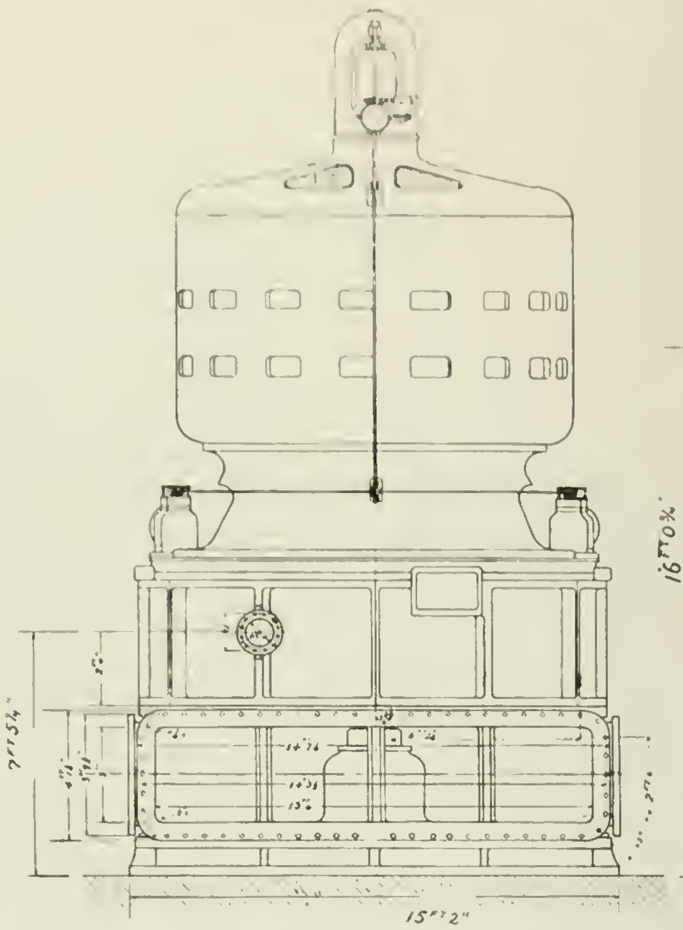
It is true that the British inch, foot, yard, engineer's link, surveyor's link, span, fathom, pole or perch, surveyor's chain, engineer's chain, bolt, furlong, league and mile would all probably retain obscure and occasional existence in this country, for a century or more after the decimalization of linear measurement, by the adoption of the metric system. It is equally true that in this country to-day we still find the "shilling" occasionally used, 119 years after the date of the national decimalization of our money. Nevertheless, we stand for the proposition that this United States does use a decimal currency at this time, and furthermore it is our profound belief that in this decimal currency we have one which is much superior to the antiquated British currency that preceded it.

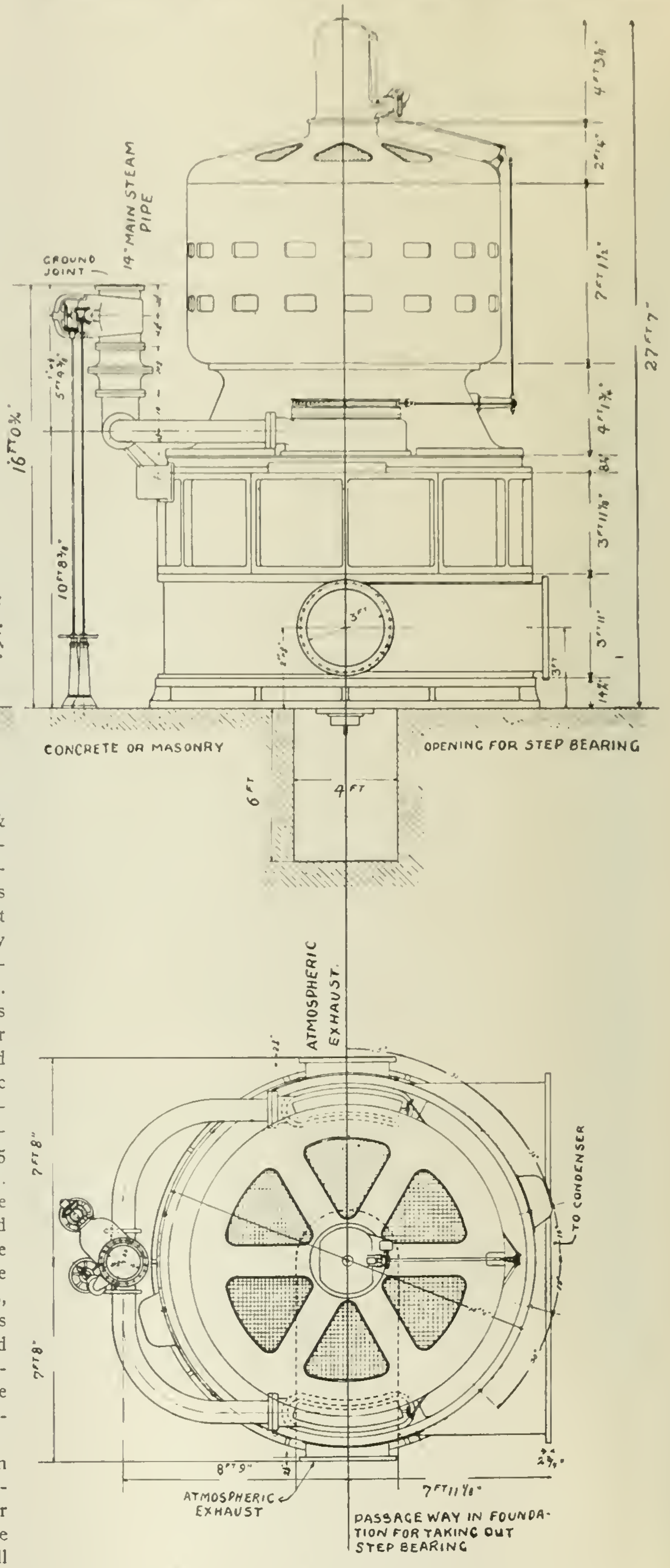
If Mr. Colles thinks there is no chance of Great Britain nationally adopting the metric system, we think the evidence is against him. The colonial premiers strongly urged the British and colonial governments to adopt the metric system at their conference of August, 1902. The Fifth Congress of the Chambers of Commerce of the British Empire at Montreal passed a yet stronger resolution in favor of compulsorily adopting the metric system, in August, 1903. The Association of Trade Protection Societies, numbering about 40,000 British commercial men, passed a resolution in favor of the metric system, in May, 1902. The Transvaal Chamber of Mines reported in favor of the metric system in November, 1902. The Federal Parliament Houses for Australia passed resolutions favoring the compulsory adoption of the metric system, in all parts of the British Empire, in June, 1903. The Cape of Good Hope House of Assembly agreed to a motion in favor of the adoption of the metric system in August, 1903. The Lancashire and Cheshire Federation of Trade and Labour Councils adopted a resolution in favor of a compulsory change to the metric system in January, 1903. The Association of Inspectors of Weights and Measures pronounced in favor of the early adoption of the metric system in May, 1903. The New Zealand Parliament has recently passed a bill exclusively introducing the metric system there in 1906.

Electric Traction for the New York Central Railroad.

One of the most momentous and important events in the history of steam locomotion and the ultimate supersession of the steam locomotive by the electric locomotive is to be recorded this week in the contract which has been awarded by the New York Central & Hudson River Railroad Company for the equipment of steam turbine power plant and the building of electric locomotives to be employed at the New York terminal of the system. The order includes an initial equipment from the General Electric Company of eight turbo-generators of the four-stage, vertical Curtis type, of a capacity of 7,500 hp each. These turbines will have a generator part delivering 25 cycle, three-phase current at a pressure of 11,000 volts. This is by far the largest order for steam turbines ever placed in this country or abroad, but it is equalled in magnitude by the order for electric locomotives. The New York Central Company has ordered no fewer than 30 electric locomotives from the General Electric Company of an entirely new design. These will be built with the cooperation of the American Locomotive Company at the latter's Schenectady shops, which are handy for the purpose. They will weigh 85 tons each and will have an adhesive weight on the drivers of 67 tons. Each locomotive will have a capacity of 2,200 hp and will be capable of hauling a train of 500 tons at 60 miles an hour. It is understood that the New York Central will have two power plants, one on the Hudson River in the vicinity of Yonkers, and the other over on the Sound, probably near the junction of the Harlem and East Rivers, both situations being determined by consideration of fuel facilities and ready supply of condensing water. The steam turbines as noted are of the four-stage type, being, therefore, similar to those contracted for by the Boston Edison Company and differing from those of the Chicago Edison Company, which are two-stage. The turbo-generator is shown in outline herewith in Figs. 1, 2 and 3.

Further details are not yet available as to the locomotives than are given above, but it is understood that they will be of the gearless type with four electric motors to each locomotive. Another interesting feature is that through the use of the Sprague multiple unit system as developed by the General Electric Company, it will be possible to operate two of these huge locomotives in multiple unit for the heaviest trains on the system, so that not a train within the radius of 40 or 50 miles from New York City would require to come in under steam. As each of these locomotives singly would give easily 2,200 hp, they would have a capacity to develop jointly not less than 4,500 hp, or practically three times as much as the best steam locomotive record. The ability, therefore, to take care of even the heaviest through express trains with the weightiest Pullmans may at once be predicated.





FIGS. 1, 2 AND 3.—DIAGRAMMATIC VIEWS OF TURBO-GENERATOR.

The obligations laid upon the New York Central by the authorities were that they should be ready to make the change so far as the Park Avenue Tunnel was concerned; but the nuisances and discomforts of that tunnel are abolished in the adoption of the larger scheme, which will virtually take care also of all of the suburban traffic of the line out to the extreme limits of commuter travel. It had been generally supposed that the company might limit its change of motive power to the city limits on Manhattan Island, but the plan now adopted is seen to involve such points as Croton, White Plains, New Rochelle and other well-known boundaries of New York suburban traffic. The point has arisen as to the interchange of traffic with the Interborough Rapid Transit system, but the tunnel of the subway having only a clearance of 13.7 ft., it is obvious that standard coaches could not be run through it.

The total cost of the change in equipment of power plant, locomotives, etc., is estimated at between $15,000,000 and $20,000,000. At the present time no details are forthcoming as to the sub-stations, the location and equipment of which, involving contracts for transformers, rotaries, storage batteries, etc., are understood still to be under study and consideration. A report is current that contracts have been awarded for Babcock & Wilcox boilers that will run up to 40,000 hp, but it has not been verified as we go to press.

The commission appointed by the New York Central Company to consider the electrification of the road's terminals has now been in session for some months under Vice-President Wilgus, who happens at this moment to be abroad in Europe, accompanied by an architect, and who is said there to be studying European stations in view of the development of the facilities at the Grand Central Depot in connection with this new work and the rapid growth of business on the New York Central. Others representing the railroad in connection with the commission are Messrs. Deems, Gibbs, Katte and Waitt; while the consulting electrical engineers are, as is well known, Messrs. B. J. Arnold and Frank J. Sprague. More recently, in connection with the power house plans, Mr. Frederick Sargent, of Chicago, has been retained in an advisory capacity in order that the commission may avail itself from time to time of his experience as one of the leading designers and constructors of power

It is assumed or understood that for straight run work, the third-rail method in some form will be adopted, although this would not be applicable around the yards. It is further understood that the locomotives will operate at a pressure around the normal 550 volts, so as to render available the resources of current supply obtainable in and around New York City, as a further guarantee of uninterrupted operation.

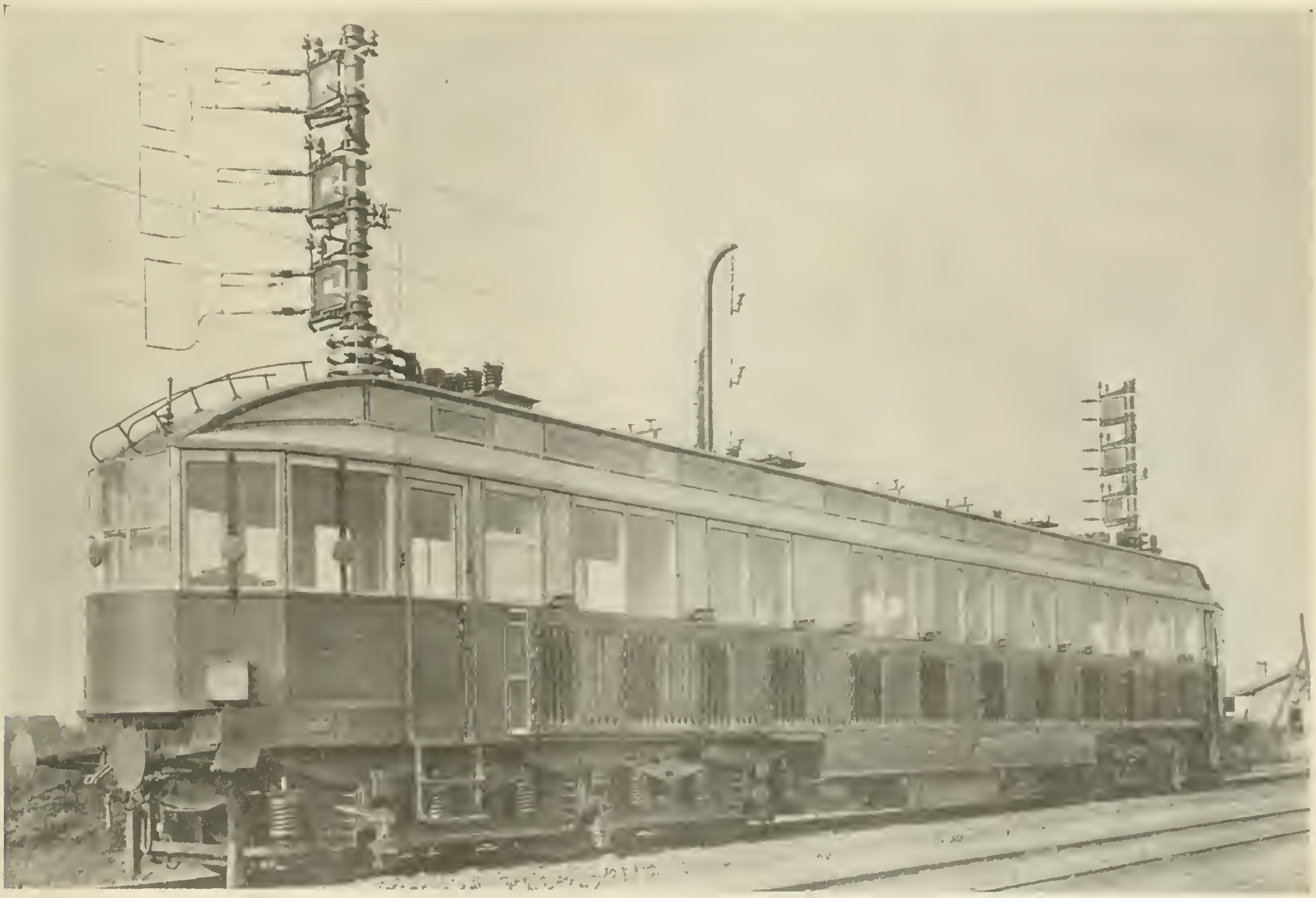


Fig. 1. View of High-Speed Car on Zossen Road.

The Latest Work at Zossen.

Cable dispatches just to hand announce the closing for the season of the memorable series of tests made on the Zossen road near Berlin with high-speed electric locomotives, at which velocities of over 130 miles an hour have been reached. We are also in receipt from Dr. Walter Reichel, of the railway department of the Siemens-Schuckert Company, of some further views and data relative to this striking work with which his own name has been so prominently and honorably associated.

As was noted in our issue of October 31, during the twenty-two months that have elapsed since the close of the first experiments the track from Marienfeldt to Zossen had been taken up and relaid with new steel rails weighing 41 kg (86.1 pounds) per lineal meter, resting on heavy spruce ties 22 in. from center to center and heavily ballasted with broken basalt. The rails are set on each tie in a steel chair, strongly bolted down, and are joined perpendicularly by beveled joints, 7 in. in length, held firmly together by bolts passing horizontally through the fishplates, so that the effectiveness of a continuous rail is practically secured. The old light rails, which had failed in 1901 and were, therefore, taken up, have been laid down flat as guard rails, resting horizontally on special cast-iron chairs in such a way that the flat bottom flange of the rail stands vertically along the inside line of each heavy rail and about 2 in. distant from the inner edge of its face. A view of the track is shown in Fig. 2. The track is a nearly level air line throughout its length, except one curve of 2,000 yards radius near its southern extremity, and is in all respects up to the highest standard of modern railway construction. The motors have been likewise improved in various minor details, but the cars are substantially the same as when first constructed. The car now shown in Fig. 1 was first shown in our issue of November 9, 1901, but was then without the wheel guards and brushes, the ventilators for the side rheostats, the hand rails on the roof, the extra springs seen in the three contact arms, and other minor details. Each is 22 meters (72.18 ft.) in length and weighs 90.5 metric tons, or about 200,000 pounds avoirdupois. Of this weight 48 metric tons comprise the body and running gear, and

42.5 tons are made up by the motors, transformers, and other details of the electrical equipment. Each end of the car rests on a six-wheel bogie truck of the American type, and the motors are four in number, one attached to the front and rear axle of each truck, the middle pair of wheels in each group running free. The wheels are 49 in. in diameter and are equipped with Westinghouse pneumatic brakes of the standard type. The transformers, which are hung beneath the middle section of the car, weigh 12 tons, besides which a storage battery of 631 pounds weight supplies the current for lighting purposes. The interior of the car is provided with upholstered seats lengthwise along the sides, and an open railing encloses at each end the space occupied by the driver.

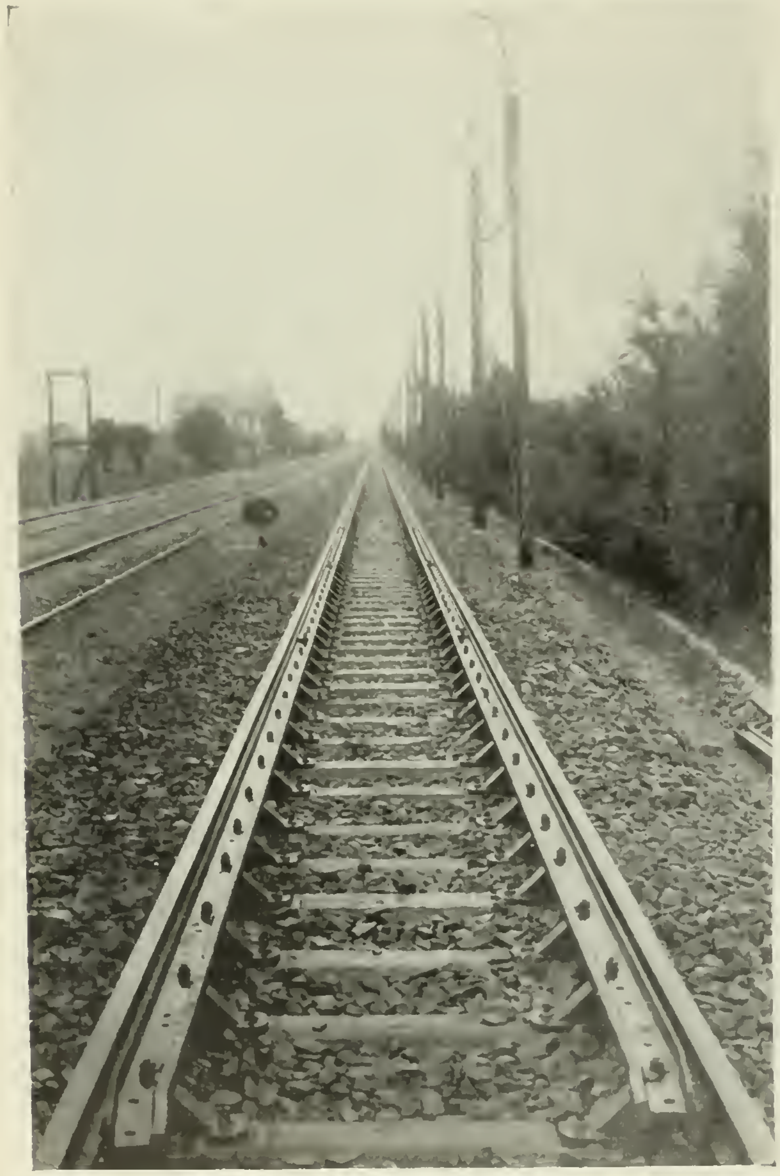


FIG. 2.—VIEW ALONG THE ROAD.

As to results and observations during the trip, Dr. Reichel says: "After all arrangements have been made and the military posts along the line notified, the current is allowed to enter the car at 14,000 volts. We leave Marienfeldt at 25 minutes after 9 and in starting up the current in each of the four motors is gradually raised to 350 amp., making the total power used 3,300 kw, or about 2,600 hp. The feeding point is passed at 80 km. an hour. * * * By the time Mahlow is reached (7 km. from Marienfeldt) a speed of 180 to 185 km. has been attained, and yet the train runs over the switches at this point without any particular shock. At this speed it is noticed that the current-collecting devices are still running quietly and there is, therefore, no scruple as to further increasing the speed. The last resistances are gradually cut out under the load of 2,300 kw and the speed rises to the hitherto unreached figures, 190 and 195. While traveling at 195 km. an hour we noticed two people standing in the middle of the track about 800 meters ahead, apparently most calmly discussing high-speed traction with each other. Luckily, they heard the warning whistle of the signal pipe and got out of the way just in time. It would not have been possible to have stopped the 93-ton car within 800 meters, as it requires fully 1½ km. to come to a full stop, at a braking pressure of 200,000 kg. * * * * * After the trip the car was examined very carefully and showed very little evidence of the demands which had been made upon it. The front of the car is covered with moths, bees and like insects which appear as if they had been crushed fast to the panes of glass and iron work. This is hardly to be wondered at as the air pressure was fully 210 kg. per square meter."

Dr. Reichel indulges in some rather interesting cost comparisons between steam and electricity from the German standpoint. A steam train consisting of a locomotive and five cars weighs 330,000 kg., contains 168 seats and uses 1,400 hp at full speed; the electric train consisting of one motor car and four trailers weighs 200,000 kg., has 180 seats and uses 1,000 hp. The initial cost of both trains is practically the same, being about 400,000 marks ($100,000). The operating cost for simply moving the train is 51 pfennigs (12½ cents) for 100 seat-km., operating with steam, and 49½ pfennigs (11½ cents) using electricity. Applying a calculation to the 150 km., or 94 mile line, between Berlin and Leipzig, we get the following conclusions: On this line an 18-hour service is furnished and 36 trains a day run every hour in both directions, so that if 40 per cent. of the seats are occupied (the trailers are put on when necessary) about 2,500 passengers are accommodated. Figuring the fare per kilometer as 6 pfennig (1½ cents), which is the present second-class fare, this would give a daily income of 22,500 marks ($5,650). The operating expenses, considering transportation only, are about 5,000 marks daily ($1,250). Adding to this the other operating expenses, particularly for employees, maintenance of way, stations, management, etc., 7,600 marks daily, this would make the daily operating expense 12,600 marks. This leaves 9,900 marks for interest on the original capital, which in one year would be 3,600,000 marks, which would give 4 per cent. interest on 90,000,000 marks. The cost per kilometer would, in this case, be about 600,000 marks.

Independent Telephone Convention at Chicago.

The regular annual convention of the Interstate Independent Telephone Association will be held at the Auditorium, Chicago, on December 8, 9 and 10. The programme, which is as follows, promises a most useful and interesting affair, and a large attendance is expected by the officers:

Tuesday Morning, December 8, 9 to 12—Reception of members and friends by the Executive Committee and officers at the secretary's headquarters. Tuesday Afternoon, December 8, 2 to 5—Address of welcome, Hon. Carter H. Harrison, Mayor of Chicago. Response and annual address by president, Senator C. E. Hull, Salem, Ill. Report of the secretary. Report of the treasurer. Selection of Executive Board. Selection of Nominating Committee. Revision of Constitution and By-Laws. Adjournment. Wednesday Morning, December 9—The officers and Executive Board will take charge of the delegates this morning from 9 to 12 in visiting exhibits. Wednesday Afternoon, December 9, 2 to 5—"Should the Territory of the Interstate Independent Telephone Association Be Enlarged, and if so, Why?" Hon. John Van Nortwick, Appleton, Wis. Discussion. "Are Our Telephone Periodicals Sufficiently Careful as to the Business Relations Sustained by Contributors?" Hon. W. H. McDonough, New York. Discussion. "Standardization of Apparatus," Prof. J. C. Kelsey, Purdue University. Discussion. "Standardization of Construction," W. C. Polk, Kansas City, Mo. Discussion. "Competition between Independent Companies and Farmers' Mutuals," O. Rex, North Manchester, Ind. Discussion. Thursday Morning, December 10, 9 to 12—"Independent Toll Line Systems, and Is the Time Ripe for Merging?" J. S. Bailey, Jr., Toledo, Ohio. Discussion. "Where Should the Line of Demarcation Be Drawn between Independent Operating and Manufacturing Companies, and the Bell Company?" Hon. Henry A. Barnhart, Rochester, Ind. Discussion. "What Should Be the Representation in the Connection of the Interstate Independent Telephone Association in Voting?" Mr. Prewitt, Winchester, Ky. Discussion. "Who is Who? What Are the true Ear Marks?" Hon. Theodore Gary, Macon, Mo. Discussion. Election of officers. Thursday Afternoon, December 10, 2 o'clock on. Officers and Executive Board will entertain the delegates.

The officers of the Association are: C. E. Hull, president, Salem, Ill.; I. A. Frazer, vice-president, Connersville, Ind.; E. M. Coleman, secretary, Louisville, Ky.; J. W. Layne, treasurer, Carthage, Mo.; C. E. Tripp, Auditorium, has charge of exhibit space. An elaborate banquet will close the convention.

Calculation of the Apparent Inductance of Armature Coils.—III.

By C. C. Hawkins.

6. *Calculation of the surface-of-core inductance.*

Secondly, the inductance from the *surface of the core* up to the pole tips at a distance of r_2 cm. from the line of symmetry midway between the poles must be reckoned; for comparative results it is assumed that the group of short-circuited spool sides is situated midway between the poles—an assumption that is not strictly accurate when the brushes are shifted away from the line of symmetry; yet its correction would involve a refinement of calculation to which the value of the results would hardly be commensurate.

The leading cases may be grouped into four or five kinds, according as the short-circuited spool sides are concentrated in one slot, or divided between two, three, four or five slots. Since the distribution of the spool sides is often different in the two considered interpolar zones, it is best to take them separately and add the two inductances together, so that the following formulæ are arranged to apply to a single interpolar gap.

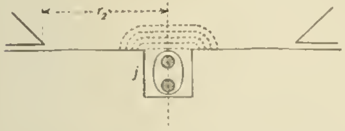


FIG. 15.—SINGLE SLOT.

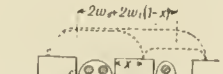


FIG. 17.—TWO ADJACENT SLOTS.

(1) When the short-circuited spool sides are confined to a single slot (Fig. 15). The permeance in one interpolar zone per cm. length of armature core is $\frac{2.3}{\pi}\log\frac{\pi\left\{r_2-\frac{w_s}{2}\right\}+w_s}{w_s}$ acted on by a m.m.f. of $4\pi j w$, where j is the total number of short-circuited spool sides in the one zone and $w=$ the number of wires in a spool side $=\frac{\tau}{2N_2}$. The resulting flux is linked with the w wires of the considered section, so that the self and mutual inductance is

$$\frac{2.3}{\pi}\log\frac{\pi\left\{r_2-\frac{w_s}{2}\right\}+w_s}{w_s}\times 4\pi j w^2\times 10^{-9}\text{ henrys; since } w^2$$

$=\frac{1}{4}\left(\frac{\tau}{N_2}\right)^2$, the coefficient required for insertion in our principal equation is for the single zone and per cm. length of core,

$$b=j\,2.3\log\frac{\pi\left\{r_2-\frac{w_s}{2}\right\}+w_s}{w_s}.$$

It is of interest to plot the value of $2.3\log[\ ]$ as an indication of the rapid rise of the inductance for small distances away from the center line as on small armatures and the gradual decline in the rate of increase as the width of the interpolar zone is increased (Fig. 16, upper curve). For the width of the slot two specimen cases are chosen, viz.: $w_s=\frac{1}{4}''$ or $w_s=\frac{1}{2}''$, and other cases might be interpolated by alteration of the scale of abscissæ, if special accuracy was required. Further, it is throughout assumed that the ratio $\frac{\text{polar arc}}{\text{pole pitch}}=\beta=0.7$, so that by altering the scale of abscissæ, as shown in Fig. 16, the same curve can be applied directly to cases involving different numbers of poles. The actual position of the short-circuited spool sides within the slot is in connection with the present section immaterial, and the figures are equally applicable to any winding, so long as the multiplier, j, is given the correct value.

(2) When the short-circuited spool sides in one interpolar zone are confined to two adjacent slots, but are not necessarily equally divided between them, let $f=$ the number of spool sides short-circuited in the slot which has the greater number, and let $g=$ the smaller number within the other slot. At some point along the central tooth the flux is zero, and thence the local flux surrounding each slot gradually increases, but as a first approximation it will suffice to calculate the permeance of each slot at its full value up to the dividing point, x (Fig. 17). The fraction x of the intervening tooth, which the local flux surrounding f traverses, will increase as $\frac{f}{g}$ increases, and is given by the relation $\frac{f}{\pi x w_t+w_s}=\frac{g}{\pi w_t(1-x)+w_s}$. Beyond the limits of the local fluxes, the permeance up to the pole tips is per cm. length of core,

$$\frac{2.3}{\pi}\log\frac{\pi\left[r_2-\left\{w_s+w_t(1-x)\right\}\right]+2w_s+2w_t(1-x)}{\pi x w_t+2w_s+2w_t(1-x)}$$

whence for substitution in our principal equation, for one zone,

$$b=(f+g)\,2.3\log\frac{\pi\left[r_2-\left\{w_s+w_t(1-x)\right\}\right]+2w_s+2w_t(1-x)}{\pi x w_t+2w_s+2w_t(1-x)}$$

To the inductance from the joint flux must be added that from the local flux, for which

$$b^1=f\times 2.3\log\frac{\pi x w_t+w_s}{w_s},\text{ or }=g\times 2.3\log\frac{\pi(1-x)w_t+w_s}{w_s}$$

according to whether the considered spool side belongs to the f or to the g group.

If $f=g$, $x=0.5$; otherwise the ratio $\frac{w_s}{w_t}$ must be known; thus if $\frac{f}{g}=2$, and if, in order to indicate the class of effect $w_s=w_t$ be assumed, $x=\frac{2\pi+1}{3\pi}=0.77$; or, if $\frac{f}{g}=3$, $x=\frac{3\pi+2}{4\pi}=0.91$.

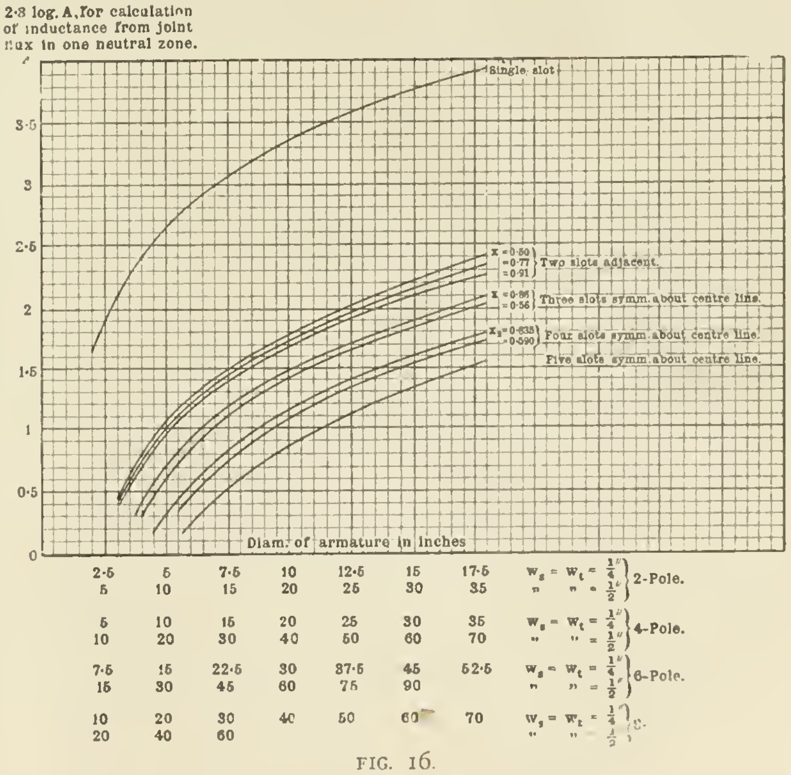


FIG. 16.

As x increases, the permeance for the joint flux decreases, but the diminution is so small as to have but little effect, as shown by the proximity of the three curves in Fig. 16, appropriate to the above three cases. Further, a relation between w_s and w_t differing widely from unity, has no great effect on the whole, since a consequent change in b is partially counterbalanced by an opposite change in b', so that if an average is struck between w_s and w_t, it is seldom necessary to consider their actual values more closely.

If, while the short circuited spool sides are confined to two slots a central slot intervenes which is empty, the local permeance may, in the case of each slot, be extended up to the full width of the tooth, while the joint permeance then has its lower limit fixed by the central gap of four teeth and three slots (Fig. 18). The coefficients are then

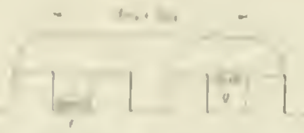


FIG. 18.—TWO SLOTS WITH INTERMEDIATE VACANT SLOT.

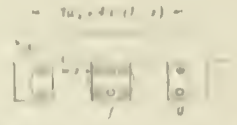


FIG. 19.—THREE SLOTS SYMMETRICAL ABOUT CENTER LINE AND CENTRAL SLOT MOST FILLED.

$$b = (f+g)\ 2.3\ log \frac{\pi\{r_2 - (1.5\ w_s + w_t)\} + 3w_s + 2w_t}{\pi\ w_t + 3w_s + 2w_t}$$

and

$$b' = f \times 2.3\ log \frac{\pi w_t + w_s}{w_s}, \text{ or } = g \times 2.3\ log \frac{\pi w_t + w_s}{w_s},$$

as the case may be.

(3) If the short-circuited spool sides are spread over three slots the center containing the larger number, f, and further, the two outside slots each contain g spool sides, so that the whole is symmetrical about a center line (Fig. 19), x is given by the relation,

$$\frac{f+g}{\pi\ x\ w_t + 2\ w_s + w_t} = \frac{g}{\pi\ w_t\ (1-x) + w_s}, \text{ whence}$$

$$b = (f+2g)\ 2.3\ log \frac{\pi\ [r_2 - \{1.5\ w_s + 2\ w_t\ (1-x)\}] + 3\ w_s + 4\ w_t\ (1-x)}{\pi\ x\ w_t + 3\ w_s + 4\ w_t\ (1-x)}$$

and

$$b' = f \times 2.3\ log \frac{\pi\ x\ w_t + w_s}{w_s}, \text{ or } = g \times 2.3\ log \frac{\pi\ (1-x)w_t + w_s}{w_s}$$

If $\frac{f}{g} = 1$, $x = \frac{2\pi - 1}{3\pi} = 0.56$, while if $\frac{f}{g} = 2$ and $= w_t$ $x = \frac{3\pi}{4\pi} = 0.75$; or, if $\frac{f}{g} = 3$, $x = \frac{4\pi + 1}{5\pi} = 0.86$. As $\frac{f}{g}$ is increased, the joint permeance now increases, yet the increase is but slight, as shown by the middle pair of curves in Fig. 16, where, as before, the value of 2.3 log $\{\ \}$ has been plotted for different values of $\frac{f}{g}$ or x.

If the two outside slots contain the same number of short-circuited spool sides, f, and f is larger than g, so that the group is again symmetrical about a center line (Fig. 20),

$$b = (2f+g)\ 2.3\ log \frac{\pi\{r_2 - (1.5\ w_s + w_t)\} + 3\ w_s + 2\ w_t}{\pi\ x\ w_t + 3\ w_s + 2\ w_t}$$

and

$$b' = f \times 2.3\ log \frac{\pi\ x\ w_t + w_s}{w_s}, \text{ or } = g \times 2.3\ log \frac{\pi\ (1-x)\ w_t + w_s}{w_s}$$

$$\text{If } \frac{f}{g} = 2,\ x = \frac{2\pi + 3}{5\pi} = 0.59,$$

$$= \frac{3}{2},\ x = \frac{3\pi + 4}{8\pi} = 0.535.$$

In this case, as $\frac{f}{g}$ increases, the joint permeance decreases as in case (2).

If the distribution about the center line is unsymmetrical and the center slot has the larger number of short-circuited spool sides (Fig. 21), a sufficiently close approximation will usually be given by the equations,

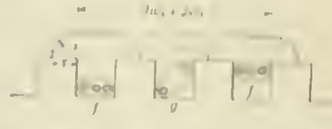


FIG. 20.—THREE SLOTS SYMMETRICAL ABOUT CENTRE LINE AND OUTERS MOST FILLED.

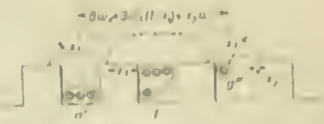


FIG. 21.—THREE SLOTS UNSYMMETRICAL ABOUT CENTRE LINE AND CENTRAL SLOT MOST FILLED.

$$\frac{f+g'}{\pi\ x_1 w_t + 2\ w_s + w_t} = \frac{g'}{\pi(1-x_1)w_t + w_s}$$

and

$$\frac{f+g''}{\pi(1-x_2)\ w_t + 2w_s + w_t} = \frac{g''}{\pi\ x_2\ w_t + w_s}$$

the radius x_1 of the joint permeance being fixed by the central slot, whence

$$b = (f + g' + g'')\ 2.3\ log \frac{\pi[r_2 - \{1.5w_s + 1.5w_t(1-x_1) + .5x_2w_t\}] + 3w_s + 3w_t(1-x_1) + x_2 w_t}{\pi\ x_1\ w_t + 3\ w_s + 3\ w_t\ (1-x_1) + x_2\ w_t}$$

and

$$b' = f \times 2.3\ log \frac{\pi\ x_1\ w_t + w_s}{w_s}, \text{ or } = g' \times 2.3\ log \frac{\pi(1-x_1)\ w_t + w_s}{w_s},$$

$$\text{or } = g'' \times 2.3\ log \frac{\pi\ x_2\ w_t + w_s}{w_s}.$$

But if the above equations give x_1 less than $(1 - x_1)$, as may be the case when g'' is small by comparison with $f + g'$, there is a slight error in the above assumption which must be empirically corrected.

If one of the outer slots has the same number of short-circuited spool sides, as the central slot or a larger number (Fig. 22),

$$b = (f + g' + g'')\ 2.3\ log \frac{\pi[r_2 - \{1.5\ w_s + \left(1 - \frac{x_1}{2}\right) w_t + 5\ x_2\ w_t\}] + 3\ w_s + (2 - x_1)\ w_t + x_2\ w}{\pi\ x_1\ w_t + 3\ w_s + (2 - x_1)\ w_t + x_2\ w_t}$$

the radius, x_1 of the joint permeance being fixed by the outer slot, and b' is the same as in the last case.

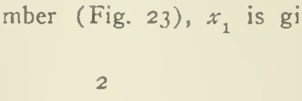


FIG. 22.—THREE SLOTS UNSYMMETRICAL ABOUT CENTRE LINE AND OUTER SLOT MOST FILLED.

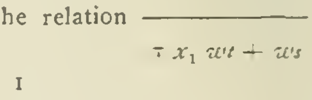


FIG. 23.—FOUR SLOTS SYMMETRICAL ABOUT CENTER LINE AND INNER SLOTS MOST FILLED.

(4) If the spool sides are spread over four slots and are symmetrical about a center line, the two inner slots containing the larger number (Fig. 23), x_1 is given by the relation $\frac{1}{\pi\ x_1\ w_t + w_s} = \frac{2}{\pi\ x_1\ w_t + 2\ w_s + w_t}$, whence it $= \frac{1}{\pi} = 0.32$; while x_2 is given by the relation $\frac{2f+g}{\pi\ x_2\ w_t + 3\ w_s + 2\ w_t} = \frac{g}{\pi(1-x_2)\ w_t + w_s}$, whence x_2

$$= \frac{(2\ f + g)\ \pi\ w_t + 2\ (f - g)\ w_s - 2\ g\ w_t}{2(f+g)\ \pi w_t}$$

Thence,

$$b = 2(f+g)\ 2.3 \log \frac{\pi\,[r_2 - \{2\,ws + 2.5\,wt - 2\,x_2\,wt\}] + 4\,ws + 5\,wt - 4\,x_2\,wt}{\pi\,x_2\,wt + 4\,ws + 5\,wt - 4\,x_2\,wt}$$

$$b' = 2.3\,f \log \frac{\pi \times .32\,wt + ws}{ws}, \text{ or } g \times 2.3 \log \frac{\pi\,x_3\,wt + ws}{ws},$$

$$b'' = 2f \times 2.3 \log \frac{\pi\,x_2\,wt + 2\,ws + wt}{\pi \times .32\,wt + 2\,ws + wt}$$

In the particular case when $f = g$, $x_2 = \dfrac{3\pi - 2}{4\pi} = 0.59$,

$$x_3 = \frac{\pi + 2}{4\pi} = 0.41,$$

$$x_1 =, \text{ as always, } 0.32;$$

while when $\dfrac{f}{g} = 2$, $x_2 = 0.835$ (Fig. 16).

(5) The case of five slots is seldom met with, but for completeness the curve of the value of the logarithmic portion of the expression for the joint permeance in one zone is added in Fig. 16.

Testing Alternators Under Full Load Conditions.

By W. L. Waters.

In Electrical World and Engineer issue for October 31, Mr. B. A. Behrend describes a modification of the Mordey method of testing large alternators on full load. While advocating the method of connecting the field coils in two groups so that the e.m.f. induced by one group opposes that due to the other, Mr. Behrend does not bring forward any experimental evidence to show that the results as regards heating, efficiency and regulation have any claim to accuracy.

Some years ago when alternators were first made in sizes too large to be conveniently tested on full load, the question of the accuracy of the results obtained by the Mordey method of testing had to be considered, and the writer made a number of tests to decide this point. The results showed that, though the method was sufficiently accurate as regards heating, it was unreliable in regard to efficiency and regulation.

The Mordey alternator consisted of a stationary disc armature and a revolving field so that the form of test suggested by Mordey was to reconnect the stationary armature coils in two groups, the e.m.f. of one opposing the e.m.f. of the other. The disc alternators of Siemens and Ferranti consisted of a revolving armature and stationary magnet, so that when the Mordey test was applied to these machines the natural modification was made to connect the field coils in two opposing groups, instead of the armature coils. When the method was applied to modern iron-clad alternators the connections were made on the magnets or armature coils, according to which was the stationary element—there being natural objections to making temporary false connections on the revolving winding.

Considering first the case in which the armature coils are connected in two opposing groups. The temperature test was made by closing the circuit of the reconnected armature coils through an adjustable resistance, then exciting the magnets at normal no-load excitation and adjusting the armature resistance till the normal current was flowing through the armature. The efficiency test was made in the same way—the full-load losses in the alternator being the power supplied to the machine during this test less the power lost in the external adjustable armature resistance. The regulation test was made by running a similar test, the armature circuit being closed through an external adjustable resistance, inductive or non-inductive, as the case might be, and the excitation adjusted to give normal voltage at the armature terminals (the voltage being, of course, refered to the number of effective and not to the total number of armature coils) and external armature resistance varied till the current flowing bore the same ratio to the normal full-load current of the machine as the number of effective armature coils bore to the total number, e. g., if we have the 12-pole machine connected four coils opposing eight, then the number of effective coils would be four and the volts at the armature terminals during the test would be one-third of the normal voltage and armature current would be one-third the normal full-load current.

If the field coils were connected in opposing groups instead of the armature coils, then the tests would be conducted in the same manner, except that in the efficiency and heating tests it was usual to adjust the armature current by raising or lowering the excitation in one of the groups of field coils independently of that in the other, instead of by means of an external armature resistance. The regulation test was sometimes run in the same way, but more usually the external resistance was varied in order to adjust the armature current—the external resistance being a necessity in this test in order to vary the power factor and the load, and in addition it is, if anything, more accurate to work the two parts of the armature at the same flux when the machine is on no-load rather than at the same flux when on full load.

There was always more or less jarring and vibration when running these tests, both on ironless and on iron-clad alternators, but unless the machine was mechanically weak there was never any serious trouble from this cause, at any rate on machines up to 750 kw.

As regards the accuracy of the results obtained by these methods. The temperature test usually gave fairly correct results, for both ironless and iron-clad armatures. Temperature tests are rarely correct within less than 10 per cent., and as carefully-designed alternators are always well within the guarantees as regards heating any small inaccuracies in this method of making the temperature tests are of small importance.

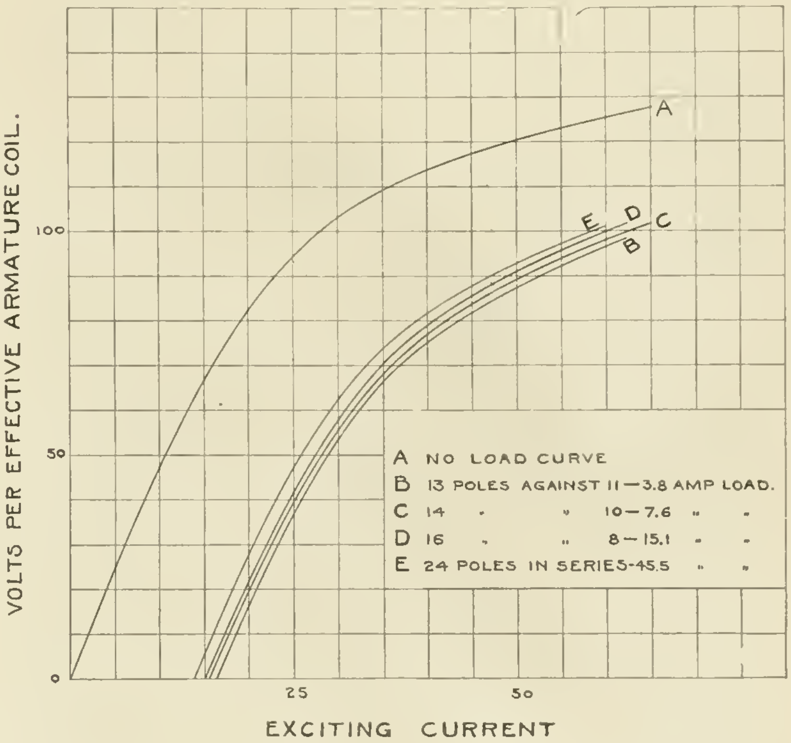


FIG. 1.—MAGNET POLES CONNECTED IN TWO OPPOSING GROUPS.

The efficiency test usually gave poor results. During the test the lag of the current in the armature is usually not far from 90°, so that any eddy currents in the iron due to the armature current are considerably increased and the efficiency comes out lower than if the test had been made on a non-inductive load.

The regulation test was usually unreliable, the results obtained varying quite considerably with the method of connection used in the field or armature. Figs. 1 and 2 show the results of regulation tests made on 100-kw, 2,200-volt, 60-cycle, 24-pole, single-phase revolving-field, iron-clad alternator. The various connections of the armature and field coils are indicated in the figures. The tests were made as described above and the results are only plotted for power factor zero—the external resistance being in this case self-induction coils which had a power factor of .1 to .15. The observed volts are divided by the number of effective coils, so that the plotted voltages are volts per effective armature coil. The armature current in amperes bears the same relation to the normal full-load current of 45.5 amp. as the number of effective armature coils bears to the total number of coils, i. e., to 24. The tests made and plotted in this way are directly comparable and we can see at once from the curve that the results of the test are not by any means consistent. The results of the straight test with all coils in series gives a regulation of 37 per cent., while the different methods of connecting the armature and field coils give results varying from 32 to 41 per cent. This test is simply given as an example—tests on other machines and with different power factor loads gave similar results. The results were sometimes more consistent and at other times less so, but the results appeared so unreliable that this method of obtaining the regulation was abandoned as being of little value.

At the present time the general method of taking the heat run on a large machine is that described in the editorial notice of Mr. Behrend's paper in Electrical World and Engineer of October 31. The alternator is excited at normal excitation and then the armature coils reconnected to give no result of P.D. and at the terminals and then direct current is sent through the armature to produce the required C^2R loss. The efficiency test is usually made by taking the core loss on no load and then measuring the C^2R losses in the armature and magnets. The regulation test on power factor 1 is a very difficult test to make with any accuracy and so is seldom made. The regulation test on power factor 0 can be made on a small alternator by loading it up on induction coils (usually field magnet coils), while on large alternators it is best made in the way referred to by Mr. Behrend, by taking a second machine and running it as a synchronous motor and then adjusting the excitation of the two machines till full load current flows between the machines.

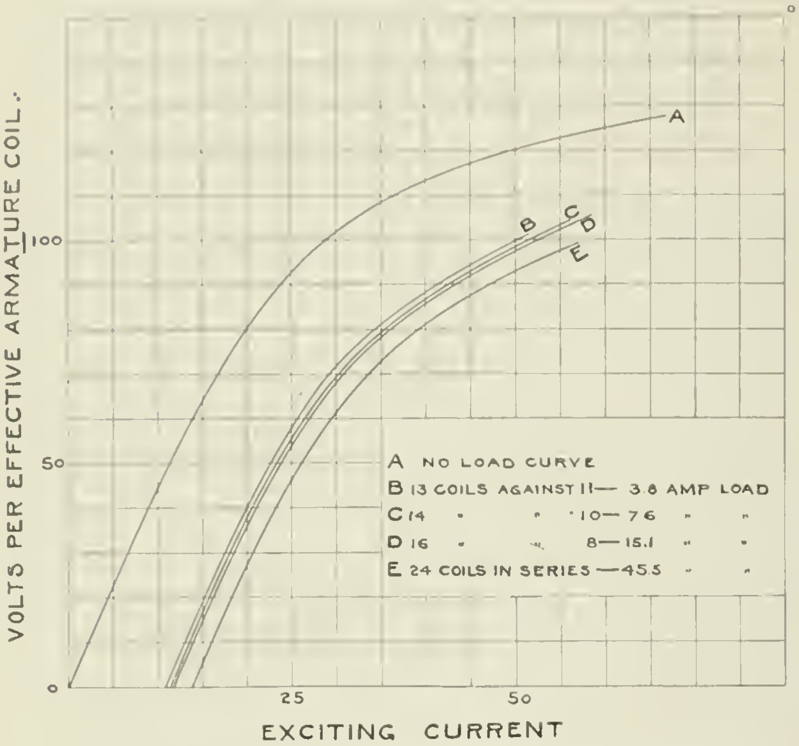


FIG. 2.—ARMATURE COILS CONNECTED IN TWO OPPOSING GROUPS.

Thus, though the Mordey test gives good results on a temperature run, and has done excellent work in the past, the trouble of making the necessary connections, and then the necessary adjustments to get the load right, have caused it to be abandoned in favor of simpler methods, so that at the present time it is practically never used.

National Electric Light Association.

It will be remembered that the proceedings of the National Electric Light Association convention at Chicago this year were of unusual scope and bulk, papers and discussions being alike of importance. The work of preparing the annual volume of transactions has been quite formidable, but the secretary hopes soon to have it ready for issue. It promises to make a substantial volume of not far short of 1,000 pages, which, with its special appendices—one of them in colors—will constitute the best example, up to date, of the Association's efforts in behalf of its members, particularly those who are unable to attend the meetings. The volume will be eagerly sought after when issued.

Meeting of Southern Indiana Independent Telephone Association.

The Independent Telephone Association of Southern Indiana held its fourth annual convention in Evansville November 11 and 12. There were about 75 delegates present and a host of visiting representatives from telephone manufacturers.

The convention was presided over by Vice President Knoefel, of New Albany. W. E. Clark, city clerk, read Mayor Covert's address of welcome. The Mayor said it was with pleasure he welcomed the independent telephone men to Evansville, but regretted the fact that the doors of the city had, up to the present time, been closed against the independents. He said he had for a year or more endeavored to open the door to the independents and he believed he would be successful in a short time. The Mayor said he once thought that to be cut off from the Bell or Cumberland Company meant to be cut off from the rest of the world. That delusion was quickly dissipated when he found the whole southern part of Indiana and contiguous neighboring states were a perfect network of independent lines, and that the instruments used by the independent people outnumbered those of the Bell or Cumberland Company by many thousands. "I also found," said he, "that service was furnished at a much lower rate than when the Bell enjoyed a monopoly and that in every instance the independent people were doing a profitable business at the rates charged."

The Mayor urged the independents of Southern Indiana to take up the fight in Evansville and help the independent movement along. Concentrated effort in this direction would, he believed, guarantee an independent local service in a short time.

The first paper on the programme was assigned to A. W. Funkhouser, city attorney for Evansville. Mr. Funkhouser said that by force of circumstances he was made somewhat familiar with the telephone conditions in Evansville. To give the people of the city and country a decent service at reasonable rates has been the sole purpose of the advocates of an independent company. Therefore, Evansville had concluded to go into the telephone business for herself. He declined to discuss the status of litigation between the city and the Cumberland Company for the reason that the matter is now in the hands of the courts, and a favorable decision was confidently expected in a short time. Mr. Funkhouser said there was not a single county in Indiana which has not independent telephone lines and exchanges and only two county seats in the entire State where the independents are not represented—Evansville and Booneville—the latter, however, having recently granted a franchise for an independent company. "There are at the present time in the State of Indiana," he continued, "134,000 independent telephones and about 40,000 Bell telephones—more than three to one in favor of the independents." He said it was a safe statement that nearly 40 per cent. of the farmers of Indiana are now connected by independent lines.

The evening session of the first day was given up to a banquet, and the visiting delegates were greatly pleased at the hospitality extended. After the cigars were passed speech-making began. E. W. Pickhardt, secretary of the convention, and George A. Cunningham talked on the Evansville situation.

The programme for the second day began with a paper by Vice-President Knoefel, on the "Independent Long-Distance Lines." The speaker pointed out the mistakes that had been made by the independents in the early history of the development and laid much of the blame for early failures to cheap construction. He said the proper construction of toll lines calls for 45 poles to the mile and No. 10 copper wire. He asserted that good service can only come as a result of good construction, and this can only be had at considerable expense at first, but would require much less expense to maintain in good order.

A. J. Payton, of Rockford, read a paper upon the "Bell People as Antagonists," which showed that he was familiar with every phase of the telephone fight. The following officers were elected: President, Charles D. Knoefel, New Albany; vice-president, L. G. Davis, Salem; secretary, E. W. Pickhardt, Huntingburg.

From the standpoint of interest and attendance the convention was the best ever held by the Independent Telephone Association of Southern Indiana. The delegates and visitors all expressed themselves as well pleased with the treatment they received from the Evansville people, and especially for the gracious manner in which the local committee made their stay in the city pleasant and profitable.

Wireless Fire Alarm Signalling Apparatus.

WIRELESS signalling apparatus lends itself admirably to a multiplicity of uses other than that of telegraphic communication, and just now it is being tested in Continental Europe relative to its value in the fire alarm service. M. Emile Guarini, prolific writer and inventor of divers devices appertaining to the emission, propagation and reception of electric waves, has conducted some interesting experiments in the transmission of wireless fire alarm signals; and he now proposes to equip the fire houses and numerous buildings of Brussels, Belgium, with this new type of apparatus.

The experimental instruments devised for this purpose are shown in the illustrations. Fig. 1 represents the transmitter photographically and the schematic arrangement upon which it is based in Fig. 2. As in an ordinary wireless telegraph system, an induction coil is employed to transform a low-potential direct current into a high-tension alternating current for charging the oscillator system. Additional apparatus is also provided for indicating the number of the burning building and its position and this is also shown in the diagram.

Referring to Fig. 2, 1 represents the tube of a thermometer; 2, mercury in the thermometer; 3 and 4, terminals of an internal circuit made of platinum and leading inside the thermometer tube; 5, a single dry cell; 6, an electromagnet operating an armature, 7; 8, a retractile spring; 9, a button forming a stop for the armature; 10, a disc having notches cut in its periphery at given distances apart, so that the exposed surfaces may represent the number and locality of the building; 11 is a spring contact making and breaking the primary circuit, which includes a battery, 12, and the induction coil, 13; 14 is the aerial wire radiating the waves; 15, the secondary of the induction coil; 16, the earthed terminal of the oscillator system; 17, an arrangement for automatically checking the disc after it has completed its revolution; 18, an insulated arc inserted in the disc to indicate that the number has been completed, and 19, the oscillator or spark-gap.

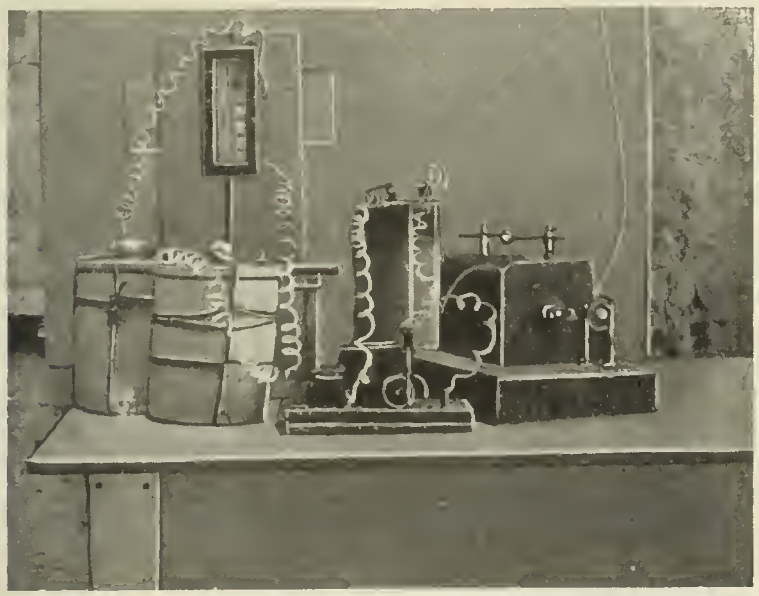


FIG. 1.—WIRELESS FIRE ALARM TRANSMITTER.

The receiver, Figs. 3 and 4, consists of an antenna, 20, connected with a coherer, 21, the opposite conductor plug leading to earth, 22, and a suitable receiving device, 23, operated by a battery, 24. This usually includes a relay, a tapper and a Morse register, as in a system of wireless telegraphy, although a single stroke bell may be used instead of the register.

This experimental equipment was placed in one end of the inventor's laboratory, where a miniature building had been erected, and at the opposite end of the room the receiver was placed in position as it would be in a fire engine house. After all these preliminary arrangements, the little building was fired.

When the heat emitted by the flames became sufficiently intense, the column of mercury began to rise in the capillary tubing of the thermometer and finally when it reached 42° Reaumur the liquid metal was forced into contact with the upper terminal, 3, and the internal circuit was closed after the manner produced by a thermostat.

The current now flowed through the circuit and energized the electromagnet, 6, and this action attracted the armature, 7, releasing the disc, 10, which revolved in virtue of its connection with a spring motor. The disc with its peripheral projections impinging upon the contact brush, 11, caused the current flowing in the primary circuit to be made and broken in accordance with the length of the actuated surfaces of metal representing numerals or letters as prearranged for indicating the number of the house and its locality.

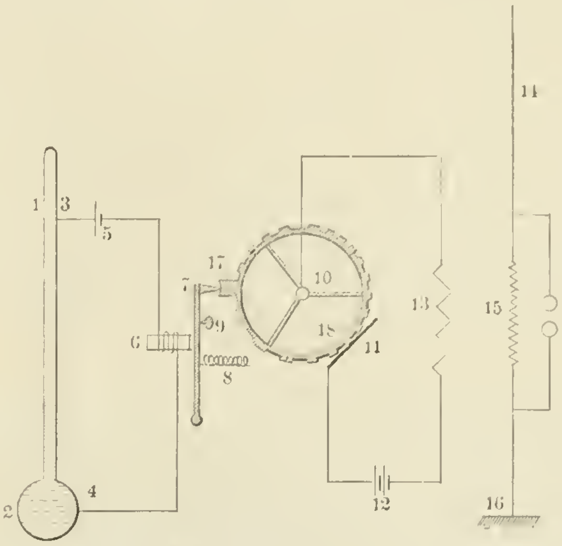


FIG. 2.—DIAGRAM OF SIGNALLING APPARATUS.

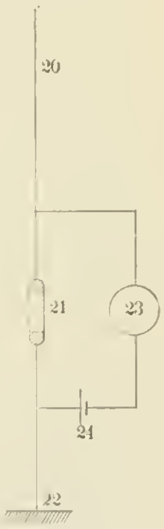


FIG. 3.—PRINCIPLE OF RECEIVING APPARATUS.

Since every disc may have any desired number of projections which may be of varying lengths, indicating dots and dashes, it is obvious that the combinations formed may be varied infinitely. This automatic device for making and breaking the primary circuit precludes the necessity of a manual key or an operator, although an arbitrary make-and-break may be interposed in the circuit and the regular Morse or Continental code transmitted.

When the current is interrupted by the disc, the impulses, which have a high time-constant compared with the automatic spring vibrator of the coil, set up alternating currents in the secondary coil, and this serves to energize the oscillator system, which in turn flashes out through space the important message notifying the firemen of the call to duty. The electric waves thus sent out impinge upon the aerial wire at the fire engine house, and these are converted into oscillations in the resonator circuit when the coherer is affected and actuates, in turn, the relay; the tapper and register respond to the fresh impulses and the latter prints on a tape the number and letter in less time than the horses can be hitched up and the engine manned.

At the first stroke a visible signal is indicated by a miniature incandescent light and the alarm is sounded by an electric gong. Guarini has worked out a scheme so that the first revolution of the disc gives a signal throughout the building on fire; and if the efforts of the occupants are able to extinguish the flames in their incipiency no alarm is sent to the engine house.

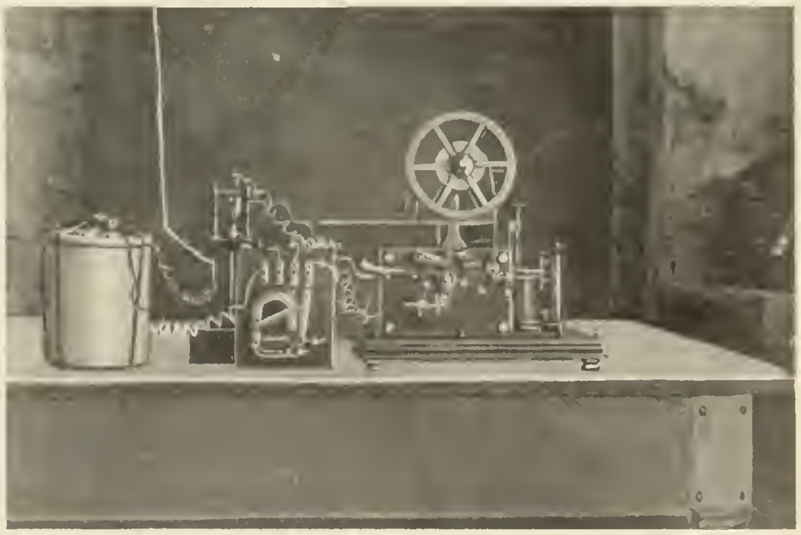


FIG. 4.—WIRELESS FIRE ALARM RECEIVER.

In this system no central station is required, but the messages are transmitted directly to the engine houses. M. Guarini gives the credit of this idea to Signor Mollo, chief of the fire department of Naples, Italy, but has worked it out and put it into commercial shape, and a practical installation is now being set up in Brussels.

Recent Progress Abroad in Wireless Telephony.

Hardly had the general surprise at the discovery and far-reaching power of wireless telegraphy passed away when investigators and inventors began to strive for a solution of the problem of wireless telephony. Of course, this latter is a very different proposition from wireless telegraphy because of the necessity in the transmission of articulate sounds of preserving the wave form. In other words, the problem becomes not only one of transmitting a sufficient quantity of energy to affect the distant receiver; but in addition the component waves must be transmitted correct in all their instantaneous values. The inefficiency or weakness of our only present telephonic transmitting means would probably be an ever effective bar to the successful accomplishment of wireless telephony were it not for the extreme sensitiveness of the telephone receiver, the sensitiveness of this instrument being so great that it responds to the minutest variation of the electrical condition of its terminals. Therefore, if the transmitter may be made by any combination of inductive coils to send out forced vibrations to the surrounding medium, a telephone receiver is pretty sure to catch them, provided it be within the radius of the final dissipation of the waves.

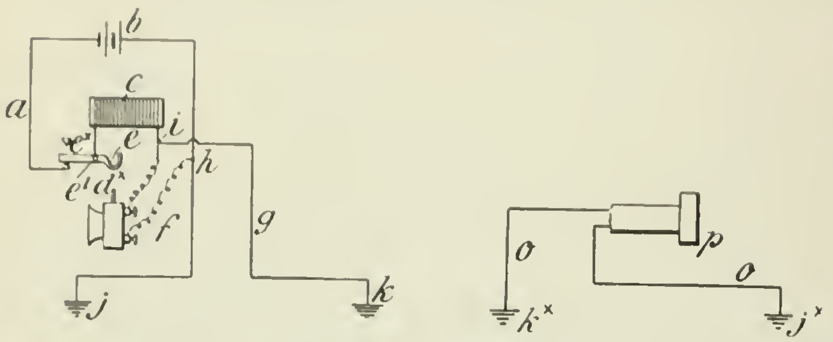


FIG. 1.—DIAGRAM OF SENDING AND RECEIVING CIRCUITS.

Experimenters soon found that with suitable arrangement of induction coil and transmitter, speech could be conveyed through the air, provided the receiving telephone was near at hand. However, if the discharge terminals be earthed, and both receiver terminals be earthed, then will the transmission take place over a considerable distance.

A still further improvement has been made by Messrs. James T. Armstrong and Axel Orling, of London, England, which enables the limits of wireless telephony to be extended. This improvement, already noted in our columns, is set forth in three American patents recently issued to these gentlemen, and, expressed in a few words, lies in "producing low-tension currents and high-potential discharges together." To this end the induction coil of other systems is replaced by a reactance coil connected with the transmitter, the battery and the earth in such a manner that the low-tension current waves directly due to the variation of the transmitter resistance, are supplemented by the simultaneous and powerful extra currents or inductive kick of the coil.

Fig. 1 shows the elementary transmitting and receiving circuits. It will be noted that the transmitter being in shunt with the ground portion of the circuit not only determines variations in the current traveling between the two grounds, *j* and *k*, but also causes variations in the current passing through coil *c*. For example, consider a sudden increase of the transmitter resistances. Simultaneously with this resistance change, an increased current from the battery will tend to pass through the earth, augmented by the inductive discharge of the coil, *c*, due to the diminution of current in it.

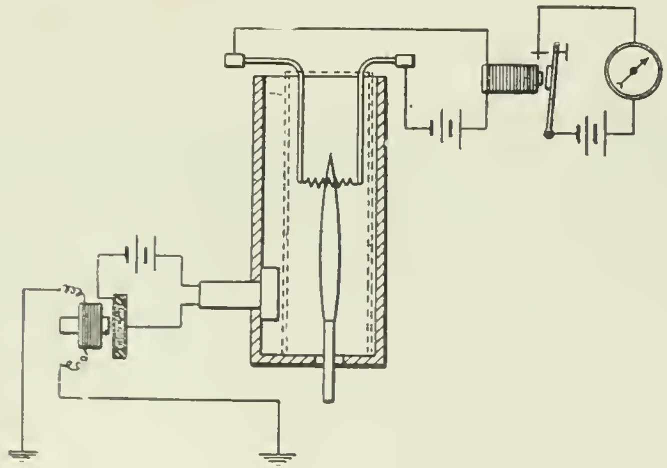


FIG. 2.—DIAGRAM OF CIRCUITS.

Now, experiment seems to show that the earth path for the current is not a direct line from ground *j* to ground *k*, but on the contrary the effect of the current variations is spread out over a large area almost as though electric ripples were sent out in all directions, these ripples being 180° apart in phase. Now, if a receiver be so grounded that the terminals are affected sufficiently and differently by the two ripples, then will the sound originally providing the ripples be heard in the receiver.

The inventors have not confined themselves exclusively to the field of telephony, but have devised an ingenious relay whereby sharp impulses of current may be received upon a telegraphic indicator or sounder. For such use the telephone transmitter is replaced by a telegraph key and condenser, while the telephone receiver becomes part of a receiver-microphone repeater affecting in its local circuit through a diaphragm chamber a sensitive flame. This flame when at normal length is in contact with a fine platinum wire, the hot resistance of which is sufficient to prevent the action of a relay or sounder in the circuit of which it is wired. When the flame becomes shortened from the action of the opposed diaphragm, according to its well-known property, the lessened resistance of the platinum wire consequent upon its being allowed to cool, permits sufficient current to flow to operate the sounder. Fig. 2 shows well the arrangement of circuit for such use of the system.

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Meeting of Indiana Bell Telephone Officials.

The annual convention of the managers and superintendents of the Cumberland Telephone Company in the Evansville district was held at Evansville, Ind., November 11. Assistant General Manager Leland Hume presided over the meeting and said the convention was being held for the instruction and benefit of the telephone business in general, and the Evansville district in particular, and that those present would be called on to tell of the conditions existing in their exchanges and territory in a straightforward, truthful way. He said he supposed many present had been reading the electrical magazines, which generally, for selfish reasons, exploited the development of the so-called independent companies, and said very little in favor of the Bell companies. He said some of the electrical journals were barren of that necessary ingredient, truth; but in this meeting he expected the facts to be told as well as the truth in all of its wholesomeness.

An interesting paper prepared by Superintendent Powell, of New Orleans, La., was then read. Mr. Powell discussed the situation in Louisiana and Mississippi and cited numerous instances of the failure of the independent telephone companies in these States.

The reports of the managers were next heard and in each instance the communication was highly satisfactory as to development, service and profitableness.

Mr. Hume made the principal address at the evening session. He complimented the managers present on the interest taken and said it was exceedingly appropriate to hold this convention in Evansville, as it was the birthplace of the Cumberland Company. He asserted that there was not a town or a cross-road in the entire Evansville district that the Cumberland Company does not reach. He claimed that in Southern Indiana the Cumberland Company was operating 10,650 telephones, against 4,250 by the opposition, this statement being borne out by the tax records. He charged telephone promoters as being largely responsible for all the friction in Evansville. He said there were numerous independent plants in Southern Indiana for sale, and that their managers had repeatedly tried to sell their property to the Cumberland Company.

Mr. C. L. Meyers spoke upon the "Methods of Opposition," and showed that he was familiar with the arts of successful telephone warfare.

Each session of the convention was well-attended and the proceedings were instructive. It is noteworthy in this connection that this convention was held at the same time and place as that of the Southern Independent Association, a report of which may be found on page 874.

Large Gas Engine Electrical Plant in Germany.

Great as is the interest at the present time in the steam turbine and its effect on the art, it may be safely said that the interest and importance of the gas engine are in every respect equal. If the steam turbine represents finality along its given line of thermodynamic development, then beyond the gas engine we may well look for glimpses of the gas turbine, but meanwhile the gas engine appears to have barely entered upon its career of possible development and utilization.

We have already from time to time called attention to and illustrated various gas engine electrical generating plants in this country and abroad, and are now able to note a very interesting and extensive plant of this nature in Germany.

The accompanying illustration, Fig. 1, shows the interior of the power plant of the mining and steel works at Gross-Ilsede, near Peine, Hanover. In this power house there are two units of 1,000 hp each directly connected to three-phase alternating-current generators which supply current for light and power. There are also at these works two blowing engines operated by waste blast furnace gases each having a capacity of 500 hp. These large gas engines are of the Oechelhaeuser type and were installed at the Bergbau und Hüttengesellschaft Ilseder Hütte by the Kölnische Maschinenbau-Actiengesellschaft of Köln-Bayenthal, Germany. Only one of the 1,000-hp units is shown in the illustration. The engines are of the double type, the revolving field of the generator acting as a fly-wheel and is located between the two sets of cylinders.

The accompanying drawings, Figs. 2 and 3, indicate the principle of working of the Oechelhaeuser gas engine and show the details of construction of a single engine and of a 500-hp Oechelhaeuser gas engine and generator at the works of the Deutsche Kraftgas Gesellschaft, of Berlin. This engine is constructed on the principle of a symmetrical arrangement of two plunger pistons working towards each other, each a simple cylinder which is open at both ends. These pistons shortly before reaching their dead points open successively the different ports, including the exhaust port, the port for rinsing the cylinder by fresh air and the gas inlet.

Such a large quantity of burned gases escape at first that the pressure in the cylinder sinks as low as the atmosphere; then the fresh air which enters blows out the rest of these gases through the exhaust pipe. A yielding cushion is thus formed between the hot exhaust gases and the fresh gas before the fresh supply enters and mixes with the air entering, forming with the latter the explosive mixture. The two pistons nearing each other then compress this mixture and it is ignited for explosion shortly before the end of the compression, thus driving the pistons from each other; and the operation is repeated, indefinitely.

In this engine the air and gas are supplied by a feed pump and are compressed in the receivers arranged around the inlet ports to such an extent that a sufficient rinsing of the cylinder is effected as well as a good mixing of the air and fresh gas. The number of revolutions of the engine and the power can be regulated in the same manner as is done with steam engines by means of a throttle valve. In this case the supply is regulated to the pump by a simple admission valve. It will thus be plainly seen that the cylinder itself has no valve operating during the piston stroke and the engine is thus greatly simplified.

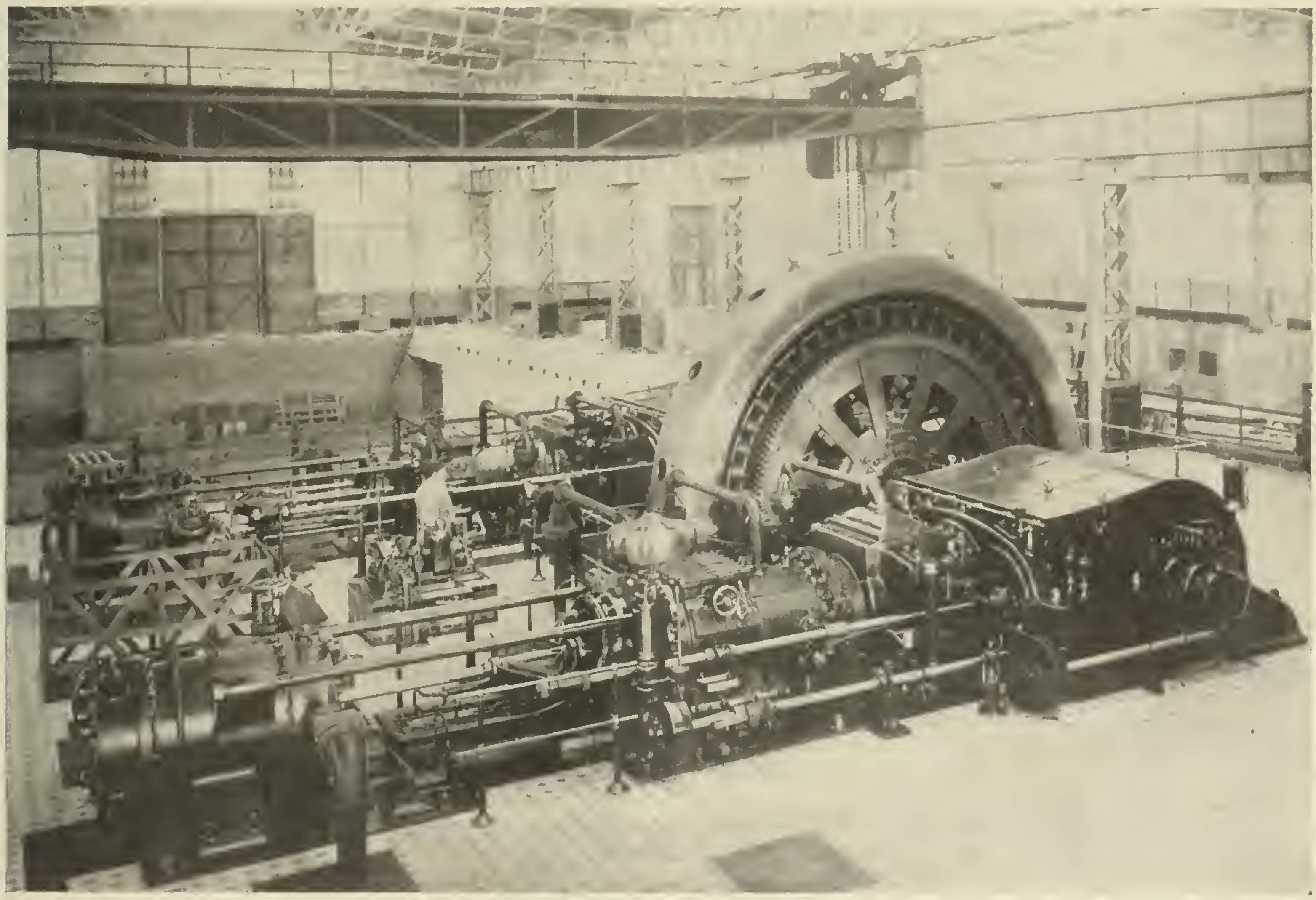
Fig. 1.—Interior View of Plant, Showing 1000-hp Gas Engine.

It will be noted that the working cylinder is arranged in its horizontal line in such a manner that it may extend freely without any alteration to that of the blowing cylinder. The working cylinder is fastened in the cooling mantle in such a way that its free expanding by the heat is secured, the cooling spaces also being brought close to the receivers for air and gas. The middle crosshead pin is not inside the working piston, but in a crosshead brought outside, which glides in a circular guide; and this pin is thus shielded from getting heated and is also accessible when desired.

Under the flooring the feed pump is arranged so that its piston feeds with the underside for the air and the upper one for the gas to the cylinder. The blowing cylinder is fastened to the end of the framing and draws in the cold air from the outside. The engine is started by compressed air stored in a receiver which is located under the flooring, and this is supplied by an electrically-driven pump, the electric motor for this outfit also serving to turn the engine into starting position. The gases are exploded by electric ignition.

A blowing engine of 800 hp capacity has a working cylinder 30¼ in. in diameter and a blowing cylinder 72½ in. in diameter, while the stroke measures 37⅜ in. in length. Such an engine is capable of compressing 17,662 cu. ft. of air per minute to a pressure of 7.7 pounds per square inch when working at a speed of 100 r.p.m.

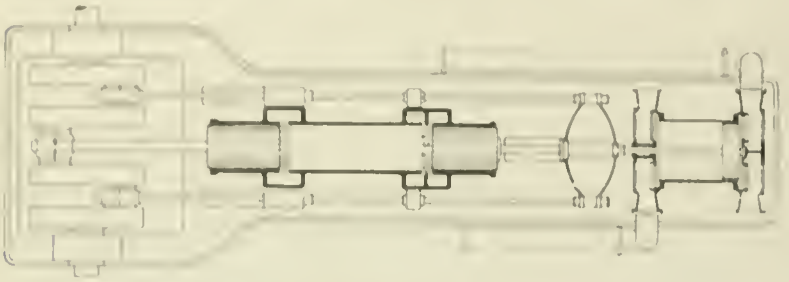
FIG. 2.—DIAGRAM SHOWING PRINCIPLE OF GAS ENGINE.

At the power house of the Südrussische Metallurgische Gesellschaft in Kamenskoje, Russia, there are three such 500-hp electrical gas engine units, and there are three 600-hp electrical units of this type at the Hörder Bergwerks und Hüttenverein at Hörde, Germany. Waste blast furnace gases, it is said, supply 1,000 hp for every 100 tons of pig iron produced when properly utilized in modern gas engines of large capacity.

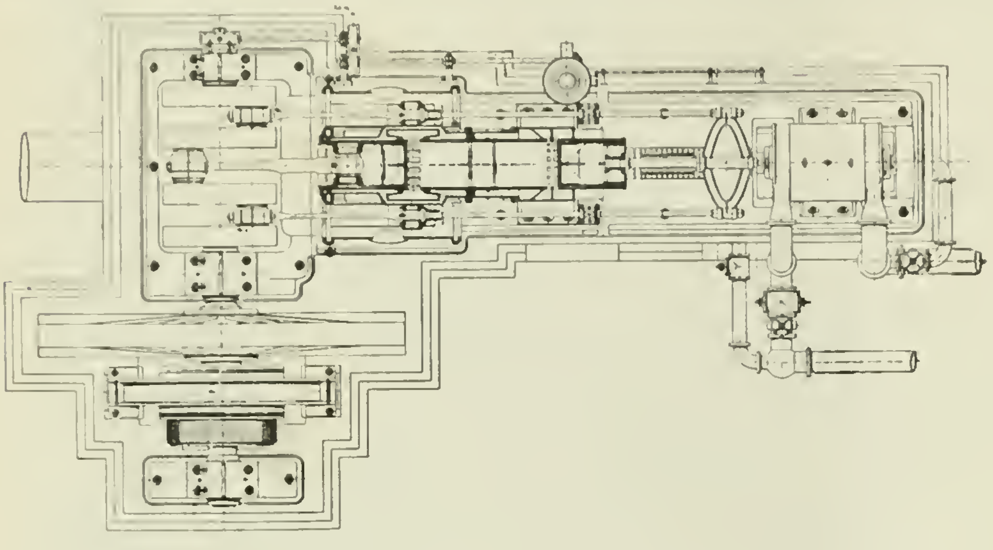
FIG. 3.—DIAGRAM OF 500-HP GAS ENGINE.

* * *

New York Electrical Society.

The 238th meeting of the Society will be held at the Hebrew Technical Institute, 34 Stuyvesant Street, Monday, November 30, at 8 p. m. Mr. W. D'A. Ryan will lecture on "Practical Problems in Lighting and Illumination." The lecture will comprise the most effective use of the various standard methods of lighting, arc, Nernst, incandescent, Welsbach and hydrocarbon, and their values and respective places in successful commercial illumination. The lighting of various kinds of mills, machine shops, iron foundries, ship sheds, the interior of steel ships under construction, stores and advertising displays will be exhaustively considered, and figures will be given for the most efficient illumination in different classes of work. The quality of diffusion will be specially commented on. For the purposes of illustration the stereopticon and blackboard will be supplemented by the use of a very elaborate collection of instruments, giving various phenomena of light waves, photometric light curves and interior illuminating effects, and introducing general engineering data. Owing to the variety of effects and current required, Secretary Guy had some difficulty as to an appropriate meeting place, but on inquiry it was found that the well-equipped Hebrew Technical Institute was fully adequate to the occasion; and thus it was arranged to hold the meeting there this time on the courteous invitation of the officers and technical staff.

Single Phase Motors for Traction.

A recent article by Finzi in the London *Electrical Review* on the use of single phase motors for traction should be interesting, since its author has recently been reported to have made successful trials with single phase traction in Milan on general lines somewhat similar to the method of Lamme, of the Westinghouse Company. The author believes that polyphase induction motors are unsuitable for traction work. While they are easy to build for high tension, they cannot well or economically work beyond narrow limits of speed, and three conductors for the current (or two if the rails are used for one), present an almost prohibitive difficulty. While this statement might appear to be too sweeping in view of the success of the Valtellina Railway, yet fitness of a system for a given industrial object, far from being proven by the success of any single plant, requires the extending of its application after the initial experiments. From this point of view, three-phase traction rather appears as a *tour de force* little inviting repetition.

Single phase induction motors are only satisfactory near synchronous speed, so that small industrial plants at a constant speed remain the only appropriate field. Mr. Finzi believes that the ideal case for electric traction is represented by the series motor with a variable voltage supply. Variable voltage can be obtained by very simple means in the case of single-phase alternating currents and only one trolley line is required with a rail as return. There is no objection to high-voltage supply since the voltage can be lowered by transformers on the train. The present single-phase traction motor of the author is the development of ideas formerly embodied in the marine type of the continuous-current motor of the Brioschi Finzi Company. Its characteristics are a laminated multipolar field core with longitudinally-divided poles, a small air-gap, low speed and a set of resistances connecting the armature windings to the commutator segments. The longitudinal division of the poles is believed to be fully as important as the laminating of the field, since it forms the simplest means to kill the reaction flux of the armature. Another less satisfactory system is to saturate highly the portion of the poles near the air-gap, which is accomplished in the Lamme single-phase motor through a number of holes in the poles. In this case the hysteresis loss is higher. Another system is to place short-circuited windings in the poles, or to use a symmetrically-distributed field winding supplied from opposite points and short-circuited at 90° from the points of supply. These subsidiary means again dissipate some energy, and leakage prevents them from attaining their end completely. Though the transverse flux is done away with, a greater difficulty remains; that is the sparking due to the short-circuiting (under the brushes) of the armature sections as secondaries of a transformer under the influence of the alternating-current-fed field poles.

The author says that his old direct-current marine motor already carried the best remedy that he knows to-day, i. e., the German silver resistances connecting the windings to the commutator enter each in its turn into their convenient short-circuit, so that the maximum current following is brought down to a lower figure. With a design giving a low-reactance voltage in the armature sections, and with an appropriate shape of the poles, this remedy allows good series motors to be designed for traction use, for frequencies of 15 to 20 or more, and for 100 to about 300 volts. The author discusses some objections which were recently made by Latour against the series alternating-current motor in general. He emphasizes that at the trials of his single-phase motor in Milan commutation was satisfactory at all speeds. Runs on the same conditions with direct current on a General Electric 52 motor did not show a better behavior at the brushes and the commutator of his motor did not require the smallest care through all the experiments. He points out that this result was obtained without any roundabout devices, simply by adequate design and the use of a suitable shape of the magnetic circuit and with the aid of those resistances between winding and commutator. While these resistances are in the single-phase motor higher than usual in direct-current machines, their presence does not appreciably lower the efficiency, because at a given moment the whole current either passes through two of them only or through two pairs of them. To have killed the transverse reaction simply by dividing the magnetic circuit—not through special windings or by short-circuiting the main stator winding in symmetrical points—does away with an ohmic loss and a non-symmetrical heating. His motor is said to have shown a power factor of 0.85 to 0.98 through a range of speed and voltage of 550 to 1,400 revolutions, and with 80 to 160 volts with the torque necessary for the equipment used. The author gives some criticisms of the Latour motor and then discusses the single-phase motor of the Wagner Company and its recent improvement by Schueler. The Wagner motor has a stator with a single-phase distributed winding, and a repulsion rotor with a short-circuiting brush-lifting automatic device that turns the system into a pure induction motor when the starting has been accomplished. The Schueler motor is based on the same principle, but the repulsion and the induction, instead of being clearly defined, cover each other mutually from the starting point to full speed, the only difference being in the moving part, which is an ordinary rotary converter rotor, with a three-phase starting rheostat connected to the slip rings and short-circuited brushes on the commutator side. Thus the commutator makes it a repulsion motor, less and less active from starting to full speed, while the rheostat makes it an induction motor, more and more active from rest to full speed. The voltage control in starting is deficient and requires complications in practice. The series single-phase motor at a constant voltage regulates its speed according to the load put on, the speed at high loads being inversely proportional to the load; it allows a voltage control without losses and with the widest speed limits. As against these advantages it cannot use high voltage directly and it is for the present bound to comparatively low frequency; but the voltage controller can be combined with the transformer and the other feature is only an obstacle when the use for traction of ordinary light and power plants is considered.

Recent Electrochemical Developments.

OZONIZER.

In these columns we noticed recently an improved form of the ozonizer and water sterilization apparatus, devised by Dr. Marius Otto, of Paris, France, who has been working in this line for a number of years. A patent granted to him on November 17 relates to an apparatus for providing small quantities of ozone from currents of low periodicity (not more than 100 periods per second). Such low-frequency currents, after having been raised in the transformer to several thousand volts, operate the ozonizer shown in the adjoining diagrams which give a vertical and horizontal section of the apparatus. A metallic cylinder, *a*, is divided into parts by vertical cuts and revolves around an axis. This cylinder communicates with one of the poles of the high-tension transformer. A thin glass tube, *b*, is covered on the outside with a metallic conducting layer, *c*, which is also divided into portions by vertical cuts and communicates with the second pole of the high-tension transformer. The air which is to be ozonized is drawn in by a ventilator through the orifices, *o*, and follows the course indicated by the arrows. The electric discharge leaps across annular space between *a* and *e*.

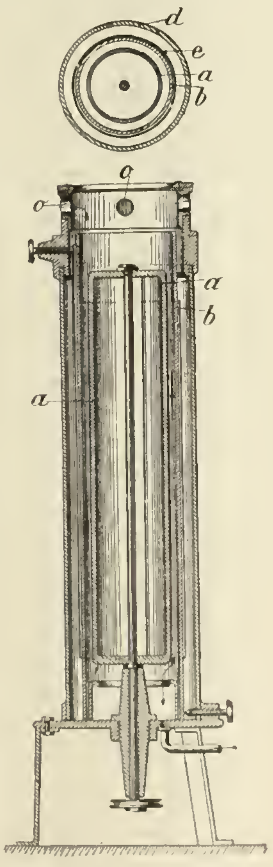

DIAGRAM OF OZONIZER.

SEPARATING OILY EMULSIONS FROM WATER.

The condensed water from steam engines contains oil in two forms, viz.: partly emulsified and partly free. Before it enters the steam boiler as feed water, the oil must be removed. The free oil particles are filtered off by ordinary filters, but the emulsified parts pass through any filter unchanged. For removing the same, the following electric method has been devised by Messrs. H. T. Davis and E. Perrett, of Lewisham, England. To improve the conductivity of the water which has to undergo the electric treatment, a small quantity of ordinary clean water or of a soda or potash solution is added to the emulsion. The water is then let into a vessel fitted with a number of suitable electrodes so arranged that the water is thoroughly stirred up. The current passing through the water has the effect that "the infinitely minute oily particles in emulsive condition are freed or let loose and unite simultaneously with infinitely small iron particles which separate from the electrodes." They are then in a condition to be easily removed by ordinary filtration.

ELECTROPLATING.

A patent granted to Mr. A. Darlay, of Paris, France, relates to a process for electroplating metallic objects without the use of an external source of current. The object to be plated is brought into contact with metallic aluminum containing a salt of the metal to be deposited. This arrangement acts as a short-circuited cell in which the aluminum is the anode and is corroded, while the metallic object is the cathode and receives the desired coating. He uses a solution of a chloride, cyanide or other compound of the metal to be deposited, containing ammonium chloride and an alkali, an alkaline phosphate or pyrophosphate, or an alkali metal cyanide. The continuous attack of the aluminum surface is assured by the alkaline character of the solution. The ammonium compound serves to improve the conductivity of the solution.

ELECTRIC BATTERY.

A patent granted on November 17 to Messrs. J. A. Lyons and E. C. Broadwell, Chicago, Ill., refers to a somewhat peculiar type of accumulator. If the chloride, bromide or iodide of lead, nickel, zinc, etc., is electrolyzed with a porous carbon anode, the metal is deposited upon the cathode, and the chlorine, bromine or iodine is absorbed by the porous anode. This porous carbon plate is either made by cementing it together in such a way as to leave it very porous throughout, or by filling granular carbonaceous material into a suitable retaining wall of cloth asbestos. Such a porous carbon electrode is stated to be able to condense and retain within its pores about 200 times its volume or three-fourths of its weight of chlorine gas and a larger quantity of liquid bromine. In this condition the cell is in the charged state. When discharging, the metal is dissolved from the other electrode, and the chlorine or bromine goes back into solution from the carbon plate, so that the original chloride or bromide is formed back.

MISCELLANEOUS.

In recording electric meters the change of friction between the commutator and the brushes during use may become a serious matter. In a patent granted on November 17 to Mr. C. H. Ingalls, of Danvers, Mass., and assigned to the General Electric Company, a method of treating the surface of the commutator and the brushes is described which prevents a change of the friction during use. The inventor applies to the surfaces in question a solution of a sulphide or polysulphide, which will act on the metallic surface in such a way that it will not thereafter be changed by the action of the atmosphere. Furthermore, so far as the commutator and brushes enter into the proper running of the meter, their condition will remain stable, and the accuracy of the meter, particularly on small loads of 5 per cent and beyond the rated capacity of the meter, will be found more reliable than with meters in which the commutator and brushes have not been thus treated.

A patent granted on November 17 to Mr. H. Campbell, of Melrose, Mass., refers to mechanical details of a magnet designed for use in connection with apparatus for the magnetic separation of ores.

German Telephony.

A cable dispatch from Berlin of November 20 to the newspaper press says: "Naval designer Zopke reported exhaustively on the uses of the telephone at sea before the Shipbuilding Technical Society recently and exhibited a new stentorian microphone, whereby a commander is able to give audible commands to the crews of six guns simultaneously. The instrument at the same instant is susceptible to the faintest sounds, and experiments are being made in the detection of the approach of ships not yet visible, by placing the instrument under the water. Designer Zopke also gave a demonstration of new fortification instruments, notably a call apparatus, which is as loud as a trumpet. The audience displayed special interest in explanations of Elisha Gray's telautograph and in the wireless telephone experiments of Prof. Simon, of Göttingen."

New Telephone Patents.

SELF-RESTORING PROTECTOR

Recently a great deal of ingenuity has been displayed in the design of "sneak current" devices, which do not become permanently injured when operating to open or ground the circuit, but which on the contrary use the very heating in response to which they operate to reset the device for future operation. The latest type of such device is shown in Fig. 1. The detailed design is best seen in the sectional view. This is a horizontal section, and shows within a closed chamber a thermal device such as a carbon rod, which forms part of the circuit to be protected. One end of this rod extends to a metal button, while the other connects with two extension plates between which is soldered a U of sheet metal. The ends of the legs of the U are flared to engage normally the corresponding line spring, which spring tends naturally to pull away from the cut-out. When such a current passes that the heating of the graphite rod melts the solder the legs of the U momentarily deflect and release the line terminal to open the circuit, and then, assuming their normal positions become resoldered as the device cools. Mr. Otto Hoffman, of Chicago, is the inventor of this protector.

A second protector recently patented is of the open space type and is designed for use at subscribers' stations. This is the invention of W. L. Ralston, of Westchester, Iowa, and consists of a pair of carbon blocks and mica separator upon a new and suitable mounting.

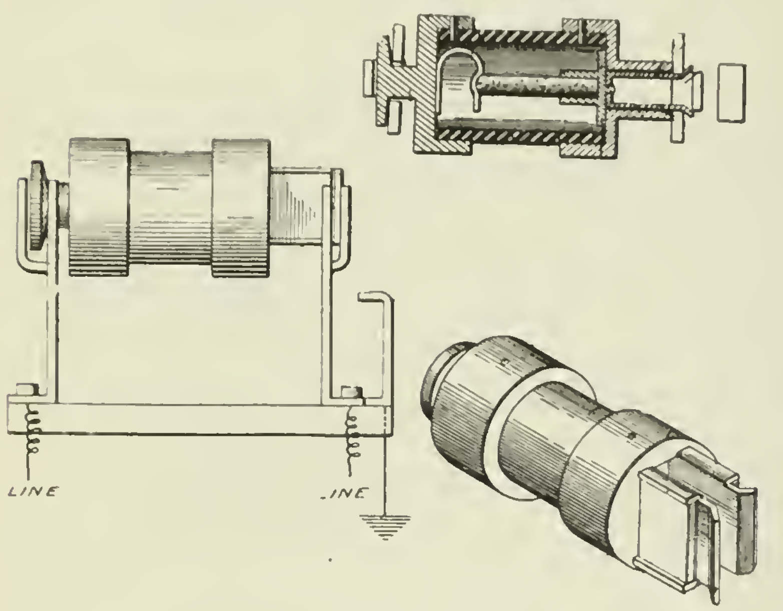

FIG. 1.—CIRCUIT PROTECTOR.

ANTISEPTIC DEVICES.

Two more antiseptic devices have made their appearance as the subjects of patents granted respectively to Messrs. W. Griffin, S. Sanker and B. Keith, of Riverside, Cal., and to H. L. Cutter, of Los Angeles. The device of the latter is a suitable mounting carrying a roll of paper adapted to be gradually drawn across the mouthpiece as desired. The paper already having done service is stored in a roll about a spindle which serves as the driving mechanism.

The other device consists of a metal extension for the mouthpiece, which contains an annular chamber in which may be placed wicking soaked in antiseptic solution. The communication between the mouthpiece and annular chamber is a series of small apertures adapted to be closed if so desired by a slight turn of the mouthpiece.

SELF-RESTORING, INTERCOMMUNICATING SWITCH SYSTEM.

Messrs. T. J. Seely and C. Hemsing have devised a self-restoring, intercommunicating switch wherein the individual line switch members on being depressed to their fullest extent engage a ringing busbar. On being released, a tilting bar acting at once as a latch and as a telephone contact, restrains a returning line spring until the rocking bar is tilted either by the depression of a second line spring or by the return of the receiver to the hook-switch.

SIGNALING A MOVING TRAIN.

Another recent patent covers a system of signaling moving trains. In this system a series of short conductors, all wired to the same line wire, are arranged upon poles at suitable intervals along the track. Each locomotive carries a contact adapted to engage the distributed contact. When it is desired to signal a train the operator, through a switchboard, puts grounded battery upon the line so that as soon as the locomotive makes a passing contact with it an electromagnetic device will cause the sounding of a whistle in the cab. The engineer will then bring his train to a stop at the next stationary contact and with a telephone outfit, of which the signaling device forms a part, call up and ask for orders. Messrs. J. A. Whyte and G. C. Edwards, of Toronto, Canada, are the joint patentees of this system.

New York Meeting of the A. I. E. E.

The monthly meeting of the American Institute of Electrical Engineers was held on November 20 at the Carnegie Music Hall, New York City, when two papers were presented, one on "The Electrical Conductivity of Commercial Copper," by Mr. Lawrence Addicks, and the other on "The Comparative Behavior of Floating and Booster-Controlled Batteries on Fluctuating Load," by Mr. Lamar Lyndon.

In the paper by Mr. Addicks, consideration was first given to the influence of chemical impurities on conductivity, and the physical characteristics were next taken up. Diagrams showed the relation between arsenic or antimony and conductivity, and between suboxide and conductivity in annealed wire. In regard to physical characteristics, Mr. Addicks discussed wire drawing, or the variation of conductivity with hardness, the effect of temperature in the annealing operation, etc., and curves also illustrated these points; although the conclusions to be formed were not very clearly brought out. Half-tones were shown of microphotographs of samples of good cast copper, as well as of "burned" trolley wire. The author remarked: "In cast copper we have a conductivity resulting from the combined conductivities of the pure copper grains and the impure matrix or cement. When this is rolled the structure is broken down and the complex shunt and series circuits are rearranged to better advantage. When hard-drawn, the molecular freedom is restrained and more work has to be done in the necessary oscillation of an atom in passing a charge on to its neighbor. In annealing, the wire is brought to a temperature at which the cement is softened and all internal strain is equalized. In burning, crystalline growth is started and reverts the metal to the original condition."

In discussing this paper, Mr. F. J. Newbury, of Trenton, said: "In regard to specifications for copper I had, about two hours before I came here, a question submitted to me by an engineer who wished to use copper strands for conducting currents of high tension, and he was trying to get some specifications that would apply to such copper strands. He wanted 00 copper strand. He wished to make up his specifications based upon the resistance per mile to the strength of that strand. I took the position that I would be pleased to make his specifications based upon the character of the individual wires of the strand—if such wires are hard drawn they have a strength of about 60,000 pounds per square inch, and should have a conductivity of 97 per cent., according to Matthiessen's standard. But when you strand them the resistance of the strand is not the same as the resistance of a copper wire of equal weight per foot—the resistance of such a strand is increased by about 3 per cent., apparently about the amount taken up in the twist. In other words, the measured current seems to follow the individual wires instead of passing freely along a line parallel to the axis of the strand, so that when you specify the resistance of the strand you are getting into a very uncertain thing, depending on the lay of the wires as well as on the conductivity. In the same way, when you go into the strength of the strand, you are getting into something that is very uncertain. The strength of the strand will be about 90 per cent. of the strength of the individual wires composing it. In a great many cases in specifications we find as manufacturers that this matter is true, that people specify the properties belonging to the strand when we believe it would be much better and simpler for them to specify the properties belonging to the individual wires composing the strand. The instruments now available for measuring the conductivity of copper wires take lengths of two to three feet and measure within one-tenth of one per cent. The testing of the strength of individual copper wires is a very easy thing, and so along that line of specifications it seems to me that the only way for you, as engineers, to specify is to specify the strength and conductivity of individual wires, and this applies, of course, most strongly to the strength. I think that is possibly all I can say to you in this respect, except that commercial copper as it runs these days comes very close to 100 per cent. conductivity, according to the tables published by this Institute, and that in strength it varies from 52,000 to about 65,000 pounds to the square inch, depending upon the reduction in drawing; 68,000 pounds is the maximum that can be gotten out of copper wire and is only done by careful manipulation; 60,000 pounds to the square inch, for ordinary masses, is a very fair specification to make."

Mr. Lyndon's paper may be said to have dealt with a specific case of battery use, as indicated by its title, or one set of conditions, involving also the use of the battery, or its function, in the station as different from its function on the line; as for example, in relieving the strain on the generators under fluctuating loads. The paper was very elaborately illustrated with curves and was an excellent treatment of its topic, occupying some 32 pages of printed matter and diagrams, to which the reader may be referred.

The discussion was rambling, but quite interesting. Mr. J. R. Appleton spoke of a recent instance in Oakland, Cal., where they have recently built a railroad in connection with a new ferry line in San Francisco. They run three and four-car trains, and there are periods during each hour when the load is entirely off the station. The station equipment is one 600-kw, and one 850-kw generator, both direct-connected to Corliss type low-speed engines. Before the battery was in operation it was absolutely necessary to have a man at the throttle of each engine to regulate the engine when the load went off the station entirely. Now, with the battery in, the 850-kw generator maintains a load between 700 and 800 amp. all the time, with swings up to 2,600 amp. on the station. This practically maintains the load absolutely constant on the generator, no strain at all, and leaves the 600-kw generator as a spare. That was a good example of what the battery would do under those conditions.

Mr. Hubbard remarked that the proper thing to do is to design the battery in such a way that should the entire load go off the station the battery will still continue to charge. Mr. J. L. Woodbridge emphasized the difference between the function performed by the battery at the station and that performed by the battery on the line. "These two are so widely different it is almost impossible to get the results from a station battery that you want on the line, and you will not get from the line battery the results you desire to get from the station battery. If you want both results it is almost absolutely necessary to put in both installations. The station battery will steady the load on the plant, but will not give you any improvement on the voltage on the circuit any distance from the power plant. On the other hand, the battery out on the line usually regulates so small a portion of the load, being connected with one of the feeders, it has a very small effect in regulating the load on the station—usually a very small section of the whole system is controlled by the battery that is floating on the line, so that the only purpose of installing a battery at a distance from the power house is to maintain voltage at that point near its average, and prevent it from going to the low minimum voltage which occurs sometimes without a separate insulation."

Prof. Goldsborough, Mr. C. Blizard and Mr. J. W. Lieb also discussed the paper in general terms, the latter laying stress at some length on a point rather outside the topic, but still important, namely, batteries in central stations, and floating on the system in parallel with the exciter sets to insure constancy of field excitation. Mr. W. W. Donaldson took up a pithy phrase of Prof. Goldsborough as to "efficiency of equalization," and said: "There is one question which Prof. Goldsborough, in speaking of what he terms 'efficiency of equalization,' has suggested to my mind, and that is what I call the 'diurnal activity' of a storage battery on fluctuating railway loads. Taking the kilowatt capacity of a battery at the one-hour rate of discharge as a basis, a wattmeter placed in the battery circuit and controlled by a polarized relay, so that only the discharge will be recorded, will show at the end of the day what work has been accomplished by the battery, or its 'diurnal activity.' This record will not be a direct indication of the efficiency of regulation, but will show positively the extent to which the capacity of the battery has been utilized. In a paper which Prof. Goldsborough read before the Institute meeting at Niagara last spring, and which embodied the results of tests on the sub-station batteries of a Western road, he gives figures from which may be calculated the "diurnal activity." On five sub-stations this varied from .85 of one to two—or in other words, the battery which did the least work, showed an output of only 85 per cent. of its capacity at the one-hour rate during a day's run, and the best showed that it was discharged twice during the same period. Prof. Goldsborough said there was evidently 'something doing' in the latter case. To my mind, a battery properly proportioned to the load and with an efficient booster, should do much more than was shown by any of the plants alluded to. The more work you can do with a battery above zero, the more you are getting for your money. If a battery discharges up to its hour capacity once a day, it is doing a certain amount of work, but if it discharges three or four times a day it is doing proportionately much greater work. This question of "diurnal activity" has not been given the attention it should receive."

As to the use of batteries in central station, Prof. Goldsborough told the following story: "Mr. Lieb very justly mentions the importance of the storage battery in connection with large communities relying upon a central generating plant for service. That point was very strongly brought out in connection with an occurrence in Chicago which involved the exhibition of a considerable amount of nerve on the part of the president of the Chicago Edison Company, Mr. Insull. It occurred this way: Before the Chicago Edison Company installed a very large storage battery in the downtown section, and when they depended very largely on the Harrison Street station for serving that district, something got wrong with the pumps in the Harrison Street station one night. The force there handled the situation as best they could and made every endeavor to get the pumps back in motion to start water into the boilers again. They lost control of the plant and the water got so low in the boilers they became alarmed and pulled the switches, and all that portion of the city was in darkness. Mr. Insull happened to be in a theatre downtown, and, groping his way out, made for the Harrison Street station. He got his men to work with lanterns, and they finally got the pumps in such condition that water again began to flow into the boilers and things were ready to start up. The question came up of starting that great system, when Mr. Insull knew that every light in the city was turned on. After the engines were started they got the switches arranged in the proper position for quickly throwing them in. All the attendants at the station went outside and Mr. Insull took a long bar, and when he got himself properly poised, with one motion he threw every switch in and put every generator into parallel. The generators fortunately took the load and nothing happened. I think any one of us would appreciate that that was a moment when it required considerable nerve to start the machinery. With a storage battery that thing could not have occurred. If the Harrison Street station shut down to-night, the storage battery would take care of the load without trouble. That is exactly what the storage battery means. We know that we must have our stations equipped so that such a thing as having a great city in darkness cannot occur."

CURRENT NEWS AND NOTES.

LAMME SINGLE-PHASE RAILWAY SYSTEM.—A car equipped on the Lamme single-phase railway system has been in experimental operation for some time on a short line of track at East Pittsburg with excellent results. One of the noticeable features of operation is the smoothness of acceleration, there not being the slightest inconvenience to passengers in attaining a rate of 1½ m.p.h. per second, or in slowing down at a corresponding rate. But a faint trace of sparking is evident at the brushes at any speed. Owing to the shortness of the line, the highest speed at which the car is exhibited is 45 miles per hour; but it is capable of a speed of 60 miles per hour. The line voltage is 1,200.

A. S. M. E. MEETING.—The American Society of Mechanical Engineers will hold its forty-eighth annual meeting in New York City December 1-4. President J. M. Dodge will deliver an address on "The Money Value of Technical Training." Among papers to be presented are the following: Prof. J. E. Sweet, "What Are the new Machine Tools to Be?"; Mr. F. A. Scheffler, "Suggestions for Shop Construction"; Mr. F. B. Perry, "Method of Determining Rates and Prices of Electric Power"; Mr. L. A. Gillet, "Three and Four-Wire Multiple Voltage Systems"; Prof. D. S. Jacobus, "Test of a Compound Engine Using Superheated Steam." A number of trips and visits to electric power plants are included in the programme, as well as a conversazione at Sherry's on December 3.

MUNICIPAL OWNERSHIP.—There is apparently a strong reaction in England against the idea that the State or the municipality must do everything. An evidence of this is the fact that E. P. Dutton & Co. are publishing this week a book entitled "Municipal Trade: The Disadvantages Resulting from the Substitution of Representative Bodies for Private Proprietors in the Management of Industrial Undertakings," by Major Leonard Darwin, author of "Bimetallism." This work is historical as well as critical.

VIENNA MOTORMEN'S OATH.—The following is, according to the *London Morning Advertiser*, the text of the oath administered to men who accept service on the Vienna municipal tram cars: "I swear on my word of honor to be faithful and obedient to His Majesty, Imperial, Royal and Apostolic, Francis Joseph I., as well as to the successors of the eminent house of Hapsburg-Lorraine, and to contribute with all my strength to the honor and profit of the city of Vienna. I further swear on my word of honor that I do not belong, or will belong, to any party which pursues republican tendencies, or to the enemies of Austria." Where does the public welfare come in under this arrangement? Here it is Parks instead of Francis Joseph.

REFLECTOR INCANDESCENT LAMP.—Mr. Clarence A. Crane, of Warren, Ohio, has patented an incandescent lamp with a reflector built into the cap end, with the idea of converting the usually hidden, or dark space, into an illuminating and radiating area, as is already done with various styles. In making this lamp he introduces the tubing from which the reflector is spun, before inserting the glass stem and filament, and spins the reflector within the bulb to fit the sides, which can be easily and quickly done with a proper expanding spinning tool. The lamp is then completed in the usual way. To offset any tendency of the reflector to work down by loosening, a small quantity of cement within the neck will hold it in place. In another form of this lamp the reflector is affixed directly to the entering stem holding the filament ends and is split on radial lines, so as to be compressible for introduction through the neck of the bulb. On account of its springiness, it spreads out to its proper position and holds a reflecting position over the filament. In yet another form it is split lengthwise so as to secure compressibility for entering the neck of the bulb.

SUBMARINE SIGNALING.—We have already illustrated and described in these pages the work of Dr. Elisha Gray and his associates in connection with the electrical ringing of bells for submarine signaling. A patent has just been issued to him on the subject, for which the application was filed in 1900, and which is assigned to the Submarine Signal Company, of Boston. Hitherto all attempts at ringing submerged bells by the direct blow of an electrically-actuated hammer have been undertaken by enclosing the whole apparatus in an air-tight chamber so that the vibrations of the bell were deadened and very few of the impulses were conveyed into the water. As our articles have already explained, in the Gray system the bell and bell hammer are divested of coverings of this character and are submerged directly in the water; while the electrical operating mechanism for actuating the hammer is contained in an air-tight chamber placed above the bell, but which may also be submerged. This bell can, of course, be controlled from a distance and the bell hammer may be of considerable size and power, giving "great initial sound-producing capacity for long-distance submarine wireless telephony."

RAILWAY MORTOR CONSTRUCTION.—A patent issued to Mr. George Macloskie, of Schenectady, and assigned to the General Electric Company, deals with the construction of street railway motors. As built hitherto the armature core laminæ have consisted of flat discs. As a consequence, there has been considerable lost space between one end of the core and the commutator; while at the other end of the core the space has been overcrowded. Hence, the journal bearing at the pinioned end of the armature has been so restricted in length as to heat very easily, while the ventilating air passages were throttled, so that the efficiency of the motor has been lessened. Mr. Macloskie presses the core laminæ into cup shape, and assembling them so that their central portions will project into the space beneath the ends of the armature coils at the commutator end of the armature; while at the opposite end of the core a cavity is provided for the reception of the extended journal bearing, permitting also of the free flow of air between the end of the core and the bearing. This invention is applicable also to dynamos and motors wherein a central hub sleeve or spider is employed for supporting the laminæ.

ELECTRIC LOCOMOTIVES.—A couple of patents granted to William Dalton and Francis J. Cole have been assigned to the American Locomotive Company, of New York, the object of these inventions being to provide means whereby electric locomotives can take curves of short radius without an independent guiding truck or liability to derailment; referring particularly to locomotives of the type in which a motor is supported at one end upon the driving axle to which its power is transmitted through gearing, and is supported at the other end upon the frame of the locomotive. The broad idea is presented in the first claim of one of the patents which runs as follows: "In an electric locomotive, the combination of two main supporting frame sections, driving axles journaled in bearings in said sections, two electric motors, each supported on one of said sections and adapted to rotate one or more of the driving axles thereof, a vertical coupling pin by which said sections are connected with the capability of relative horizontal movement, and a cab-supporting frame secured rigidly to one of said sections and supported, with the capability of relative horizontal movement, upon the other section." By means of this coupling pin the useful effect of a special radial truck is obtained, while avoiding the use of radius bars.

LIGHTNING ARRESTER.—Mr. Henry E. Raymond, of Schenectady, N. Y., has secured and assigned to the General Electric Company a patent on lightning arresters. It is an application of what he claims to be his discovery of the fact that the tendency of a lightning charge to jump an air-gap is increased by an increase in the extent of the surfaces of the electrode dischargers, which are exposed to each other. These increased surfaces also serve to convey away quickly from the dischargers and the air-gaps the heat generated by the lightning. Mr. Raymond embodies this invention in the standard form of arrester with a non-inductive resistance in series with the air-gap to prevent the line current from continuing the arc formed by the lightning discharge. His drawings show the metallic dischargers of cylindrical form mounted in connection with conducting strips and non-inductive resistances placed in series with the line and supported in the usual clips or brackets. A lightning discharge flowing along the strips will have four contemporaneous paths between the dischargers, the peculiar arrangement of which provides also a very large effective area of spark-gap; while it is believed that a capacity or resonant effect is created which serves to assist the discharge. All the dischargers are rotatable about their axes, and of course the number need not be limited to four.

LETTERS TO THE EDITORS.

Testing Alternators Under Full Load Conditions.

To the Editors of Electrical World and Engineer:

SIRS:—Permit me to comment in a few words on the paper of Mr. W. L. Waters, which you were so kind as to send me. Mr. Waters says: "In ELECTRICAL WORLD AND ENGINEER issue for October 31, Mr. B. A. Behrend describes a modification of the Mordey method of testing large alternators on full load. While advocating the method of connecting the field coils in two groups so that the e.m.f. induced by one group opposes that due to the other, Mr. Behrend does not bring forward any experimental evidence to show that the results as regards heating, efficiency and regulation have any claim to accuracy." Mr. Waters informs me that he wrote these lines before he saw the second installment of my paper in your issue of November 14, in which I gave tests which corroborated the accuracy of the improved method which I described in regard to the heating and the regulation of alternators. I have repeated these tests on a number of machines, and I have found them very accurate. I wish to call attention to the curves in the issue of November 14, which seem to me to give very good results. In these tests it was not necessary to bolt down the machine carefully, as there was no jar nor vibration.

In regard to the method recommended by Mr. Waters and also in the editorial of October 31, I should like to remark that if a heat run of a polyphase alternator is made by putting direct current through the armature with the fields in opposition, the magnetic field set up by this direct current in the stationary armature is itself stationary, and, therefore, the revolving field cuts through it at a speed which corresponds to the full frequency. If the revolving field is supplied with damping circuits, or if the field coils rest against collars made of metal, the eddy currents in these damping circuits or collars are so large that they not only vitiate the results of the test, but they also lead to a considerable increase in driving power. It seems to me that as long as a simpler and much more logical method can be used, this method of using direct current is far-fetched, inaccurate and inelegant. The tests which Mr. Waters describes were all carried out with the Mordey method, and had he tried the improved method recommended in the article of October 31, he would have found satisfactory agreement between this method and the usual way of making the regulation test on a low power factor.

South Norwood, Ohio. B. A. Behrend.

Metric System and Foreign Trade,

To the Editors of Electrical World and Engineer:

Sirs:—On page 398 of your issue of September 5 you make the following statement: "Setting aside the matter of the intrinsic merit of the metric and English systems, the fact remains that the latter is a handicap to our foreign trade, and to study and research in the engineering and scientific literature of the continent." By this I surmise that you take your stand upon the so-called "foreign trade argument" as the rock of salvation for the metric system, and I, therefore, take the liberty of saying a few words on this subject, particularly in view of some new and very interesting, and to you, I am sure, quite acceptable evidence which has just come to light. I refer to a document just published by the French Society of Civil Engineers, consisting of replies to a certain series of questions, which was submitted by the American Chamber of Commerce in Paris. The replies to these questions were undertaken by a commission composed of seven prominent members of the society, all, of course, thoroughgoing metricists. There are thirty of these questions, but I will quote here only those which concern immediately the argument in question, and the answers given.

"*Question* 18.—Has the use of the *bushel* in the United States ever had any influence on the total importations of cereals into France, and why?

"*Question* 19.—In like manner, has the use of the *gallon* in the United States been the cause of any diminution in the importation into France of petroleum, oils, wine, alcohol and other liquors, and why?

"*Question* 20.—Similarly, has the use of the *pound* in the United States had any influence on the quantity of cotton, copper, coal, etc., imported into France?

"*Replies* 18, 19 *and* 20.—It is difficult to reply to these three questions. All the products measured by means of the bushel, gallon and pound are the object of important transactions which always arrive in complete cargoes. The calculations for the conversion of these units into metric units are not then everyday calculations, and are effected but once for considerable quantities. This question of unity of measure is, therefore, certainly less important in these particular cases. The conditions of price and quality outweigh all others.

"*Question* 21.—The machine tools, locomotives, typewriters, bicycles, etc., manufactured in the United States, are constructed with the aid of English measures. It is fair to say, in so far as concerns most particularly machine tools, that certain members, such as leading screws and verniers, are constructed according to the metric system when the machines are destined for France. Has the fact that all these machines are, aside from this detail, constructed with English measures ever influenced their importation into France, or compromised in any manner whatever their efficiency and their output in French factories?

"*Question* 22.—Supposing for the moment that American machine tools were completely drawn up under the metric system, would there result any increase in the number imported into France? Would France have used more machines than she has used during the last five years on this supposition, or supposing that the general adoption of the metric system by the United States was an actuality?

"*Replies* 21 *and* 22.—So far as concerns small machine tools, apparatus, such as bicycles, typewriters, etc., which are sold by the piece, the question of the unity of measure is of small importance; however, so far as concerns typewriters, American constructors have been obliged to combine the keys of the apparatus in such manner as to satisfy the necessities of the French language. . . .

"*Question* 23.—Is it not reasonable to admit that the choice of machine tools is dictated only by the practical considerations of output, efficiency, price, time of delivery, etc., and independent of the system of weights and measures utilized in their construction?

"*Reply* 23.—Although the choice of machines is dictated by practical considerations of output, efficiency, etc., and the United States appear to combine advantageous conditions, we have just stated that countries employing the metric system seem to apply by preference to countries whose system of measures is in harmony with theirs, etc., etc.

"*Question* 24.—Can it be admitted, on the other hand, that the United States would import from France a greater quantity of silks, feathers, leather, machines, musical instruments, optical instruments, instruments of precision, wines, automobiles, etc., if France used the English system of weights and measures? Is it not logical to recognize that the importance of products imported from France into the United States is entirely independent of the system of measures employed in the two countries, and depends exclusively on quality, output, adaptability, price and time of delivery of these products and conforms to the general law of supply and demand?

"*Reply* 24.—The system of measures employed, whatever it may be, is evidently without effect on the products to which these measures have no application, such as silk, flowers, feathers, confectionery, etc.

"Whatever may be the system employed, France cannot pretend to export to the United States anything but products whose conditions appear favorable to the latter country. France will be subject to the effects of the law of supply and demand; the effects of this law are largely influenced and often obscured on the American market by the action of prohibitive tariffs, etc., etc.

"*Question* 25.—From this point of view, can it be affirmed that the importance of the commerce between France and the United States would have some chance to grow under the hypothesis that the United States adopted the metric system, or France the English system of weights and measures? If the reply is affirmative, under what conditions would this increase be produced, and why?

"*Reply* 25.—The replies to questions 18, 19, 20, 21, 22 and 23 reply to this question."

Here you have a simple and direct interrogatory put from the American side, and containing all the points which are of interest to American manufacturers, so far as concerns foreign trade; and there you have the answers of this eminent body of French engineers in cold type. What more can be said on the subject? It is plain from these answers that in not one case, which is of the slightest importance to United States manufacturers, would the adoption of the metric system have any appreciable effect whatever as regards France, and the same can be said of any other country. The fact, then, which remains is not, as you say, the "foreign trade argument," but that this so-called argument is a product of the imagination of the people engaged in promoting the metric system. It seems a pity to use this venerable spook, which has done business for half a century, so harshly, but is it not about time to lay it in its grave?

If the prometric people wish to convince American manufacturers that they need the metric system in their business, they will have to begin with some other stock in trade than the "foreign trade argument." I cannot help making the following further reflection, as it seems so extremely pertinent to the occasion, and calls itself so prominently into view: America produces more steel, more copper, more cotton, more machine tools and more agricultural machines than all the rest of the world put together; and more coal, iron, textiles, cereals and many other classes of commodities than any other country. The value of her manufactures is triple that of all Europe put together, and the clearing house exchanges at New York are double those of London.

Mr. S. S. Dale, editor of the *Textile World Record*, writes me: "The manufactured silk products of the United States is larger than that of any other country. The American textile industry, particularly the cotton branch, is growing by leaps and bounds, while the industry in other countries is stationary, or increasing very slowly. The English system of weights and measures is the standard for numbering cotton yarn throughout the whole world, except France, and the French use a system that is not metric." Will some one on the other side please explain how such things can coexist, for on the metric theory it is an impossibility?

Under these circumstances is it not somewhat ludicrous, to say the least, to talk about running after a country of diminishing population and increasing debt, like France, to get a theoretical advantage for which nobody who is responsible for these great sources of wealth has any use? Why should the mountain go to Mohammed? In this calculation we have left out Great Britain altogether, and the comparison would hold true even were Great Britain a metric country; but the talk about the possibility of Great Britain "adopting" the metric system there, governmentally or popularly, is pure out and out rubbish. Even were the government to adopt it, the people never could be got to do so, and even were the people to adopt it, the government certainly would not do so until fifty years afterward. This matter has been so clearly shown from the discussion in England relative to decimal currency, a brief history of which I have given in my paper on the metric system (*Trans.* A. S. M. E., December, 1896), that nobody who is capable of comprehending the meaning of history can have any doubts on the subject.

MILWAUKEE, WIS. GEORGE W. COLLES.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Direct-Current Dynamo Design.—POOLE.—A paper discussing a method of predetermining direct-curent dynamo or motor characteristics with regard to sparkless operation, and also a system of designing applicable to a complete line of mechines of a given type or class. The author advocates the application of the ratio between the e.m.f. induced in a coil and the reactance e.m.f. of the coil during commutation as the criterion of sparklessness, and describes his method of arriving at these two values. The reactance e.m.f. is deduced according to the method of Hobart and Parshall; the e.m.f. induced in the coil by the field flux during commutation is approximated on the basis of the average flux density over the pole face, with a correction for the effect of the cross ampere-turns on the armature. The method applied to the designing of a full line of machines consists broadly in expressing as many variable factors as possible in terms of the armature diameter; the magnetic density at the pole face is made proportional to the 1/6 power of the armature diameter, the speed to the 2/3 power, the air-gap length to the 5/6 power, and so on. This method works out to the simple formula, $Kw = 0.022\ D^{1.5}\ LpP$, D being the armature diameter, Lp the axial dimension of the pole face and P the number of poles. The paper contains too many formulæ and tables to admit of abstracting them. —*Jour. Frank. Inst.*, November.

Weight and Cost of Electric Machines.—BRESLAUER.—In a review of progress in electrical engineering, the author shows that the weight and price of electrical machines have been reduced now to nearly one-half what they were seven years ago. Fig. 1 gives the results for machines built by a German manufacturing company. The curves I and I' give the kilograms per kilowatt in 1896 and 1902, respectively, each scale division of the ordinates representing 10 kg. The curves II and II' give the price in marks per kilowatt, each scale division of the ordinates representing here 10 marks (or $2.50). All figures have been reduced to a uniform speed of 1,000 r.p.m. It will be seen that with modern machines the same power is obtained with only one-half weight compared with 1896. It will also be seen that the price has been reduced very considerably in the same time. This change is due to refinement of design and not to any radical changes. Radical changes have, however, been introduced recently, especially by Behn-Eschenburg, Fischer-Hinnen and Deri, who remove armature reaction and field distortion in direct-current machines by means of compensation windings. The importance of this invention is said to be evident in its application to the Ilgner system of operating hauling machines. It is believed that this machine will find much application to mining.—*Zeit. f. Elek.* (Vienna), October 25.

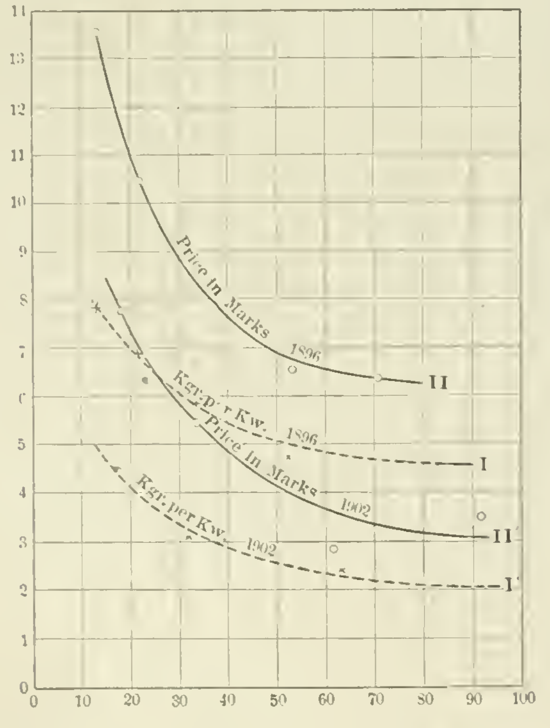

FIG. 1.—WEIGHT AND COST OF ELECTRIC MACHINES.

Output Coefficient.—BURLEIGH.—A communication with reference to the recent articles of Hobart and Esson. He does not think either of the methods advocated by these authors to be on a fair comparative basis, i. e., the output of a machine does not vary directly proportional to the peripheral surface of the armature; neither does it vary as $D^2 \times L \times C \times r.p.m.$ The correctness of this criticism is proven by the necessity of changing the value of the coefficient, C, for every different size of dynamo, although it may be a line of machines designed on the same basis. The writer suggests the following method of obtaining a coefficient, the value of which can be easily determined and which forms a simple and reliable means of comparing dynamos by their specific output coefficients. The output coefficient is defined by the equation, $C = D\ L/\sqrt{W}$, in which C is the output coefficient, D the diameter of the armature in inches, L the length of the armature in inches over laminations, and W the watts generated per revolution. If the number of revolutions per minute is R, we get the output in watts equal to $(D\ L/C)^2\ R$.—Lond. *Elec.*, November 6.

Heyland Motor and Generator.—BRESLAUER.—In a review of recent inventions in electrical engineering the author discusses the prospects of the Heyland commutator type of alternating-current induction motors and generators. While tests of machines built according to this principle have proven the correctness of the theory, yet the complications due to the commutator may be expected to prevent the universal application of the compensated motor instead of the small ordinary induction motor. On the other hand, the Heyland principle seems to promise great practical advantages in its application to generators, since it removes all difficulties in operating alternators in parallel. This should be of great importance in view of the increasing use of gas engines. Still more surprising appears the latest invention of Heyland by which the compensation principle is applied to the normal synchronous machine. The firm of Kolben & Co. have already built such machines and have obtained favorable results so that they have now undertaken the manufacture of a larger number of such machines up to 1,500 kw.—*Zeit. f. Elek.* (Vienna), October 25.

Formulas for the Comparison of Dynamo-Electric Machines.—PICOU.—An article in which the author, after some general remarks on the value of formulas for the "output coefficient," etc., discusses at some length the special formula, which he attributes to Kapp, and which states that the power is equal to the output coefficient multiplied by the square of the armature diameter by the armature length and by the angular speed. He shows how this formula may be derived theoretically and gives two formulas for the output coefficient as function of other details of the design, one of the formulas relating to smooth, the other to toothed armatures.—*L'Ind. Elec.*, October 25.

REFERENCE.

Formulas for Designing Electric Machines.—Sengel.—An article in which the author refers to recent publications of Arnold, Rothert and Dick and gives a series of formulas which he has derived from the dimensions of existing machines. From the formulas of the other authors mentioned his formulas differ, especially because he takes into account the number of poles, and uses as the basis for designing a dynamo the useful number of lines of force which pass per pole into the armature. He deals with direct-current generators, alternating-current generators, transformers and induction motors.—*Elek. Zeit.*, October 29.

Lights and Lighting.

Alternating-Current Searchlights.—In the use of alternating current for operating electric searchlights, the arrangement of the two carbons perpendicularly above each other or side by side in a horizontal direction, has the disadvantage that the arc light, which is generated, is utilized to a comparatively small degree, only one-third of the light rays falling upon the reflector. To counteract this disadvantage, two different arrangements have been devised by Weinert and Engelsmann. Weinert's device is shown in Fig. 2, and it is stated that the light effect produced is higher by 60 or 70 per cent. than with perpendicular or with horizontal carbons. The device of Engelsmann, who uses two reflectors, is shown in Fig. 3. Both figures are self-explanatory.—*Zeit. f. Beleucht.*, October 30.

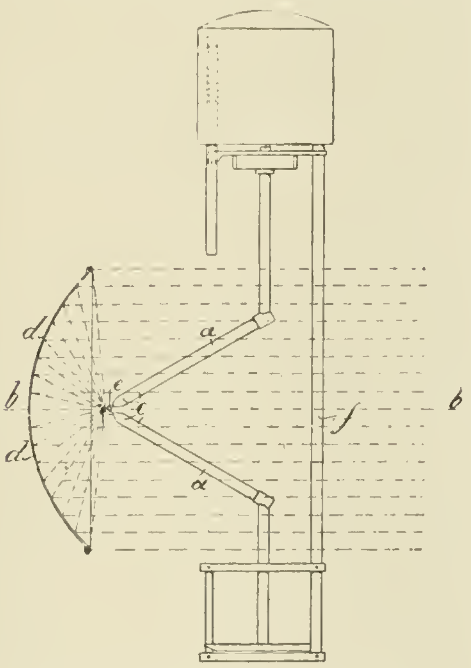

FIG. 2.—ALTERNATING-CURRENT SEARCHLIGHTS.

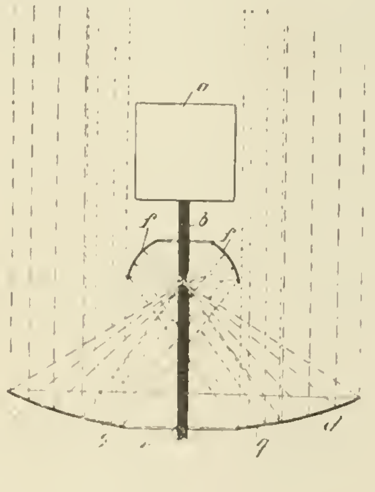

FIG. 3.—ALTERNATING-CURRENT SEARCHLIGHTS.

Arc Lamps.—Breslauer.—In a review of recent inventions in electrical engineering the author discusses the success of several firms supplying arc lamps of smaller candle-power than usual, for instance, lamps of 2.5 amp. and 120 candles. It is thought that such lamps might successfully compete with incandescent gas light in public buildings, restaurants, etc. An Italian engineer, Rignon, is said to have devised arc lamps for 1 amp. with 1 mm. carbon. The German patents of this invention have been bought by the Allg. El. Ges., of Berlin.—*Zeit. f. Elek.* (Vienna), October 25.

REFERENCE.

Thorium Filament.—For incandescent lamp filaments, thorium is very suitable on account of its high melting point and its high electric resistivity, but the manufacture of thorium filaments is extremely difficult, and such filaments are mechanically weak. The Siemens & Halske Company, of Berlin, therefore, use a filament of a mixture of thorium with some thorium carbide.—*Zeit. f. Beleucht.*, October 30.

Power.

Refuse Destructors.—A report by the surveyor and the electrical engineer of Hammersmith on the advisability of installing refuse destructors. They arrive at the following conclusions: First, that in the case under consideration barging away is more economical at the present time; second, that the refuse has not sufficient calorific value to justify the combination of a dust destructor with the electricity works; third, that there is every probability that the cost of cremation of refuse will greatly decrease, whereas the cost of barging is more likely to increase. A time will come when the destructor will be necessary, and it would be good policy to obtain the necessary ground at once. Figures are given of the annual returns of six London municipal electric lighting stations, three of these having the assistance of destructors, and three being operated with coal only. The capital expenditure per kilowatt is $400 for non-destructor stations, and $590 for destructor stations. "The working costs of non-destructor stations is 0.4 per cent. per unit higher than the destructor stations, which, upon 5,774,644 units (their total output), represents $24,475. The extra cost of the capital involved to effect that saving is, at 5 per cent., apparently $36,975, showing a net loss of $12,500 per year as the cost of combining dust destructors and electric lighting stations." It is editorially remarked that the extra cost of the capital due to the installation of destructors thus considerably overbalances the saving in fuel costs; but this does not take into account the inconvenience of the electric lighting undertaking due to irregularities of steam pressure and supply, to say nothing of the intolerable smell and dust. If combined destructor and electricity works are really as successful as their advocates claim them to be, the various supply companies would be only too anxious to adopt them. The local authorities could then get rid of their refuse at very little expense, while the supply companies would destroy it free of charge in return for steam generated. But supply companies are generally concerned with money-making and are not yet convinced that such combined stations have a tendency in this direction.—Lond. *Elec.*, October 30.

Fly-Wheels.—Strohm.—An illustrated article on fly-wheels and fly-wheel accidents. If the steam boiler be conceded the unenviable position of first in the line of destroyers, fly-wheels should rank very close to it. He deduces the formula for the energy stored in a rotating fly-wheel, and considers the tensions and stresses set up in it. The primary cause of fly-wheel destruction is excessively high rotative speeds, and this may be brought about through a multiplicity of causes. The bursting speed of a solid rim-cast wheel is about 425 ft. per second; but it is customary to make this not more than 100 ft. per second. At this speed the tension per square inch of rim section is 1,000 pounds, which gives a factor of safety of 18, which is quite large. But it is not possible to construct all fly-wheels of the one-piece type for many reasons. Hence, it is generally found that fly-wheels from 10 to 15 ft. in diameter are cast in halves, and bolted together strongly at the hub and at the rim. The joint thus formed, however, constitutes a weak point in the construction. The author considers the various ways of holding fly-wheels of large diameter together.—*Am. Elec.*, November.

Traction.

Polyphase Traction.—Breslauer.—In a review of recent inventions in electrical engineering the author discusses the recent experiments of Lamme and Finzi. He thinks that, however successful both may be, they have not solved the problem to feed the motor with high-tension current directly from the trolley wire. This would be desirable in order to overcome the necessity of carrying the heavy transformers on the cars. A voltage of 10,000 on the trolley wire would be desirable for long distance lines. He thinks that the solution of this problem is approached on the suburban line between Berlin and Spindlersfeld, where a single phase motor is used, which is said to have the well known properties of the series motor, a voltage of any amount being supplied only to the stator. That road is operated at 6,000 volts. No exact information is yet available concerning the methods by which this result has been obtained, except that Winter and Eichberg have here applied the same principle which they applied before in their three-phase motor, transformed variable voltage being supplied to the collector of the rotor. By selecting a low voltage at the collector and by special windings, the danger of sparking has been overcome. The author remarks that any repulsion motor gives the possibility of working directly with high voltage in the stator. The superiority of the Winter-Eichberg motor seems to be a higher power factor, as it is claimed that a power factor equal to unity may be obtained.—*Zeit. f. Elek.* (Vienna), October 25.

Electric Traction in Canals.—Petit.—A long article illustrated by diagrams on the question whether for electric traction of canal boats it is preferable to have the electric locomotive run on the ordinary towpath or on rails along the canal. A full account is given of experiments made by Gérard on the canal from Charleroi to Brussels, according to a report made by him to the Duesseldorf International Congress of Navigation. The decision reached for this canal is that the use of rails would save $520 per km. per year under the supposition that the maintenance of the towpath in a condition required for electric traction would be $380 against $64 for the maintenance of a road with rails capable of carrying the mechanical apparatus of a weight of 4,000 to 6,000 pounds. The problem investigated by Gérard is essentially a mechanical one and refers to the traction effort required for hauling barges. The experiments were made by bringing the boats to a certain speed, then allowing them to drift along and measuring the decrease of the speed and therefrom the retardation. The results were plotted in forms of curves. One of the interesting results obtained is that there are to be distinguished three regions of speed; in the special case under consideration the first is from zero speed to 1.5 km. per hour, the second from 1.5 to 3, the third from 3 to 4 (4 km. per hour being the maximum speed allowed on canals in Belgium). In the lowest class of speed the traction effort is nearly constant. Above a speed of 1.5 km. per hour the traction effort varies rapidly with the speed; it is 147 kg. for a speed of 4.2 km. and 21 kg. for a speed of 1.5 km. In the lowest region of speed (up to 1.5 km.) the level of the water remains uniform and the boat is not raised. For a speed between 1.5 and 3 km. a stream of water is produced between the walls of the canal and the barge in a didection opposite to the movement of the barge. For a speed between 3 and 4 km. the level of the water is raised before the boat and, in general, the level of the water shows distinct deformation at both sides and at the end of the boat. From the experiments it was deduced that it is theoretically possible to start without slipping on rails, even on wet rails. While the first cost of installing a roadway with rails will be higher than without rails, the cost of maintenance will be considerably lower for the former system and this is, therefore, preferred. The polyphase induction motor is believed to be thoroughly suitable for this kind of work.—*La Revue Tech.*, September 25.

San Francisco.—An article on the San Mateo extension of the United Railroads of San Francisco. This railway was built for interurban service, but a considerable portion of the line extends through city streets and suburban districts where the speed is restricted, while in the open country between towns the company has secured a private right of way and operates its cars at a very high schedule. The construction work of the line is all of very high standard, both overhead and in the permanent way. Power is furnished from the Bryant Street power house, the San Mateo line being divided into three sections. Direct current at 550 volts is supplied to the first section directly from the power house, while the other two sections get current from two sub-stations.—*St. R'y Jour.*, October 31.

REFERENCE.

Brussels Tramway System.—Reyval.—A profusely-illustrated description of the power plant and sub-stations of the Brussels tramway system. The total network comprises about 50 miles double track, with 109 trains of 15 tons in ordinary service and 295 trains of the same weight during rush hours. The power plant contains four three-phase alternators, each giving 1,500 kilovolt-amp. at 6,600 volts. The frequency is 25. There are three sub-stations with transformers and synchronous converters.—*L'Eclairage Elec.*, November 7.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Motor Generators Versus Rotary Converters.—Hobart.—The conclusion of a very long article, illustrated by diagrams, which has been published in form of a serial in this journal for some time. The final results of a series of diagrams show that only in cases where the distance of transmission is so short the voltage so high, or the outlay for cables so great that a very low resistance per phase is obtained, can rotary converters be satisfactorily operated for automatic control of the commutator voltage for practically constant voltage at all loads, much less then for 5 per cent. or 10 per cent. higher commutator voltage at full load than at no load. Even with a low resistance per phase, it is necessary to provide large, expensive and wasteful auxiliary reactance coils in order to obtain satisfactory voltage control by automatic phase adjustment, and for anything more than a very low resistance per phase there is soon reached a value of the reactance beyond which it is ineffective in improving the conditions in this respect. In fact, with shunt-excited rotary converters, and even with a small percentage of series winding, reactance makes the regulation still worse. A large percentage of series winding is very important from the standpoint of regulation of the commutator voltage by phase control. The principles developed by the author are finally applied to a typical case, and for this purpose the Central London Railway is chosen. Owing to the short distance of 6¼ miles from the power house to the most remote sub-station, the conditions are especially favorable to a fair showing for rotary converters. The original sub-station installation consisted mainly of six 900-kw synchronous converters, 21 air-blast transformers, each of 300 kw, with blower sets for circulating the air through them and all necessary switch gear and auxiliary apparatus. These were located in three sub-stations, distant respectively 1.6, 3.5 and 6.2 miles from the generating station. The average distance is, therefore, about 3.8 miles. The cost of the high-tension cable equipment is estimated at $90,000; that of the six converters at $67,500; that of the transformers and ventilating motors at $31,500, and that of the switchboards and gear at $27,000. If one were to lay out a plant of similar capacity with motor-generators, ⅔ as great total copper cross-section in the cables would be ample, less subdivision of the cables would be necessary, and three independent cables from the power house would give fully as great security as the four cables employed in the rotary converter installation. Hence, the individual cables would have but slightly less cross-sections of copper per core, and the specific cost would be but slightly increased. The cost of the cables is estimated at $62,000. The cost of motor-generator is taken 75 per cent. higher than that of the rotary converters; that is, $118,000. The transformer item falls out. The outlay for switchboards and gear may be taken ⅔ as great kilowatt since the number of panels, switches, bus-bars, etc., may be greatly reduced and simplified. The cost of switchboards and gear is taken as $18,000. He, therefore, arrives at a cost of $216,000 for rotary converters against $198,000 for motor generators. Whether the interest on this 9 per cent. less outlay for the motor-generator scheme would affect the 3 per cent. to 6 per cent. lower efficiency of operation, would require a careful analysis of the operating costs. The author does not intend to assert that in the Central London plant the use of motor-generators would have led to ultimate higher earning capacity, but this example serves to illustrate the basis on which a comparison should be made, and shows that with longer systems requiring a greater proportional outlay for high-tension cables, the balance tends towards showing an economic advantage to be gained by the use of motor generators.—Lond. *Elec. Rev.*, October 23.

Copenhagen Central Station.—Hentzen.—A long and profusely-illustrated description of the new Oestre electric plant, which is the third municipal station of Copenhagen. There are now three municipal stations in Copenhagen, each one being situated about the center of gravity of the lighting system which it supplies with current. The new station contains three steam-driven, direct-current dynamos of a normal capacity of 500 kw and a maximum capacity of 600 kw, running at a speed of 100 r.p.m. The current is used both for traction and for lighting and power. It is distributed by the third-wire system with 220 volts between each outer and the neutral. Storage batteries are connected in parallel with the dynamos. The battery for lighting contains 272 cells of about 2,750 amp.-hours' capacity. The battery for traction contains 270 cells, of about 900 amp.-hours' capacity. For charging the latter battery, which requires a voltage of 700 volts, a booster is provided which is connected in series with the main dynamos. It is driven by a motor and gives an additional voltage up to 180 volts, with 500 amp., which is the normal current required for charging. There is also installed a balancer which, either in conjunction with the lighting battery or alone, serves to balance the voltages in the lighting network. It consists of two dynamos mounted on the same shaft, of 220 to 250 volts and 132 amp. The mechanical equipment, especially of the boiler and engine room, is described in detail.—*Elek. Zeit.*, October 29.

Engine and Dynamo Breakdowns.—An illustrated abstract of Longridge's annual report on breakdowns of engines and dynamos insured by the Engine, Boiler & Employers' Liability Insurance Company. Of dynamo breakdowns, 17 per cent. were due to accident, 25 to dirt or neglect, 15 to deterioration, 15 to bad workmanship or design, 5 to overload, and the causes of 23 per cent. were unascertained. Of the motor breakdowns 13 per cent. were due to accident, 18 to dirt or neglect, 26 to deterioration, 15 to bad workmanship or design, 13 to overloading, while the causes of 15 per cent. were unascertained. The parts which failed first in the dynamos were armatures and rotors, 68 per cent.; magnet coils and stators, 9 per cent.; commutators and brush gear, 12 per cent.; miscellaneous, 11 per cent. The parts which failed first in motors were armatures and rotors, 54 per cent.; magnet coils and stators, 16 per cent.; commutators and brush gears, 21 per cent.; miscellaneous, 9 per cent. Some curious accidents are recorded.—Lond. *Elec. Rev.*, October 30.

Wires, Wiring and Conduits.

Insulating Paper.—Beaver.—A communication stating that most of the commercial "Manila paper" has no appreciable proportion of Manila fibre in it, but is full of wood and straw. Such paper is utterly unsuitable for cable or other insulating work. Engineers should insist on having their Manila papers free from wood pulp of any kind or from fibres of the straw and esparto class.—Lond. *Elec.*, October 30.

Neighbour.—Another communication on the same subject. He agrees that it is very difficult to obtain pure Manila paper. This is due to two causes: first, the difficulty of obtaining sufficiency of the fibre, and second, the great stringency of the specifications provided by electrical engineers. For instance, it is sometimes specified that the paper is to be absolutely free from knots, pinholes, etc. This is a requirement which cannot be fulfilled with pure Manila paper, since Manila, unlike most other fibres used in paper making, must not be beaten too fine if the strength of the web is to be maintained; so that a few pinholes and a considerable number of knots and unbeaten fibres in "pure" Manila paper are inevitable. On the basis of some years of experience the writer claims that a wood paper made from a good, clean sulphite pulp and carefully cleared from acid—considering its strength and uniformity of texture, its price and also its freedom from grits, metallic particles and pinholes—has a more than even chance in disputing the field with its more expensive rival.—Lond. *Elec.*, November 6.

Underground Concrete Conduit.—A note on a recent trial at the Metropolitan Railway power station of a new system of underground concrete construction. Iron pipes, about 4 ft. in length, were coated with a 1 to 4 mixture of paraffin wax and graphite to a thickness of about ¼ in. These were then screwed together to form one piece of any desired length, and after being placed into position they were firmly embedded in concrete. After some days the concrete has dried and becomes firmly set. If steam is then passed through the pipes, on account of the low melting point of the paraffin wax mixture it is possible to withdraw the pipes, leaving a layer of mixture on the inside of the concrete conduit. This layer, it is claimed, acts as an excellent lubricant and enables cables to be drawn in with great ease and minimum abrasion. The cost is from 25 cents to 31 cents per year-run of conduit. The opinion is expressed that for long lines of cable the application of the system will be attended with difficulties on account of the fact that the steam passing over greater lengths cools down. The principal advantage is said to be due to the fact that the conduit when completed is absolutely seamless, manholes being placed at intervals of about 150 yards.—Lond. *Elec.*, October 30.

Electro-Physics and Magnetism.

Combined Coherer.—Turpain.—An account of experiments in which a number of coherers were connected in parallel attached to the same antenna. They preserved their relative sensibilities whether in open or closed circuit, but the sensibility of each was much less in an open than a closed circuit. The order of sensibility may be rapidly determined by producing waves which just make the most sensitive coherer respond, and then cutting out that coherer while increasing the strength of the waves until the last coherer is cut out in the same manner. The author also connected several coherers in series, and again determined their relative sensibility by exposing them to the same wave-train, and then measuring for each coherer separately the amount of cohesion as indicated by its conductivity. In this case the order of sensitiveness of the various coherers changes with the connection, since the coherer which is directly attached to the antenna has a greatly-increased sensibility. The author has adapted these results to the measurement and automatic registration of thunder storms, and also to the construction of very sensitive detectors both for wireless telegraphy and for Hertzian wire-wave telegraphy, but he gives no details of these applications.—From *Comptes Rendus*, October 12; Lond. *Elec.*, October 30.

Coherer.—Robinson.—A continuation of his researches with a single-contact coherer, consisting of two straight pieces of copper wire, which carried at one end steel caps. These rods were suspended by silk threads, and the steel caps, the ends of which were spherical, pressed slightly against each other and formed the single-contact coherer. In using the coherer with direct current, it was noticed that on applying to the coherer ends a potential difference greater than the critical potential difference, the resistance of the coherer fell almost instantaneously to a certain value, which he calls "impulse value." It then dropped slowly further until the relation of the resistance of the coherer to the resistance of the circuit was such that the resulting potential difference at the coherer ends took on a definite value which was called the "equilibrium potential difference." In the course of experiments it was noticed that the regularity of the results increased markedly as the applied potential difference became greater. The greater the applied voltage, the smaller is the impulse value of the coherer resistance, the relation between the two being evidently not a linear one. The greater the sensitiveness of the coherer, the smaller is the impulse value of the coherer resistance for the same applied voltage.—*Phys. Rev.*, October.

REFERENCE.

Radioactivity.—Partridge and Bradbury.—A Franklin Institute paper which gives a good summary of the subject. They discuss its history, describe the preparation and properties of polonium and radium and the chemical and physiological effects of Becquerel rays, refer briefly to various hypotheses on the sources of energy emitted by radioactive substances and notice the phenomenon of induced radioactivity.—*Jour. Franklin Inst.*, November.

Electro-Chemistry and Batteries.

Alkaline Accumulators.—Schmidt.—A general discussion of the advantages of alkaline accumulators. Their chief merit lies in the fact that, apart from water, no constituent of the electrolyte enters into the reaction, so that a relatively small amount of electrolyte is required and the weight is reduced. The final result of the discharge may be described as a transference of oxygen from one electrode to the other electrode through the medium of water. The author points out that any metals whose oxides are insoluble in alkalines are suitable for electrodes in alkaline accumulators. Such are the ordinary metals, cadmium, iron, nickel, copper, mercury and silver. Zinc oxides are soluble in alkalines, but not in alkaline silicates, aluminates or carbonates. Accumulators consisting of two electrodes of the same metal are most disadvantageous, since self-discharge by the accidental deposition of one metal upon the other is avoided. The difficulties encountered are mainly mechanical, and concern the mounting of the oxide in the shape of cohesive and yet porous masses. The oxide has to be prepared beforehand as is done by Edison in his nickel-iron accumulator, and is contained in small metallic boxes closely packed. The oxide is utilized to a greater extent the nobler the metal. In silver the utilization reaches 100 per cent. The yield of Edison's accumulator is now given as 25 watt-hours per kg, but the efficiency is stated to be less than that of lead accumulators and the price is higher.—From *Mit. Phys. Ges. Zürich*, No. 5, in Lond. *Elec.*, October 30.

REFERENCES.

Production of Copper, Nickel and Zinc from Chloride Solutions.—Koehler.—The first part of an illustrated historical and critical sketch of the development of the production of copper, nickel and zinc from chloride solutions. In the present compartment the work of Body and the early experiments of Hoepfner are mainly dealt with.—*Electrochem. Ind.*, November.

Primary Batteries.—Hildebrandt.—The first part of an article on "constant cells," in which the author gives a brief historical sketch of the development of practical primary batteries. In this instalment he deals especially with the Daniell, Grove and Bunsen cells.—*Centralbl. f. Accum.*, November 1.

Classification of Electrochemistry.—Townsend.—The conclusion of his article on systematic classification of the various subjects of electrochemistry. His scheme of classification has recently been adopted unofficially by the patent office and is now the working system by which the United States and foreign patents are classified in the examining division. He gives brief notes of comment upon the scope of the subdivisions to indicate the character of the material included therein.—*Electrochem. Ind.*, November.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Wireless Telegraphy.—Prasch.—The conclusion of his article illustrated by diagrams on the characteristic distinguishing features of the various systems of wireless telegraphy. A summary is given in form of a table.—*Zeit. f. Elek.*, October 23.

Wireless Telegraphy.—Turpain.—A complete account of the proceedings of the International Conference on Wireless Telegraphy, recently held in Berlin.—*L'Eclairage Elec.*, October 31.

Printing Telegraph.—An illustrated description of Steltje's type printing telegraph.—*Sc. Am.*, November 7.

Telephone Engineering.—Dommerque.—Another article of the sèrial on telephone engineering, this one dealing specifically with aerial cable lines.—*Am. Elec.*, November.

MISCELLANEOUS.

Aluminothermics.—Goldschmidt.—An exhaustive and profusely-illustrated description of the various engineering applications of the author's thermit process. The author describes in detail the applications of the process to rail welding (see Electrical World and Engineer, November 21, page 854), to repairing broken machinery, especially broken stern-posts of steamers, to welding wrought-iron tubes and solid rods, to the repair of castings, and the use of "anti-piping thermit" for improving iron and steel castings and preventing blow holes and piping. The author recently made experiments to find whether silicon could be substituted for aluminum in the thermic reaction. While silicon has a very high oxidation heat, the speed of reaction is slow, and even if only part of the aluminum is replaced by silicon the process is unsuitable for engineering purposes.—*Electrochem. Ind.*, November.

Physiological Effect of Zinc Ions.—Leduc.—Under this title an account is given of experiments which show the marked effect of an electrodeposition of zinc upon the growth of hair. Two electrodes of 10 sq. cm. surface were applied to the ends of a space 10 cm. by 6 cm. on the shaven skin of a rabbit, contact being made by means of hydrophil cotton impregnated with a 1 per cent. solution of zinc chloride. A current of 10 milliamp. was passed for 40 minutes. At the end of that time nothing was seen at the cathode (where the current leaves the skin), but at the anode (where the current passes from the zinc chloride cotton into the skin), there were a number of small white circles, showing that the zinc had penetrated into the skin. In about eight days these circles peeled off. The zinc having been introduced on July 10, the hair on the place of application of the anode showed a decided growth on the 20th, the hair on that place growing much faster than that on the other shaven surface. On August 3 the hairs were 5 mm. or 6 mm. long and on August 10 they were 10 mm. long, whereas on the other parts of the shaven surface, including that under the cathode, the growth was insensible. The surface where the zinc had been introduced was marked out by a thick fleece of gray hair on a buff background. A similar introduction of chlorine and, in another experiment, of potassium, exerted no action on the growth of hair.—From *Arch. D'Elec. Med.*, October 15; Lond. *Elec.*, October 30.

REFERENCE.

Obituary.—A brief account, with portrait, of the life and work of the late Dr. Richard Fellinger, chief of the Vienna Siemens & Halske Works.—*Zeit. f. Elek.* (Vienna), October 25.

New Books.

Elementare Vorlesungen uber Telegraphie und Telephonie.
By Dr. Richard Heilbrun. Berlin: Georg Siemens. 63 pages, illustrated.

We have already had occasion to notice the four preceding part of Dr. Heilbrun's serial upon the telegraph and the telephone. The number before us takes up telegraphic instruments at the point where No. 4 closed, and it is largely taken up in a description of telegraphic receiving instruments, both of the Morse form and the various dial patterns of apparatus more common in Europe than in this country. Next follows a chapter upon the various forms of electrical supplies chiefly for telegraphic service in which batteries and battery installations are treated. Chapter XV is devoted to a discussion of the operation of the Morse telegraph, but stops in the middle, and the reader is left hanging, like Mohammed's coffin, between this number and the next in a state of somewhat aggrieved wonder as to the nature of the remainder of the discussion. In a similar manner do operators sometimes have the circuit snatched away from them.

Engineering Preliminaries for an Interurban Electric Railway.
By Ernest Gonzenbach. New York: McGraw Publishing Company. 71 pages, 5 illustrations. Price, $1.00.

In this volume Mr. Gonzenbach has taken a prominent electric railway in the West and has shown step by step how the design of the line was evolved from the conditions of population, kind of territory traversed and probable business to be expected.

Unlike many engineering works the book is entirely non-technical, being purely descriptive, but with it Mr. Gonzenbach shows himself to be a consummate engineer, for he has given an example of how to produce a property adapted to the requirements of the territory with the least initial investment and operating cost. His descriptions are so terse and clear and so free from technical terms that even the lay reader becomes interested and has finished the volume ere he is hardly aware of it.

With some of Mr. Gonzenbach's conclusions there are engineers who will probably differ, but each point is fortified with so powerful a battery of common sense reasoning as to make the deductions well nigh impregnable. There are few examples of descriptive engineering that are as complete and thoroughly worked out, yet the reader must not forget that it is a description of a particular case and that therefore the deductions can by no means be necessarily applied to all other electric railways.

Die Strassenbahnen in dem Vereinigten Staaten von Amerika.
By Gustav Schimpff. Berlin: Julius Springer. 190 pages, 224 illustrations. Price, 6 marks.

American engineers have been so busy completing electric railways that they have had very little time to write accounts of this art, and what are in existence are publications chiefly to be found in our own files or those of the *Street Railway Journal*. Perhaps, therefore, it is not strange that from Germany comes a most complete description of American electric railways that is so thorough that doubtless many American constructors will wish for a translation.

The first chapter is an account of what we should term "Urban Lines." The cities of New York, Chicago, Detroit, Cleveland, etc., are illustrated with maps presenting the street railway systems and half-tones showing photographic reproductions of the parts of the streets which the road serves.

Terminal loops receive considerable attention. Then comes a chapter upon track, particularly that of the urban variety, with special attention to rail bonding.

The conducting system comes next with illustrations of both overhead lines and conduit systems. Curiously, the third-rail systems are completely ignored.

The subject of cars is treated at length. Many dimensioned drawings and cross sections are shown and the merits and demerits of the various forms of trucks illustrated at length.

We are now brought to about the middle of the volume at which point the construction of the power station is taken up and very fully illustrated by plans and sectional drawings from the largest of the railway stations in this country. Electric machinery follows as a sub-division of the power station. A chapter upon the handling of cars, followed by a few pages of American street railway statistics, completes the volume. The illustrations are particularly good and well chosen and the letter press leaves little, if anything, to be desired.

The Engineering and Electric Traction Pocket Book. By Philip Dawson. New York: John Wiley & Sons. 1411 pages. Price, $5.00.

Few electrical engineers need any introduction to Mr. Dawson, for during the past few years he has made the acquaintance of nearly all the American profession, if only through the previous editions of his pocket book. The one now before us is arranged upon the same general plan as the former editions; but it has grown considerably and now numbers some 1,400 odd pages. In fact, it can hardly be termed a pocket book, for there are few of even the most capacious of pockets into which this volume could be placed without serious inconvenience to the owner; but as a desk companion the new edition will prove even more welcome than the former ones.

There is little to note so far as the general arrangement of the work is concerned, for it is divided into the same sections of track, overhead line and feeders, power stations, storage batteries, conduit systems, general data, testing and maintenance that existed in the earlier editions. But each one of these shows conspicuously the effect of the revision, both in being thoroughly brought down to date in containing much new and useful matter, and in the elimination of errors that formerly existed.

More than ever the work is a data book, explanatory matter having been condensed to a minimum amount, while tabular matter has been expanded. There are few engineering data books that are as cosmopolitan, for the author has very skillfully combined English and American data in such a manner as to make the book valuable to electric railway engineers in both countries. Often an English book is of but little value in this country and conversely, but Mr. Dawson has availed himself of information which is so universally true as to be international in its character. Inevitably English practice prevails, but the American engineer will have little difficulty in translating amperes per square inch, for example, into current per circular mill.

Under power station considerable attention is devoted to the gas engine, for it is already demonstrated that this form of prime-mover soon will be, if it is not already, a serious competitor of the steam engine. Even the steam turbine receives a modicum of notice, although only one form of this machine is described.

Considerable space is devoted to illustrating the so-called "contact electric railway." This form is not as yet commercial and, therefore, a description of theoretical systems seems somewhat out of place in a practical handbook. A few estimates of costs are given, but in this respect, like all other pocket books, the volume is weak in a subject that is of paramount interest to the constructing engineer. The typography and general arrangement is an improvement upon the former volumes and leaves little to be desired.

BOOKS RECEIVED.

Wireless Telegraphy. By Charles Henry Sewall. New York: D. Van Nostrand Company. 229 pages, 85 illustrations. Price, $2.00.

The Dynamo. By Hawkins and Wallis. New York: The Macmillan Company. Third Edition. 925 pages, 413 illustrations. Price, $3.00.

Electric Lighting and Power Distribution. Vol. II. By W. Perren Maycock. London: Whittaker & Company. 690 pages, 407 illustrations. Price, 7s. 6d.

A Handbook for the Electrical Laboratory and Testing Room. Vol. II. By J. A. Fleming. London: *The Electrician* Printing and Publishing Company. 622 pages, illustrated. Price, 14s.

Arithmetic of Electricity. By T. O'Conor Sloane. New York: Norman W. Henley & Company. Sixteenth Edition. 162 pages, illustrated. Price, $1.00.

Electric Toy Making. By T. O'Conor Sloane. New York: Norman W. Henley & Company. Fifteenth Edition. 183 pages, illustrated. Price, $1.00.

The Murphy High Potential Interrupter.

By A. Frederick Collins.

The great value of an apparatus for producing rapid, successive and quickly-recurring interruptions and restorations of high potential electric currents has been known and appreciated by workers in many branches of the electrical industries. An exceedingly clever device, at once simple in construction and operation for effecting the interruption of heavy currents at high potentials, is the invention of Mr. Thomas J. Murphy, electrical engineer of the Compagnie des Tramways de l'Est Parisienne. The interrupter found its origin in the observation of the phenomena following when a heavy direct or alternating current of low or high voltage is conducted across an air-gap by a disruptive discharge.

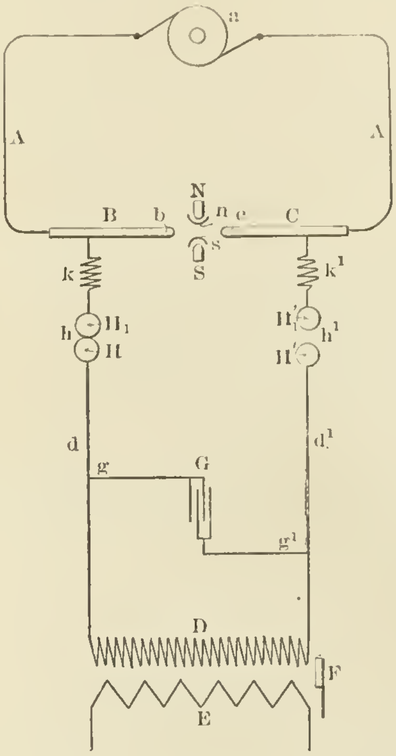

FIG. 1.—DIAGRAM OF INTERRUPTER CIRCUIT.

By referring to the diagram, Fig. 1, it is self-evident that if a source of current, *a*, is connected in circuit with an air-gap, *b c*, having a greater length than the difference of potential will disrupt, no current will pass and therefore no arc will be formed; but if, on the other hand, a disruptive discharge from an induction coil or a frictional machine is made to take place between the terminals, *b c*, a momentary conductor is formed across the air-gap and the current from *a* will flow at that instant between *b c*, since the air insulation is broken down.

To prevent the current flowing continuously from *b* to *c* for an indefinite period after the initial resistance of the air has been broken down by the spark bridging the distance between the terminals, an electromagnetic blow-out is employed; that is, an electromagnet, *N S*, is mounted with its polar projections at right angles to the terminals forming the gap and thus a strong magnetic field is produced which reacts on the arc and disruptive discharge by extinguishing them and so interrupting the current.

The magnetic blow-out may be replaced by any other equivalent device, offering resistance to the passage of the current, such as a blast, *g*, of air, a jet of carbon dioxide or other gas, or an oil bath, etc. To prevent the deviation of the high-potential sparks from the induction coil, which take place between the terminals, *b c*, and impinging on the poles of the electromagnet, plates of mica or other dielectric are interposed in the path of the discharge and secured to the poles of the magnet.

The terminals or electrodes, *b c*, are continuations of the heavy current circuit, *B C;* these are made preferably of carbons arranged so that they can be adjusted to increase or decrease the length of the air-gap and a device is also included for regulating the distance between these electrodes automatically, a type of arc lamp mechanism or spring motor being employed for the purpose.

To insure good conductivity the electrodes or terminals joining the spark-gap are covered with a metallic sheathing, usually a coating of electrodeposited copper, and these are, in addition, protected by a sheathing of some highly refractory insulating material. To further insure absolutely uniform operation of the interrupter, the electrodes, together with their accompanying electromagnet, may be entirely enclosed in a vessel wherein a partial vacuum obtains.

There are several methods for producing the disruptive discharges between *b* and *c*. The one preferred by Mr. Murphy is shown in the diagram. The electrodes, *B C*, are connected to the terminals of the secondary coil, *D*, joining the high-potential circuit of an induction coil, the inductor or primary coil, *E*, supplying the interrupted e.m.f.; the oscillations in the secondary, *D*, may be regulated by means of an ordinary mechanical vibrating make and break, *F*, or, if desired, the induction coil may be replaced by an alternating-current transformer and the disruptive discharge produced after the method of Fleming.[1]

In the method shown in Fig. 1, a condenser, *G*, having a suitable value is shunted across the circuit of the secondary coil, *g g'*. That portion of the high tension circuit indicated at *d d'* has spark-gaps interposed as shown at *h* and *h'*; these are formed of metal spheres, *H H* and *H'H'*, and are also made adjustable. From the spark-balls, *H H'*, to the conductor electrodes, *B C*, the wires may be coiled as indicated at *K K'*, forming choking coils, although in practice it is not absolutely essential to include them.

The interrupter operates in the following manner: Assume that a current passes in the primary, *E*, of the coil, and that the mechanical vibrator of the induction coil is performing its function of making and breaking the current flowing in the inductor; also that the spark-balls, *H H'*, are separated in order not to have a closed shunted circuit between *d d'* by way of the main circuit, *A*, so that the potential in the secondary, *D*, may attain its maximum value; sparks will then pass through the air-gap, *b c*, without any untoward results being caused by the presence of the main conducting circuit, *A*, since the reactance of the section *A* will be so great that the difference of potential between the two conductors, *d d'*, will always equalize by way of *b c*.

Now, if the generator, *a*, sends a current into the circuit *A*, this current will traverse the gap, *b c*, along with the sparks, and there will be as many interruptions of the main current as there are oscillations in the secondary, *D*, of the coil. The function of the condenser, *G*, is to intensify the disruptive discharge, since in this case it is the condenser which is charged and discharged through the gaps, *h* and *h'*.

In certain cases Mr. Murphy has found it possible to eliminate the action of the vibrator of the coil and to produce the interruptions of the current in the secondary coil automatically, by the interruptions of the current in the principal circuit itself; it is then, of course, necessary to employ a suitable means for starting the principal current in the main circuit, which can be done by closing the gap, *b c*, by a fine fusible wire.

Like the choking coils, the condenser is very useful, but like them, also, it may be dispensed with, especially where the capacity of the secondary of the induction coil is found to be sufficient. If, oppositely disposed to the conditions indicated in the drawing, and if the secondary wires from *h* to *B* and from *h'* to *C* were straight, the arrangement of the sparking between *b* and *c* would be solely determined by the characteristics of the induction coil and condenser; but when these wires are coiled as choking coils are interposed, the oscillations of the current due to the secondary discharge may be modified by the presence of these coils, as is well known.

The fundamental claim to invention in this interrupter by Mr. Murphy is that of causing electric currents of high potential to be conducted across an air-gap in the circuit of the current proceeding from a suitable source by passing successive oscillatory discharges through the non-conducting intervening space, so that the current passes during the duration of the spark, but ceases to pass between successive sparks as described above.

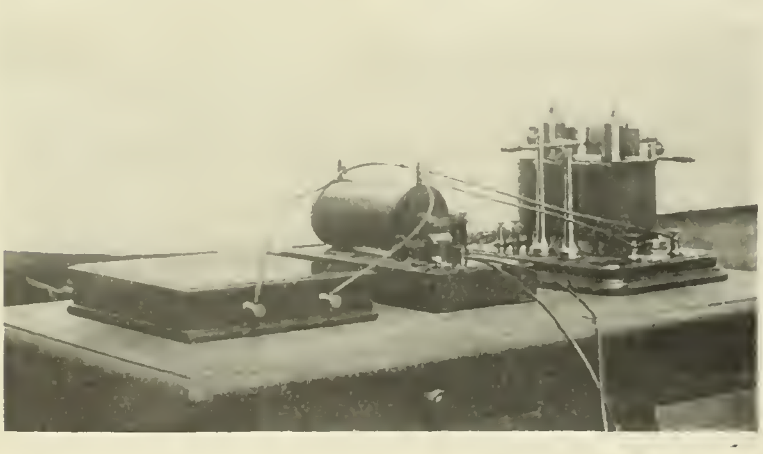

FIG. 2.—GENERAL VIEW OF INTERRUPTER.

A curious effect noticed by the inventor in his earlier experiments was that until the critical e.m.f. and intensity of the condenser spark occurred, it was found that the main current would not follow the spark unless both were positive or both negative; that is, the main current preferred flowing in the same direction as the current from the induction coil which produced the disruptive discharge.

The duration of the main current appears to be prolonged and also the conductivity of the gap increased if the action between the field and the main current is such as to cause the arc to be blown downward. The Murphy interrupter has been operated on as high a potential as 500 volts direct current. At this voltage it gave forth a musical sound that was extremely painful to the ear. Under certain conditions, for example, when adjustments of the apparatus were made, the arcing and disruptive discharges combined results in loud explosions in the open air. The induction coil employed gave 45 mm. sparks with a condenser consisted of ten plates 12 cm. square. The interrupter of the induction coil has an especially high frequency of make and break, and is used with a storage battery of 14 volts; the interruptions are so rapid that even at this voltage there is practically no sparking at the contact.

There is a multiplicity of uses to which this new interrupter may be put, and one that has occurred to the writer is its utilization as a rectifier for alternating currents in accordance with the phenomenon observed by Mr. Murphy and stated above.

Electricity in New Bridge Building Plant at Pittsburg.

The new plant of the American Bridge Company, at Ambridge, near Pittsburg, Pa., represents a total cost or investment of $5,000,000 with an output of about 24,000 tons of steel bridge per month. There are several features of interest in the large steam and electric generating power house and in the application of electric power about the shops. The boiler house contains two batteries, each with two Babcock & Wilcox 250-hp units equipped with an electric coal-hoisting and conveying apparatus and overhead steel and concrete hopper-bottom bins. This provides for a storage of 60 tons of coal, about sufficient for three days' supply, over each battery. The hoppers deliver to a Roney stoker under which there is a trench containing a hopper at each stoker in which the ashes are received and discharged, when convenient, into dump cars that deposit their contents in adjacent fills. The boiler house is large enough for as many additional boilers bringing up the capacity to 2,000 hp, estimated to be required for the plant here described; and it is capable of future extensions. The brick-lined steel smokestack is 8 ft. in diameter outside and 90 ft. high.

In the power house there are already installed two 300-kw Crocker-Wheeler generators and Erie City Iron Works compound engines. There is also one 100-kw Fort Wayne generator and one temporary 80-kw Gibbs generator operated by a standard Westinghouse engine. There is one Worthington compound 23 and 38 x 8½ x 24-in. pump for supplying water at 880 pounds pressure to the eye-bar and bending and forge shops. It is provided with two weighted accumulators 12 ft. in diameter and 18 ft. high. There is one 25 x 4½ x 15-in. Worthington pump for temporary distribution service and two 10 x 6 x 10-in. Dean pumps with 4-in. outlets to the buried 12-in. cast-iron fire main which encircles the yard. They are cross-connected so as to be interchangeable with the 7½ x 5 x 6-in. and the 6 x 4 x 6-in. Worthington duplex boiler feed pumps. There are two 500-hp Cochrane feed water heaters, and there is a small Worthington pump to return the drip from the hydraulic system which is stored in an overhead tank in the power house and returned to the suction pipe so as to secure the benefit of the grease contained in the water.

It is contemplated to eventually install one 500-kw General Electric generator and one 500-hp Reynolds-Corliss cross-compound engine, which has been ordered from the Allis-Chalmers Company. Room is reserved for two more generators and engines if necessary. After the Corliss engine is installed there will also be installed two Wheeler Engineering Company's surface condensers and air pumps, each with a capacity of 20,000 pounds of steam per hour. There are now in service two 14-in. Buckley jet injector condensers at the upper end of the 24-in. exhaust pipe above the roof. The plant is arranged so that the whole or a part of it can be operated as condensing, or the whole or part may supply exhaust steam for heating the shops. The building is served by one Pawling & Harnischfeger 60-ft., 25-ton girder crane which commands the entire floor area.

The electrical plant now installed develops 1,200 kw at 250 volts.

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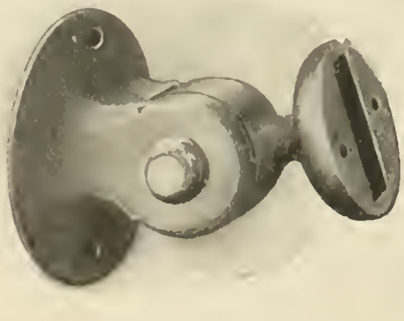
[1] Fleming's method consists of stepping up an alternating current to 25,000 volts which then charges a number of Leyden jars and these discharge through a spark gap.

The generator mains are carried underground to the sides of the building and thence up to the gallery and in it to the east end, where they drop to the switchboard trench and distribute to the different generator panels. The current is measured through a total output panel on which there is a 16,000-amp. integrating wattmeter made by the General Electric Company; a 6,000-amp. ammeter and a voltmeter connected across the busboard, both of them Weston instruments. At present there are four 1,000-amp. distributing panels, each provided with a Weston ammeter. These panels are equipped with Cutter double-arm circuit-breakers. All the panels were built by Albert and J. M. Anderson, of Boston, and an additional 300-kw panel was built by the Walker Electric Company, of Philadelphia. Weston instruments and Cutter circuit-breakers are used throughout. The boards are made of polished slate 2 in. thick. The generator panels are 7½ ft. high and 2 ft. wide. The distributing panels are 18 ft. high and 7½ ft. wide and are arranged for extension in either direction. Circuits are carried through conduits from the switchboard pit to a pit in the bending and forge shop, thence up the wall to a wire cupola on the roof which is the center of distribution for the whole plant and from which the mains are run north and south to the various shops. They are carried over the yard cranes on bridges. The main bridge shop circuit consists of two 1,000,000 circ. mils lines and two 750,000 circ. mils lines, feeding the east and west sides, respectively. It is intended to carry the same load on separate cables for power and lighting and to use multiple and enclosed arc lamps throughout. The bridge shop cables are fire and water-proof and are carried through the center line of the shop on the roof trusses with outlets in iron pipe conduits on the vertical columns and in trenches from them to the machines. The drill and riveting gantries are operated under the Ward Leonard system controlled either from the gantries or from the riveting machine, and arranged so accurately that the gantries and riveter can be handled within a fraction of an inch. The hydraulic pumps in the bridge shop have air accumulators with automatic electric control operated by the movement of the accumulator. The bridge shop has 300 Toerring arc lamps, mostly suspended from the crane track girders. The lighting and current distribution in the eye-bar and bending shops correspond essentially with that in the bridge shop. Eye-bars are charged in the heated furnaces by machines using the Electric Controller & Supply Company's electro-magnet.

In the office building there are 727 incandescent lamps in the private offices and 131 arc lamps in the halls. Crocker-Wheeler motors are used for some of the eye-bar machinery and for the bridge shop gantries operated under the Ward Leonard system. Elsewhere all the motors are of the Westinghouse type, of 5 hp minimum size.

Arm for Telephone Transmitters.

The accompanying illustration is of a new arm for interior telephones, which is being introduced by the W. J. Barr Manufacturing Company, Cleveland, Ohio. It is of the rotary type, the cord being concealed. Neatness of design is one of its distinguishing features, and it is made of brass nickel-plated or of iron black-enameled. This arm, it is stated, has been adopted by several prominent manufacturers for hotel and interior work.



TRANSMITTER ARM.

The W. J. Barr Company states that it is now manufacturing nearly 30 varieties of telephone arms and is supplying practically all of the leading manufacturers in this country, as well as several in European countries.

Arm, Pin and Bracket Convention.

The first annual convention of the National Arm, Pin and Bracket Association, convened on the evening of the 10th of November, at the Lookout Mountain Inn, Chattanooga, Tenn. The president being absent, Secretary J. B. Magers took the chair. The plan to regulate a uniform base on which to work and standardize the goods manufactured, was discussed. This took the greater part of the evening, after which the association adjourned to meet on the 11th at 11 o'clock.

At the second day's session, the meeting was called to order with E. J. Noblett in the chair. The first matter of importance was the election of officers for the ensuing year. The election resulted as follows: President, C. H. Houston, Chattanooga, Tenn.; vice-president, Daniel Ravenel, Franklin, N. C.; secretary, J. B. Magers, Madison, Ind.; treasurer, R. L. McOuat, Indianapolis, Ind.

Next in order was the appointing of the Executive Committee by the president, as follows: E. J. Noblett, Chicago, Ill.; A. A. Towers, Ellijay, Ga.; A. W. Bruner, Paoli, Ind. The other members of the committee will be appointed later by the president, who now has the matter under consideration.

It was decided to hold the next convention in St. Louis, Mo., in July, 1904. The Executive Committee was ordered to draft a letter to be sent to all supply dealers, stating the object of the association and requesting their co-operation in all matters pertaining to the standardizing of the articles manufactured by the various concerns interested in the movement.

They were also ordered to prepare resolutions which were adopted thanking the Chattanooga people for their hospitality to the members of this association. There being no other business to come before the convention, it adjourned to take a trip over the city and view Chickamauga Park.

Proposed Utilization of Falls of the Ohio River.

Our Indianapolis correspondent states that at the final conference between capitalists representing the Widener-Elkins interests and electrical experts and engineers employed by the syndicate and Major George McK. Derby, chief United States engineer for Indiana, it was announced that the plan for utilizing the falls of the Ohio River, near New Albany, to generate power for a vast electric system will be favorably recommended to Congress and the War Department. The project has been under consideration for some time. It was necessary, however, to secure the consent of the War Department to the plan and to demonstrate to Congress that navigation and certain riparian rights maintained by the government would not be impaired.

The Widener-Elkins people for the past three months have had engineers busy making plans and estimates to be presented to Major Derby. These plans are made with a view of being put into execution on the Indiana side of the river, a mile above the government dam.

It is proposed, by the plans, to widen the present mill race and extend it to the whirlpool eddy, a distance of one mile from the starting point. The power thus made available will be used for the generation of current. The wheels to be used are similar to some of those at Niagara Falls and the Chicago Drainage Canal. The engineers do not disclose the amount of power that may be secured, but say it will be on a large scale.

It is given out that if the final consent of the government is secured the promoters will spend at least $2,000,000 for the initial power plant, which will be of sufficient capacity to furnish electric light and power to Louisville, Cincinnati, Urbana and Indianapolis and cities and towns within a wide radius, covering parts of the three States—Indiana, Ohio and Kentucky. The plan is to organize a company and select directors from the traction companies now operating in Cincinnati, Urbana and Indianapolis.

Among those present at the conference besides a number of electrical experts and local citizens, were Dr. Louis Duncan, Massachusetts Institute of Technology; John Birkinbine, Philadelphia, engineer, and representing the United Gas Improvement Company; W. K. Schoepf, president Cincinnati Traction Company; Major George McK. Derby, United States engineer; Benzette Williams, Chicago, engineer, and Fred A. Joss, Indianapolis, representing the Terminal Traction Company.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Stock prices advanced and transactions were more active, due to covering by the extended short interest and to the favorable impressions created by the termination of the United States Steel conversion operation and the rise in Steel bonds and stocks. Outside participation was very narrow and dealings were mainly professional. The principal rise of the week was in the new Steel bonds, from 66 to 72, the preferred advancing from 50¼ to 53⅝, and the common from 10¼ to 12⅛. Pennsylvania Railroad was also a prominent stock in the transactions. Manhattan Railway showed strength in sympathy with the rest of the traction group, and General Electric developed advancing tendencies on small dealings due to investment buying. Amalgamated Copper was steady, but rather inactive. Boston reports a quiet market throughout the week. All of the electric and traction securities at New York, with one exception, closed with substantial gains and the business transacted in all was quite extensive. Brooklyn Rapid Transit closed at 38½ on transactions of 95,820 shares, a net gain of 1¾ points; the extreme quotations were 36¾ and 39⅝. Metropolitan Street Railway, after having dropped to 112, reacted and closed at 114½, this being 1 point under the highest price of the week and a net gain of 2½ points. General Electric fluctuated between 148, the lowest, and 157½, the highest, closing at 155, this being a gain of 8¾ points. Westinghouse common closed with a net loss of 1 point, the last quotation being 137; preferred closed at 170. Western Union made a gain of 1¼ points, closing at 84¼. Following are the closing quotations of November 24:

NEW YORK.

	Nov. 17	Nov. 24		Nov. 17	Nov. 24
American Tel. & Cable	78	77	General Electric	149½	152⅝
American Tel. & Tel	125	125	Hudson River Tel	..	.
American Dist. Tel	23	26	Metropolitan St. Ry	114	115⅝
Brooklyn Rapid Transit	38¾	38⅝	N. E. Elec. Veh. Trns	..	.
Commercial Cable	.	140	N. Y. & N. J. Tel	..	..
Electric Boat	22	23	Marconi Tel	..	..
Electric Boat pfd	48	48	Western Union Tel	83½	84¾
Electric Lead Reduction	*1	⅝	Westinghouse com	136	137
Electric Vehicle	6	5½	Westinghouse pfd	165	167
Electric Vehicle pfd	8	8			

BOSTON.

	Nov. 17	Nov. 24		Nov. 17	Nov. 24
American Tel. & Tel	124¾	125	Western Tel. & Tel. pfd	75	79
Cumberland Telephone	115	*115	Mexican Telephone	1¼	1¼
Edison Elec. Illum	*242½	241	New England Telephone	120	120
General Electric	149	152	Mass. Elec. Ry	18	17½
Western Tel. & Tel	7½	7¾	Mass. Elec Ry. pfd	76	76

PHILADELPHIA.

	Nov. 17	Nov. 24		Nov. 17	Nov. 24
American Railways	.	41	Phila. Traction	..	95
Elec. Storage Battery	46	47	Phila. Electric	5¾	5⅞
Elec. Storage Battery pfd	..	47	Phila. Rapid Trans	11½	11⅛
Elec. Co. of America	7¼	..			

CHICAGO.

	Nov. 17	Nov. 24		Nov. 17	Nov. 24
Central Union Tel	..	..	National Carbon pfd	85	87
Chicago Edison	..	..	Metropolitan Elev. com	..	17
Chicago City Ry	..	164	Union Traction	5½	5
Chicago Tel. Co	..		Union Traction pfd	25½	28
National Carbon	19	19			

*Asked

MICHIGAN TELEPHONE.—The protesting Michigan Telephone stockholders who are endeavoring to have set aside the recent foreclosure sale in Detroit, Mich., allege in their petition to the courts of that State that of the $5,000,000 capital stock outstanding $4,000,000 is held, owned or controlled by the American Telephone & Telegraph Company; $700,000 is held in the State of Michigan by 700 stockholders and these stockholders have no representation upon the board of directors. The property is valued at $12,000,000 and has an earning capacity of $2,000,000 annually, which is constantly increasing. From a report made at the annual meeting in June, 1903, covering the year of 1902, and made more than eight months after the bill of complaint was filed, it appears that the gross earnings were $1,549,331 and that the expenses were $1,632,230, showing an apparent deficit of $82,699. An analysis of the expense items is alleged to show that there was charged against earnings the sum of $394,521 as interest, which interest has not been paid. Expenses also include $480,000 under the head of maintenance, which is alleged to be a fictitious charge, and does not truly represent the amount so expended. It is alleged that instead of being insolvent at the time of the foreclosure mortgage, the company was amply solvent and had at all times sufficient money with which to pay said interest. The bill states that the number of telephones in the State is 53,000, and the company is now earning a sufficient revenue to pay 5 per cent. on its bonds and stocks and $1,200,000 for operating and $300,000 for maintenance.

CALIFORNIA TROLLEYS.—The actual consolidation of the electric roads H. E. Huntington has built and is to build in California with the Southern Pacific may never take place, but, according to advices from San Francisco, E. H. Harriman and Kuhn, Loeb & Co., of the Southern Pacific, have become large owners in the Pacific Electric Railway, of H. E. Huntington and I. W. Hellman, in Southern California. They are also to be close partners of Huntington in the electric systems he aims to build out from Stockton and Fresno and elsewhere in the State. The deal signifies that Harriman has prevented any combine between Huntington and Hellman and the Santa Fé in the south. On an agreed basis, the lines of the Southern Pacific, wherever they come into competition with the Huntington electric lines, are to work in harmony. In the San Joaquin valley a network of electric lines is to be built, but the Harriman and Huntington arrangement will prevent these lines from being a disastrous source of competition to the Southern Pacific.

MARYLAND TELEPHONE & TELEGRAPH.—The earnings of the company from October 1, 1902, to September 30, 1903, were:

Gross	$351,865
Expenses	155,159
Net	$196,706
Taxes, subway rental, interest on ground rent	28,426
Balance	$168,280
Interest on first 5s $1,000,000 issue	50,000
Balance	$118,280
Interest on $1,155,000 general mortgage bonds	34,489
Surplus	$83,790

CUMBERLAND TELEPHONE.—The Cumberland (Bell) Telephone & Telegraph Company reports as follows: October gross, $292,340; expenses and taxes, $177,466; October net, $114,874; other income, $9,863; total income, $124,737; charges, $12,199; surplus, $112,538. The general balance sheet as of October 31, 1903, shows: Assets—Construction (exchange plants and toll lines) $14,172,286; supplies on hand, $241,440; real estate (exchange buildings) $527,330; stocks and bonds, $228,014; cash, $233,475; total, $15,402,545. Liabilities—Capital stock, $11,364,650; bonded debt, $1,046,000; debentures, $239,000; balance bills and accounts payable and receivable, $597,793; surplus, reserve and undivided profits, $2,155,102; total, $15,402,545.

AMERICAN RAPID TELEGRAPH BONDS.—The committee representing the old American Rapid Telegraph Company bondholders has distributed a final dividend of $2.55 per bond, upon the $2,894,000 bonds, which many years ago foreclosed upon the Rapid Telegraph Company property and sold the same to the Western Union Telegraph Company. This makes a total dividend distribution extending over several years of $265.55 per $1,000 bond. It was expected at one time that more than 30 per cent. would be realized, but the suit against the Western Union Telegraph Company, to recover rental previous to the sale was decided adversely.

BOSTON WEST END STREET RAILWAY.—The West End Street Railway Company, through its lessee, the Boston Elevated Railway, has petitioned the Railroad Commissioners for authority to issue its negotiable bonds to the amount of $700,000, the proceeds to be used in paying bonds of the Metropolitan Railroad and of the Middlesex Street Railway Company, both of which latter lines are leased to the West End Company.

BEAVER VALLEY TRACTION MORTGAGE.—The Beaver Valley Traction Company, which operates 15 miles of street car lines in Beaver Valley, has mortgaged its entire holding to the Northern Trust Company, of Philadelphia, for $3,000,000, and will use the money to extend the lines to meet the Pittsburg Railway Company's line at Corapolis and the New Castle Street Railway at Mahoningtown.

GENERAL ELECTRIC DIVIDEND.—The report that the General Electric Company is to declare an extra dividend of $2 per share at the next meeting is without foundation. The business of the company continues excellent, but there is no thought of distributing extra dividends at this time, even with large contracts in sight like that for the New York Central plant.

ANOTHER THIRD-RAIL ROAD.—It is stated that the Scioto Valley Traction Company, which is building from Columbus to Chillicothe, Ross County, will adopt the third-rail system. Its power house, at Valley Crossing, will cost about $400,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Retail trade has been greatly stimulated over the larger part of the country by the cold weather, and as a result jobbing demand in seasonable lines has been quickened. It is noted that inquiries for holiday goods in some sections exceed last year's, the feature being the high grade of materials taken. Interior retailers, helped by favorable agricultural conditions, it is stated, are meeting their obligations more promptly. Farming interests are apparently in good financial condition. Southern conditions are especially good. Railway earnings continue in a very satisfactory state, the increase in gross receipts for the first half of November being 5½ per cent., while the net for September, exclusive of coal roads, advanced 4 per cent. Against these favorable developments is the situation in the labor world; the gloomy outlook for building, the closing down of some iron and steel mills, blast furnaces and leather tanneries, although others have started up again, and the continued hesitancy in the buying of practically all commodities. In the iron and steel market the general tendency is toward a lower price level. The exports of iron and steel were of moderate volume. A rapid increase in exports is expected, however, as the result of the cut of 33⅓ per cent. in railway freight rates. Twenty thousand tons of steel rails have been sold for delivery at Beirut, Syria, the quotation, it is reported, being under $19, at the Atlantic seaboard. The demand for anthracite coal is light and mining companies are restricting production in order to maintain prices. The output of bituminous coal is very heavy. The copper market relapsed into dullness, and home consumers hold off with orders. On the other hand, exports continued very heavy. Quotations are nominal, at 12½ to 13c. for Lake; 12⅜ to 12⅝c. for electrolytic; 12⅛ to 12⅜c. for cathodes and casting stock. Lead was reduced $6 per ton by the American Smelting & Refining Company, and, notwithstanding this cut, the market remains dull. The business failures for the week ending November 19, according to *Bradstreet's* statistics, aggregated 234 against 250 the week previous, and 201 the corresponding week last year.

CULTIVATING FOREIGN TRADE.—The Foreign Trade Association of America, organized to foster the growth of our export trade, has been incorporated under the laws of New York State, and a meeting to elect a temporary board of officers will be held at the rooms of the association at 66 Broad Street on December 1. The first regular meeting, at which permanent officers will be elected, will be held on the second Tuesday in January. The membership of the new association includes practically all the members of the old export club, and will number about 250. The following trades are represented: Hardware, paper, dry goods, glassware and crockery, shoes and leather, woodenware, light machinery, rubber goods, oil, paint and varnish, drugs and chemicals, electrical and structural machinery, iron and steel, groceries and provisions, lumber, agricultural implements and building equipment. A feature of the association's work will be its advisory board. When a trade attains a membership of five in the association it will select a committee of three, the chairman of which will be a member of the advisory board. This board's duty will be to recommend measures for the general benefit of the export trade. An arbitration committee, to adjust disputes without recourse to litigation, will also be a feature of the association. The association will hold its first annual dinner at the Waldorf-Astoria on December 16.

THE NEW RUSSIAN TARIFF is of interest on account of its increases; but we are not aware it has gone into effect yet. The unit of levy is the pood, or 36.112 pounds. Machines and apparatus, complete or incomplete, fitted together or in parts, of cast iron, wrought iron, or steel, with or without parts composed of other materials, even in combination with copper to an extent not exceeding 25 per cent. of the total weight of the machine, imported by the western land frontier are assessed 3.06 rubles ($1.58) in the new tariff, against 2.10 rubles ($1.18) in the present tariff. Gas and naphtha motors, steam engines, portable engines except those connected with complex thrashing machines and steam plows, locomotives, locomotive wagons, steam-driven tricycles and electrical locomotives, pumps and hand fire engines, compressors, and ice-making and refrigerating machines are assessed 4.38 rubles ($2.26) in the new tariff. On typewriting and sewing machines the new duty will be 5.58 rubles ($2.87). On all machines made of copper or its alloys, or in the composition of which copper or any alloy of copper is present in a proportion exceeding 25 per cent. of the total weight of the machine, the duty is raised from 6.48 rubles ($3.34) to 10.80 rubles ($5.56), an increase of $2.22. Dynamo-electric machines and electric motors of all kinds and transformers are raised from 2.10 rubles to 10.20 rubles ($1.08 to $5.25), an increase of $4.17.

MEXICAN HYDRAULIC PROJECTS.—Guillermo Brockmann, of Mexico City, who is largely interested in El Oro mines, and who handles considerable quantities of American machinery, has secured a concession to utilize the Rio de la Cienaga, in the vicinity of El Oro, for electric power. A company has been organized in Mexico City with an initial capital of $150,000, for the purpose of erecting the necessary plant. M. Marroquin y Rivera and Manuel Serrato, Mexico City, engineers, are primarily interested in a project to construct a plant on the River Conchos, between La Cruz and Julimco, for the purpose of generating current. Jesus Avalos, who owns a large plantation in the municipality of La Piedad, State of Michoacan, is to build a water power plant on the Lerma River. The plant will furnish power for operating sugar mills and lighting the villages in the neighborhood. Manuel Hernandez, of Santa Maria del Rio, State of San Luis Potosi, is the projector of a scheme to construct a large dam on the Santa Maria River, where a large plant is to be built and equipped with turbines. The water will be pumped to Santa Maria del Rio.

NOVEL USE FOR REFRIGERATION.—In some electrical tests where exact results are required, it is important that certain instruments, or baths, or chambers, be maintained at a constant temperature, and in other tests it is quite necessary that the air be comparatively dry. To secure these desirable conditions in its new laboratories at Eightieth Street and East End Avenue, New York City, the Lamp Testing Bureau has installed a refrigerating machine which will cool the air of one room to the temperature required and freeze the moisture from the air of another room when the humidity is higher than it should be for the best working conditions. The company hopes to have its new laboratories ready for work about January 1, when it will abandon its present temporary quarters at 14 Jay Street, New York.

PUEBLA LIGHT AND POWER NEGOTIATIONS OFF.—The negotiations looking to the taking over of the lighting and power systems in Puebla, Mexico, by Canadian interests have been declared off. A. E. Worswick, formerly chief engineer of the Mexico City electric traction system, who was conducting negotiations with the Canadian people, is now in Europe. Private advices state that Wernher, Beit & Co., of London, have been approached with a view to their taking up the matter. The Portzuelo Electric Light & Power Company is the name of the concern which furnished light and power for Puebla and vicinity. It operates a water power plant having a capacity of 4,000 hp.

ELECTRIC EQUIPMENT FOR POPOCATEPETL.—Mexican advices state that the death of Andrew H. Green, the "father of Greater New York," who was the leading interest in the American syndicate which recently acquired the Popocatepetl volcano, will not delay the construction work which the syndicate has in view. An electric railway is to be built up the mountain. The power plant will be installed on the adjacent volcano of Ixtaccihual. A. H. Smith and Captain Charles Holt, representing the American syndicate, are now in Mexico. The railway and power plants are expected to cost not far short of $1,000,000.

EQUIPMENT FOR SPAIN.—The Santamarina Company, of Barcelona, one of the prominent electrical engineering and contracting firms in Spain, is placing some fair-sized orders here for various equipment. The Spanish concern is represented in New York by C. J. Harrington, 15 Cortlandt Street. Some Wagner motors have just been ordered. Mr. Harrington has a good-sized order in hand for lamp supplies to be shipped to Buenaventura, Colombia. A substantial order for third-rail insulators has also been secured from the Brooklyn Heights Railroad.

HUDSON (MASS.) LIGHTING PLANT.—The town of Hudson, Mass., is now installing a General Electric 1,040-2,080-volt, three-phase generator, with a seven-panel blue Vermont marble switchboard. The generator is direct-connected to a Harrisburg cross-compound condensing engine, developing 375 hp at 125 pounds steam pressure, with 26-in. vacuum. The entire station has been overhauled and changed around into compact and convenient form and added to at an expense of $15,000 under the design and direction of Mr. W. G. Lawrence, manager.

EQUIPMENT FOR MERIDIAN TROLLEYS.—The Meridian (Miss.) Light & Railway Company is about to re-equip its rolling stock and will put six or eight new double-equipment 40-hp cars on in addition to eight already in operation which have been thus fitted; the apparatus being Westinghouse 40-hp motors and new standard General Electric controllers. The large new power house is nearing completion—said to be the largest in the State—and there is a likelihood that a steam turbine unit may be installed.

RAILWAY LIGHTING CONTRACT.—The United States Light & Heating Company has been awarded the contract for equipping all of the Empire State Express cars for the New York Central Railroad with its automatic system of electric lighting and ventilating; also cars for the Twentieth Century Limited.

BALL ENGINE ORDER.—The Chicago, Burlington & Quincy Railroad Company has ordered a direct-connected engine from the Ball Engine Company, Erie, Pa.

THE CITY OF SEATTLE, WASH., has let contracts for all of the equipment of the municipal electric light and power plant which is to be installed on the Cedar River. The first bids for the generators were thrown out and on the second set of bids the Bullock Electric Manufacturing Company was awarded the contract. The bids from all the competing companies were very close, being within $100 of each other on an $18,000 contract, and the Bullock Company, having the lowest bid, was given the order. The contract calls for two 1,200-kw, 2,300-volt, three-phase, 60-cycle, revolving field alternators with a speed of 400 r.p.m. and two 75-kw, 830-r.p.m. exciters. The power plant will operate under a head of 560 ft., the water being conveyed through 1,080 ft. of 48-in. steel riveted pipe. The Pelton Water Wheel Company, of San Francisco, has been awarded the contract for the water wheels and pipe. The station voltage will be raised from 2,300 to 44,000 volts by two banks of transformers (with a third bank for emergency), each bank consisting of three 400-kw transformers, and transmitted over two separate transmission lines to a sub-station in Seattle. Each line will be composed of three No. 1 copper or equivalent aluminum wires, spaced 75 in. apart, on poles approximately 125 ft. apart. At Seattle the current will be stepped down from 40,000 volts three-phase to 2,200 volts two-phase for power, incandescent lighting and arc and incandescent street lighting through constant current transformers. John Martin & Co., of San Francisco and Seattle, have been awarded the contract for the transformers, the Standard Underground Cable Company, the contract for the wire, and the California Electric Works the contract for the insulators. The specifications were drawn and the engineering work on the plant is being done by R. H. Thompson, city engineer, of Seattle.

LOWER FREIGHT RATES.—The request of the steel manufacturers of this country for a reduction by the railroads of the freight rate on iron and steel products from interior points to the seaboard for export has been granted by the railroads at a long meeting which was held at the offices of the Trunk Line Association in this city. The reduction granted is 33⅓ per cent., and applies to all articles on the so-called special list, including billets, but not including steel rails. The latter, with a number of other articles, appear under the official classification list, and action on this list was referred to the so-called Iron and Steel Committee, which will meet in the second week in December to consider the application of the steel men. The new rate applies only to export business and carloads. Shipments of less than carloads remain under the old tariff. The old rate from Chicago to New York was $27.50 a hundred, or $5.50 a ton. The reduction of one-third brings this rate down to $17.50 a hundred or $3.50 a ton from Chicago. From Buffalo and Pittsburg to New York the rate was formerly $14.50 a hundred or $2.90 a ton, while the new rate will be $9.50 a hundred or $1.90 a ton. The same rates will apply via Boston, while the other ports will receive the usual differentials. The new rate will take effect December 1.

PRICES OF COAL have been cut for bituminous. Virginia, West Virginia and Maryland products are engaging sharply in competition with the cheaper products of Pennsylvania and elsewhere. The prices of George's Creek, Pocahontas and New River coals have been quoted in the last few days at $2.90 and $3.25. Previous to last week New River and Pocahontas coal was held stiffly at $3 to $3.25, and George's Creek coal 25 cents higher. A few weeks ago all these higher grade coals were held at $3.50 to $3.75, and even higher for some varieties. The first break was made last month, when the Executive Committee of the Bituminous Association abandoned the agreement as to the minimum prices. One cause of this action was the belief of certain high-grade producers that they had been engaged in a vain effort to maintain the market in the face of general slashing of the prices of the inferior grades. The falling off is not ascribed altogether to industrial dullness. It is explained that many consumers, having the big strike fresh in their recollection, and fearing another as a possibility, bought heavier stocks of coal than usual early in the present year and consequently do not require as much as usual now.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Indiana Interurban Construction Company for the installation of a battery of Chloride accumulators for the Kokomo, Marion & Western Traction Company, at Kokomo, Ind. This battery consists of 288 cells, having a capacity of 384 kw, to be used in regulating the load on 60-cycle rotaries, so that the lighting and railway service can be obtained from the same generators. A contract has also been closed with the Department of Commerce and Labor at Washington, D. C., for two batteries to be operated by the National Bureau of Standards at Washington, with the Clark University at Worcester, Mass., and with the Bacon Air Lift Company for the residence of Hermon B. Duryea, Westbury, L. I. This latter installation consists of a battery of 68 cells, having a capacity of 46 kw to be used for lighting and power after the generator plant is shut down for the night.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company instrument statement for month ended September 20, and since December 20, is as follows:

Month ended Sept. 20.	1903.	1902.	1901.
Gross output	79,406	75,011	75,578
Returned	33,438	43,334	33,482
Net output	45,968	41,677	42,096
Since Dec. 20.			
Gross output	812,229	808,334	683,171
Returned	358,831	346,689	301,289
Net output	453,398	461,645	381,882
Total outstanding	3,603,718	2,987,251	2,334,698

SOME AMERICAN BALL ENGINE ORDERS.—The American Engine Company, New York offices White Building, Liberty Street, has secured a contract for three engines to be installed in the new dynamite factory under construction at Washburn, Wis., by the Atlantic Manufacturing Company. The plant will be electrically operated. There will be one 100-hp, one 120-hp and one 135-hp duplex compound engine to be belted to generators for light and power service. Another contract in hand calls for a 160-hp simple engine to be direct-connected to a Crocker-Wheeler generator of 100-kw capacity for lighting purposes in the Brooklyn plant of the American Can Company.

5,000-KW WESTINGHOUSE TURBO-GENERATORS.—A 5,000-kw type of Westinghouse turbo-generator is now under construction at Pittsburg, the first units of this type being built on order from the Philadelphia Rapid Transit Company, and the Pennsylvania Railroad Company, for the New York tunnel power plant. Unlike some of the recent Westinghouse turbines, the three sections of different diameter will be united in one frame. The speed will be 750 r.p.m. and three-phase currents will be generated at 25 cycles and 13,000 volts.

AMERICAN STEAM SUPERHEATER COMPANY, 176 Federal Street, Boston, Mass., has just issued its first catalogue illustrating and describing this specialty and discussing the practical advantages of superheat. The company has already begun to do business and reports orders for its superheaters from the Atlantic Mills in Providence, R. I., and the Nashua Light, Heat & Power Company, of Nashua, N. H. The first order is for use with a Westinghouse 400-kw turbine, and the second for three 500-kw General Electric turbines.

3,000-HP GAS ENGINE.—The Westinghouse Machine Company has completed the designs for a 3,000-hp gas engine, which will soon be put under construction. The machine will be of the horizontal type, and have two tandem cylinders, the pistons of which will connect with two cranks displaced 180°. As each cylinder will be double-acting a very uniform effort will be imparted to the shaft, this type being particularly well adapted for electrical generation.

MEXICAN WATER POWER SCHEMES.—Water power plants are to be built on the Scolapan river in the State of Vera Cruz and also at Tezuitlan, State of Pueblo, Mexico, for electric lighting and industrial purposes. Domingo Barrios Gomez, of Japantla, State of Vera Cruz, is the chief party concerned in both enterprises.

PLANT WANTED SOUTH.—The city of Sandersville, Ga., wants estimates on an equipment for lighting the town. The present figuring on the requirements are for 1,000 arc lights and 3,000 to 5,000 incandescents in a territory two miles square. All communications should be addressed to Mr. S. G. Lang.

THE AUTOMATIC ELECTRIC COMPANY, of Chicago, has received an order from Bills Brothers for complete equipment of an automatic exchange of 2,000 stations (initial installation) for Sioux City, Iowa. The exchange will have an ultimate capacity of 10,000 telephone stations.

QUIMBY PUMPS IN ENGLAND.—The Quimby Screw Pump Company, Limited, has been organized under the British Limited Liabilities Act for the purpose of manufacturing the Quimby pump in England. The capital of the company is $105,000.

ELECTRIC ROCK DRILLS FOR NEW ZEALAND.—The Denver (Colorado) Engineering Works have taken a contract for electric rock drills for use in New Zealand mines. The contract came through Muller, MacLean & Co., 116 Broad Street.

THE SAFETY INSULATED WIRE & CABLE COMPANY, of New York, has secured the contract for completing the fire and police underground cable work in Atlanta, Ga., for $2,819. The work was suspended recently owing to lack of funds.

STERLING AGENCY IN AUSTRALASIA.—The Sterling Electrical Manufacturing Company, of Warren, Ohio, has appointed Barre, Johnston & Co., of Sydney, New South Wales, as its Australasian agents.

General News.

THE TELEPHONE.

CECIL, ARK.—The Ozark & Cecil Telephone Company, of Cecil, has been incorporated with a capital stock of $5000. William Jones is president, W. G. Stockton, vice-president, and J. C. Wiggins, secretary and treasurer.

SAN DIEGO, CAL.—After a heated discussion in the City Council and its committees the Home Telephone Company has been granted a franchise to operate in the city.

ATWOOD, ILL.—The Atwood Mutual Telephone Company has increased its capital stock from $6000 to $9000.

TUSCOLA, ILL.—The Home Rural Telephone Company and the Tuscola Telephone Company have been merged.

NASHVILLE, ILL.—The Nashville City Council has granted a franchise to the Rixman Telephone Company of Irvington. The Southern Union Telephone Company which now operates a system in this city opposed the measure, but the objection was overruled.

EVANSTON, ILL.—Evanston is to have a new telephone line to compete with the Chicago Telephone Company. Business men and capitalists in the suburb are back of the plan. James E. Keelyn, who has organized similar companies at Waukegan, Racine and Kenosha, is at the head of the movement.

THOMASBORO, ILL.—Steps are being taken here to organize a farmers' mutual telephone company. Among those interested are J. E. Leonard, Thomas Leonard, Peter Murray, M. C. Busey, James Connett and Dr. T. J. Exton. It is proposed to build lines from Thomasboro to Leverette, and a branch will be extended northwest to connect with the South Tomlinson Telephone Company.

RICHMOND, IND.—The City Council has begun a movement to get the poles and wires of the telephone, telegraph, electric light and street car companies, now on Main Street, underground. The matter has been put in the hands of a special committee for investigation.

TIPTON, IND.—The Delaware & Madison County Telephone Company has secured an option on the Tipton Telephone Company. The local service has not been very satisfactory and if the exchange goes into the possession of the Delaware & Madison Company it will be rebuilt with an automatic switchboard and otherwise improved, thus insuring first-class service.

FINCHFORD, IA.—The Finchford Mutual Telephone Company has been incorporated with a capital stock of $10,000. Mr. W. W. Plantz is president.

WATERLOO, IA.—Four mutual telephone exchanges in Black Hawk County have combined and incorporated with a capital stock of $10,000.

OLDHAM, KY.—The Oldham Telephone Company has been incorporated with $10,000 capital stock by R. B. Blackmore, R. B. Cassady, Joseph Saber and others.

MT. STERLING, KY.—The East Tennessee Telephone Company has purchased several small companies operating in this section of the state. It will extend its system to cover every part of eastern Kentucky.

ANN ARBOR, MICH.—The Washtenaw Home Telephone Company has been granted a franchise in this city.

DIBLEY, MINN.—The Barnesville & Wolverton Telephone Company will build 35 miles of line through Mitchell and Atherton townships.

CANON CITY, MINN.—The Canon City Rural Telephone Company has been formed here to build a line from this city to Faribault. Mr. H. H. Crossett is president.

INDEPENDENCE, MO.—The American Electric Telephone Company, of Chicago, recently made shipment of a 3000 capacity common battery type, mahogany cabinet multiple switchboard and exchange equipment to Independence, Mo. This switchboard is equipped complete for four-party selective signaling system. The power plant includes machinery necessary for handling the party line service.

ARMSTRONG, MO.—The Farmers' Telephone Company, composed of farmers of Burton and Prairie townships, has been organized by the election of the following-named officers: Asa Thompson, president; William Forbes, treasurer, and Bert Blousett, secretary. Seventy-five farmers are stockholders in the company and work is rapidly progressing in the erection of lines. This company will have connections with all the towns in Howard County.

WEST POINT, NEB.—The Ainsworth Telephone Company, under the management of Mr. Joseph F. Jankele, is putting in a local telephone system.

FREMONT, NEB.—Representatives of the independent telephone companies of eastern Nebraska to the number of 30 met on Nov. 10 and formed the Nebraska Independent Toll Line Association. The following-named officers were elected: President, I. D. Clarke, Papillion; secretary, J. Howard Heine, Hooper; auditor and treasurer, W. D. Crist, Fremont. Rate committee: A. M. Munn, Nebraska City; O. M. Thorp, Wahoo; T. H. Pollock, Plattsmouth; J. C. Killarney, Auburn; A. E. Gantt, Falls City.

LIBERTY, N. Y.—The Liberty & Jackson Telephone Company, of Liberty, Tioga County, has been incorporated; capital, $5000.

BABYLON, L. I., N. Y.—The village trustees have granted a telephone franchise to the New York & Long Island Telephone Company.

GALWAY, N. Y.—The Galway Telephone Company has been incorporated with a capital stock of $5000. Mr. C. F. Mairs is one of the directors.

EDEN, N. Y.—The Eden Telephone Company, of Eden, Erie County, has been incorporated; capital, $3000. Directors: D. A. Palmerton, Y. C. Barto and J. D. Caskey, of Eden.

NEWBURGH, N. Y.—The quarterly meeting of the Orange & Sussex County Independent Telephone Association was held recently at Newburg. The committee in charge of issuing the new book of subscribers reported the work well under way. A connecting line to Albany is nearly completed.

DRYDEN, N. Y.—The Dryden Telephone Company has been incorporated here with a capital of $10,000. The incorporators are Edwin C. Dedrick, Webb Corbin and Alfred Myers, of Dryden.

BUFFALO, N. Y.—The Commercial Telephone Company, of Gowanda, has been incorporated to operate in Erie and Cattaraugus Counties; capital, $50,000. Directors: E. C. Fisher, Gowanda; B. H. Phillips and E. L. Falk, Buffalo.

CINCINNATI, OHIO.—The Pataskala & Hebron Telephone Company has been incorporated with a capital stock of $65,000.

BROOKVILLE, OHIO.—The Brookville Telephone Company has increased its capital stock from $6000 to $10,000. J. C. Snyder is president.

PEMBERVILLE, OHIO.—The Pemberville Telephone Company has bought the interests of the Bradner Telephone Company in the Bell exchange. The new company will rebuild the plant and install new telephones.

CROOKSVILLE, OHIO.—The Crooksville Telephone Company has been incorporated with $10,000 capital stock by J. C. Moore, S. M. Winn, T. F. Wilson, J. B. Rhodes and others to build a local telephone system.

CINCINNATI, OHIO.—According to Cincinnati dispatches the local Bell Telephone Company's name has been changed from the City & Suburban Telegraph Association to the Cincinnati & Suburban Telephone Company.

ELMORE, OHIO.—The stockholders of the Ottawa County Telephone Company have reelected the present officers and declared the usual semi-annual dividend. E. O. Harkness is president. A number of improvements are being arranged for.

TOLEDO, OHIO.—Regarding a rumor that the Postal Telegraph & Cable Company had secured control of some independent telephone lines in Ohio, denial is made by local officials. It was explained that a telephone company desired the joint use of a number of poles, offering in return the free use of a test station for the telegraph company in a nearby town. The telephone company also offered to telephone messages to a few towns on this route where the telegraph company would not locate offices for the want of sufficient business.

WHITE EAGLE, OKLA.—The Reservation Telephone Company of this place has been incorporated with a capital stock of $5000. Mr. G. W. Carsen is one of the directors.

EASTON, PA.—The Easton & Bethlehem Telephone Company is being formed here. Mr. J. D. Broadhead is president.

PATTON, PA.—The Huntingdon & Clearfield Telephone Company is extending its lines and is now building 40 miles of trunk line from Patton to Clearfield.

VANDERGRIFT, PA.—The telephone system at this place, with 200 subscribers, is operated by the Vandergrift Electric Light & Power Company. The subscribers pay $1.50 and $2 a month.

LAKE VIEW, PA.—Mr. F. E. Benson, secretary of the Northeastern Penna. Telephone Company informs us that his company gives free use of its lines to all stockholders, and that it is maintained by tolls collected from non-stockholders. Each stockholder pays $2 per year. The company has at present 500 subscribers. During the past year it has added 30 miles of toll lines.

SPARTANSBURG, S. C.—It is announced that two additional copper metallic circuits will be strung between Selma, N. C., and Spartansburg, S. C., by the Southern Bell Telephone Company.

ROCK HILL, S. C.—A subscription list of 354 is the record of the Rock Hill Telephone Company. General Manager J. E. Pryor informs us that possibly the company may install the central energy system next year. The company is at present building a 30-mile line.

SUMTER, S. C.—The Sumter Telephone Company is moving into new quarters and is changing its system from ground metallic to full metallic circuit. The company has 320 subscribers, with 300 miles of toll line. It uses apparatus of the Telephone Manufacturing Company and the Sumter Telephone Manufacturing Company, and reports a steady growth.

DENTON, TEX.—The Home Telephone Company will build lines throughout the county for the use of farmers.

PETERSBURG, VA.—The Petersburg Telephone Company has begun to build a line from this city to Chesterfield Courthouse, and will complete it during the month. Petersburg is now in telephone communication with Dinwiddie, Prince George, Surry, Isle of Wight and Nansemond. The lines are rapidly being built to various points around the city, and within two years there will not be an important point in Southside Virginia that will not be connected by telephone with Petersburg. As soon as the line to Chesterfield has been completed the company will build a line to Mecklenburg, Va.

MILWAUKEE, WIS.—The West Shore Telephone & Telegraph Company has applied for a franchise in this city.

HUSTISFORD, WIS.—The South Hustisford Telephone Company, of Hustisford, Dodge County, has been incorporated with a capital stock of $300. The incorporators are W. H. Jones, E. C. Randell, E. E. Randell, S. B. Jones and H. O. Ryder.

CIUDAD PORFIRIO DIAZ, MEX.—An extensive telephone system is to be built in this district which borders on the Rio Grande. It will be under governmental control and a tax has been levied to meet the cost of construction. The lines of the proposed system will extend to all of the principal towns and larger ranches in the district.

OTTAWA, ONT.—The organization of the Canadian Telephone & Telegraph Company has been completed. The total capital is $1,000,000. Ottawa will be the headquarters of the concern, and if it can get a franchise from the Council of this city it will begin the construction and installation of its system forthwith. It is empowered to build trunk lines, and ultimately hopes to see its system stretching across the continent.

ELECTRIC LIGHT AND POWER.

OZARK, ALA.—Bonds amounting to $15,000 have been sold for the installation of an electric light plant.

FORDYCE, ARK.—The Fordyce Light & Water Company has been incorporated with a capital stock of $20,000, of which $6250 has been subscribed. B. H. Woods is president and treasurer, J. G. Pattillo, vice-president, and John Hampton, secretary.

YREKA, CAL.—The Siskiyou Electric Company has applied for an electric franchise in this city and bids for said franchise will be received Nov. 27. J. F. Brown is City Clerk.

TRINIDAD, COL.—Press despatches from Trinidad state that on the morning of Nov. 10, dynamite was exploded under the electric power house at Hastings, 20 miles north of Trinidad. No damage was sustained to the machinery, though one corner of the building was destroyed. It was thought to have been the work of some sympathizer with the strike in the mining camps.

SILVERTON, COL.—The fight which has been on here the past two years between the independent electric light company and the municipal plant is about to culminate in disaster to the independent company. At present incandescent lights are furnished to consumers by each plant at a rate of about $1 per light. This rate is about to be still further reduced. The city council has decided to levy a tax upon property owners for the maintenance of the city electric plant and furnishing lights to all without any direct charge therefor. It is estimated that lights can thus be furnished at a cost of not to exceed 50 cents each per month. This move, it is said, will effectually do away with the independent plant, as its owners cannot maintain their business and provide lights at a lower rate than is now in force.

IDAHO FALLS, IDA.—A company recently organized here contemplates establishing an electric power plant on the Snake river. The estimated cost is $75,000.

BOISE, IDA.—It is stated that the Mercantile Trust Company, of Boston, has filed in the United States Court here a bill for the foreclosure of a mortgage against the Boise-Payette Electric Power Company. The mortgage covers $475,000 of bonds issued by the company. The court will be asked to appoint J. W. Cunningham, secretary of the Capital Electric Light, Motor & Gas Company, as receiver to take charge of the company. The Boise-Payette Electric Power Company, it is stated, has defaulted in the payment of its semi-annual interest amounting to $13,250. Later reports are to the effect that the Court has appointed Mr. Cunningham as receiver.

MARSHALL, ILL.—The Marshall Heat & Light Company has been incorporated to operate heat, light and power plants; capital, $15,000. Incorporators: Fred J. Bartlett, Harry B. Dulaney and Walter Cole.

JERSEYVILLE, ILL.—The Union Water, Light & Traction Company has been incorporated; capital, $50,000; to operate power, light, heat, water and railway plants. Incorporators: Owen Ford, J. M. Gore, B. V. Beekman.

STERLING, ILL.—The City Council will increase the price of electric lighting on Dec. 1. To those using their own meters the price will be raised from 11c. to 13c. per kilowatt, and to those using city meters from 12c. to 14c. per kilowatt. Discounts will be allowed for prompt settlement of bills.

LA GRANGE, ILL.—The La Grange water works plant, which also houses the electric light plant from which water and light are supplied to that village and to Grossdale, was destroyed by fire on Nov. 18. The electric light plant will be placed in operation as soon as second-hand machinery can be secured to tide over until such a time as new machinery can be obtained. In the meantime the village streets will be in darkness.

FT. WAYNE, IND.—The County Commissioners have authorized Engineer Reilling to prepare plans for an electric light plant for the poor farm, to cost about $3,000.

EAGLE GROVE, IA.—The citizens have voted to grant a franchise to the Eagle Grove Light & Heating Company.

MILO, ME.—Dr. H. A. Snow, F. E. Guernsey and W. S. Owen, are interested in the construction of an electric plant here, to cost about $15,000. C. O. Sturtevant is the engineer.

FAIRFIELD, ME.—The power house of the Waterville & Fairfield Electric Railway & Light Company, used for the incandescent system of lighting, was burned recently. The loss on the machinery was about $6000, covered by insurance. Loss on the building was slight.

LAWRENCE, MICH.—The citizens have voted to issue $15,000 electric light bonds.

CAPAC, MICH.—Bids will be received Nov. 30 by the Board of Village Trustees for furnishing a 135-hp horizontal automatic engine, to be direct-connected to, or to drive by belt a single-phase, 60-cycle, 2,300-volt, 90-kw alternator. John Hewitt is chairman.

MINNEAPOLIS, MINN.—Franchise negotiations with the General Electric Company are under way. The corporation has consented to accept a gross earnings tax in addition to all other state, city and county levies, and not in lieu thereof. It is also willing to have its meters inspected and its lamp efficiency tested at regular intervals by city officials. The company does not object to a rival concern, but says it is unwilling to consent to a franchise which carries with it the legal power of any private plant to light the structures nearby.

VERSAILLES, MO.—The citizens of this place have voted bonds to the amount of $10,000 for the purpose of erecting a city electric light plant.

HANNIBAL, MO.—The municipal board of Hannibal has retained the Arnold Electric Power Station Company, of Chicago, to advise as to necessary changes and the replacing of the old system by a modern one in the near future.

JOPLIN, MO.—The United States Supreme Court at Washington has decided the case of Joplin City against the Southwest Missouri Light Company in favor of the city. The case involved the right of the city to erect lighting works of its own, to be operated in competition with those of the light company.

BILOXI, MISS.—The deal has been closed and the deed signed transferring the assets of the Biloxi Electric Light Company to the Biloxi Electric Street Railway & Power Company. The consideration was $29,500 in cash and $18,000 in stock.

NEW BRUNSWICK, N. J.—The Public Service Corporation of Newark has purchased the Central Electric Company plant here, which supplies this city, Metuchen, Bound Brook, Perth Amboy, Woodbridge and Rahway with light. The company purchased the business, paying $17 per share for all the stock.

SYRACUSE, N. Y.—The Syracuse Lighting Company is to expend $30,000 in equipping its plant with stokers.

HICKSVILLE, L. I., N. Y.—The Nassau Electric Light & Power Company, of Roslyn, has secured the contract for furnishing 50 street lights, at $15 per light per year.

NEW YORK, N. Y.—The Bradley Universal Heat, Light & Power Company, of New York City, has been incorporated; capital, $100,000. Directors: F. D. Lyon, H. A. Bradley and Benjamin Patterson, of New York City.

MALONE, N. Y.—The Fort Covington Light, Heat & Power Company, of Malone, has been incorporated to manufacture electricity; capital, $12,000. Incorporators: Patrick Keefe, Mida M. Keefe and John O. Weeks, of Malone.

ROSLYN, L. I., N. Y.—The Nassau Light & Power Company, of Roslyn has purchased property at Glenwood, and will remove to this site the plant now located at Roslyn. It is proposed to erect a plant double the capacity of the present one.

BATAVIA, N. Y.—The stockholders of the Consolidated Gas & Electric Company have voted to increase the capital stock of the company from $200,000 to $300,000. Only a portion of the authorized increase of stock will be issued at present. Subscriptions for $25,000 worth at par, $100 a share, have been received.

TROY, N. Y.—It is stated that the Hudson River Electric Power Company has purchased a site, and will soon commence constructing a transformer station and office building. The intention of the company is to furnish power to Troy by means of a cable laid along the bed of the river from Watervliet to Troy.

NEW YORK, N. Y.—The West Side Electric Company is preparing to fight the New York Gas & Electric Light, Heat & Power Company. The West Side Electric Company has obtained a decision from the Appellate Division of the Supreme Court making permanent the injunction which it had obtained ensuring it the use of conduits. The concern will now place its wires in the conduits and proceed to do business.

LIDGERWOOD, N. D.—A franchise for a water and light plant is stated to have been granted to Ralph Maxwell.

VALLEY CITY, N. D.—A. H. Gray, of Valley City, has bid $20,500 for the purchase of the city plant, including a 20-year franchise to be paid in street lighting.

HAMDEN JUNCTION, OHIO.—The citizens have voted to issue bonds for an electric light plant.

CORTLAND, OHIO.—The village is desirous of securing a lighting plant. A proposition was made by the Warren Electric Light & Power Company to string its lines to the town, but the company decided that it would not pay.

MILTON, ORE.—It was voted to issue $27,000 bonds, of which $12,000 will be used for improvements to water works and electric light plant.

EAST McKEESPORT, PA.—The question of issuing $10,000 electric light bonds is under consideration.

MYERSDALE, PA.—The Borough Council has instructed the Light Committee to prepare plans and secure bids for a municipal electric light plant.

SHIPPENSBURG, PA.—The Shippensburg Electric Light Company and the Shippensburg Gas Company will hereafter be operated under one management for the purpose of reducing expenses and improving the service.

OIL CITY, PA.—Councils have refused the application of the Central District & Printing Telegraph Company to install a conduit system in this city. The company is now operating without a franchise, but will rebuild its overhead system at an expense of $12,000.

BRENHAM, TEX.—An electric light plant will be installed in the Brenham cotton mill.

LAMPASAS, TEX.—It is reported that the capacity of the electric light plant here is to be increased.

AUSTIN, TEX.—The municipal electric light and water works plant here are to be enlarged. The city water and light commission can give information.

COLUMBUS, TEX.—John A. Cook and Sealy B. Moody, of LaGrange, Ill., contemplate establishing a large electric power plant near here. It is proposed to construct a canal 1000 yards long from the Colorado River, which will afford a waterfall with a height of about 18 feet. The electrical energy generated by this plant is to be used for the operation of irrigation, cotton mill and flour mill machinery. Messrs. Cook and Moody represent a syndicate of capitalists who are ready to invest in the enterprise if the report is favorable. A survey is to be made with the view of determining the cost of the project.

SPOKANE, WASH.—Mr. P. Johnson, of this city, and other local capitalists have arranged for the installation of an electric lighting plant at Troy, Ida.

LEON, MEXICO.—J. S. Martison, representing a syndicate of Chicago capitalists, has been investigating the situation in this section with the view of establishing a large electric power plant near here, the power thus generated to be utilized by industrial concerns of this city.

OSHAWA, ONT.—The contract for an electric light plant has been awarded to Thos. N. Deverall, for $5,115.

The Electric Railway.

SANTA ROSA, CAL.—The Santa Rosa Railway Company has been incorporated here to build an electric railway between Santa Rosa and Petaluma, connecting with Sebastapol and Forestville. It is stated that all the rights of way have been secured and that work will commence soon. The company is capitalized at $1,000,000, and Frank A. Brush, Alfred D. Bowen, Thomas Archer, Francis Cutting, Charles Towne, L. T. Wagner and Alfred G. Sheath are stockholders. Burke Corbet, of San Francisco, is treasurer.

COLORADO SPRINGS, COL.—The announcement is made by General Manager C. W. Wells that the Pike's Peak cog road is to be operated by electric power. Mr. Wells states that negotiations have already been entered into with the Pike's Peak Hydro-Electric Power Company to furnish electrical energy for the operation of the road next season. General Manager Wade, of the power company, is authority for the statement that trolley cars can be operated successfully above an elevation of 12,000 ft., and that with proper apparatus the electrical storms abounding on and around the summit of the peak during the summer months will have no effect on the operation of the road by electricity.

SPRINGFIELD, ILL.—Articles of incorporation for the Freeport-Dixon Electric Railway Company, with principal offices at Freeport, and a capital stock of $50,000, have been filed. The incorporators and first board of directors are O. T. Smith, F. W. Siecke, W. A. Hance, Boyd P. Hill, C. F. Hildreth, R. P. Eckert and F. A. Read, all of Freeport.

CHICAGO, ILL.—The strike of the employees of the Chicago City Railway continues and the prospect of an agreement between the contending forces seems to be as remote as ever. On November 19 all the drivers, including "tow-boys" at the cable barns and wrecking wagon drivers, joined the strike. Efforts were made by Mayor Harrison and a committee of mediation to find a common ground on which all the interests concerned might meet, but after a three-hours' session no results were attained. A session of the joint conference was held on the 20th, and it looked as if the basis for a settlement had been reached, but all the plans failed eventually. The company has determined upon a fight which shall end only when the union employees have surrendered. The company has issued a peremptory demand that the strikers who went out on Nov. 12 surrender their badges and other property belonging to the corporation. They are then to receive the money due them for work done previous to the beginning of the strike. Cars are being run on four of the trunk lines of the company, and at last reports were meeting with little interference. Both sides have, according to the latest advices, declared their determination not to yield a single point.

ANDERSON, IND.—The Council has granted Wallace B. Campbell, of this city, a fifty-year franchise into or through this city. The proposed road will connect Anderson, Noblesville and Lebanon.

NEWCASTLE, IND.—The Indianapolis, Newcastle & Winchester Traction Company has been incorporated, with $100,000 capital. The officers are B. F. Koons, of Moorland, president; E. L. Watson, of Winchester, vice-president; C. S. Hernly, of Newcastle, secretary; Daniel E. Storms, of Indianapolis, treasurer.

RICHMOND, IND.—Announcement is made that the Columbus, Greensburg & Richmond Traction Company has disposed of its bonds in New York. The amount of money realized from the first bond issue is about $2,500,000. A preliminary survey of the line is to be made as soon as the general course of the route is determined upon.

DES MOINES, IA.—The Des Moines & Missouri Railway Company has filed articles of incorporation. The road will extend from Des Moines southwest. The capital stock is $50,000. George G. Wright, G. M. Garver, George Elmore, J. A. Garver, Jr., Leland Windsor, A. R. Bemis, F. H. Hunter, M. H. Wilson are the incorporators.

LEXINGTON, KY.—The interurban electric railway between Lexington and Paris, Ky., owned by the Blue Grass Traction Company, is now in operation.

LOUISVILLE, KY.—The Commissioners of Harrison County have granted a right of way to the Leavenworth Electric Railway Company. The company is to construct and operate an interurban line between Leavenworth, New Albany and White Sulphur Springs. Thomas P. Elsworth, of Leavenworth, is president of the company, and S. A. Beals is secretary.

AUGUSTA, ME.—Surveys have been completed for the electric railway from Camden to Belfast. The distance is 18 miles. It is proposed to construct the line during 1904. W. B. Getchell, of Augusta, is chief engineer.

LEWISTON, ME.—The articles of association for the Lewiston & Kennebec Street Railway have been approved by the State Railroad Commissioners, and the survey of the road is to be begun early in the spring. The road will run from Lewiston to Sabatis. The incorporators are Sidney M. Bird and Maynard S. Bird, of Rockland; George W. Heselton, of Gardiner; John D. Clifford and Charles C. Benson, of Lewiston, and Edward W. Gross, of Auburn.

WESTFIELD, MASS.—The Woronoco Street Railway Company is building an addition to its power station in Westfield. Two new engines are being installed. A 325-kw generator will complete the equipment.

BOSTON, MASS.—It is announced by the officials of the Boston & Albany Railroad that the Newton Lower Falls branch will soon be operated by electricity, the power to be furnished by the Watertown & Newton Electric Lighting Company. This branch is about 11 miles long, and runs from Riverside to Newton Lower Falls.

BOSTON, MASS.—The Horse Neck Beach Street Railway Company has been incorporated at the office of the Secretary of State, with a capital stock of $200,000. The board of directors consists of Benjamin W. Carlow, Henry L. Brett, Artemas S. Pennock, Alvin F. Waite, Ben. T. Smith, Philander H. Brightman and E. G. Gifford.

SPRINGFIELD, MASS.—The Springfield Street Railway Company is completing the installation of machinery which will double the capacity of its power plant. A 3000-hp engine has been installed and a battery of boilers is being put in which, when completed, will furnish 3500-hp. A 2000-kw General Electric generator completes the new equipment.

GRAND RAPIDS, MICH.—Surveys have been completed by the Grand Rapids & Southern Michigan Traction Company for its proposed line running from Kalamazoo to Grand Rapids. This company was organized some time ago, with a capital stock of $1,300,00.

DETROIT, MICH.—Henry P. Wickham, of Detroit, has bought the franchises and grade of the Union Traction Company in Genesee County at sheriff's sale. It is said that he will probably transfer them to the Nester-Russell-Tarsney syndicate, which is planning an electric railway from Saginaw to Flint.

NASHUA, N. H.—The connecting link in the electric railway service between Concord and Boston will be begun next Spring. A mortgage has been received at the office of the City Clerk by which the Goff's Falls, Litchfield & Hudson Street Railway conveys to the American Loan & Trust Company, of Boston, all real estate and other property it may acquire to secure $300,000 in 5 per cent. gold bonds. It is understood that this amount will be used to equip the road.

WOODSFIELD, OHIO.—The Barnesville & Woodsfield Electric Railway Company, of Barnesville, has been incorporated, with $25,000 capital stock. The line will open up territory not reached by either steam or electric roads.

LIMA, OHIO.—The Western Ohio Railway Company has finished its line from Lima to Piqua, Wapakoneta to St. Marys, Celina, New Bremen and Minster, a total of 78 miles. Service was inaugurated Nov. 1. Arrangements are now being made for running cars direct from Lima to Dayton without change.

LANCASTER, PA.—A preliminary survey has been made of the proposed Lancaster & Southern Electric Railway.

LEBANON, PA.—Surveys have been completed and right of way obtained for the proposed electric railway between Palmyra and Valley Glen Park.

JOHNSTOWN, PA.—It is stated that work is to be commenced by Feb. 1 on the projected Conemaugh Valley Street Railway to connect this city and Ebensburg. The line will run via South Fork, Maple and Wilmore.

BLOOMSBURG, PA.—At a recent meeting of the Bloomsburg Town Council an ordinance was passed granting the Danville & Bloomsburg Electric Railway entrance to the town. The new road will be ten miles long, extending from Danville to Bloomsburg. The entire right of way has been obtained by the company, and work will be begun by the contractor next spring.

SUNBURY, PA.—Surveys for the extension of the Shamokin Extension Electric Railway Company through Irish Valley to a connection with the lines of the Sunbury & Northumberland Electric Railway on Second Street have been completed. The line will run via Augustinville and Seven Points, and nearly all the right of way has been secured. Track laying will be commenced about April 1.

WAYNESBORO, PA.—Surveys are being made for an electric railway between this city and Hagerstown, Md., connecting the lines of the Chambersburg, Greencastle & Waynesboro and Hagerstown Electric Railway systems. The line will be about 11 miles long, and the cost of building and equipping will be borne jointly by Pennsylvania and Hagerstown capitalists. The building of the Chambersburg, Greencastle & Waynesboro line has almost reached Greencastle.

WELLSBORO, PA.—A public meeting in the interests of the proposed electric railway between Wellsboro and Elmira, N. Y., was held here. H. M. Rhymer, of Elmira, the chief promoter, states that the cost of construction will be about $1,000,000. It is intended that people living along the proposed route take about $200,000 worth of stock. After the completion of the main line branches from Covington to Blossburg, 6 miles, and from Sullivan to Troy, 9 miles, will be considered.

DOWNINGTOWN, PA.—The West Chester Street Railway Company now obtains all the power for operating its cars in West Chester from the power house in this borough. Formerly power was leased in West Chester. With the completion of the Lenape power house the company will have three power houses within 13 miles of West Chester—Downingtown, Coatesville and Lenape. The site for the new power house at Lenape has been changed slightly, and water for the boilers will now be drawn from the Brandywine Creek.

YORKTOWN, VA.—The extension of the lines of the Newport News Railway & Electric Company to Yorktown is about to materialize.

OSHKOSH, WIS.—The Common Council has passed an ordinance granting a franchise to the Fond du Lac & Oshkosh Electric Railway Company. The franchise provides that the company pay to the city $35,000 in instalments of $1000 per year. The company has agreed to pay $21,000 in instalments of $500 a year.

VICTORIA, B. C.—G. H. Gray, of Victoria, is surveying for a mono-rail railway, which a syndicate of Minneapolis capitalists proposes to build. The route will be up Hall Creek, Upper Duncan and the west fork of the Lardeau, all in the Lardeau-Duncan district.

LONDON, ONT.—The deal between the Southern Traction Company and the English syndicate which is financing the scheme to build an electric railway has been closed and the money placed at the disposal of the local company.

WALKERVILLE, ONT.—The Ontario Traction Company, of Walkerville, Ont., has taken out papers of incorporation to construct an electric railway from Windsor to Chatham, Ont., through Walkerville, and surveys will be made at once. The incorporators are Willis F. Brown and F. M. Ohl, of Toledo, Ohio, with C. M. Walker, E. F. Ladore and J. H. Coburn, of Walkerville, Ont., Canada. Willis F. Brown, of Toledo, Ohio, is general manager and chief engineer.

NEW INDUSTRIAL COMPANIES.

THE RECIPROCATING ROTARY ENGINE COMPANY, of New York, has been incorporated; capital, $100,000. Directors: C. F. Jewett, A. M. Davidson, New York; Herman Neilson, South Brooklyn.

THE NIAGARA GARAGE COMPANY, of Niagara Falls, N. Y., has been incorporated to manufacture various kinds of motors. Capital, $5000. Incorporators: A. H. C. Hardwick, H. S. Mathews, W. L. Adams, all of Niagara Falls, N. Y.

THE MOLINE INCANDESCENT LAMP COMPANY has been incorporated at Moline, Ill., to manufacture electrical apparatus. The capital stock is $30,000, the incorporators being Albert H. Kreitler, Conrad F. Gratz, Sr., and Elmer E. Morgan.

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PERSONAL.

MR. HOWARD S. KNOWLTON, of Boston, has recently joined the engineering department of the Colorado Telephone Company, and is now stationed at the Denver headquarters.

MR. CHARLES BRIGHT, F. R. S. E., so well known in connection with his writings on the history of the submarine cable, is writing the story again in popular form for the British publishing house of Sir George Newnes.

MR. D. MAZENET, of Mexico City, managing director of the Mexican General Electric Company, which concern represents the interests of the General Electric Company in Mexico, left this week for home after some six weeks' sojourn in the States.

MR. ROBERT McF. DOBLE, the consulting engineer, has returned to San Francisco after an absence of several months in Mexico, having completed the installation of the hydro-electric power plant and transmission of the Guanajuato Power and Electric Company.

MR. CALVIN W. RICE, consulting electrical engineer with the General Electric Company, delivered an address recently on electrical development before the New England Loft Dried Paper Manufacturers' Association at their banquet at the Nyassett Club, Springfield, Mass.

MR. J. K. ROBINSON, of Iquique, Chili, who represents the Westinghouse and other prominent American manufacturing interests in Chili, Peru, Bolivia and Ecuador, will leave for home Dec. 1. He is at present at the offices of the William E. Peck Company, 116 Broad Street, New York.

MR. E. B. ELLICOTT.—A telegram from Chicago advises us that the city electrician of Chicago, Mr. Edward B. Ellicott, has been appointed chief electrical and mechanical engineer of the St. Louis Exposition and has been granted leave of absence by Mayor Harrison from December 1 to May 1.

PROF. C. P. MATTHEWS, of Purdue University, is on leave for treatment of his eyes which appear to have been seriously affected. He has, however, associated himself temporarily with the Lamp Testing Bureau in New York City, taking up duties that will not tax his sight. His friends hope for early and complete recovery.

MR. E. O. CAROLAN, manager of the London offices of the General Electric Company and director of the British Thomson-Houston Company, Limited, is now on a visit to this side. At present he is on the Pacific Coast, whence he will go to Mexico for the purpose of gaining an insight into the principal electrical projects in the Southern Republic.

MR. C. F. CUTLER.—Charles F. Cutler has been elected a director and president of the Hudson River Telephone Company, James H. Manning, of Albany, who has filled the office of president for a number of years, retiring. Mr. Cutler is president of the New York Telephone Company, the New York & New Jersey Telephone Company, and the New York & Pennsylvania Telephone Company.

MR. HENRY L. SHIPPY, New York manager of the John A. Roebling's Sons Company, has been seriously ill with appendicitis, but we are glad to state is now recovering rapidly, without the necessity of an operation. This news of convalescence is most cheering to a host of friends and will, we know, be hailed with pleasure not only under the snowy peak of Fujiyama but on the streets of Johannesburg—wherever this popular prince of good fellows has wandered as a globe trotter.

MR. A. FREDERICK COLLINS has obtained permission from the Navy Department to install experimental apparatus for wireless telephony on the battleships *Kearsarge* and *Alabama*. These two vessels are now moored about one hundred and fifty yards apart at the Brooklyn Navy Yard. Mr. Collins will erect telephone booths on each ship. He will work under the supervision of Lieutenant Hudgins, of the *Kearsarge*. Wireless telegraphy has been the subject of several experiments in the Navy Department, and several vessels are equipped with the apparatus, but wireless telephony has not been tried in any navy in the world. If the results are satisfactory, the West Indian squadron will make further trials this winter in Caribbean waters.

MR. J. D. CRARY has been elected president of the American Trade Press Association, which has a membership of more than 100 of the largest trade and technical publications of America. He succeeds Mr. J. M. Wakeman, of the ELECTRICAL WORLD AND ENGINEER. Mr. Crary is the founder, owner, and managing director of *The New York Lumber Trade Journal*, and the founder of the New York Lumber Trade Association. Mr. Crary has been secretary of that association since its start, eighteen years ago. He is also connected with the Association of Dealers in Masons' Building Materials. He is a Director and Chairman of the Membership Committee of the Apollo Club of Brooklyn, and a member of Montauk Lodge No. 286, F. & A. M.

MR. B. F. WASSON, of Clinton, Ill., the president of the Farm & City Telephone Company, which is one of the largest independent telephone companies in the State of Illinois, has been assigned the position of making a display of the evolution of the independent telephone in the Electricity Building at the World's Fair at St. Louis. He has already quite a collection of the different parts of some of the old telephones, but asks his telephone friends to help him out in this undertaking, by sending a telephone or any part of a telephone that is not commonly found, to be placed in this collection. Everything that is entrusted in Mr. Wasson's care will be taken care of, and when put on exhibition will have the name of the loaner, when patented, and manufactured by whom. When the Exposition is over the articles will be returned if requested without any expense.

MR. ORRIN E. DUNLAP, the well-known writer on Niagara topics, has a very interesting article in the December *Booklovers' Magazine* on "The Frost King of Niagara." He figures out that the "ice bridge" there would support a 20-story skyscraper and as to the Falls running dry, says: "On the 29th of March, 1848, Niagara ran dry as a result of a great ice jam at the entrance to the river near Buffalo. At that time the ice swept down the lake in such quantities that a jam of unusual proportions was created at the entrance to the river. So effective was the ice jam that no water passed around it. After the falls had drained the river channel the spectacle of the falls running dry was developed. There were many remarkable sights, and residents of the locality ventured to places that they had never expected to reach. Horses were driven far out in the river bed, and the most distant points in midstream knew the sound of footsteps. Millers, when called in the morning, were amazed at the information that there was no water in the river. People left Table Rock, on the Canadian side, and walked along the brink of the Horseshoe fall one-third of the way over to Goat Island. On March 22, 1903, a similar condition existed."

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LEGAL.

TOLEDO TELEPHONE RATES.—Suit has been filed in the Ohio Supreme Court to test the question of the right of the Toledo Home Telephone Company to charge a rate in excess of the amount fixed in its franchise.

TELEPHONE SUBWAY FRANCHISE.—The application of the Independent Telephone Company, of New York, to run its wires in the subway of the Rapid Transit Railroad has been denied by the New York supreme court. Reference was made to this application in our issue of Nov. 14 last.

PAYMENT OF EXCESS FARE.—At Hudson, N. Y., on November 18, City Court Judge Tilden decided in favor of the Albany & Hudson Railroad a case which rose from the refusal of two men to pay 5 cents excess demanded of them. When the men persisted in their position the conductor ran the car back to Police Headquarters and had them arrested for violating a city ordinance. The question now decided in the affirmative was whether the company could sell tickets at 10 cents in the office and charge 15 to those who paid on the train, even if the office were not open at all hours during the running of trains. Judge Tilden decided that a refusal to pay fare under these circumstances constituted disorderly conduct within the meaning of the city ordinance.

SUBWAY COMPANY SUED.—Corporation Counsel of New York City has brought suit, by direction of the Mayor, against the Consolidated Electrical Subway Company. The complaint says that the annual statements of the company to the Comptroller were "false, fraudulent, untrue and made in bad faith," and that its net annual profits have for a long time exceeded 10 per cent on the actual cash invested, one-third of which surplus, under its contract, should have gone to the city and has not been paid. The city demands an accounting and that it be decreed that the company has failed to observe the terms of its contract in such a way as to bring into operation another clause of the contract, under which, upon such failure the city may take possession of the subways on certain specified terms.

FRANCHISES CANNOT BE UNREASONABLE.—The supreme court of Wisconsin has just handed down a decision which virtually determines the extent to which communities can go in granting public service franchises. The Northwestern Heat, Light & Power Company obtained a franchise from the village board of West Allis, Wis., authorizing it to furnish lights for fifty years at $120 per lamp per year. The franchise was submitted to a vote of the people and ratified. Notwithstanding that certain citizens brought action to set it aside on the ground that it was unreasonable, both as to the time the franchise ran and the cost of the lights. Expert testimony was taken as to the cost of producing lights and the probable cost in the future. Judge Tarrant in the lower court decided the point in favor of the company because the people had voted in favor of the franchise, and held that it was not sufficiently unreasonable to warrant the court in overriding the expressed wishes of the people most interested. The supreme court, however, decided that it was so unreasonable that it could not stand and reversed the decision of the lower court.

CONTRACTS BY TELEPHONE.—When J. W. Young went to the Klondike, in 1898, he left instructions with a friend to have a trunk stored with the Seattle Transfer Company. This friend, a Mr. Ramsey, accordingly called up the company by telephone and asked them to call for the trunk. A second request was made before the trunk was taken away. Mr. Ramsey did not recognize the voice answering him at the telephone and had no means of proving that a Seattle Transfer Company agent got the trunk, save that some one, whom he did not see, called for it. In the Summer of 1891 Mr. Young wrote down from Alaska to Mr. Ramsey to have the trunk forwarded to him. The Seattle Transfer Company was unable to find the property in its warehouse and denied ever having received it. A suit followed and on the strength of the telephone conversation a jury gave Mr. Young $240 damages. The Supreme Court of the State of Washington, in ordering a reversal, holds that "communications, when material to the issues, through the medium of the telephone, may be shown in the same manner and with like effect as conversation had between individuals face to face, but the identity of the party sought to be charged with liability must be established by some testimony either direct or circumstantial. To hold parties responsible for answers made by unidentified persons in response to calls at the telephone from their offices or places of business concerning their affairs opens the door for fraud and imposition and establishes a dangerous precedent which is not sanctioned by any rule of law or principle of ethics of which we are aware."

Trade Notes.

CROCKER WHEELER COMPANY, Ampere, N. J., has established headquarters for the Southern representative of its Washington office, Mr. S. M. Conant, at 425 Empire Building, Atlanta, Ga.

AMERICAN REFLECTOR & LIGHTING COMPANY, Chicago, has been compelled by increase of business to take larger quarters and is now located at 199 to 205 Van Buren Street and 275 Franklin Street, that city.

F. BISSELL COMPANY, wholesale electrical supplies and machinery, Toledo, Ohio, has just issued a bulletin, No. 6, showing some 61 different kinds of wires, strands and cables. It can be had on application. It represents a great deal of trouble and expense and is very interesting.

ZENITH LAMPS.—The heavy demand for Zenith lamps swamped the manufacturers and delays were the consequence. The Electric Appliance Company of Chicago, general sales agent, now reports a big stock, and states that the large increase in the factory output will mean no more delays in filling orders for this specialty.

AUTOMATIC ELECTRIC COMPANY, of Chicago, has issued a "bulletin de luxe" containing letters received from subscribers to the big automatic telephone exchange built by the company for the Dayton, Ohio, Home Telephone Company. It contains also letters from the management, and other matter, constituting a record of great interest as to results in the automatic field.

THE REYNOLDS ELECTRIC FLASHER MFG. COMPANY has recently made changes and additions to its shop which will enable it to meet the increasing market for sign flashers and to fill orders more promptly than heretofore. The demand during the past fall has been so large that the company has had difficulty in keeping up with its orders; hence the need of increased facilities.

THE STERLING ELECTRICAL MFG. COMPANY has brought out a pocket tape measure enclosed in a neat celluloid case on which is inscribed the name of the company and an illustration of the Sterling special incandescent lamp. The latter shows the illumination of the lamp as being 16-cp from all light-giving points of the bulb. The New York office of the company is in charge of Mr. Francis Granger, at 26 Cortlandt St.

THE K. & B. COMPANY, 56 North 7th Street, Philadelphia, has recently been appointed local agent for Buckeye incandescent lamps. This company is also agent for the Electric Carriage Call Company's system and has effected several installations in Philadelphia. Among the other specialties in which the K. & B. Company is doing a good business are Hadaway electric heating apparatus and Norden-Bittner interchangeable letters for sign work.

MR. GEORGE H. MOSEMAN has been appointed selling agent for the Weston Electrical Instrument Company with offices at 176 Federal Street, Boston. This is a new departure, and Mr. Moseman is the first selling representative that company has had in this territory. Mr. Moseman was connected with the old United Edison Company and with the Edison General Electric Company for four years prior to the formation of the General Electric Company, with which he had a connection also of ten years' standing.

THE COLONIAL SIGN COMPANY, of Akron, Ohio, is the company making electric signs in which the letters are of white vitreous porcelain, as already described in Electrical World and Engineer. One of the latest orders it filled is a sign for the Hotel Rodman, Philadelphia, the owner of which is the Hon. John Wanamaker. The order was secured not only because of the beauty of the sign letter and its legibility both day and night, but because of the safety of construction, including the impossibility of short circuit and other electrical faults.

FREIGHT ON NEW YORK CENTRAL.—New York Central officials have made public the running time of a freight train loaded with export cotton, which is was said holds the freight record between Montreal and New York. The train made the 435 miles between Valleyfield, Quebec and New York in 16 hours and 20 minutes. Two hundred bales of Egyptian cotton were in store at Valleyfield, a few miles south of Montreal. They had been sold to Liverpool spinners and in order to make delivery it was necessary to get the cotton to New York within seventeen hours.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., has issued a circular calling attention to its line of electric fixtures. One room of its establishment has been especially fitted up for the purpose of its fixture display. It is tastily decorated and the display itself while not large is of an exceedingly attractive nature. The fixtures shown are varied, including almost everything of electrical or combination nature, also glassware and trimmings. The display is a convincing proof that the company is in the fixture business to stay and is prepared to take care of that class of trade.

ELECTRICAL DATA.—The Chase-Shawmut Company, Newburyport, Mass., has just issued the 1904 edition of its pamphlet containing electrical data. There is a great deal of information in the pamphlet in the way of rules, formulas, wire and other tables, all of which are constantly being referred to by engineers. Switchboards are also given prominent attention, and many illustrations show how they are constructed and connected. Various illustrations show completed switchboards manufactured by the Chase-Shawmut Company. Other products of the company, including fuses, conduit boxes, rail bonds, etc., are represented.

LAMP TESTING BUREAU.—The equipment of the new electrical testing laboratories of the Lamp Testing Bureau at 80th Street and East End Avenue, New York, is planned to be as complete and up-to-date as a wise and liberal management can make it. Nothing better indicates the broad policy of the company than the fact of its having recently sent its test officer, Dr. Clayton H. Sharp, to inspect all of the principal electrical laboratories of Europe, so that on his return he may be better able to equip the new laboratories to meet the needs of those who require its services. During Dr. Sharpe's absence the company has secured the services of Dr. C. P. Matthews, late of Purdue University, to advise concerning the photometric equipment of the new laboratories.

ALLIS-CHALMERS ENGINES IN FOREIGN COUNTRIES.—The Allis-Chalmers Company has just issued a 78-page booklet containing a list of foreign users of engines built by it. This record shows that of a large number of Allis-Chalmers engines are used in almost every country on the face of the earth, and is strong evidence of the high regard with which this make of engine is held throughout the world. Scattered through the pages of the pamphlet are illustrations representing the different types of machines produced by this company. In general the line includes engines for power purposes, pumping engines, hoisting engines, blowing engines and air compressors. Views of the company's various and thoroughly equipped plants are also presented. This list is particularly interesting as an evidence of the vitality of American industry and enterprise.

THE ELECTRIC CONTRACT COMPANY, 202-204 Centre Street, New York City, has just issued a very handsome catalogue, No. 4, with regard to its electrical novelties of all kinds, including particularly dry batteries, Williams' spark coils, Jaeger incandescent bulbs, and automobile supplies. The catalogue illustrates a number of portable lights combining dry battery and miniature incandescent lamps put up in flask and stick form, as well as in tapers, watchstands, scarf pins and other specialties. It includes also the company's electric gas lighter, medical set of Ecco apparatus, dental lamps, testing sets and other varieties of that character. A special section of the catalogue is devoted to the Williams spark coils, which are put up in very handy and compact form, and arranged in multiple for special automobile purposes. A separate section of the catalogue is also devoted to the Jaeger miniature incandescent lamps, which have long been before the public, and which enjoy an excellent reputation. These are profusely illustrated with prices and descriptive data. A page is devoted to the Phoenix handy receptacle for trimming Christmas trees and general decorative work. This receptacle is fitted with two triple insulated leading wires and provided with a sharp pointed screw thoroughly insulated by mica washers and which sticks easily into either hard or soft wood.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 17, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

744,018. METHOD OF FORMING COILS FOR ELECTRICAL APPARATUS; Edward L. Aiken, Schenectady, N. Y. App. filed Dec. 5, 1898. A coil made by bending a relatively wide and thin strip of conducting material edgewise into a helix without reduction of cross-sectional area.

744,041. TELEGRAPHIC CODE; Charles G. Burke, Brooklyn, N. Y. App. filed Sept. 21, 1901. In this code each character consists of two parts, each composed of one or more dots and each part having a numerical signification, both parts construed as a whole indicating a definite position on a chart or scale to which has been assigned a letter of character.

744,046. ELECTRIC PRINTING TELEGRAPH APPARATUS; Henry Casevitz, Paris, France. App. filed March 14, 1903. Details.

744,051. TIME LIMIT DEVICE FOR MOTOR CONTROLLERS; Fred B. Corey, Schenectady, N. Y. App. filed May 24, 1902. The device comprises a dash pot and a step member constructed to prevent a too rapid movement of the controller while allowing a free movement from one contact point to the next.

744,053. DEVICE FOR ALTERNATING CURRENT MOTOR CONTROL; Joseph Le C. Davis, Schenectady, N. Y. App. filed July 22, 1903. Two alternating current motors, the winding of one member of each being supplied with a commutator, a closed circuit including said winding and means for producing in said circuit a current varying simultaneously in magnitude and phase.

744,055. ELECTRIC RAILWAY SYSTEM; William Embley and Abraham A. Shobe, Jerseyville, Ill. App. filed April 10, 1903. The conductor is mounted in hangers which are free to slide in their supports to accommodate the expansion and contraction of the conductor.

744,077. COMMUTATOR; Charles H. Ingalls, Danvers, Mass. App. filed Oct. 3, 1901. (See page 879.)

744,084. DYNAMO-ELECTRIC MACHINE; George Macloskie, Schenectady, N. Y. App. filed July 19, 1902. (See Current News and Notes.)

744,093. ELECTRIC ARC LAMP; James McLaughlin, New York, N. Y. App. filed July 26, 1902. Clutch dogs are pivoted at the lower end of the tubular core of the solenoid and project into the same, an adjustable device with which the lower ends of the dogs engage for opening them are placed at the limit of movement of the core.

744,096. OZONIZER; Marius Otto, Paris, France. App. filed May 29, 1903. (See page 879.)

744,103. TELEPHONE CUT-OUT; William Lee Ralston, Westchester, Ia. App. filed July 22, 1903. (See page 880.)

744,106. LIGHTNING ARRESTER; Henry E. Raymond, Schenectady, N. Y. App. filed July 22, 1899. (See Current News and Notes.)

744,115. QUICK BREAK SWITCH; Howard R. Sargent, Schenectady, N. Y. App. filed April 18, 1902. An auxiliary blade is hinged to the main blade and connected thereto by a spring which lifts it quickly out of the clips, the auxiliary blade having integral ears fitting the main blade and guiding it in its movement.

744,117. PRIVATE TELEPHONE SYSTEM; Thad. J. Seely and Charles Hemsing, Milwaukee, Wis. App. filed Oct. 23, 1901. (See page 880.)

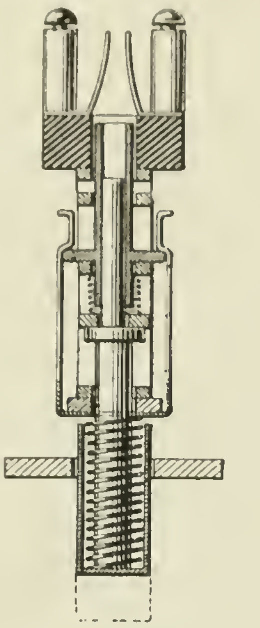
744,124. ELECTRIC METER; George Stern, Charlottenberg, Germany. App. filed July 9, 1901. An alternating current meter for a four-wire three-phase system, comprising two meter systems in one of which two current windings having equal numbers of turns are combined with a single potential winding and in the other of which two current windings having a ratio of turns of one to three are combined with a single poteotial winding.

744,125. CIRCUIT BREAKER; Samuel B. Stewart, Jr., Schenectady, N. Y. App. filed Jan. 23, 1901. Improvements in an overload switch for trolley cars.

744,130. ELECTRIC ARC LAMP; Elihu Thomson, Swampscott, Mass. App. filed May 21, 1901. An arc striking magnet in series with the arc, a derived circuit magnet tending to shorten the arc, a shunt circuit around the arc striking magnet and means for maintaining the shunt circuit open when the electrodes of the lamp are together and for closing it when the electrodes are about to feed together.

744,144. METHOD OF WINDING DYNAMO ELECTRIC MACHINES; John B. Wiard, Lynn, Mass. App. filed March 21, 1903. A winding consisting of an independently wound long coil woven in and out of the notches of the core in such a manner as to make a number of short coils connected in series.

744,145. WINDING FOR DYNAMO ELECTRIC MACHINES; John B. Wiard, Lynn, Mass. App. filed April 3, 1903. See preceding patent.



744,215.—Circuit Controller.

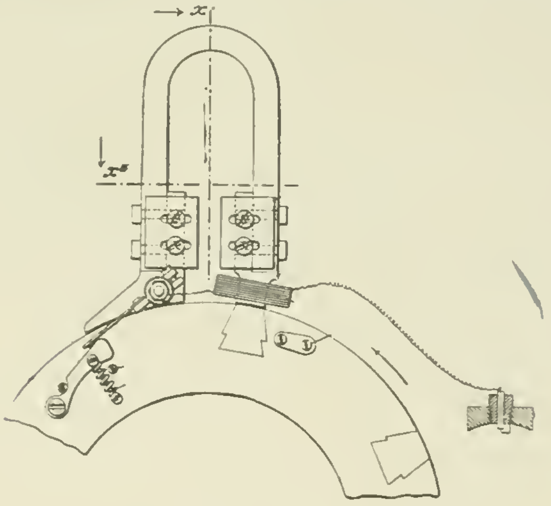
744,165. AUTOMATIC PRINTING TELEGRAPH SYSTEM; Louis Casper, Chicago, Ill. App. filed March 10, 1898. A transmitter tape having different series of perforations is fed or controlled by a motor synchronous in action to another motor operating the printing wheel of the receiver, the tape being used to send multiple signals or impulses which vary in polarity and current intensity.

744,168. AUTOMATIC SWITCH; Joseph M. Comer, Spokane, Wash. App. filed March 30, 1903. A magnet operating through a pawl and ratchet and levers to throw the switch point of a railway.

744,170. PROCESS OF DEPOSITING METALLIC COATINGS ON METALLIC OBJECTS; Andre Barlay, Paris, France. App. filed Aug. 26, 1899. (See page 897.)

744,171. METHOD OF SEPARATING OILY OR SIMILAR IMPURITIES FROM WATER; Henry Tadwell Davis and Ernest Perrett, Lewisham, England. App. filed Dec. 1, 1902. (See page 879.)

744,178. CONTROLLING DEVICE FOR MOTORS; Charles A. Dresser, Chicago, Ill. App. filed June 19, 1902. Two motors operated by a controlling device which itself is operated by the closing of a single circuit, the controller comprising a series of actuating parts successively brought into action to start one motor, to start a second motor and to slow down or stop the first motor.



744,573.—Magneto Electric Generator.

744,187. SYSTEM OF ELECTRIC TRACTION; Lucius T. Gibbs, New York, N. Y. App. filed April 13, 1903. The vehicles carry dynamos and propelling motors and are also connected with a line wire so that excessive power generated will be delivered to the line for use by other vehicles.

744,197. THERMAL CIRCUIT-PROTECTOR; Otto C. Hoffmann, Chicago, Ill. App. filed Jan. 19, 1903. (See page 880.)

744,215. CIRCUIT CONTROLLER; Adam Lungen, New York, N. Y. App. filed Nov. 13, 1902. The circuit controller comprises two rods having motions independent of each other, a spring interposed between them which is compressed and expanded by the relative movements of the rods and a latch adapted to restrain one rod, but to be released by the tension of the spring.

744,216. ELECTRICAL STORAGE CELL; John A. Lyons and Edward C. Broadwell, Chicago, Ill. App. filed Jan. 26, 1903. (See page 879.)

744,246. ELECTRIC RAILWAY SYSTEM; Abraham A. Shobe and William Embley, Jerseyville, Ill. App. filed April 10, 1903. A means for mounting the conductor in a manner permitting it to freely expand and contract without injury to its supports or insulation.

744,247. ELECTRIC RAILWAY SYSTEM; Abraham A. Shobe and William Embley, Jerseyville, Ill. App. filed April 10, 1903. The return current is carried by an insulated conductor mounted upon the traffic rail.

744,248. RAILWAY SIGNALING SYSTEM; Judson Shoecraft, Eskridge, Kan. App. filed Aug. 30, 1902. Details.

744,261. SYSTEM OF ELECTRIC LIGHTING FOR CARS; Charles P. Tolman, Boston, Mass. App. filed July 30, 1903. An arc and an incandescent lamp are located in the same headlight with automatic means for throwing the incandescent lamp into circuit in case the arc lamp fails.

744,303. ELECTRIC LOCOMOTIVE; William Dalton and Francis J. Cole, Schenectady, N. Y. App. filed July 20, 1903. (See Current News and Notes.)

744,304. ELECTRIC LOCOMOTIVE; William Dalton and Francis J. Cole, Schenectady, N. Y. App. filed Aug. 20, 1903. (See Current News and Notes.)

744,330. ELECTRIC LAMP SOCKET; John H. Goehst, Chicago, Ill. App. filed May 12, 1902. A receptacle adapted for signs and consisting of two parts, one being a nut threaded onto the other and arranged to clamp the face of the sign to hold the receptacle thereto.

744,336. ELECTRICAL RINGING OF BELLS FOR SUBMARINE SIGNALING; Elisha Gray, Highland Park, Ill. App. filed Dec. 24, 1900. (See Current News and Notes.)

744,337. MEANS FOR DISINFECTING TELEPHONE-TRANSMITTER MOUTHPIECES; Maurice Griffin, Sylvester Sanker and Boyd Keith, Riverside, Cal. App. filed May 18, 1903. (See page 880.)

744,354. ELECTRIC ALARM SIGNAL FOR RAILWAY CARS; David N. Jordan, East Providence, R. I. App. filed Jan. 29, 1903. The tread of the car step operates an alarm circuit closed by the weight of a passenger to inform the conductor if a person is entering the car or alighting therefrom.

744,362. IMPLEMENT FOR LAYING UNDERGROUND CONDUITS; Mathias Kondolf, Rochester, N. Y. App. filed Feb. 2, 1903. An expanding device to be inserted in the conduit to hold a section in alignment until it is permanently fixed.

744,423. ELECTRICAL CLUTCH AND BRAKE MECHANISM; Abram P. Steckel, Buffalo, N. Y. App. filed June 3, 1903. The clutches and brake are provided with electrical controlling means whereby either can be thrown into and out of action separately, the arrangement being such that the brake is energized and brought into action to retard the driven shaft after a clutch is de-energized and before another clutch can be brought into action to reverse the driven shaft.

744,446. TROLLEY GUIDE; Milton Walker, Cambridge, Mass. App. filed April 3, 1903. Beneath the trolley frog is a guide rail upon which a truck runs to properly guide the trolley wheel across the frog.

744,463. TROLLEY HEAD; Joseph Bishop, Westbrook, Me. App. filed March 26, 1903. A device to retain the wheel upon the wire.

744,481. MAGNET; Henry F. Campbell, Melrose, Mass. App. filed July 9, 1902. (See page 879.)

744,496. INCANDESCENT ELECTRIC LAMP; Clarence A. Crane, Warren, Ohio. App. filed May 18, 1903. (See Current News and Notes.)

744,497. TELEPHONE HYGIENIC APPLIANCE; Horace L. Cutter, Los Angeles, Cal. App. filed March 9, 1903. (See page 880.)

744,507. MIRROR DECORATING AND ILLUMINATING DEVICE; Sabella G. Doherty, New York, N. Y. App. filed June 12, 1902. An ornament hanging in front of a mirror is studded with lamps supplied through conductors hidden behind the ornament itself.

744,530. PORTABLE ELECTRIC LIGHTING APPARATUS; Edwin R. Gill, New York, N. Y. App. filed April 7, 1902. Details.

744,573. MAGNETO ELECTRIC GENERATOR; Leon J. Le Pontois and Adolphe Clement, Levallois-Perret, France. App. filed Aug. 13, 1901. An igniting circuit which includes a coil about one of the pole pieces of the field magnet of the generator, a device for producing variations in the magnetic circuit and automatic devices influenced by centrifugal force for controlling a break in the igniting circuit.

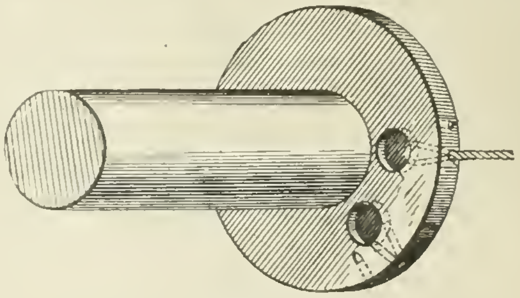
744,575. MINIATURE TELEGRAPHIC INSTRUMENT; Benjamin I. Levi, New York, N. Y. App. filed Dec. 26, 1902. A small sized key and sounder intended as a novelty or toy.

744,599. RAILWAY SIGNALING APPARATUS; James A. Norton, Odebolt, Ia. App. filed May 13, 1901. Details.

744,631. INSULATOR; Edward F. Schoenthaler, Long Branch, N. J. App. filed June 16, 1903. The insulator has a widened slot to receive the wire which is confined therein by a binding wire and a link closing the entrance to the slot.

744,650. ELECTRIC COIL TERMINAL; Richard Varley, Providence, R. I. App. filed Aug. 29, 1903. A terminal consisting of a U-shaped wire is anchored in the flange of a magnet spool by running its arms through two passages in the flange and twisting the projecting ends together.

744,655. COMBINED SIGNALING AND TELEPHONIC INTERCOMMUNICATING SYSTEM FOR RAILROADS; John Alexander Whyte and Gordon Cameron Edwards, Toronto, Can. App. filed Jan. 24, 1903. See page 880.)



744,650.—Electric Coil Terminal.

744,665. CONTROLLER; Thorsten von Zweigbergk, Preston, Eng. App. filed April 7, 1902. The combination of a pair of series wound motors connected together in series independently of the controller, the fields and armatures being thus on a closed local circuit and a controller adapted to convert the local circuit into a derived circuit from the source of current or to form a bridge across it for braking action.

744,680. ELECTRIC MOTOR; Rudolf Eickemeyer, Jr., and Mary T. Eickemeyer, Yonkers, N. Y. App. filed June 2, 1898. The invention comprises an armature core provided with two separate windings, each two coils in each winding having sides which reversely overlie each other and are located between similarly reversely overlaid sides of coils belonging to the other winding.

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EXPORT TRADE.

The situation in regard to American export trade is very encouraging, not only with respect to agricultural produce of all kinds, but in regard to manufactured articles. There is, in fact, a revival of export trade justifying the hopeful views here taken of the situation, and which bids fair to continue because based on a lower range of prices. The figure of such goods exported in October was $37,558,676, or within a few dollars of October, 1900, the high-water mark. Allowing for difference in prices, it might be found that the recent volume of trade was greater—and for that reason, healthier. We cannot hold foreign markets during periods of abnormal high prices; we cannot even compete abroad at such times; and hence our export trade is in itself a great factor for keeping our domestic prices at a parity with those of the rest of the world; this in turn giving steadiness and reasonability to imports, which simply run into absurd figures when commodities of all kinds reach here the figures that lately were current. The outlook for American manufacturers and for their foreign customers is to-day excellent, and more than ever is it seen that such trade is worthy of sedulous cultivation.

LIGHT AND POWER IN MONTREAL.

Canada has long been the center of some of the best electrical development in the British Empire, and the Toronto street railway system need only be cited as one instance; while this week we draw attention to the work in light and power around Montreal, as another. We question whether any of our readers have realized that Montreal is to-day the greatest center of transmitted power in the world. It seems to us likely that San Francisco, in view of the Standard transmission system, may be in some respects a superior rival to Montreal; but the Standard network is in reality a thing by itself without relation intrinsically at present to such work as is being done steadily every day along the borders of the St. Lawrence.

It will be evident from the article by Mr. Adams, of which we now print the first installment, that the Montreal system is still in a transition state of some complexity, so that the talented young chief engineer, Mr. P. G. Gossler, has been working under very difficult conditions. There has been a great consolidation, and on top of it has come the long-distance transmission problem, to which again such men as Mr. Ralph D. Mershon have had to give their best thought. Within the short time available it has not been possible to reconstruct and harmonize the system as to frequencies, voltages, etc. Hence, the odd periodicity of 63 cycles, due to having to combine and operate in parallel systems originally designed to operate at 66 and 60 cycles. The one has been dropped 5 per cent. and the other raised 5 per cent., to enable paralleling. Another year will probably see uniform phase and periodicity over the whole of the stations. Meantime the story told in this and succeeding issues will be found full of interest.

THE ARC OF ANCIENT DAYS.

An English correspondent of our worthy contemporary, the *American Gas Light Journal*, has been gloating, with obvious satisfaction, over the sputtering of irate British reporters at the very bad behavior of some arc lights at a political meeting in Sheffield. That said arcs were highly improper in their reported action admits of no dispute, but we must look beneath globes to motives before passing too hasty a judgment. Personally, we would rather hear an arc lamp chatter than listen to the average political speech but at all events the sensibilities of our British friends seem to have been wounded and our worthy contemporary is promptly at hand with words of consolation. Here in our own country the arc lamp has been taught better manners by a strenuous process of improvement, and we have yet to hear of even a ward primary being broken up by such inconsiderate action. The arc in its state of pristine savagery was an unlovely member of society. But the day of reformation came and in its state of comparative sanctification the arc lamp is a distinguished member of the illuminati. To be serious, arc lighting in Sheffield evidently needs reform, and if such disturbances are common we would advise a liberal importation of American-made arc lamps and the adoption of American methods. Unless we are greatly mistaken, this lighting is done by one of England's vaunted municipal plants. At the present time there is little excuse for bad regulation on arc systems or for sputtering arcs. Even if good arcs were not available, there is the Nernst lamp to fall back upon and some of the finest results ever obtained in the lighting of large buildings have been due to the ordinary incandescent lamp. Any one of the three is vastly preferable to the ghastly greenish emanations from a Welsbach mantle in its chronic state of decrepitude, for a horrible example of which inspect such streets as are alleged to be lighted by that means.

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RADIUM AND HELIUM.

According to cable dispatches, during the past week, Sir William Ramsay, in a recent lecture before the London Institution, made the interesting announcement that his experiments with radium showed that radium has the power of changing into the apparently quite different element, helium. It seems that radium is not content with continuously emitting α-rays, β-rays and γ-rays; but also gives off a heavy gas. When this gas is collected in a glass vacuum tube and sealed off, spectrum analysis indicates that it changes in the course of some days from radium to helium. The rate of emanation has been calculated to be such as would convert radium entirely into helium in the course of two millions of years, if helium be the only substance thrown off. It has been supposed that the matter projected from the cathode in cathode rays, within the Röntgen ray tube, was of a different and more elementary nature, than the matter composing the cathode surface, but the supposed "protyle" was not shot off in sufficient quantities to make its subsequent and independent physical investigation readily possible. Here, however, a certain small quantity of gaseous matter is reported to have one spectroscopic name and nature on first collection, and a quite different name and nature on a subsequent date.

Chemists have always clung to the hope, and cherished the belief, that the list of seventy odd elements might be curtailed. All these elements were considered as substances which had not yet yielded to further or more remote analysis. It may, however, at any time, be found possible to reduce some element or elements to yet more elementary forms. The old alchemists sought vainly to convert one metal to another. The recent conclusions of physicists that atoms of substances are complex structures, of which ions are the component parts, has paved the way for the revived belief that matter is evanescent in type, and that it may be capable of being changed from one substance to another, either by internal forces in cases of particular instability, or by external forces, such as those that exist in the neighborhood of a Röntgen ray tube cathode surface. It now seems as though radium may be one of those forms of matter which exists in a condition of ionic or subatomic instability, and that radium may be constantly breaking down subatomically, with a disengagement of energy, to form a new and more stable subatomic structure or structures, such as helium. The very possibility of such a condition opens to the mind a new universe and a new range of speculation. The stellar visible universe appears to consist of masses of matter describing in many instances planetary orbits in cyclic paths about local centers of gravity. The microcosm of a single atom may perhaps be but a minified planetary system, in which ions, or groups of ions, perform orbits of corresponding small periods and dimensions. One particular orbital arrangement may represent sodium and another platinum.

Prof. Ramsay is quoted as saying that the price of radium had risen tenfold during the past half-year, owing to the Austrian Government having suppressed all further exportation of refuse from the uranium oxide works at Joachimthal, a town in Bohemia. Radium never has been cheap. Prior to the corner by the Austrian Government, the price quoted was six thousand dollars per gramme, or nearly three millions of dollars a pound. If the price now quoted is ten times greater, it would be about twenty seven millions of dollars per pound, avoirdupois. It is said that there are men in the United States worth one hundred millions of dollars. How interesting it must be for such persons to reflect that they are worth nearly four pounds of radium. If, however, it is true that radium minus radiation energy equals helium, then it may be found possible, perhaps, to energize and invigorate helium in some way and make it into radium. This might soon hurt the market; but at first it would seem as though such a procedure, assumed as possible, might be distinctly profitable.

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STREET RAILWAY CONDUIT LIMITATIONS.

For many years past this journal has advocated the claims and merits of the underrunning trolley conduit style of street railway wherever density of passenger traffic and other conditions render its adoption feasible, and we have been glad to witness its widespread introduction into New York City. There are places, however, for which it is not only ill-suited, but impossible, and one of these is most assuredly West Street, New York, where the local traction interests are now trying to secure the right to install the overhead trolley instead of the antiquated horse cars that have so long lumbered up the tracks and hindered rather than expedited travel. In view of the opposition offered in some quarters, a few comments are in order. It is not altogether with satisfaction that we contemplate the fact that New York City is the last great stronghold of the once ubiquitous horse car. There are to-day more horse cars in the metropolis than in all the rest of the United States put together, and we are not proud of the distinction. It is peculiarly galling that the foreigner landing at one of the great piers should, for his first glimpse of the much-vaunted American rapid transit, catch sight of one of the battle-scarred veterans that rattle their bones over the West Street track. There seems to be an altogether unreasoning prejudice against the installation of an overhead trolley system in that situation. It is a situation where draining a conduit thoroughly enough to keep it in working order is out of the question. Conduit working has been found successful wherever the conduit can be kept clear enough of water to allow of a fair degree of insulation, but with West Street at its present grade insulation is a hopeless task. It is a place where occupancy is secured only by the incessant use of the pump in basement and cellar.

There seems, on the other hand, to be no adequate reason why the overhead trolley should not be used there with entire success. A trolley system when reduced to merely the working conductors and their suspensions, is unobtrusive, and, indeed, the wires are hardly noticeable in glancing down such a street. If necessary, the trolley wires could be run higher than usual, so as to accommodate the truck-load of maximum height. No street in New York has more acute need of rapid transit facilities. We are disposed to think that the real reason for the opposition which has appeared is not in the least based upon æsthetic grounds nor upon the fear of establishing a precedent. It results, we think, from a recognition of the fact that where the electric car comes, the obstructive truck must hustle or make way for it. In plain words, certain interests for their private advantage want to keep West Street reserved for their slow trucking, utterly regardless of the rights and wishes of the hundreds of thousands of citizens going and coming from the Jersey shore who daily are compelled to frequent it. As long as the dingy old horse cars stay, those cars can be neatly trapped into blockades and rendered so unpopular that the call for rapid transit will be smothered. Once modern trolley cars are placed in service and the track rebuilt to meet the new requirements, trucks will be compelled to give the cars a fair show on their own tracks, and the present clattering, jamming, loud-swearing monopoly will be at an end. Here as everywhere the electric road stands for the rights of the people against the special privileges of the few.

Our own opinion is that in most cities—not all—an overhead trolley system reduced to its lowest terms, with all feeders underground and no overhead wires of other systems to fall upon the working conductors, is altogether more satisfactory than a slotted conduit system. The slot rail there is, from a practical standpoint, more objectionable than the overhead structure. To object to the latter on æsthetic grounds is rank hypocrisy, for neither civic pride nor a sense of artistic propriety ever seems to hinder disfigurement of the streets when dollars are in sight. A city that tolerates abominations like the "Flatiron" Building and allows its downtown sidewalks to be obstructed by skids and packages at all hours of the day cuts but a sorry figure while protesting against trolley wires in the name of "Art." A well-installed trolley system on West Street would be an immense convenience to the whole west-bound population of the city and would give the city a water front of which it need not be ashamed. The objectors merely want to keep on converting the public street to their private ends, driving off its legitimate owners by making the street continually impassable. The West Street ride in trolley cars would be one of the most enjoyable in the city, improving the property there to an untold degree also. To-day the street is a damp and dingy avenue of dilatory traffic and everybody suffers, not only at every high tide, but every day of the year.

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THE HEREDITY FACTOR IN TECHNOLOGICAL EDUCATION.

In a lecture recently delivered in London, Prof. Karl Pearson declared that he had set himself the problem, six or seven years ago, of determining how far mental and moral qualities and capabilities were inherited, as compared with physical characteristics. In other words, how far are health, good temper and aptitude in science inherited by comparison with the inheritance of such readily determinable physical characteristics as stature, muscular strength, or color of hair. This problem opened up the necessity for three collateral lines of inquiry: First, a measurement of the extent to which physical characteristics are inherited in man; second, a comparison of the inheritance of physical characteristics in man, with respect to inheritance in other living things—e. g., man compared with horses; third, a measurement of the extent to which mental and moral characteristics are inherited in man.

The method of measurement as described was very interesting and depends upon hereditary conditions discovered by Galton for both human beings and sweet peas. This is the principle of fraternal regression, and may be described as follows: If one member of a family of brothers is found to deviate from the general average of the community by a given amount in a certain physical characteristic, as for example, by being two inches above the normal mean stature, the other brothers will tend to have an average deviation of half that amount, or in the case considered, by one inch in excess. If the most devious member has a certain deviation, the average other brother will be divided in his allegiance between the devious brother and the common stock and will have half the deviation, on the average. This is a property which is said to run through both plants and animals and to be a characteristic of physical heredity in general. It is closely connected with the quantitative degree of inheritance from father to son; and is a characteristic which can be applied without taking in more than a single generation, since it only needs observations on a large number of members of a community in which brothers exist. Any physical quality or proclivity is found to be distributed in a large community according to the laws of errors in observations; i. e., equal small numbers of large and opposite deviations from the mean, and equal increasing numbers of lessening opposite deviations from the mean, with the great majority having nearly the mean value. Thus in height, or strength, or color, or any physical measurable quantity, the great mass of the people deviate but little from the mean, but deviations occur equally often above and below, and are distributed like accidental errors in the use of a measuring instrument.

Prof. Pearson measured the fraternal regression in regard to physical characteristics of young people by sending 6,000 circulars to about 200 schools, and obtaining reports upon measured physical properties of the students. In all of these the fraternal regression was found to come out close to one-half. A very large number of observations were next compiled upon 1,918 pairs of brothers as to mental and moral characteristics, and the result of this investigation showed that the fraternal regression was also very close to one-half, within the limits of observational error. Similar conclusions have been arrived at as to the fraternal regression in physical characteristics of other living things. Prof. Pearson concludes finally that mental and moral aptitude of any kind are inherited according to the same law as applies to physical variations. The result has a very important bearing upon education, for it is useless to expect great results from education, if applied to inapt students. Great success in education can only be hoped from the application of good education to gifted or apt pupils, and the aptitude can be stimulated, but cannot be created. It must be inherited and follow the laws of heredity, which are seemingly erratic in the single individual, but which are perfectly definite and reliable in the mass of individuals. If the talented classes of a nation do not proportionately reproduce themselves in the succeeding generation, the nation will decay in talent. Prof. Pearson, speaking in England, regards it as probable that an era of great dearth of ability is approaching, because the more talented classes are found to be failing in vitality and relative reproductiveness. He considers that the progress of a nation lies largely in the hands of the most advanced citizens, those who deviate positively most from the great mediocrity of the nation in respect to mentality of various kinds. These deviations are always to be expected by the laws of error, but they can be fostered and magnified by any stimulation of the reproductiveness of the individuals possessing them. On the other hand, any systematic means for causing the more intellectual deviations to disappear has a great depressing influence on the future of a nation; as for instance, the action of the Spanish inquisition, maintained steadily for several centuries, in eliminating and killing intelligent heretics.

American Central Station Statistics.

Mr. W. M. Steuart, chief statistician of the United States Census Office, has just issued a most interesting and important preliminary bulletin devoted to electric light and power stations for the year ending June 30, 1902. A few figures relating to the report were issued a month or two ago and this bulletin will be followed up by a more elaborate and complete report. As it is the present document embraces no fewer than 50 tables, which, with the running discussion on them, constitute the first thorough treatment of the kind that this great industry has yet received; and laying the foundation for all such statistical work in the future. We shall have occasion to return to this subject, and to present many of these tables and accompanying remarks to our readers. For the moment it must suffice to note that at the time of the enumeration there were 3,620 central electric stations in operation. The cost of their construction and equipment amounted to $504,740,352. The gross income for the year was reported at $85,700,605, and the total expenses at $68,081,375. These stations furnished employment to 23,330 wage earners, who received $14,983,112 as wages during the year. The power plant equipment consisted of 5,930 steam engines with 1,379,941 indicated horse-power, and 1,390 water wheels with a stated horse-power of 438,472. The generating plants consisted of 12,484 dynamos of every description with a stated horse-power of 1,624,980. A noteworthy feature of the development of this industry has been the installation of plants operated under the control of municipalities. There were 815 of these plants in operation. The cost of their construction and equipment was reported at $22,020,473. They gave employment to 2,467 wage earners and paid $1,422,341 in wages. These figures do not, however, tell the full central station story, as during the same year there were 252 electric railways doing a central station business as previously noted in these pages; nor, of course, are any data presented from the 50,000 isolated plants—more or less—that exist all over the country. The current output for the year is estimated and returned at 2,453,502,652 kw-hours, or about 25 per cent. of the possible work that the stations could do in 24 hours of daily operation.

The general introduction of electric lighting is shown by the fact that of the 1,892 places reported at the Twelfth Census as having a population of 2,500 and over, 1,511 had one or more central electric stations operated either independently or in connection with an electric railway, and there were 1,960 places with a smaller population having similar stations. In addition, there were a number of large central electric stations which furnished current to surrounding cities, towns and villages, so that an enumeration of the places in which central stations were located by no means represents the distribution of the current. Moreover, the term "central electric station," as used in this report, includes a number of plants, but in cases where two or more plants were operated by the same individual, firm or corporation, and located in the same State, a separate report was secured for each whenever the system of accounts permitted the preparation of separate returns; otherwise, one report was obtained to cover the operations of all plants. For instance, the Edison Electric Company, of Los Angeles, Cal., generates current in three mountain water power plants and four steam plants in different localities, all connected by transmission lines. These seven plants were included in one report and were counted as one station. There were 1,463 central electric stations operated by private companies or municipalities in connection with the manufacture of gas, the operation of water works, or other industries. It is very interesting to note that there were only 827 cities and towns in which one or more gas plants were in operation. The fact that 75 per cent. of the central electric stations are in places of less than 5,000 inhabitants, as compared with 22.8 per cent. of the gas plants, indicates the wider distribution of the electric stations which have enabled the inhabitants of the small places to enjoy illuminating facilities.

More than 150 private and municipal stations have commenced operations during each year since 1888, and in each of nine years since that date more than 200 have been installed, the greatest number, 277, being reported for the year 1898. Each State and territory contains a number of central electric stations operated under private ownership, and all, with the exception of three territories, and the District of Columbia, Nevada and Wyoming, report one or more municipal stations. Illinois contains the greatest number of stations operated under private ownership and Ohio the greatest number under municipal control. The greatest proportion of central electric stations is found in the North Central States. In 1890 these States contained 43.1 per cent. of all the electric stations in the United States, and in 1902 the proportion had increased to 47.1 per cent. The greatest percentage of increase in the number of stations is shown for the South Central States, where 79 stations had been installed up to 1890. This number increased to 404 in 1902, or 411.4 per cent. Of the total number of stations reported, 2,805, or 77.5 per cent., were operated under private or corporate ownership and 815, or 22.5 per cent., under municipal control. There were 13 stations operated under private ownership in 1902 that were formerly under municipal control. Of the 815 municipal stations, 77 commenced operation under individual or partnership control and 93 under corporate ownership. A further division of stations operated under private ownership is made in Table 34, from which it appears that 964 stations, or 34.4 per cent., were installed by individuals or firms, and 1,828, or 65.2 per cent., by corporations. At the time of the enumeration in 1902, the number of stations operated by individuals or private firms had been reduced to 756, or 27 per cent., while the number controlled by corporations had increased to 2,049, or 73 per cent.

Ramsay on Radium and Helium.

Sir William Ramsay, professor of chemistry at University College, London, who, with Lord Rayleigh, separated helium from the air, in a lecture last week before the London Institution, made the interesting announcement that his experiments with radium had shown that that element has the power of changing by some subtle process into another element, namely, helium. He described how a long search into the problem of what becomes of the minute particles with which radium is always parting was quite lately rewarded. Besides its other manifestations, radium constantly gives off an emanation which seems to behave in all respects like a heavy gas. It can be collected in tiny flasks, measured, weighed and used to display the characteristic properties of radium, but it is not permanent. In about a month it entirely disappears. The question is, "What becomes of it?" Sir William has caught this emanation in the act of vanishing. He found that after it had been collected a couple of days its spectrum, which previously was entirely unlike any yet studied, began to display the typical yellow line of helium.

In four or five days the helium grew brighter, and in another week the spectrum of helium was positively blazing in the hermetically sealed tubes that had been filled with the pure emanations or gaseous output of radium. In other words, one element had been literally seen to change into another.

This realization of one of the oldest of human dreams was, said Prof. Ramsay, very suggestive of transmutation. The problem might not be actually solved, but it was by no means absurd. Prof. Ramsay calculated that if radium turned into helium and nothing else it would take 2,000,000 years to dissolve into gas, but if helium is only one of the substances given off the transmutation would be proportionally shorter. He is now investigating to learn precisely how much helium was produced from the radium, what happened in the change and how long it took. He pointed out that several groups of elements linked together by Mendeljeff's periodic law showed a remarkable similarity of properties, tending to suggest that the accepted elements were not the final forms of matter, and that they were ultimately reduced into a few simpler forms. He asked if the world was on the verge of some great generalization, showing that all the so-called elements were merely elusive forms of one or two fundamental kinds of matter.

Prof. Ramsay stated that Profs. Rutherford and Soddy were co-operating with him in his investigations. He incidentally remarked that the price of radium had increased ten fold in the last six months, owing to the action of the Austrian Government, which had created a corner therein by refusing to allow further exports of refuse from the uranium oxide works at Joachimthal. As a result, the nominal price of radium is about $250.000 for one-fifteenth of an ounce.

Among a number of other interesting points the lecture showed the power of radium to make certain minerals and chemical compounds luminous. Prof. Ramsay subjected a piece of the mineral willemite to the "bombardment" of radium particles, whereupon it shone brightly. In an interview after the lecture Sir William said it was practically impossible at present to obtain more radium. It had been said that an American company had been formed to mine it, but he had tested the American ores supposed to contain it and found them absolutely worthless.

Montreal, the Greatest Centre of Transmitted Power—I.

By Alton D. Adams.

INTRODUCTION.

FIG. 1.—REAR VIEW OF CENTRAL STATION.

MONTREAL, Canada, consumes more electrically-transmitted water power than any other city in the world. This power is drawn from three generating stations located on as many different rivers at distances that range up to about 85 miles from the central sub-station in the city. These rivers, the St. Lawrence, the Richelieu and the St. Maurice, draw their water supplies from half a continent. With the vast drainage area of the Great Lakes behind the St. Lawrence, the entire Champlain Basin between the Green and Adirondack Mountains to gather water for the Richelieu, and a great stretch of northern Canada to supply the St. Maurice River, the reliability of electrical supply from water power is assured in Montreal. The superlative capacity of the water-driven apparatus in this electrical supply system seems evident from a statement of the figures for the generating and sub-stations. At Chambly power house, on the Richelieu River, 17 miles by the transmission line from the central sub-station in Montreal, the combined capacity of the main electric generators is 16,800 kw. The Lachine power house, on the St. Lawrence, five miles from the sub-station just named, contains main generators of 6,000 kw total capacity. Both of these power plants are devoted exclusively to the operation of the Montreal system. Neglecting the total equipment of the great power house at Shawinigan Falls, on the St. Maurice River, which is operating under a head of 145 ft., and in which three turbines are installed at present, having a capacity of 6,000 hp each, and generators of 3,750 kw, and whence energy is transmitted 85 miles to a sub-station in the suburbs of Montreal, the capacity of transformers at this sub-station is 5,000 kw, and they require about 6,000 kw in generator capacity at the Shawinigan plant. The total rating of the present generators in water-power stations, devoted to electrical supply in Montreal, is thus 28,800 kw. This capacity will shortly be increased in two directions. A fifty-year contract requires the company operating the Shawinigan plant to deliver up to 20,000 hp for electrical supply in Montreal. Still another water power located at Soulanges, on the St. Lawrence, is about to be developed and transmitted for the city system.

In anticipation of the increase of capacity at the water power plants the sub-stations in Montreal have been equipped beyond immediate requirements. Besides that of the Shawinigan system already mentioned, there are two sub-stations in Montreal devoted to general electrical supply. At one of these, known as the McCord Street sub-station, the total capacity of transformers that receive the high-tension transmitted energy is 7,000 kw. In the main or central sub-station, the total capacity of transformers connected to the transmission lines is now 27,500 kw with room for an increase. Including the 5,000 kw at the Shawinigan sub-station, which is entirely devoted to the Montreal electrical supply system, save for one item of 250 hp, the combined capacity of stepdown transformers is thus 39,500 kw or 52,000 hp. It is safe to say that no other city on the American continent, or even in the world, has an equal capacity of stepdown transformers delivering energy from water powers to an electrical supply system for all purposes.

Besides the water-power plants and sub-stations already named, the system includes five steam power stations at as many points about the city and suburbs, with a combined capacity of 5,700 kw. These steam plants are in large part a legacy of former conditions, and are now held as a reserve for the water power system. The largest of these steam-driven stations, that on Queen Street, has a capacity of 2,400 kw, and has been remodelled and made fire-proof during the past year.

THE AREA OF SUPPLY.

Electric light and power supply is distributed by the Montreal system in the city and island of that name for a distance of about fourteen miles along the river front, and to an average width of between three and four miles back from its bank. Included in the service area is a strip of territory about one mile wide and four miles long on the main land opposite to the city. Within this area there are at present served 11,152 customers using commercial arc and incandescent lamps, and 870 customers using motors, besides the cities and towns that are supplied with street lamps. The municipalities whose streets are lighted number fifteen, including Montreal, and all except two of these are on the island. The total connected load of street lamps numbers 1,717 of the arc and 577 of the incandescent type. Commercial lighting service is rendered to 11,152 customers, who have connected to the system 299,903 incandescent lamps, 1,514 arc lamps and 405 pieces of various apparatus, such as fans and heaters. Power service is rendered to no fewer than 870 consumers, who employ 1,109 electric motors with an aggregate capacity of 19,172 hp. From these figures it may be noted that the utilization of water powers has made the operation of motors an exceptionally important part of the business of the Montreal system. The commercial lamps above named, together with a part of the incandescent street lamps, are operated through 2,161 service transformers with an aggregate capacity of 13,249 kw. For the motor load 695 transformers with a total capacity of 6,980 kw are employed, but these transformers do not operate all of the connected motors, because many of these motors are of the direct-current type, and many of the alternating motors operate at the full voltage of distribution so that no transformers for them were required.

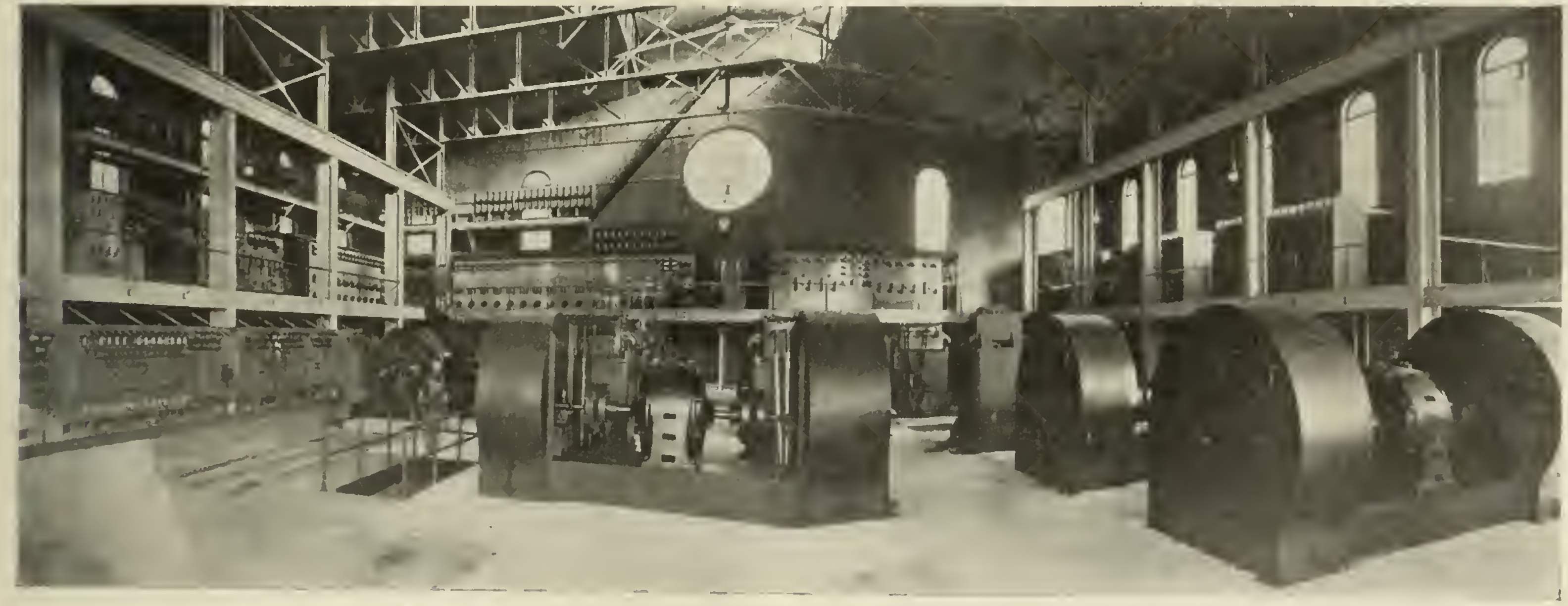


Fig. 2.—General View of Interior of Central Station, Montreal.

WHAT CONSTITUTES THE SYSTEM.

This great system, which constitutes the only public supply of light and power in Montreal, has been welded together out of diverse elements. The Montreal Light, Heat and Power Company, the owner of the system, was incorporated by the Quebec Legislature in March, 1901, for the purpose of consolidating all the gas and electric companies doing business in the city. In conformity with this purpose the charter of the company authorizes it to acquire plants for the supply of gas, electricity or other source of light, heat or power, by purchase, lease or otherwise. Furthermore, the company may lease and operate all or any part of the plants of any other company engaged in the supply of light, heat and power, and may acquire and hold the stocks and bonds of any such corporation. When the Montreal Light, Heat and Power Company has acquired the plant of any other company engaged in similar lines of business, then the Montreal Company may exercise the charter rights and franchises of such other company. Besides the foregoing powers, the Montreal Company has the right to construct its pipes, lines and conduits under or over the public streets and highway of that city or of any place or territory within one hundred miles therefrom in any direction.

Pursuant to these liberal and important powers the Montreal Light, Heat and Power Company acquired a majority of all the capital stock of each of the following named companies: The Montreal Gas Company, the Royal Electric Company, the Montreal & St. Lawrence Light & Power Company, the Imperial Electric Light Company, Ltd., the Lachine Rapids Hydraulic & Land Co., Ltd., the Standard Light and Power Company, the Citizens' Light & Power Company, Ltd., the Temple Electric Company. The Montreal Light, Heat and Power Company, together with the eight subsidiary companies just named, controls the entire supply of gas and electrical energy in that city and its suburbs. The dates of incorporation of these subsidiary companies are of interest as showing the great increase in public service that has resulted from the introduction of electrical supply and the application of water power therein. The Montreal Gas Company was incorporated in 1847, and engaged in the supply of gas in Montreal and its suburbs. In 1884 the Royal Electric Company was chartered to supply electrical energy in Montreal, and at the time of the consolidation was the largest distributor of that product in the city. The Montreal & St. Lawrence Light and Power Company was incorporated in 1888, and has built the large hydro-electric plant at Chambly, that now forms a part of the Montreal electric system, and transmitted the energy there developed to the city. Energy from this plant was first used at Montreal in August, 1899. The Imperial Electric Light Company was chartered in 1896 to supply electrical energy in Montreal from a steam power plant. The Lachine Rapids Hydraulic Land Company, Limited, was incorporated, in 1896, to develop the Lachine Rapids and transmit electrical energy therefrom for use in Montreal, which has since been done. Both the Citizens' Light and Power Company and the Standard Light and Power Company were incorporated in 1892 for the purpose of either gas or electrical supply.

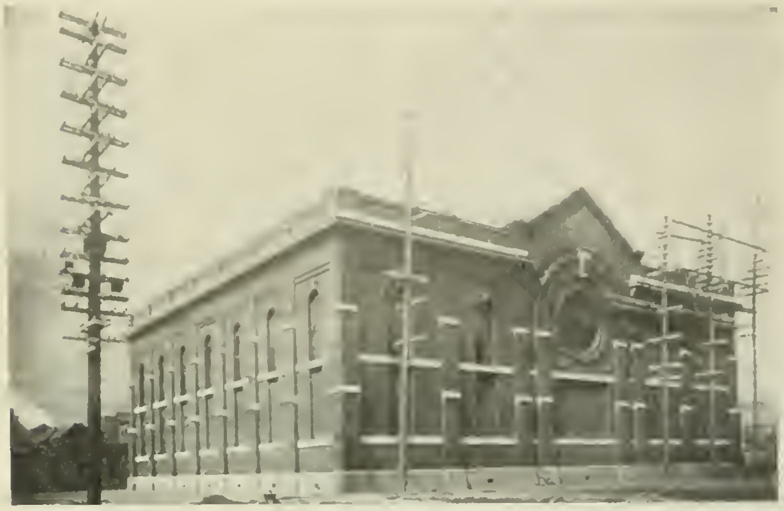


FIG. 3.—FRONT VIEW OF CENTRAL STATION.

From the above it appears that the Royal Electric Company, one of the subsidary corporations just mentioned, is the oldest of those now engaged in electrical supply in Montreal, as its formation dates from 1884. It would be interesting, if possible, to trace the increase of electric loads among all the companies at Montreal during past years, but the facts are not at hand for any of these companies save the Royal Electric. Figures for the loads of this company are, however, no doubt more representative and larger than figures for any one of the other companies concerned. Direct-current arc lamps connected to the circuits of the Royal Electric Company numbered 1,287 in the year 1890; 1,666 in 1895, and 1,859 in 1900, showing an increase of 44 per cent. during the ten years. During the same period the load of arc and incandescent lamps on the alternating current circuits rose from an equivalent of 1,835 incandescent lamps of 16 cp each to an equivalent of 93,498. In other words, the load of arc and incandescent lamps on alternating circuits was 59 times as great in 1900 as it was in 1890. Direct current motors first appeared on the circuits of the Royal Electric Company in 1892, when their total rating was only 50 hp, but by 1900 this capacity had risen to 1,253 hp, or 25 times the rating in the earlier year. The latest factor in the electric load was the alternating current motor, which did not appear in the returns until 1897, and was then credited with a combined rating of 18 hp. Three years later, in 1900, the capacity in connected motors of this type reached 3,417 hp, representing an average addition of more than 1,100 hp in capacity yearly. It is hard to believe that this rapid increase of electrical loads was not due in some measure to the utilization of water power, for between May 31, 1899, and May 31, 1900, the Royal Electric Company secured control of the hydro-electric plant at Chambly, energy from that plant was delivered at Montreal in August, 1899, and the rise of electric loads was more rapid during the year between the two dates just named than in any other of the decade. Thus, during the twelve months that ended May 31, 1900, the increase on the Royal system of the equivalent load of 16 cp incandescent lamps was 14,460, and the rise of capacity in connected motors was 116 hp for those of the direct-current, and 2,176 hp for those of the alternating type. To water power must also be traced the strong tendency to consolidation that culminated in 1901.

The charters of the Montreal Light, Heat and Power Company and of its subsidiary companies are perpetual, and the stockholders of the former company, by a vote of two-thirds of the stock represented at any special general meeting called for the purpose, may increase its capital stock to any amount deemed necessary for its purposes. Debenture bonds may be issued by the company to an amount equal to 75 per cent. of its capital stock, and these bonds may be secured by a transfer to trustees of all or any part of its assets. Up to April 30, 1903, the Montreal Light, Heat & Power Company had issued $17,000,000 in capital stock, and $3,500,000 in 4½ per cent. bonds. During the year ending at the date just named, the excess of earnings by the company over its operating expenses was $900,872.95. This excess of earnings over operating expenses amounted to 46 per cent. of the gross earnings of the company in that year. For the year ending April 30, 1902, the first after the formation of the Montreal Light, Heat & Power Company, the company earned $821,217.45 above the expenses of operation, and this sum was 46 per cent. of its gross earnings in that year. Besides paying all operating expenses and interest charges on its bonds and loans the Montreal company declared four quarterly dividends of 1 per cent. each, during each of the two fiscal years just named, the only ones of its existence. After all these payments there remained a surplus of over $140,000.

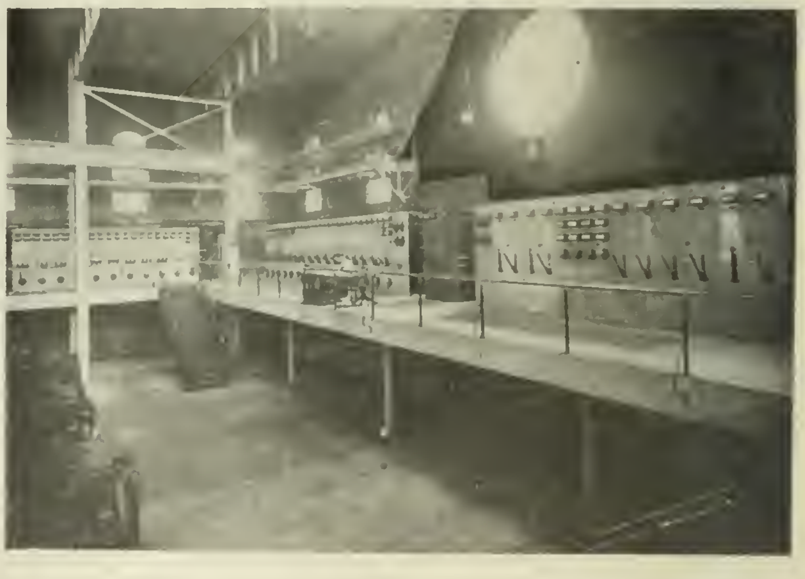


FIG. 4.—DISTRIBUTING SWITCHBOARD AND TRANSFORMER PANELS.

FEATURES OF DISTRIBUTION.

Electrical supply in Montreal and its suburbs is distributed from three sub-stations, which are designated as the central, the McCord Street, and the Shawinigan sub-station respectively. The central sub-station is nearest of the three to the business center of the city, the McCord Street sub-station is about one-half mile distant to the west, and the Shawinigan sub-station is approximately 3⅝ miles to the east. At each of these sub-stations the energy transmitted from one or more of the water power plants is transformed or transformed and converted to alternating current at 2,400 volts, 63 cycles per second, and either two or three-phase. At the central sub-station a portion of this 2,400-volt alternating current is transformed to 4,000-volt constant current for the series arc lamps, and another portion of the 2,400-volt current is transformed and converted to direct current at 250 volts for a three-wire system of 500 volts between outside wires, that carries a part of the motor load. All three of the sub-stations are tied together by the 2,400-volt feeders, so that the energy received from either water power plant may be delivered to consumers on any part of the distribution system. Constant, direct current is supplied for a part of the series street lamps by means of motor-driven arc dynamos.

Of the total number of arc street lamps, 1,717, the enclosed series alternating arcs comprise 1,333, and the remaining 384 lamps are of the series open direct-current type. All of these street arc lamps are of nominal 2,000 cp each. The enclosed alternating arcs operate nominally on 80 volts and 7.5 amp. each, or 480 actual watts. On the direct-current arc lines the rating is 9.6 amp.

Of the 577 incandescent street lamps, 106 of 65 cp and 273 of 32 cp are on the constant alternating-current lines, 37 of 32 cp are operated by constant direct-current circuits, 50 of 32 cp are in multiple

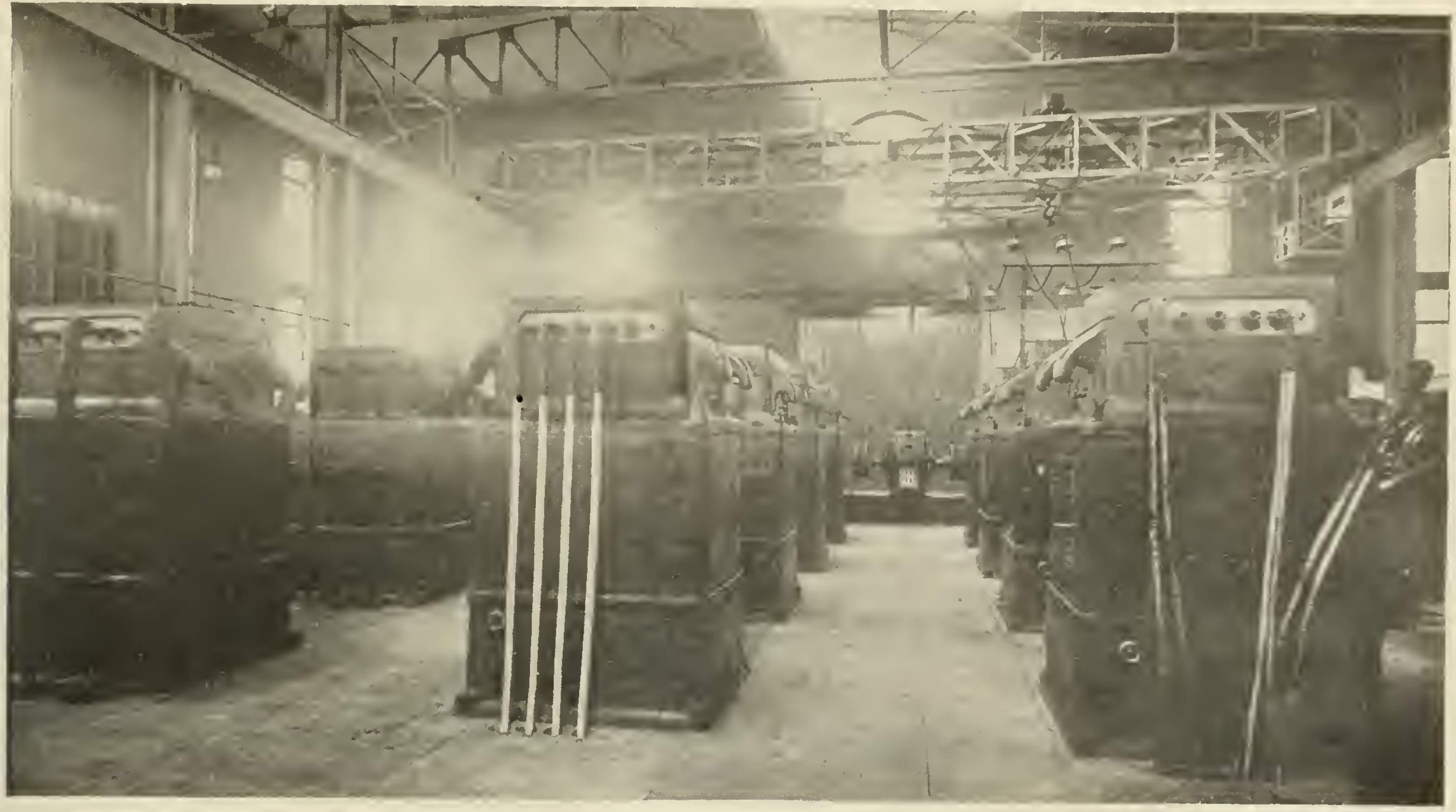


Fig. 5.—Transformers, Central Station.

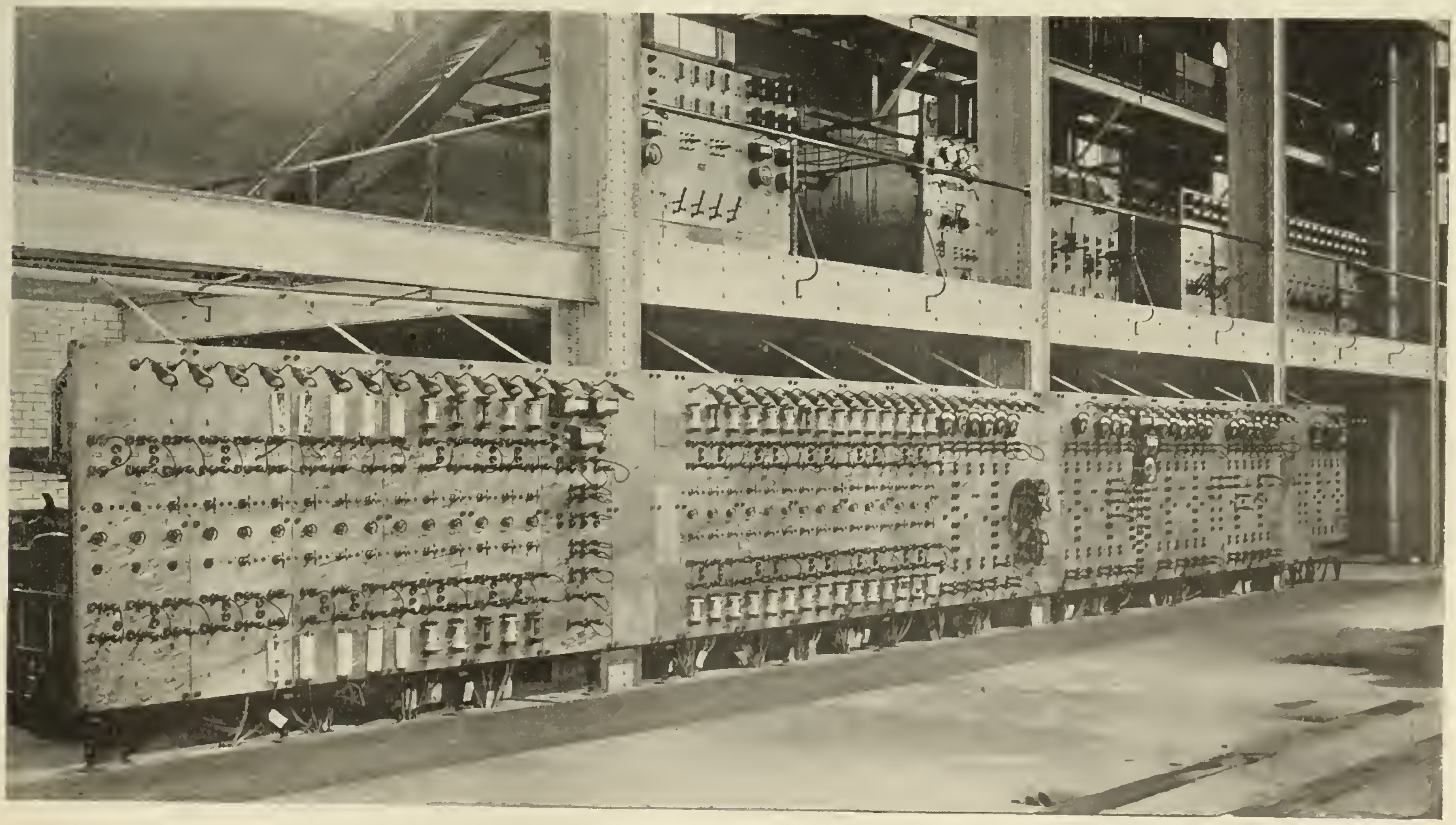
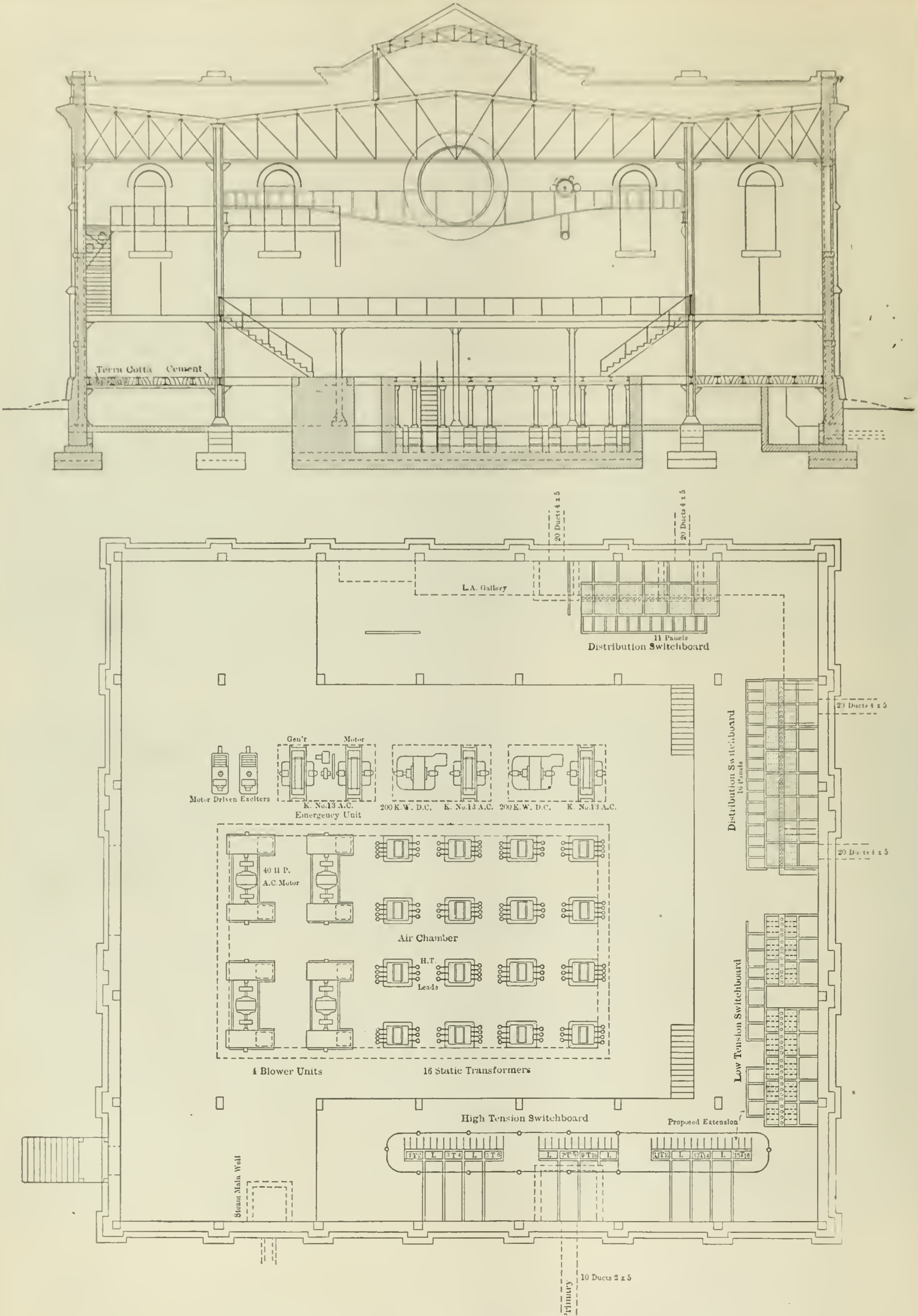


Fig. 6.—Switchboard for City Lighting.



Figs. 7 and 8.—Cross-Section and Floor Plan of Montreal Central Station.

on the 220-volt system, and 91 of 32 cp and 18 of 16 cp each are in multiple at 110 volts. The 299,903 incandescent lamps in commercial service include a variety of candle-powers below 16, so that the equivalent number of 16-cp lamps would be somewhat less than this total figure. The constant-potential commercial arc lamps of both the enclosed and open types number 1,277 on alternating circuits. Commercial service also includes 23 constant-current, enclosed alternating arcs and 214 direct-current series open arc lamps.

Most notable in this supply system is the load of stationary motors, because of their large number, great aggregate capacity and the unusual average capacity of each. Of the 1,109 motors connected to the distribution lines, 580 motors in use by 426 customers are of the alternating type and have an aggregate capacity of 16,556 hp, giving an average capacity of 28.4 hp each. Comparing these motors with the number of customers using them, it appears that the average was 1.36 motors and 38.8 hp per customer. The exceptionally large average horse-power per motor and per customer points clearly to the extensive use of these alternating motors in manufacturing operations. Some of these alternating motors are of the synchronous, but the greater number is of the induction type, and all are supplied with current of 63 cycles and either two or three-phase. Most of these motors are operated from the 2,400-volt circuits through transformers that lower the voltage to about 550; but some of the large sizes receive the full line voltage in their windings. Direct-current motors number 529, are in use by 444 customers and have an aggregate capacity of 2,616 hp. The average capacity of these motors is thus almost 5 hp each, and the average per customer is 1.2 motors and 6 hp. Comparing these figures with those for alternating motors it appears that the average power per customer and per motor is nearly six times as great for the alternating as for the direct-current type. From this fact the obvious conclusion is that the alternating type of motor is more generally applied where comparatively large powers are required. The two largest consumers of electric power connected to the Montreal system—that is, the Montreal Street Railway Company and the Dominion Cotton Mills Company—use 21 motors of the alternating type that have an aggregate capacity of 8,005 hp, besides some smaller sizes. If the number of these exceptionally large motors and their total capacity are deducted from the corresponding figures for all motors of the alternating type, the result shows 559 of these motors with a combined rating of 8,551 hp. These last-named figures correspond to a capacity of 15.3 hp per motor on an average, or 2.5 that of the like average for all of the direct-current motors. This again brings out the fact that the alternating motors have been more generally selected than the direct-current type by the users of large amounts of power.

The Montreal Street Railway Company has a larger capacity in motors connected to the system of the Montreal Light, Heat & Power Company than any of its other customers. This capacity amounts to a total of 4,915 hp and is made up by seven 2,200-volt, two-phase motors that operate with alternating current of 63 cycles per second. Six of these motors are of the induction type and rated at 700 hp each, while the seventh is a synchronous motor of 715 hp. For the supply of energy to these motors seven two-phase circuits are run from the central sub-station of the electrical supply system to the generating station of the street railway company, a few blocks distant. These induction motors are believed to be among the largest of this type in use anywhere. It is believed that these induction motors require less skill in their operation, and cause less fluctuation of voltage in the electric supply system than synchronous motors of equal capacity. On the other hand, one disadvantage of induction motors, that of a very short air-gap between the rotating and stationary parts, is here illustrated. Thus, in these great induction motors of 700 hp each the air-gap for each of two is said to be only 3/32 in., and the air-gap for each of four only 0.0825 in. from iron to iron. Each of these seven motors is direct-connected to a continuous-current generator that supplies the street railway system at about 550 volts.

The plant of the Dominion Cotton Mills Company is probably one of the largest of its kind that draws its power from a public system of electrical supply. In these cotton mills the total number of electric motors is 27, and their combined rating amounts to 3,412 hp, divided as follows: Number of motors, 5 of 300 hp each, 1 of 240 hp, 5 of 200 hp, 1 of 150 hp, 2 of 100 hp, 2 of 75 hp, 1 of 50 hp, 1 of 30 hp, 1 of 20 hp, 2 of 15 hp, 2 of 10 hp, 1 of 7 hp, 3 of 5 hp. All of these motors in the cotton mills are of the induction type, save one of 200-hp capacity, which is synchronous. The fact that the Montreal electrical supply system is able to furnish power for this great manufacturing plant on terms that make it unprofitable for the latter to operate with steam is a striking illustration of the advantages of transmitted water power.

Of the 2,161 service transformers used for lighting service on the Montreal system, 1,068 are of less than 5-kw capacity each, 314 have an individual rating of just 5 kw, and 779 transformers are rated at 7½ to 60 kw each. All of these lighting transformers have a combined rating of 13,249 kw, and of this total the transformers of less than 5 kw each represent 2,222½ kw, the transformers of just 5 kw each 1,570 kw, and those of more than 5 kw each an aggregate of 8,930-kw capacity. Of the 695 transformers used for power service, 273 are rated at less than 5 kw each, 98 transformers have just this individual capacity, and 324 transformers are of larger sizes up to 170 kw. The combined rating of 6,980 kw in these transformers used for power purposes is divided into 620 kw for those of less than 5 kw each, 490 kw for those of just 5 kw rating, and 5,867½-kw capacity in transformers that range from 7½ to 170 kw each.

Comparing the lighting and the power transformers it appears that the average rating of all the former is 6.1 kw, and of all the latter 10.0. Of the aggregate rating of 13,249 kw for all lighting transformers, 67 per cent. is in units of more than 5-kw capacity each, while of the 6,980 kw of total capacity in power transformers 85 per cent. is represented by those of more than 5 kw each. These figures bring out one desirable feature of a motor load, namely, that the transformers required for its operation are usually of larger average capacity and consequently of higher efficiency than those used for lighting. Of course, large motors of 100 or more horse-power each have the farther advantage that they may take current directly from the distribution lines, and thus require no service transformers whatever.

More Tunnel Traction for New York.

The New York Rapid Transit Commission has granted a franchise to the Hudson & Manhattan Railroad Company to run a tunnel under the North River from Exchange Place, Jersey City, to Cortlandt Street, Manhattan. William G. McAdoo is the president of the company and also is president of the New York & New Jersey Railroad Company, which has received a franchise to run a tunnel under the North River, entering Manhattan at the foot of Christopher Street. The tunnel which will enter the city at Cortlandt Street will run to Church Street and then will form a loop, running back through Fulton Street to the place where the tunnel strikes Manhattan. There will be a spur from the station in Church Street, and this spur will connect at Broadway and Dey Street with the lower Broadway spur of the rapid transit subway.

When the franchise was brought up before the Rapid Transit Commission at last week's meeting, Mayor Low made the point that last summer he had insisted on a change in the grant so as to prevent the corporation from merging with any other company. The attorneys for the tunnel projectors had declined to accept any such condition, and Edward M. Shepard, counsel for the commission, together with Corporation Counsel Rives, had prepared an amendment which was suggested as a general compromise between the position taken by the Mayor and that taken by the company. This was to the effect that, in the event of a merger between the tunnel company and any other concern, both merging companies should agree to carry out all of the obligations of both companies. To this the Mayor consented. The franchise gives to the company a 25-year grant with the privilege of two renewals, one at ten and the other at fifteen years, at varying rates of compensation, equivalent to the city of 3 per cent. of the capital involved and of the earnings of the company as estimated.

Chicago Electrical Association.

A meeting was held at the Lewis Institute on November 20. Before a large audience Professor John D. Nies described split-phase power measurements on alternating circuits. The three-voltmeter method of measuring power in an inductive circuit was described in detail and demonstrated. This, as is well known, consists simply in a method of separating a given impedance into its components, resistance and reactance. The actual power, of course, is then readily found by multiplying the square of the current by the resistance thus found.

Methods of Signaling and Operating in Telephone Exchanges—I.

By Kempster B. Miller and Charles S. Winston

THE importance of deciding at the outset on the best methods of signaling and operating in telephone exchanges cannot be overestimated. It affects the quality of service given throughout the whole life of the exchange, and therefore the popularity of the enterprise; it affects the cost of operation and therefore the revenue of the company; and it also very materially affects the original cost of the installation, including the switchboard apparatus, the buildings it occupies and the wire plant.

Given a certain definite thing to accomplish, in the way of conveying automatic signals in a telephone exchange, the circuit man will always rise to the occasion, usually with more than one way of accomplishing it. The manner in which the signals between the various persons concerned in different parts of the exchange may best be conveyed and interpreted is, as a rule, more difficult of solution than the designing of the circuit after the method has once been decided on. It is a question in which the personal equation of both operator and subscriber enters to a large extent; and this fact alone makes it solvable by long experience and study, rather than by pure reasoning power alone.

Primarily, the question involved is "what does the subscriber want?" and this rather than what the electrical engineer says "he ought to want," should form the basis of future work. The work of determining what the subscriber, using the word collectively, actually does want has been and probably always will be difficult. This should devolve on the "traffic engineer," if we may use the term, who in turn should require of the electrical engineer a system which with due regard to effectiveness and to economy of operation, and of first cost will come nearest to the ideal set by the demands of the subscribers.

The question resolves itself into two important factors. First, the giving of the best possible service to the community; and second, the working of the apparatus, the plant and the operators, to the best advantage from an economical standpoint.

Much has been written concerning the circuits employed in nearly all branches of telephone service, but few articles have appeared on the methods of signaling and operating, dealing with the general problem of the functions which the circuits should perform. There has been as much diversity as to what should constitute a proper code of signaling in the various branches of telephone service; that is, as to the manner in which the signals should be communicated to, and interpreted by the various persons concerned in making a connection, as there has been in regard to the actual circuits for accomplishing such ends when once determined on. Experience alone has taught what is best, and it is only in recent years that practice has become fairly well standardized. It is the purpose of this article to show what some of these standards are and why they are, regardless, as far as possible, of any circuit arrangement.

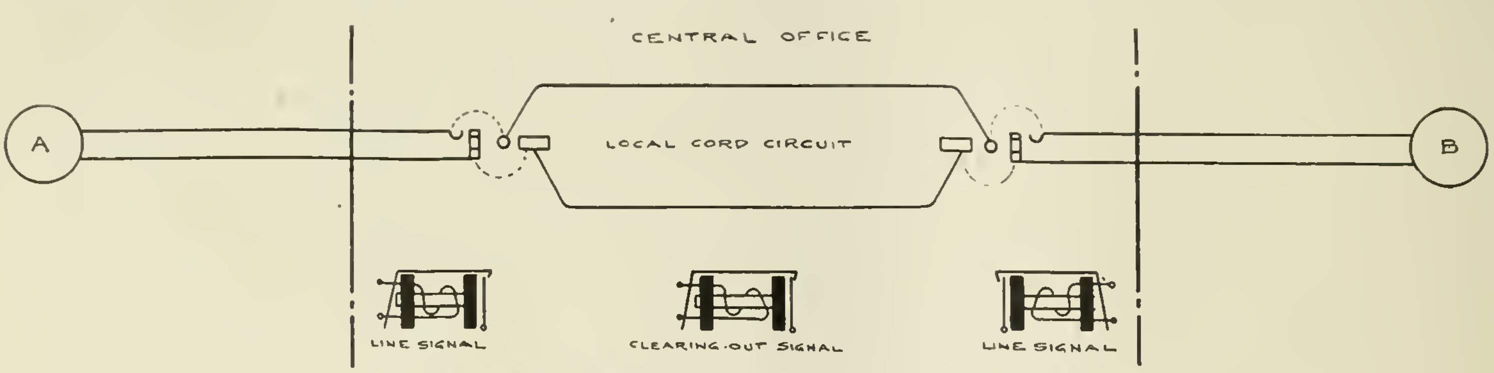


Fig. 1.—Connection Between Two Subscribers Through a Magneto Office.

In the modern forms of magneto systems still widely used in small exchanges, the operator can depend only partially on signals, and must rely for obtaining much of the information as to the conditions of a connection, by frequently listening in on the circuit for verbal communications with the connected subscribers or with other operators. What signals are transmitted by the subscriber are done by some voluntary act on his part, which he is liable to do improperly, or to forget altogether, so that the magneto system is much more dependent on the untrained human element than it should be.

To make this more clear, reference is made to Fig. 1, which represents the essential elements of a connection between two subscribers' station equipped with magneto instruments. In order to call the central office, subscriber *A* turns his generator crank, which displays at the central office a signal in the form of a shutter, belonging to the annunciator corresponding to that line. If the subscriber is a novice, he may first remove his receiver from the hook, which may or may not prevent his sending any signal at all. Thus the very act of the subscriber's attempting to originate a call is dependent on his performing certain acts in a definite order, none of them being in any sense automatic. The operator seeing the signal, inserts an answering plug, and by means of a key listens in to ascertain the number of the subscriber desired, after which she completes the connection by inserting her calling plug into the jack of the subscriber called for (subscriber *B*), and by means of her ringing key calls him. She has no means of knowing when subscriber *B* responds, or when subscriber *A* gets tired of waiting and hangs up his receiver, other than by frequently listening in on the circuit to hear or inquire whether the conversation is in progress.

When the subscribers have finished their conversation, one or both of them may remember to operate their generators, and thus throw the clearing-out signal associated with the cords as a disconnect signal for the operator. As is well known, they frequently neglect this, in which case the operator can only ascertain by inquiry. Again, the display of the clearing-out signal conveys no definite information to the operator, as it may mean one of several things: Both subscribers may desire a disconnection, one subscriber may desire another connection, one or both may desire the attention of the operator, or it may mean that one of the subscribers has attempted to ring the other subscriber direct. In any event, the operator must listen in on the circuit to know how to interpret the signal. All this requires time and necessitates the tieing up of the apparatus for a longer time than is actually necessary. Besides this, the constant listening in of the operator is a disagreeable feature to the subscriber, and destroys all idea of secrecy on his part.

One of the many and also one of the most important advantages in common battery systems which are now rapidly supplanting the magneto, is the fact that at all times after a connection has been established it is possible for either subscriber to attract the attention of some operator, and the operator who has charge of the connection knows at all times the exact conditions on the lines; that is, she knows whether the called subscriber has answered the call, or whether the calling subscriber is waiting for the connection to be established, whether conversation is finished, and at the end of the conversation whether either subscriber desires her attention for making another connection or for any other purpose.

The common battery system naturally lends itself to automatic signaling because, all sources of electrical energy being at the central office and ready for service on every line, it remains only for the subscriber to close the circuit to draw on the energy or to open the circuit to shut it off. These acts on the subscriber's part are performed without his volition, inasmuch as they are made accessory to some other act which he must perform in order to use the instrument.

The whole tendency of telephonic development has been to simplify the work of the subscriber by giving him nothing to do further than placing the receiver at his ear and asking for what he wants. This tendency has gone hand in hand with the simplification of the subscriber's apparatus, and these two facts have led to the doing away with the magneto generator and local battery, thus reducing the apparatus at the subscriber's station to the fewest possible elemental parts.

In the signaling from the subscriber to the general office and between the various operators at the exchanges, the tendency has been, and is constantly growing, to have every signal automatically sent, and to mean positively one thing and one thing only. Each operator is made a specialist, performing one class of work only, and no matter what the requirements on her may be, she is always to interpret each signal in a certain inflexible way. In this connection it may be said that we believe that those in charge of large exchanges who are loading their regular operators up with various classes of special work, are making a grave mistake; and further, that any tendency in the development of telephony which tends to increase the complexity of the subscriber's instrument, or to throw an additional amount of work on the subscriber, is taking a decided step backward.

Before going further, to avoid confusion, we will define what we believe to be the proper meanings of two much-abused terms in telephony—"telephone office" and "telephone exchange."

A telephone office is an establishment in which telephone lines center, containing equipment for interconnecting the lines for conversation in accordance with the demands of the subscribers served by them.

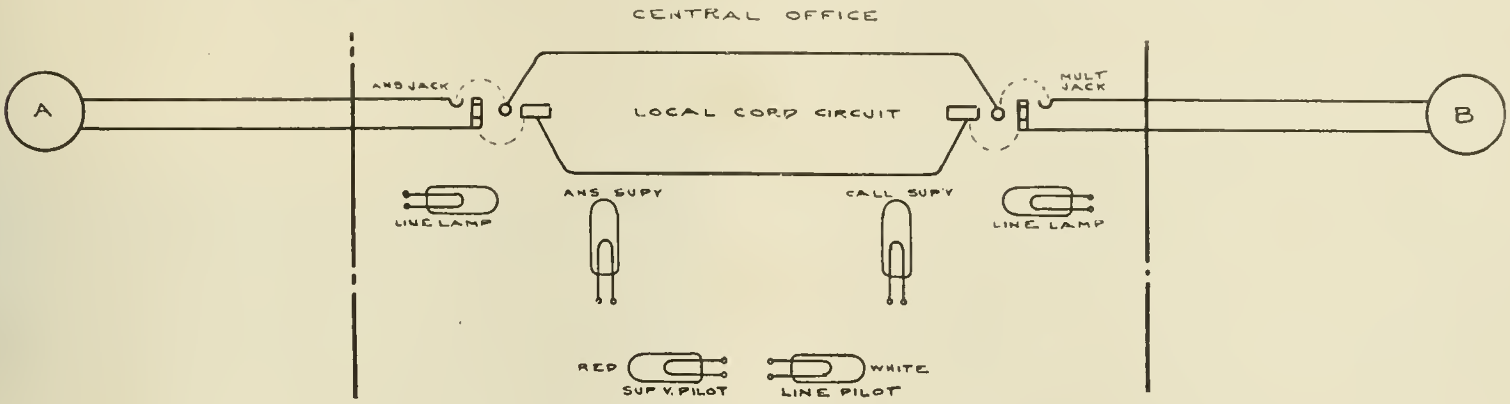


Fig. 2.—Connection Through a Single Common Battery Office.

A telephone exchange is an organization of one or more telephone offices, with their extending lines and substation apparatuses for supplying telephone service to a given community.

In discussing the methods of operation in common battery exchanges it will be necessary to classify service under several headings, on account of the large number of kinds of service that are required, owing to the existence of one or more offices in the same city, of toll connections, private branch boards, measured service, etc. In the accompanying figures *A* always represents the station of the calling subscriber, and *B* that of the called.

I. CONNECTION BETWEEN TWO SUBSCRIBERS IN THE SAME COMMON BATTERY OFFICE.

When a subscriber desires to converse with a second subscriber in the same office, he will remove his telephone from its hook, and thus light the line lamp (Fig. 2) associated with his line at the multiple switchboard. In order to assist the operator it is customary to locate at each position a pilot lamp, which lights whenever any line lamp at her particular position lights. The operator noting that this pilot lamp is lighted, inserts the answering plug of one of her cord circuits into the answering jack immediately above the line lamp, which lighted at the same time. This act will extinguish both the line and the pilot lamps, putting the line lamp out of service and leaving the pilot lamp ready to assist in attracting the attention of the operator to another call on some other line. The operator will then throw the listening key, and having found out from the calling subscriber the number of the line with which connection is desired, will test the multiple jack of this line with the calling plug associated with the answering plug in use, and in case the line is busy, she will tell the calling subscriber and pull down the connection. If, however, the line called for is clear, the operator will insert the plug into the multiple jack and ring.

Associated with each plug of a cord circuit is a supervisory lamp, each of which is under the exclusive control of the subscriber with whose line the corresponding plug is connected, this control being affected by the position of the subscriber's switch hook. When the operator inserted the answering plug into the answering jack of the calling subscriber, the supervisory lamp associated with that plug remained unlighted, because the subscriber's receiver remained off its hook. As soon, however, as the calling plug has been inserted into the jack of the called line, the supervisory lamp associated with that play will light and will remain lighted until the called-for subscriber responds to the call by taking his receiver from its hook, when the lamp will be extinguished, thus indicating to the operator that a response has been made and that the conversation is in progress. Both supervisory lamps will remain unlighted until the end of conversation, when both subscribers will hang up their receivers and thus light the answering and calling supervisory lamps associated with the cord circuit which has been used for the connection, which is a positive signal to the operator for disconnection.

It is customary practice for many independent companies to locate at each position a supervisory pilot lamp which will light whenever the answering supervisory lamp of any cord at that position is lighted. As the cord circuits of the Western Electric Company cannot be provided with this feature without many complications, Bell companies do not provide this pilot lamp.

The wire which carries battery for all of the line and supervisory pilot lamps in an office is ordinarily carried through the winding of a relay which is so wired that when operated it causes a bell or buzzer to ring, whenever a switch, which controls it, is thrown to the proper position. This bell or buzzer is intended to be used as a night alarm, and is not left in circuit during the day time. With this arrangement, at night or during the least busy hours of the day, one or a few operators may handle the entire office, the operator's attention being attracted to a call on any part of the board by the sound of the night alarm. A glance along the board will then show her at which position a pilot lamp is lighted, and on reaching that position the line lamp will show which particular line needs attention.

In case the exchange has party lines with selective signals, some means should be provided by which the operator will know which party she has rung last. If an indicating scheme is not provided, it is often necessary for the operator to ask the calling subscriber to repeat the number of the line which he has previously called for, an undesirable thing, because the subscriber may have forgotten the number, having once told it to the operator. Even if the subscriber has not forgotten the number, he does not understand why it has been necessary for the operator to again request the number, and is apt to attribute it to carelessness or incompetence.

The best practice to-day, where selective signaling party lines are used in considerable numbers, seems to be to equip each pair of cords in the entire office with party-line ringing keys, each key being provided with an indicator to show which of the several selective ringing currents had been last sent to the line by that particular key. With this arrangement, an operator noticing (by the calling supervisory) that a called party has not responded, has only to repeat the same ringing operation which the indicator on that ringing key shows her was last made.

In some cases, instead of supplying each pair of cords with a complete selective ringing key, a master key is provided on each position, which when operated determines the selective ringing current which the individual ringing key on each cord will send to the line. Although these master keys are sometimes provided with indicators, this practice is faulty because while the indicator may show what selective current was last used on that position, it does not show what pair of cords it was used on, and the operator is little better off than without it. This plan has only cheapness to recommend it.

For some unknown reason there are some multiple switchboards in use and others are now being constructed wherein the answering jacks are placed in a bank just above the plug shelf, while the corresponding line lamps are placed in a separate bank above them. This practice is to be strongly condemned from an operating standpoint, as by it one of the chief advantages of the lamp signal is lost, *i. e.*, the placing of the signal for each line immediately adjacent to the answering jack belonging to that line, so that the operator may plug into the proper jack in response to a call without once removing her gaze from the displayed signal or bothering her head about the number of the calling line. There are no apparent structural advantages to warrant this sacrifice in operating speed.

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Work of the Motorman on the Zossen Car.

Further details were given, with illustrations, in our last issue as to the recent high speed work on the electric road at Zossen, and we are now able to present a view of the interior of the motorman's cab of the Siemens & Halske car. From a first glance it might appear that a motorman with the multiple limbs of an octopus, the eyes of an argus, and the speed of a whip snake would be needed to watch and look after all these indicators, controllers, levers, brake handles, etc., but as a matter of fact the car lends itself to easy control and no difficulty worth mention is found in operating it by the "man at the helm." As to the cars themselves, it may be noted that certain changes were made in the motor wiring on the Allgemeine car. At first all the motors were started simultaneously, but later the stator windings of the four motors were placed in circuit one after the other, the motors being started by gradually short-circuiting the rotor windings. This arrangement avoided an unnecessarily heavy current intake at starting and also permitted the cutting out of the stators of one or more motors after normal speed had been attained and only two or three motors were required to continue running the car at the same speed. Although these motors were rated at 250 hp they carried 750 hp each at starting without rising more than 20° C. because the motors were cooled by compressed air.

The apparatus used during the trial runs is shown in the general view of the Siemens-Halske cab and consists of the following: *A* is the principal compressed air reservoir for operating all of the apparatus; *B* and *C* are ammeters for truck No. 1 and truck No. 2, respectively; *D* is the line voltmeter; *E* is the handle for the air whistle; *F* is the pressure gate; *G* is the acceleration indicator; *H* is the pressure gauge for the brake cylinder; *I* is the pressure gauge for the train line pipe; *J* is the speed indicator; *K* is the switch for connecting up the speed indicator according to the direction of running; *L* is the Westinghouse air brake valve; *M* is the motor switch; *N* is the controller switch; *O* is the rheostat indicator; *P* is the air compressor switch; *Q* is the starting rheostat, and *R* the hand brake wheel.

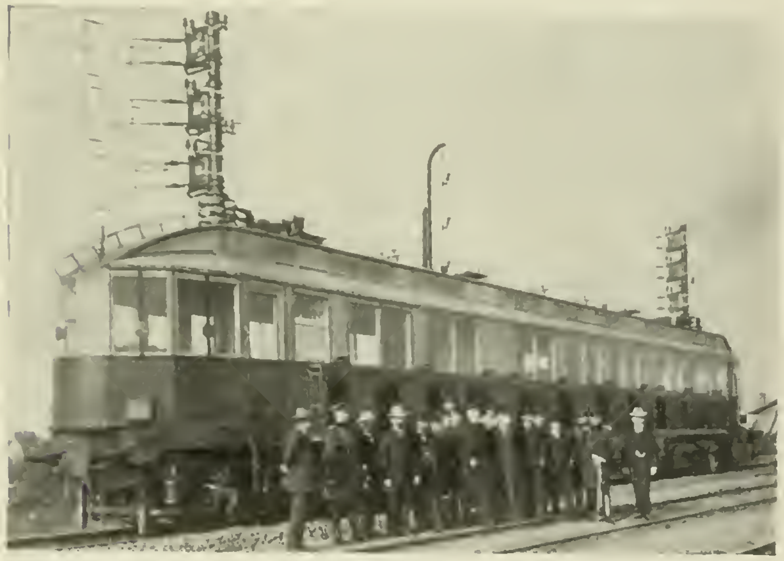

FIG. 1.—CAR AND THOSE CONDUCTING TESTS.

To enable all readings to be made simultaneously a clock was used which rang a bell twice every 10 seconds, the instruments being read immediately after the second ringing. The speed was measured in several ways. One of the methods included the use of a precision voltmeter which indicated the voltage of a small direct-current generator coupled to a car axle and also had a scale divided into kilometer-hours. Besides a number of mechanical speed indicators, the Siemens-Halske Company used a graphic recording instrument, which made three different records. Each pencil was operated by an electromagnet and the recording paper strip by clockwork. One of the pencils punched a hole along one part of the strip every second, the second pencil was actuated by a current flowing through a battery and the free middle axle of one of the trucks, one perforation being made for every revolution of the axle, the third pencil perforated the paper every time a kilometer mark was passed, this being accomplished electrically by having a small contact brush strike iron projections placed near the track and spaced one kilometer apart.

To determine the air pressure several openings were made in the walls of each car, each opening being connected with a U-shaped glass tube partly filled with water and graduated to millimeters. The pressure was, therefore, measured by noting the change in the height of the water columns in the branches of each tube.

The acceleration was determined according to the method suggested by Kapp. A vertical glass tube was placed at each motorman's stand, both tubes being connected by a pipe running through the car floor parallel to the rails. The tubes were filled to a certain height with colored water. When the car started the liquid in the front tube began to fall while that in the rear tube rose. The acceleration was determined by measuring the distance between the tubes and the difference in height of the water columns.

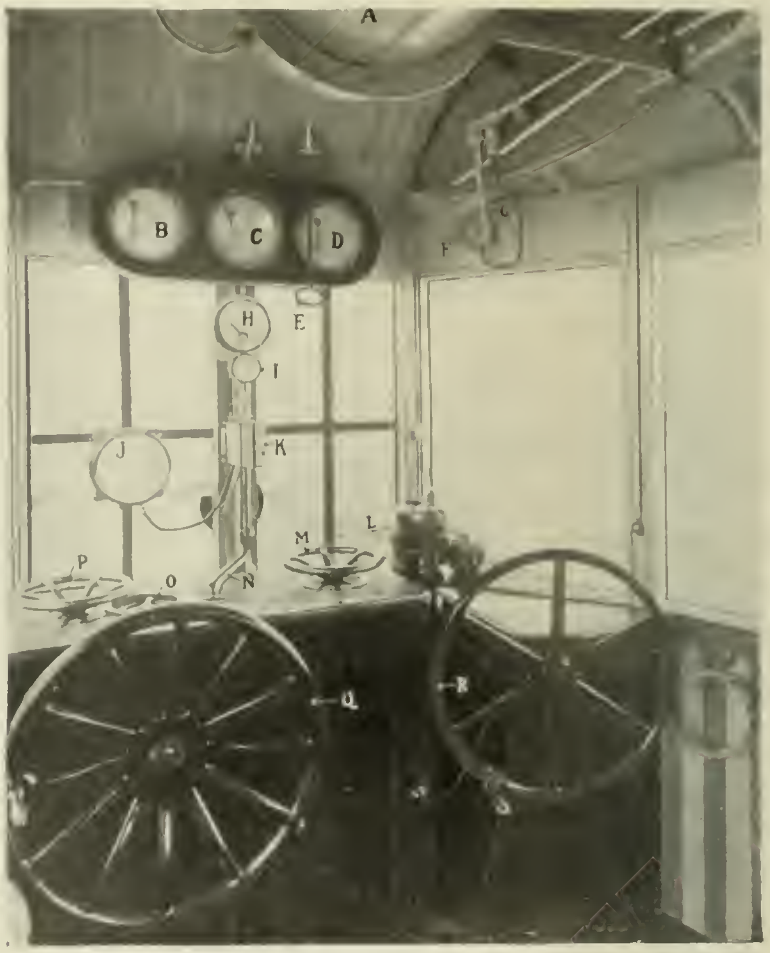

FIG. 2.—INTERIOR OF MOTORMAN'S CAB.

Another interesting device used was an automatic brake pressure regulator, combined with a speed indicator, which served to keep the brake pressure proportional to the retardation desired. Several instruments were also used for measuring the torque of the motors and the swaying of the car.

◆

Chicago Municipal Lighting.

Mayor Carter Harrison, of Chicago, has recently declared that the city of Chicago will enter the electric lighting field at once in competition with the gas and electric companies. The attempt to enter the field by selling to corporations and private individuals electric current made in the municipal plants, it is expected, will result in an appeal to the courts by the big lighting corporations. This, Mayor Harrison declares, is what the city would invite, as it will determine its right to deal in public necessities. "It is just as well to meet this matter at once," said Mayor Harrison. "The earlier we enter the field the earlier we will be prepared to take advantage of the development of the power at the mouth of the great drainage channel connecting the waters of Lake Michigan and the Mississippi River."

Calculation of the Apparent Inductance of Armature Coils.—IV.

By C. C. Hawkins.

By the use of the foregoing rules coupled with the pictures of e.g., Fig. 10, the total value of the sum $b + b' + \ldots$ for the pair of interpolar zones can be calculated for the different kinds of winding, specimens of results being given, Figs. 24 and 29. The process of calculating the surface-of-the-core inductance is by their aid greatly simplified, since by the alteration of the scale of abscissæ they are readily adapted to different numbers of poles and average widths of tooth and slot. Further, although the absolute degree of accuracy that can be claimed may be but small, yet since they are all reduced to a definite basis of procedure they furnish comparative figures for immediate application by the designer to the different kinds of winding, and incidentally serve to bring to light certain interesting points. As a general rule no shorter chord is considered than will give four slots, or in exceptional cases five slots, concerned per interpolar zone. The lower end of each curve indicates the smallest diameter of armature on which the particular winding should be employed when the short-circuited spool sides practically span the entire interpolar zone. If extended to still smaller armatures, the band of spool sides approaches dangerously near to the pole tips even when the angle of lead is zero.

The curves for any given number of spool sides per slot and given value of s show clearly the advantage of separating the short-circuited spool sides among a number of slots as by long and short-chord windings in contrast to diametric. As more slots are brought into action by spreading out the wires, the local flux surrounding the considered section is in many cases reduced, and the joint flux due to all the short-circuited spool sides is as it were driven further outwards towards the pole tips. At the pole tips and beyond them the variations of the flux are *ex-hypothesi* damped out, so that the inductance from the joint flux is reduced; but the advantage is gradually reduced with a given width of tooth and slot as the diameter of the armature is increased. With small armatures when the wires are spread out, the apparent inductance is very much reduced from its value for the diametric case, but with larger armatures the influence of the joint flux becomes more and more predominant, and when the area which it traverses becomes large as compared with that of the local flux the reduction for any given degree of chord is much less marked. Naturally, too, the change from long to short chord produces nothing like the same proportionate reduction as the change from diametric to long chord.

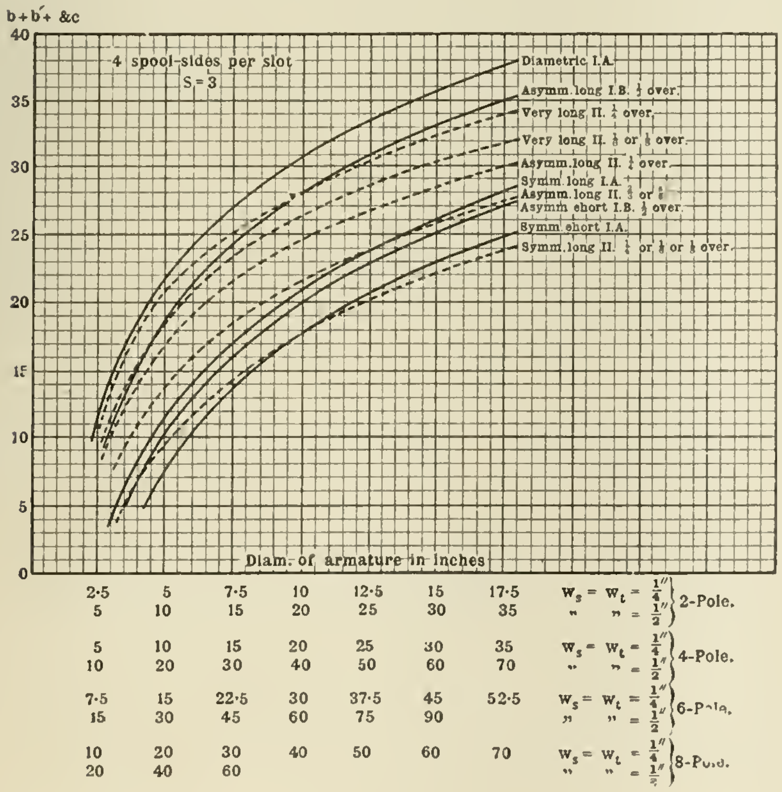

FIG. 24.

The general tendency of the fractional cases is also well shown by the dotted curves as compared with the full-line curves. Whenever with a given value for s the total number of short-circuited spool sides in a pair of interpolar zones is reduced by one or two, as compared with the number for whole values of $\frac{N_2}{2p}$, then for the windings which are most closely analogous the fractional curves bend over and become flatter. This is simply due to the fact that the local flux remains more or less the same, but the joint flux is positively reduced, and this has the preponderating effect in armatures of large diameter. It should be noticed that with fractional windings and taking only a pair of interpolar zones, there may be $2s$ or $(2s - 1)$ short-circuited spool sides in a zone, and that it is by no means necessary for the number to be alike in the adjacent pair of zones. But it will also be seen that when the number of spool sides per slot is large and s is also large, the divergence of the fractional from the analogous whole cases becomes less and less, since obviously the addition or subtraction of two spool sides from a comparatively large number has no great effect. Practically, therefore, so far as $L + \Sigma M$ is concerned, when s is fairly large there is but little difference between fractional or whole windings, and any advantage that may be claimed for the former must be based solely on considerations of Ls, which has yet to be discussed.

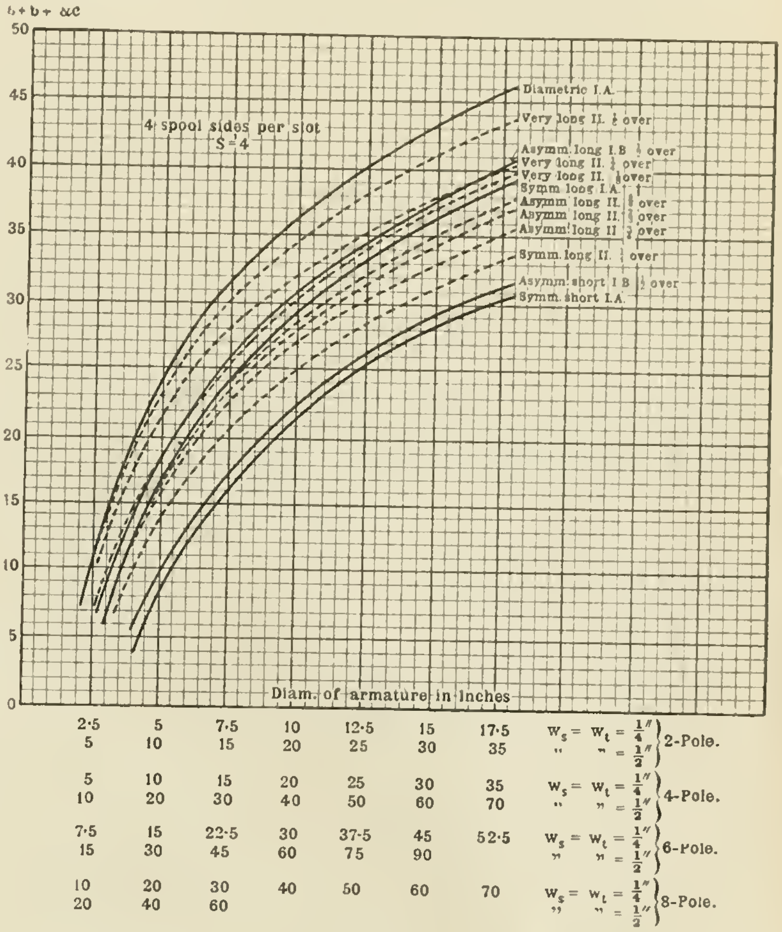

FIG. 25.

If for the same number of spool sides per slot and for the same class of winding, the curves for different values of s are plotted together, as in Fig. 30, it will be seen that as the band of short-circuited wires increases with increasing values of s, the rise of the surface-of-the-core inductance is never in proportion to the increase of s when once $s > \frac{kn}{2}$, but is more nearly so on large armatures, where the joint flux plays the most important part. As the adjacent slots become more balanced, the local flux decreases, and the rise is but slight, if the armature be of small diameter. Thus the curves cross one another higher and higher up as the influence of the joint flux reasserts itself on armatures of large diameter.

7. *Calculation of inductance of end connections.*

The self and mutual inductance of the end connections can be calculated after the method employed by Prof. Arnold.§ If s sections are simultaneously short-circuited at one brush, their end connections run side by side; let ds = the diameter of a circle whose

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§ Die Gleichstrommaschine, vol. i, p. 332.

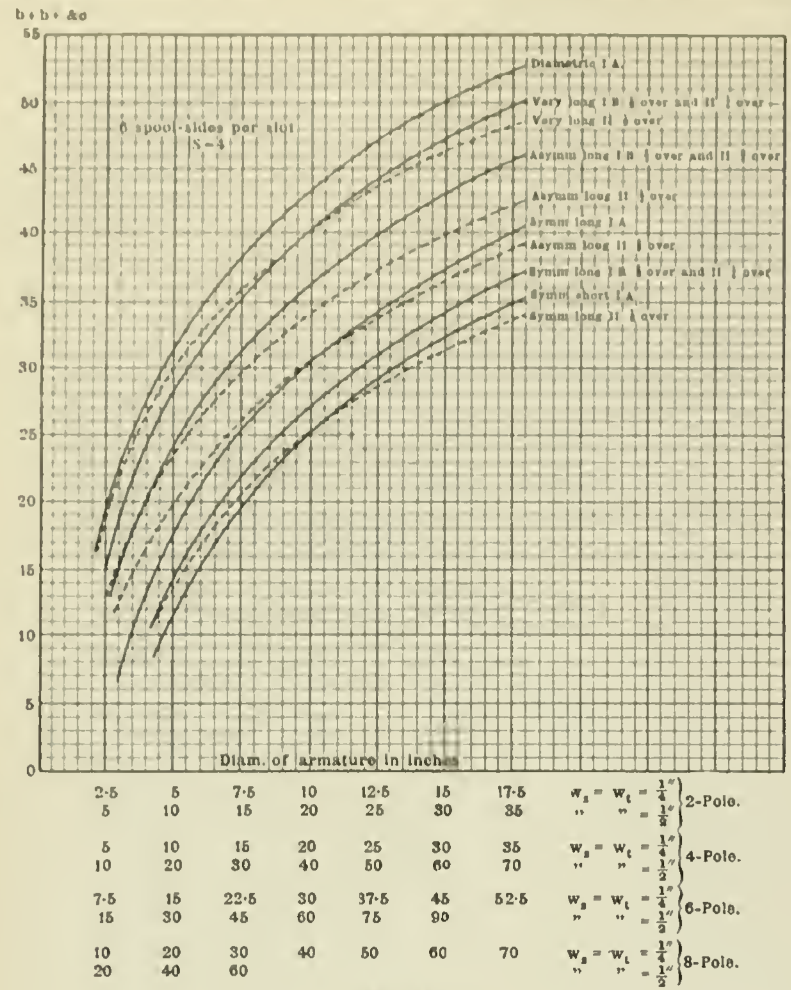


FIG. 26.

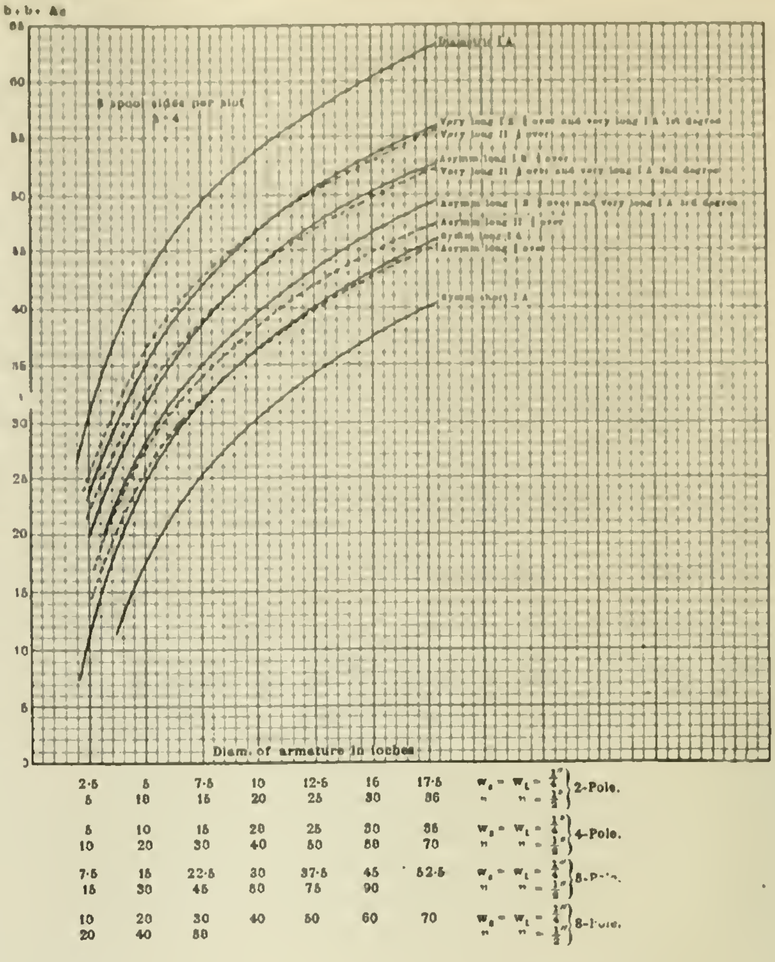


FIG. 28.

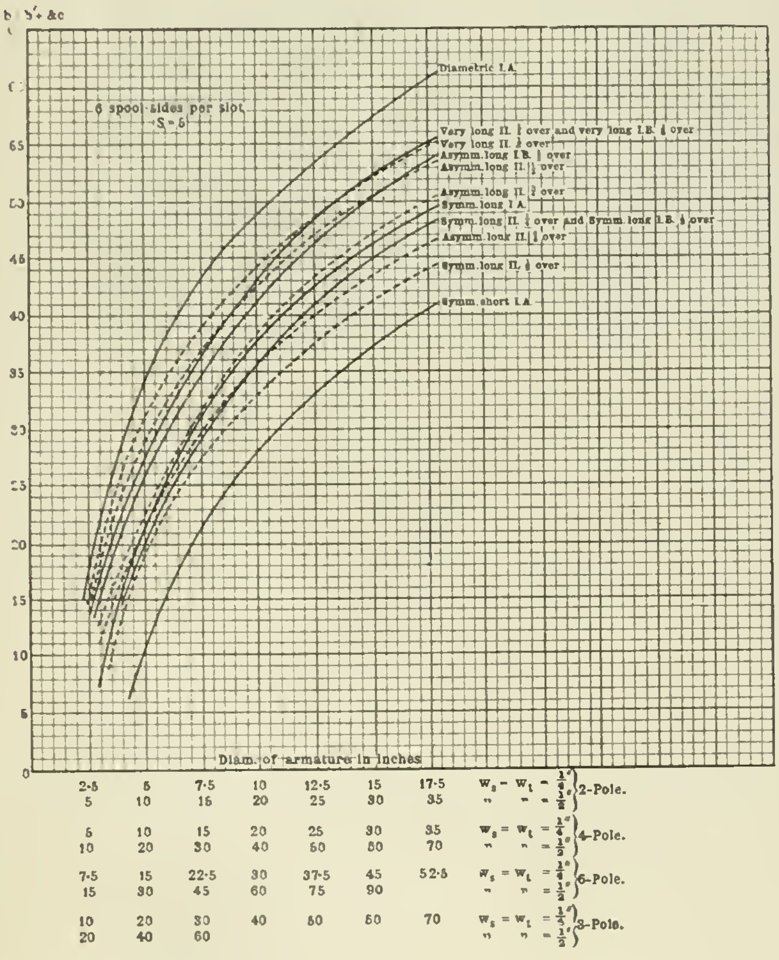


FIG. 27.

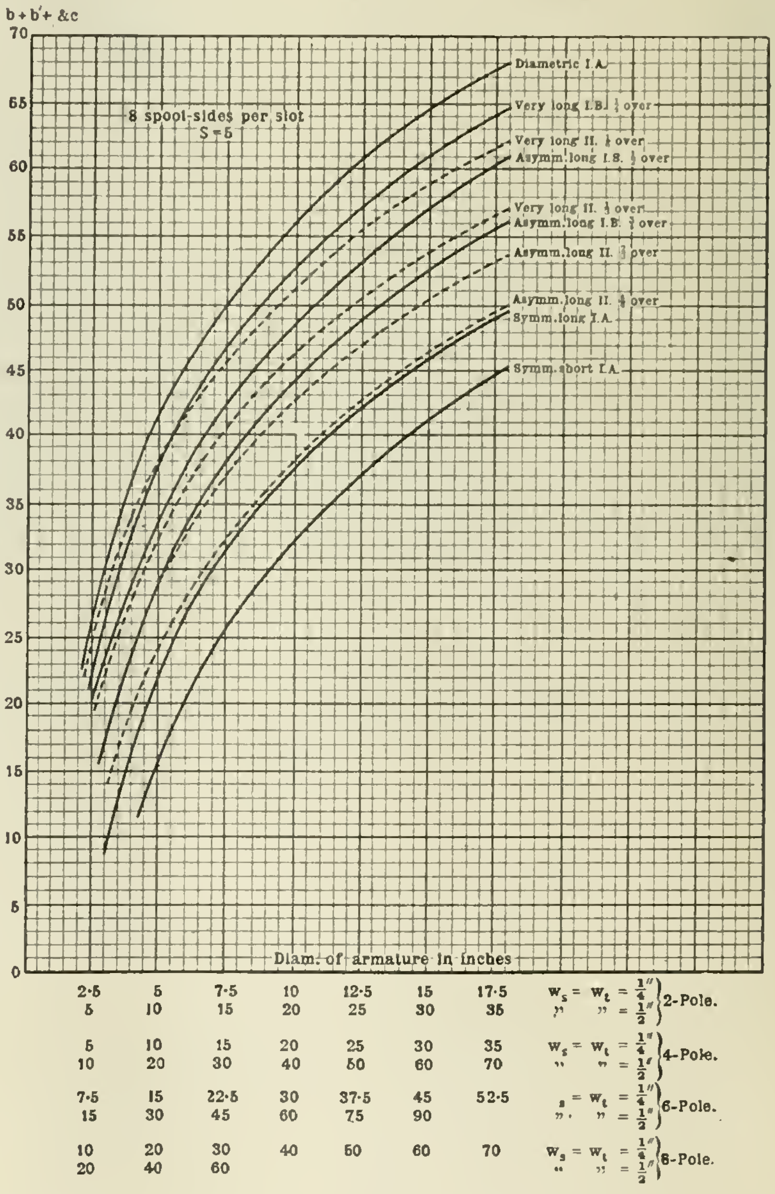


FIG. 29.

CALCULATION OF THE APPARENT INDUCTANCE OF ARMATURE COILS.

periphery is equal to that of the group of s spool ends, inclusive of insulation and any air-gaps which there may be between them, as in Fig. 31, where the periphery of the dotted circle is equal to the periphery of the rectangular packet of three spool ends, each containing four wires. The two V-shaped sets of end connections, one at either end of a barrel-wound drum armature and each of length l' cm., may be replaced by an equivalent circle of radius, $r = \frac{l'}{\pi}$ (Fig. 32). The permeance of a circle of air round the end connections of width $d\,x$ (Fig. 33) is $\frac{l'\,d\,x}{2\pi\,x} \times 2$, and this is acted on by a m.m.f. of $4\pi\,w\,s$, where w is the number of wires in one spool side. An element of the inductance is, therefore, $d\,L = \frac{4\pi\,w^2\,s\,l'\,d\,x}{\pi x}$ and the integral of $\frac{d\,x}{x}$ between the limits of the radius, r, of the complete circle and the radius $\frac{ds}{2}$ of the small equivalent circle, or

$$\int_{d\,s/_2}^{l'/\pi} \frac{d\,x}{x} = log\,\frac{l'}{\pi} - log_e\,\frac{ds}{2}$$

Since $w = \frac{\tau}{2N_2}$, the coefficient for insertion in our chief equation is

$$c = (2.3\,log\,\frac{l'}{ds} - 0.45) \times s.$$

8. *The wave-wound armature.*

While in the above the lap-wound armature has been alone considered, the curves being only immediately applicable to wave-wound machines if the armature be two-pole, yet the series-connected wave-wound armature in multipolar fields must also be treated. Here the various interpolar zones are dissimilar to one another, either all or part of them, and, taking first the case when only two sets of brushes are employed, a first approximation will consist in finding the pair of interpolar zones which give the maximum inductance and expressing the total inductance as a certain percentage of this value when multiplied by p. For this percentage the average value is about 90 per cent., but the validity or otherwise of such a figure deserves further examination.

The inductance of the end connections is p times that of a single section when there is only one inductor in each spool side, and is but very slightly less when there are a large number of inductors forming a common spool which is afterwards joined up to the next section by a single connecting wire. On the other hand, the inductance from the slots and from the surface of the core is appreciably reduced below the value of p times the value for a single pair of zones. No one ratio holds even over a small range of cases with great strictness, owing to the divergence in different machines of the relative values for the slot and surface inductances. But apart from this, certain further remarks may be added with special reference to the inductance from the surface of the core. For a given value of s and a fixed number of poles, the percentage is always less in the case of a small armature than in a large armature, since the spreading out of the spool sides has proportionately less effect as the value from the joint flux beyond the limits of the short-circuited wires assumes a preponderating influence. Next as the value of s is increased, the percentage rises since the distribution in the several zones becomes more nearly similar, the presence or absence of certain spool sides having less effect when the total number is large. There is, therefore, no fixed value of the percentage that can be regarded as generally applicable, and it is better to work out once and for all curves for the several cases analogous to Figs. 24 and 29 rather than to rely upon any average results.

When, as many sets of brushes as there are poles are employed, it should be observed that the time during which a section is undergoing short-circuit either at one brush or between two brushes of the same sign is increased. It is best, therefore, to consider a single section between two adjacent brushes of the same sign and when in the position of maximum inductance, and then to take the entire time during which it is undergoing short-circuit, partly as a portion of a zig-zag winding round the whole armature and partly as a single section short-circuited by adjacent brushes of the same sign. If T be the time of short-circuit as ordinarily reckoned from the width of a brush, the general formula for the real time of short-circuit is $T\left(1 + \frac{x}{y}\right)$, where x is the fraction of a sector which results from $\frac{N_2}{p}$, and y is the width of a brush expressed in terms of the width of a sector. Thus with four poles and an armature with every slot equally filled, $\frac{N_2}{p}$ always leaves a remainder $\frac{1}{2} = x$, and if the brush width is equal to the width of one sector, $y = 1$, so that $T' = 1\frac{1}{2}\,T$; but if the brush width is equal to twice the width of a sector, $T' = 1\frac{1}{4}\,T$. With six poles and four spool sides per slot, $\frac{N_2}{p}$ may leave as a remainder either $\frac{1}{3}$ or $\frac{2}{3}$, so that the increased times for the same widths of brush as above are $1\frac{1}{3}\,T$ and $1\frac{2}{3}\,T$ for the narrow brush, or $1\frac{1}{6}\,T$ and $1\frac{1}{3}\,T$ for the wide brush. In every case when the number s is great, so that y is great, the increase of the time is but small; e. g., if $s = 5$, and the brush has a width of $4\frac{1}{2}$ sectors, the increase in the four-pole machine is only some 10 per cent.

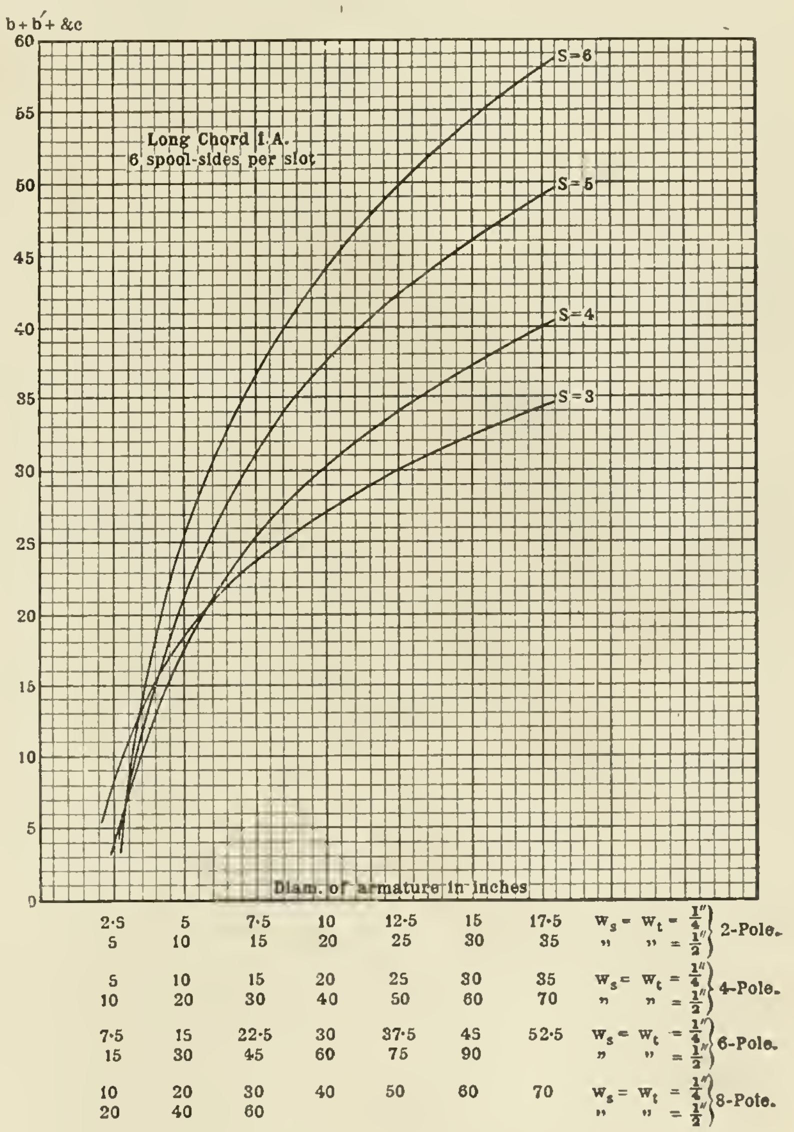


FIG. 30.

9. *Use of* $L + \Sigma\,M$ *in practice.*

The practical use of the foregoing calculations may now be summarized by saying that when the value of $\frac{2J\,(L + \Sigma\,M)}{T}$ is thence deduced, it has been found by the writer to give a very sound indication of the relative merits of different machines from the point of view of sparkless running. When the number of turns per spool, lengths of core, widths of slot and tooth and lengths of end connections, etc., are widely varied as between two machines, it is, in fact, impossible by inspection, to estimate their relative inductive voltages unless the data are submitted to definite mathematical calculation. The dimensions of the quantity $\frac{2J(L + \Sigma M)}{T}$ are those of a voltage, and it is evidently the average rate of change of the self and mutually induced volts on the supposition of a straight line of current; it is analogous to a reactance voltage, but is preferable thereto as being entirely free from any supposition of a sine wave of change which is confessedly never met with in the practical dynamo. As a maximum permissible limit for satisfactory running, the writer would give the relation $\frac{2J(L + \Sigma M)}{T} \overset{<}{=} 1.75$, while for complete sparklessness with a fixed position of the brushes from zero to full load, $\frac{2J(L + \Sigma M)}{T} \overset{<}{=} 1$. Any such statement requires, however, to be checked by a second condition, viz.: that there must not be too great a difference between the densities of the field in which the short-circuited sections find themselves at no load and full load respectively; in other words, there must at full load be either a negative reversing field, or at least a reasonably weak positive field. In short, there must not be too much distortion of the field by the cross ampere-turns of the armature, and the second condition must take the form of a limiting ratio between the ampere-turns required by the air-gap and teeth and the ampere-wires of the armature under a pole. In conjunction, then, with the limiting ratios given above for the inductive voltage, the ampere-turns expended over the double air-gap and teeth should not be less than 1¼ times the ampere-wires under a pole, or 1½ times for a fixed brush position; in fact, as the inductive voltage approaches the lower or higher limit, the ratio may be lowered or must be raised to suit the degree of stringency in the terms of the specification or in the nature of the work.

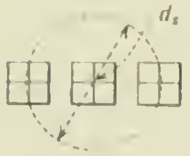


FIG. 31.

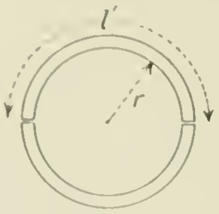


FIG. 32.

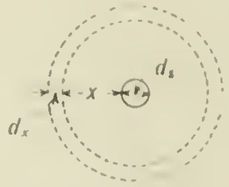


FIG. 33.

Data as to Independent Telephonic Growth.

An attempt is being made, as already noted in these pages, by the Queen City Telephone Company, of Cincinnati, to obtain a franchise in that city, and a hearing on the subject was had recently before the council committee on telephones and telegraphs, at which a number of independent telephone leaders appeared and made statements. Mr. James B. Hoge, general manager of the Federal Telephone Company, of Cleveland, said: "In Cleveland, when the independent franchise was granted, the Bell people were operating something like 3,000 telephones, and to-day there are between 20,000 and 25,000 telephones working in Cleveland. In Columbus when the franchise was granted, they had something in the neighborhood of 1,700 telephones. Now that same ratio will hold good in any number of other cities where the independent people have plants in operation, while the Bell Telephone Company from 1878 to 1894 without competition were able to put in use but 243,432 telephones in the whole country. During the next seven years with competition they increased that number to 1,020,647; this from 1895 to 1901, the independents having in operation 1,500,000 in 1901 and in excess of 2,000,000 now."

Mr. Maxime Reber, general manager of the United States Long-Distance Company, of Cleveland, said: "We operate very largely in the State of Ohio. There is hardly an independent telephone exchange in the State of Ohio which has not access to our lines. We have lines that reach up into Michigan, Indiana and connect with the lines of other long distance companies at those points. We have lines that reach into Pennsylvania and make connections there with Pittsburg; we have lines that reach from the northwestern part of Pennsylvania, there making connections with the companies that are furnishing long-distance service out of Buffalo clear across the State of New York to Albany. While the independent development is of very recent date, and that of the long-distance service has been subsequent to the exchange development, yet to-day there is a very comprehensive system of long-distance lines connecting several independent exchanges in the country from which excellent service is furnished. In our own company we have something over 2,050 miles of pole lines on which are strung about 20,000 miles of wires."

Mr. E. A. Frazee, president of the Home Telephone Company, of Connersville, Ind., said: "I began business in 1895 with 120 subscribers. Prior to that time the Bell company had 52 telephones and they now have 150 subscribers. We have 600 subscribers in Connersville. Wherever a telephone has an influence on trade certain lines of business have almost entirely changed from Cincinnati to Indianapolis. The grocer formerly ordered his goods entirely from Cincinnati; now it is almost entirely from Indianapolis. The hogs and live stock that formerly came to Cincinnati now almost all go to Indianapolis almost wholly on account of the telephone facilities.

"There was a wholesale traveling man in my office telephoning orders. He said he did only 5 per cent. of his business over the Bell, and did not use the Bell at all, only when he could not get the independent. That may seem strange, but the Bell rates are high; it costs to talk to Cincinnati 45 cents for three minutes, and 15 cents additional for every minute over that time; to Indianapolis, 30 cents for five minutes, 6 cents a minute. Now, in addition to that, the wholesale men buy tickets in advance; and Mr. Sherrin, who is president of the New Company, informs me that they give a discount, when they buy $100 worth, of 25 per cent., so that it cuts this down one-fourth, and half of these wholesale men reverse all the messages; my reversed telephone messages are a good part of the business; when the traveling men talk and messages are reversed, it does not cost the traveling man a cent to inquire of his firm in Indianapolis the price of hogs to-day or anything in reference to the market. The message is always reversed."

The following is a selection from the remarks of the Hon. S. P. Sherrin, president of the New Telephone Company, of Indianapolis: "At the beginning of the independent movement, which was in 1895, we had in Indiana all told 6,000 telephones; we had in the city of Indianapolis 1,700 telephones. We now have of independent telephones alone in the whole State of Indiana, 107,000; that is not a guess, gentlemen, it is an actual count; we have 107,000 telephones (independent) in Indiana. In the city of Indianapolis we have 7,725 on our list. The independent busiess was a spontaneous growth. When the Bell patents expired, the people who had been hungry and doing everything they could without telephones for 18 or 19 years, just simply arose in their might and got telephones. We have in the State of Indiana $8,000,000 invested in independent telephones, and of that $8,000,000 there is not 3 per cent. of it outside of the State.

"Now, before the beginning of the independent telephone movement there was in the State of Indiana not a single farmer who had a telephone, not one; now 25,000 are in the houses of farmers. The great benefit to the State of Indiana obtained in the independent development as outlined by Mayor Bookwalter is that these people cannot only reach Indianapolis, but they can be reached. The business of the stock yards has quadrupled since the independent telephone service began at Indianapolis. There is not a man who has a hog to sell in Indiana who has not a telephone. The same thing with the stock of all kinds, and the stock yards people in Indianapolis are in communication with not less than 107,000 telephones. At our office we frequently have a broker send out as many as thirty-five messages at one time. In the morning the stock yards man will call up and say, 'I want Mr. So-and-So at ——' and give the entire list all the way down to thirty-five and goes on about his business. Then our chief operator takes the list and distributes the names to several operators and the man is called, and within an hour he has transacted the business, with men 30, 40, 50 and 75 miles away."

Telephone Transmitters.—I.

By Arthur V. Abbott, C. E.

The magneto telephone is a reversible device and can act either as transmitter or as a receiver; so Prof. Bell's invention solved the problem of the electrical transmission of speech by providing an instrument that could be used interchangeably at each end of the line. In earliest telephone installations only a magneto was provided, which was alternately a transmitter and a receiver, but it needed only a brief experience to demonstrate that while the Bell instrument was so efficient a receiver that the models of to-day show but little change, it was eminently unsatisfactory as a transmitter, for when the magneto telephone is used for transmission it is only possible to converse over very short lines, and even under the most favorable conditions one must so shout as to make the use of the telephone a burden to the speaker, and an annoyance to the listener. But the electrical transmission of speech even in the somewhat uncertain fashion of the earliest instruments, was so stupendous an achievement that every inventor was aroused to an effort to improve, each seeking to use some different electrical principle, either to produce a better instrument or to evade earlier invention.

Every transmitter so far invented operates upon one of the following three principles: *First, electro-magnetic induction; second, electrostatic induction; third, microphonic contact.*

Electro-Magnetic Transmitters.—Naturally first endeavors were efforts at the improvement of the magneto telephone, and it presently appeared under a thousand different guises: Magnets were bent and contorted into numerous curious and grotesque forms, instruments equipped with several diaphragms appeared, and all the possible combinations of the various parts of the receiver were unearthed and tried, until inventors weary of further quest decided that it was necessary to seek in some other direction for an improved transmitter, and the magneto instrument was relegated to the office of the receiver. Nevertheless, for a full survey of the subject, a consideration of the principles of the magneto as a transmitter must not be overlooked, for the operation of that instrument is not quite so simple as at first sight appears, and experts are not unanimous in the explanations offered. Some are disposed to credit the ability to excite electrical waves to a molecular motion of the particles of the iron core under the magnetic changes produced by the movement of the diaphragm. Doubtless this action exists, but it appears insufficient to account for the results produced.

It has been believed that there is some sort of reaction between the spirals composing the field coils—perhaps partly due to an electrostatic action, and partly to an electromagnetic one. But this assumption seems also inadequate. It is certain that the motion of the diaphragm does cause marked changes in the magnetic circuit, which seem to be sufficient to explain upon the basis of electromagnetic induction the operation of the instrument as a transmitter, and on the whole the balance of opinion favors this explanation, though it is probable that all three actions are operative.

If it be true that the ability of the magneto instrument, when acting as a receiver, to initiate sound waves depends upon a varying magnetic field produced by electric currents over the line, the greater the changes in line current the louder the receiver will talk. Hence, the object of the transmitter should be to produce the greatest possible variation in such currents. When the magneto instrument is used as a transmitter, its ability to create pulsations in the line depends upon the amount of motion which its diaphragm can make under the impulse of the sound waves which it receives, and its limitations under such circumstances are very obvious.

When one speaks into any transmitter, only a small percentage of the energy of the sound waves reaches the diaphragm. Owing to rigidity, molecular friction, losses in the magnetic field and the conducting system, the little energy that affects the diaphragm is still further reduced, so that it has been estimated that at the receiving end only two or three-tenths of one per cent. of the energy expended at the transmitting end reappears as sound. Naturally the first attempts at improvement were concentrated upon the diaphragm in an endeavor to obtain a greater excursion; but in this direction the limitations were soon reached, for while it is easy to secure a greater volume of sound, distinctness of articulation is almost at once sacrificed by the confusion which arises from the splitting up of the diaphragm into parts which vibrate independently of each other. So to secure crispness and distinctness the diaphragm must be thin, and vibrate through a small space, considerations which obviously preclude a magneto instrument from developing powerful impulses in the line.

Electrostatic Transmitters.—One of the earliest attempts to improve the transmitter was an effort to utilize electrostatic induction instead of electromagnetic. A telephone operating upon this principle was brought out by Mr. Edison in 1877. Fig. 1 shows the general method adopted. In the model, *A*, a resonant chamber, *V*, having a mouthpiece, was provided around the circumference of which a number of plates, *P*, were placed, which were connected through a battery to the line. Just inside of this row of plates a second set was placed, which were free to vibrate under the sound waves. As the plates moved to and fro they increased and diminished the space intervening and thus varied electrostatic capacity. A more practical model is shown at *B*, in which there are a number of metal plates free to move, separated by insulating material. One set of plates is connected to one side of the line and the other set to the other side. Speaking against the front plate of the system sets up a vibratory motion between all the plates, thus varying electrostatic capacity. Instruments of this kind are found to give exceedingly excellent articulation, and will act both as transmitter and receiver; but like the magneto instrument, they are very deficient in power and can only be used on the shortest lines and under the most favorable circumstances.

Microphonic Contact Transmitters.—The next step was to provide some exterior source of electricity which should be entirely independent of the motion of the diaphragm, capable of delivering to the line any desired volume of current, and then to arrange the vibrating system to be merely a regulator, or valve to control the amount of current, so that it shall be proportional to the acoustic waves. A somewhat similar example is that of a gun. The energy that propels the ball resides in the charge of explosive, and a very feeble pressure upon a properly-arranged trigger is sufficient to release an enormous amount of energy. It was hoped that by providing a battery to supply the electrical energy, a vibrating mechanism could be invented that should control this current in accordance with the sound waves. In other words, the transmitter ought to be a valve operated by the sound impulses which should allow more or less current to flow. In a rough way an ordinary Morse key operates upon this plan, for under the touch of the fingers it injects into the line squirts of electricity from the battery, whose relative duration and frequency form the telegraphic alphabet.

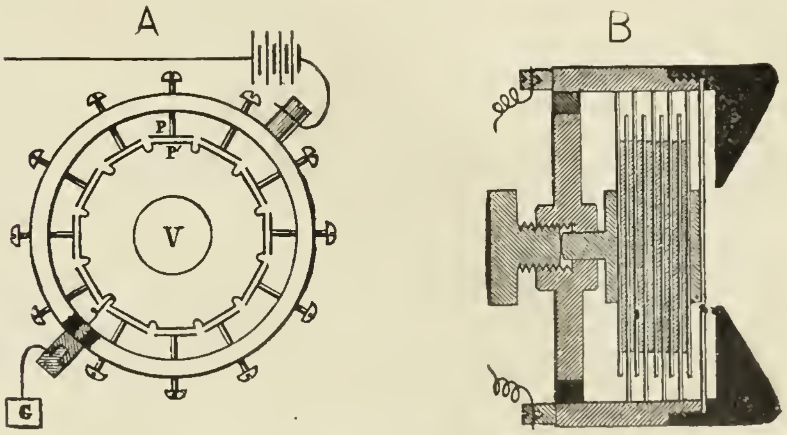


FIG. 1.—CONDENSER TRANSMITTER.

It was upon this plan that the old Reis telephone was built, which consisted of a battery and a diaphragm that carried a platinum contact which opened and closed the circuit with every sound wave, but for the successful transmission of speech something infinitely finer and more delicate was necessary. In the Reis telephone the surface of the bearings were made of polished platinum and all possible pains taken to obviate the resistance, which even at that time was well known to exist in a circuit containing an imperfect contact. Therefore, when the contact pieces touched each other there was essentially no resistance in the circuit, save that of the metallic conductors, and if the contact pieces were separated by ever so small an amount the resistance of the circuit was almost infinite. It was a dead open-and-shut affair, with no possibility of any intermediate condition that could render the gradations necessary to articulate speech, so this apparatus was only a slightly refined reproduction of the Morse key, capable of sending little else than dots and dashes.

For several years prior to the appearance of the Bell telephone it had been known that an imperfect contact introduced great resistance into an electrical circuit, and that this resistance would vary widely with the pressure applied to the surfaces. But all inventors had ignored the possibility of utilizing this fact in the construction of an electro-acoustic valve that would produce a more powerful transmitter. In 1877 Mr. Edison produced a transmitter whose operation he explained upon the theory of varying pressure applied to a bit of carbon. This transmitter is shown in Fig. 2. *A B* is the diaphragm against which the sound waves impinge, in the center of which is a button, *C*, which presses against an electrode, *D*, which is in contact with a thin circular cake, *E*, made of compressed lampblack. This rests against a metal button that forms the other electrode. Over transmitters utilizing either electromagnetic or electrostatic induction this instrument was a vast improvement, and it probably operated on the principles now included in all carbon transmitters.

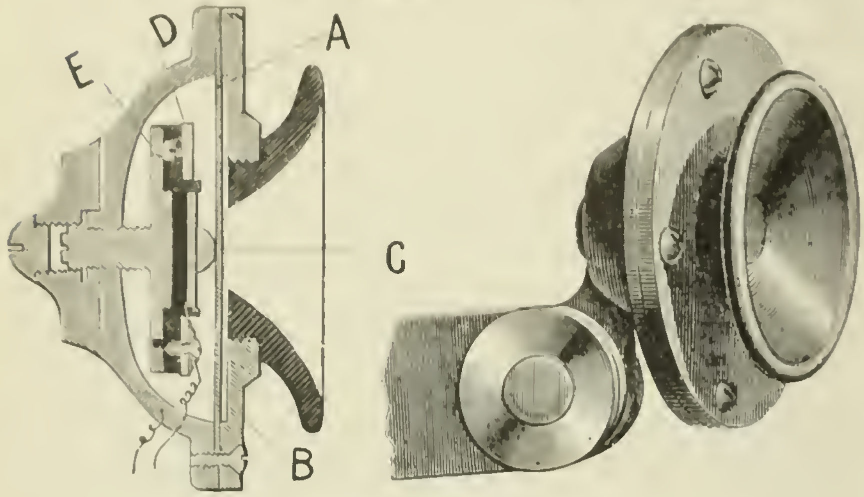


FIG. 2.—EDISON CARBON TRANSMITTER.

Mr. Edison is reported as explaining the operation of this transmitter by assuming that the specific resistance of the carbon button varied very greatly under pressure, and that the slight changes in pressure, due to the motion of the diaphragm, were sufficient to account for the improvement in the volume of transmission. Experiments have since shown that with any pressure up to the actual crushing point of carbon there is too little change in its resistance to make this theory a satisfactory one. About the same time, Mr. Berliner, while practising with the Morse key, discovered that the resistance of an imperfect contact could be greatly varied by a slight change in the pressure applied thereto, and, on April 4, 1877, filed a caveat in the American Patent Office covering this principle. About a year subsequently Prof. Hughes published a description of an instrument which he termed the microphone, on account of its apparent ability to greatly increase the loudness of faint sound.

There seems little reason to doubt at all that both Berliner and Edison were the earliest *constructors* of microphonic transmitters; but, either owing to the reticence imposed by patent law, or by a failure to fully comprehend the extent of the discoveries embraced in their models, these inventors failed to describe their inventions in so clear a manner as to reserve to themselves the full credit thereof. Prof. Hughes sought no patents and certainly was the first one to fully and clearly *describe* the action of the microphonic contact.

A microphone built upon the Hughes plan is illustrated in Fig. 3, from which it is seen that the foundation of the instrument consists of a box which acts as a resonant chamber. In the illustration a cigar box is used to show how easily such an instrument can be made. Upon the box a small piece of carbon is placed upon which a lead pencil or any piece of carbon rod stands, the upper portion of which leans lightly against another carbon block. A dry cell and a receiver are placed in circuit with the carbon pencil; if, under these circumstances a faint sound wave impinges upon the box, the receiver will emit a greatly intensified reproduction, and by adjusting the carbon rod so that a very poor contact is made with the carbon blocks, the instrument can be made almost incredibly sensitive. The ticking of a watch placed upon the sound board reappears as the roar of a boiler shop. The footsteps of a fly become the tramp of an army, and if carefully adjusted the microphone talks astonishingly as compared with the transmitters of twenty-five years ago.

In describing the operation of the microphone, Prof. Hughes recognized that an imperfect contact, which had so long been the *bete noir* of the electrician was responsible. He assumed that in the case of an imperfect contact a great resistance was introduced into the circuit, but that a very slight change in pressure was able to vastly change such resistance, with a corresponding increase or decrease in the current. For telephonic purposes the very thing which electricians had striven to avoid was the one solution of the problem. Prof. Hughes showed that the material of which the microphone was constructed mattered little, and that almost any substance would be operative provided the contact between its surfaces was poor. As shown in Fig. 4, it is feasible to construct an excellent microphone out of three screws, one of which is laid across the other two, and it matters little whether they are iron or brass, only the older, dirtier and more rusty, the better. The operation of the microphone is explained as follows: Under normal conditions the carbon rod stands loosely upon the lower block, and leans very lightly against the upper one. There are, therefore, two places of contact between which the pressure is exceedingly small. Consequently, the resistance of the circuit at these points is large and but little current will pass. Suppose a sound wave impinges upon the apparatus, throwing all of its parts into vibration. Owing to inertia, the carbon rod and the blocks do not move mathematically together. Consequently, the pressure between the contact surface varies with every sonorous intonation, increasing and decreasing as the wave ebbs and flows and exactly in proportion thereto. Now, while the actual change in pressure between the surfaces is exceedingly small, even when measured in a fraction of a grain; yet the fact remains that an almost inconceivably minute change in pressure can produce a relatively very great change in the electrical resistance of a bad contact. Therefore, a small sound wave may produce a great variation in the current traversing the receiver, and so excite in its diaphragm vibrations of great amplitude, with a production of correspondingly loud sounds. The microphone does *not magnify* sound in the same sense in which the microscope enlarges the object at which one gazes, for the receiver only repeats the *energy changes* in the current in the circuit, and these energy changes may, or may not, faithfully repeat the sound waves that originated them. The fact that under the very best conditions speech reproduction is markedly imperfect is conclusive evidence that microphonic reproduction is by no means infallible. While it is certain that the success attending the employment of the microphone as a speech transmitter is due to the changes in contact resistance, we are quite in the dark as to how a slight change in pressure is able to effect such a marked change in resistance. There are four theories, none of which is entirely satisfactory, and it is probable that all play a part.

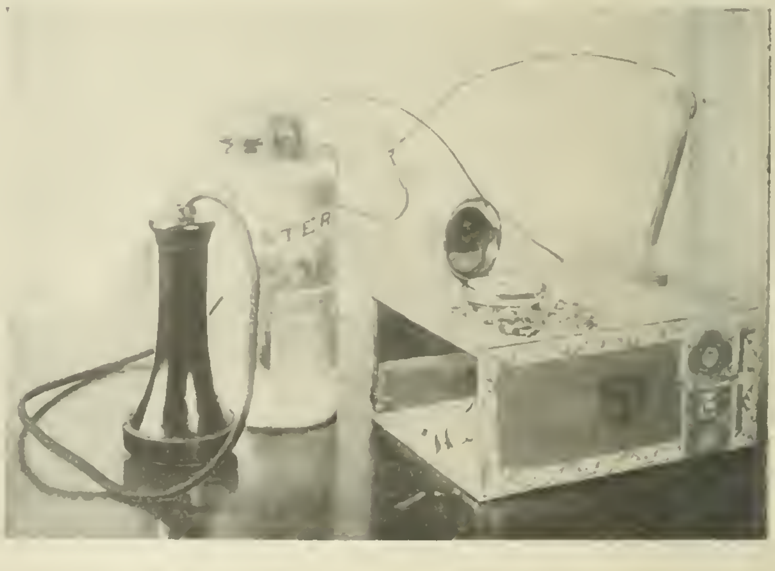


FIG. 3.—ILLUSTRATION OF HUGHES MICROPHONE.

First, there is the theory originally advanced by Mr. Edison that a change in pressure effects an actual change in the specific resistance of the material employed. This theory has probably the least support.

Second, it is believed that upon the surface of bodies resembling carbon, air and other gases exist in a peculiar state of condensation about which very little is known, and that very slight variations in pressure affect both the thickness and the state of condensation of the gas envelope that encloses every particle. It is supposed that this variation may be sufficient to account for the changes in resistance. Mr. Berliner has recently advocated this explanation.*

Third, according to the atomic theory, it is supposed that even in the densest solid the ultimate molecules are not in contact, but are separated by spaces which, in proportion to molecular sizes, are very great, and that the cohesive attraction to which the strength of all bodies is attributed is not due to actual contact between the particles, but merely to the fact that many of them have come within each other's sphere of attraction. In the case of a bad contact it is imagined that only a few molecules of one body are close enough to those of the other to be within this sphere. So it is quite conceivable that a very slight increase in pressure might result in squeezing an enormously greater number of molecules within each other's orbit. On the whole, this theory seems to be the most probable, and has the greatest number of adherents.

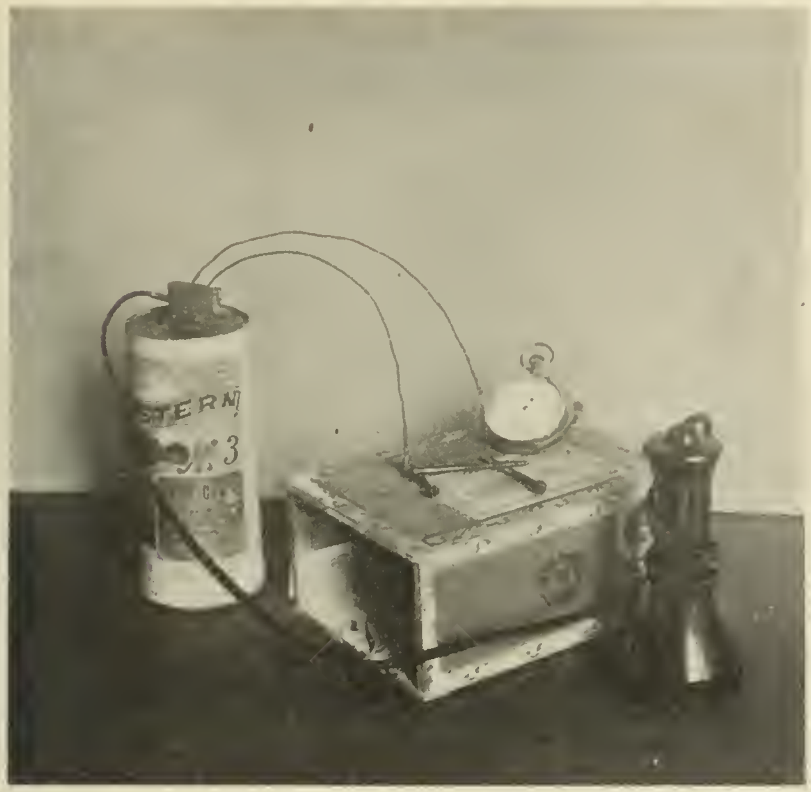


FIG. 4.—ANOTHER FORM OF HUGHES MICROPHONE.

Fourth, it is imagined that between the carbon particles slight arcs may form, and that as the resistance of carbon varies very rapidly with changes in its temperature a slight current may warm the carbon sufficiently to lower its resistance markedly. This would cause a still greater current to flow, with further heating, so that the carbon would react upon itself and continually allow more and more current to pass. That arcs do form in carbon transmitters, experience amply proves, but as soon as they occur the quality of transmission almost immediately changes and the listener is at once made aware that something unusual is happening. Usually the character of transmission is unfavorably affected, so that this explanation seems inadequate.

Whether any or none of these hypotheses shall prove to be the true explanation of microphonic contact, the future only can decide, but whatever that verdict shall be, it is certain that to-day every successful commercial transmitter is a microphone in some form or other, and so a study of commercial instruments leads to a classification according to the way in which microphonic contacts are employed.

1st. The single-contact transmitter.
2nd. The series-contact transmitter.
3rd. Multiple-contact transmitter.
4th. Multiple-series transmitter, or granular instruments.

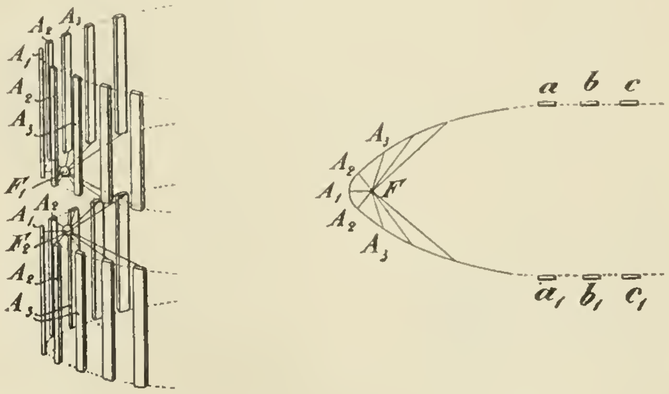
Steam Turbines for Warships.

According to a Washington dispatch a board of naval officers has submitted a report to the Navy Department strongly asserting that steam turbine engines are adapted for naval purposes. It is thought that the Navy Department will endeavor to secure an appropriation to test steam turbines in some torpedo boats. The English navy is now equipping some of its ships with turbines.

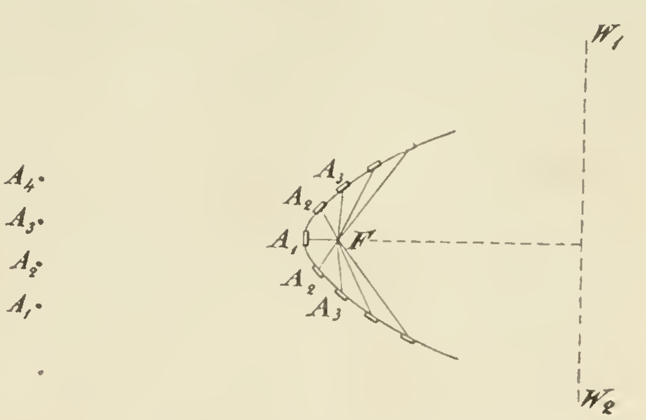
Directing Waves in Wireless Telegraphy.

An interesting patent has just been issued in this country to Mr. F. Braun, of Strassburg, Germany, on means for directing waves for use in wireless telegraphy. The application was filed in this country on February 19, 1902. The invention relates to reflectors and consists chiefly of a metallic grating of parabolic form.

Fig. 1 is a diagrammatic view illustrating the theoretical physical principle. Fig. 2 is a section of the new reflector. Fig. 3 is a perspective view, while Fig. 4 represents an improvement or modification of the reflector by means of deflectors. It is well known in optics that series of luminous lines located in one plane and parallel to each other at equal distances apart and having the same phase and amplitude of oscillation will produce what is called in optical science a "wave front," which is a plane. These lines are indicated in Fig. 1 by points A^1 A^2 A^3 A^4, which represent sections of the luminous lines making up the wave front normal to the plane of the drawings. The same effect can also be obtained by the arrangement of a parabolic mirror. If, for instance, in Fig. 2 *F* is the luminous point and A^3 A^2 A^1 A^2 A^3 are parts of a parabolical mirror of cylindrical shape, W^1 W^2 will indicate the wave front which is a plane. This method may be employed for wireless telegraphy in the following manner: A series of parallel rods, A^3 A^2 A^1 A^2 A^3, are arranged at equal distances from each other, so as to produce a cylindrical parabolical mirror in the form of a grating. Each rod is connected by a straight wire to a small ball, *F*, set in the focus line of the mirror. As shown in Fig. 3, two sets of rods are provided for, and between the two balls, *F F'*, set in the focus line a spark is generated from time to time by a Ruhmkorff apparatus or an electrical static machine. This is not shown here, however. Now it will be evident that as all rods are excited from the same center and as the phase difference of the oscillations of the single rods is determined by the length of the corresponding wires the set of rods act in such manner as to generate a wave front which must be in a plane. The wave motion, therefore, will be essentially rectilineal.



FIGS. 1 AND 2.—DIAGRAM ILLUSTRATING PRINCIPLE OF REFLECTION.



FIGS. 3 AND 4.—DIAGRAM OF REFLECTOR.

It is obvious that by these means the greatest amount of the radiating energy will be guided in one direction. The phenomenon is physically analogous to the ordinary parabolic mirror and to Hertz's mirror for electric waves. Its peculiarity, however, is that every rod fulfils its own oscillation, provided it is tuned by ordinary means, as capacity and self-induction, to the same periodicity.

The advantage of the new system over the ordinary metallic continuous parabolic mirror is that much more energy is set in action, as the energy depends on the capacity of the single rods, which may be increased by increasing the capacity of the rods and adding, for instance, condensers to the same. A further advantage may be secured by suitable additional rods, *a b c*, Fig. 4. or similar bodies—as, for instance, human bodies. These bodies act to prevent lateral deflection.

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* See *American Electrician*, March 7, 1897.

Recent Developments in Multiplex Telephony.

An invention of considerable interest to all engaged in telephony is that recently announced by the issuance of a patent to Mr. Willard M. Miner covering the art of practical multiplex telephony. Mr. Miner's invention appears to be a wide departure from generally recognized standard practice, although based on well-known laws of physics. The study of acoustics reveals a situation having unusual bearing on the art of transmitting several conversations over one circuit at one time. Mr. Miner was associated with the late Lieut. F. Jarvis Patten, who it will be remembered invented a system of multiplex telegraphy and did important work on alternating-current apparatus. Mr. Miner has also been a student of telephonic matters generally for a period of over 20 years and has thus had more than a passing interest in acoustics as applied to music. Several years ago he and others acquired the patents and apparatus of Lieut. Patten used in the development of his multiplex telegraph system and undertook to apply such apparatus to the development of multiplex telephony, but it was found after exhaustive experiments that the Patten telegraph apparatus was commercially inoperative telephonically.

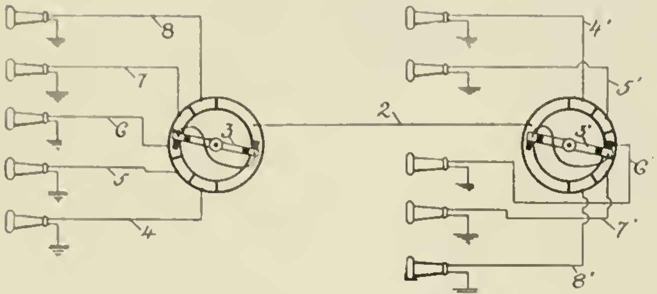


FIG. 1.—MULTIPLEX TELEPHONY.

It was at this point that Mr. Miner began the application of his studies in acoustics to the transmission of speech in multiple, finding that there was a wide difference between interruptions of the circuit and closing the circuit at frequent intervals. For instance, it was found that 100 interruptions per second would not affect the transmission of speech, and on this theory other investigators have been working for some time. But when the number of closures or contacts is considered, on which multiple telephony is based, an entirely different field is opened up. With 100 interruptions speech is possible. With 100 contacts or closures per second, speech may be possible, but certainly it is not commercial. In multiplex telephony the basic principle is that of successively closing the circuit of the different branches or multiples of the line, it being necessary that all other branches should be disconnected except the one actually engaged; and Mr. Miner came to the conclusion that in order to secure commercial multiple telephony it would be necessary to have contacts or closures to correspond as near as possible with the frequency of the vibration of the human voice in singing or speaking. In other words, the principle of the invention is to have a contact or closure provided for each and all of the vibrations of the human voice in spoken words and all musical tones.

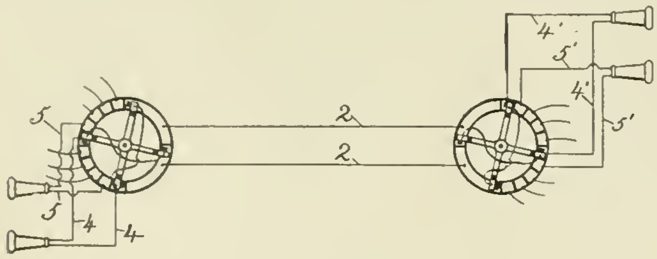


FIG. 2.—MULTIPLEX TELEPHONY.

By means of the Patten-Miner system of multiplex telegraphy Mr. Miner secures synchronism, the fundamental feature of all multiple telegraph or telephone systems. His recent invention is the outgrowth of the above system and by associating these two important inventions together, a complete multiplex telephone and telegraph system is secured.

It will be understood, then, that the apparatus devised by Mr. Miner, while in its general form the same as that heretofore used for multiplex telegraphy—or telephony for that matter—such apparatus is run at a much greater speed so as to bring the frequency of the closures of connection upon the several branches or subcircuits up to a rate approximating in greater or less degree the rate of the vibrations of the overtones characterizing speech. A rate of closure of 1,000 or 2,000 per second will not answer the purpose, but as the rate increases and passes beyond 3,000, improved results become apparent, and are markedly better when a rate of 3,500 or 3,600 per second is reached; the best results being obtained with a rate of about 4,300 per second.

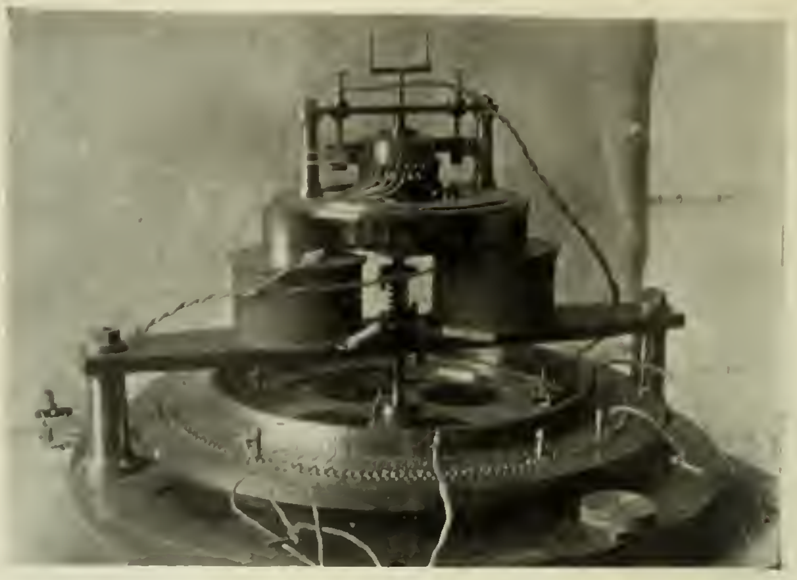


FIG. 3.—PATTEN DISTRIBUTER.

The accompanying cuts, Figs. 1 and 2, illustrate in diagrammatic fashion a pair of rotating circuit closers or distributers in a typical form sometimes employed for multiplex transmission over a single line circuit. The rotary arms at opposite ends of the line 2 are marked 3, 3', respectively. They are kept in synchronism by any means known in the art, and each is shown as rotating over five contacts, to which are connected respectively the five-branch or subcircuits, 4, 4', 5, 5', 6, 6', 7, 7', 8, 8'; the correspondingly numbered branches include the telephonic apparatus or sets of apparatus that are used in conjunction for conversation. The circuit shown is a ground circuit, but, as will be obvious, the apparatus might be organized in the well-known manner as is shown in Fig. 2, to provide a metallic circuit for each telephonic transmission.

Fig. 3 shows one of the original Patten "mills" or distributers.

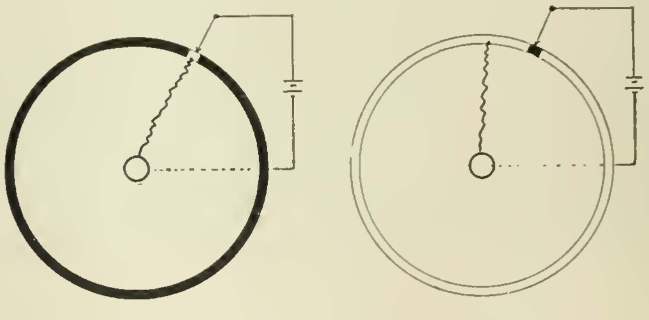


FIG. 4.—MULTIPLEX TELEPHONY.

Mr. Miner had this machine with him in the West in 1891 when making telegraphic tests between Chicago and Minneapolis. It and another like it have also been used by Mr. Miner in his multiplex telephone experiments in New York City. Fig. 4 shows the difference between 100 contacts or closures per second on an electric circuit and 100 interruptions per second. If the two wheels shown are revolving at a speed of 100 revolutions per second, one will give 100 contacts per second, while the other will show 100 interruptions per second, with a decided difference, it is said, between the two sets of phenomena and the consequent result.

Single-Phase Motors for Traction.

In the preceding issue appeared an abstract of the first portion of a paper on single-phase motors for traction, read by Dr. Giorgi Finzi at the annual meeting of the Italian Association of Electrical Engineers, held at Naples October 11. Below is given an abstract of the concluding portion of the paper, in which the Finzi single-phase railway system is described in detail:

Tests of the Finzi single-phase traction motor showed that for a given torque the current is slightly higher with a higher voltage, and this is more pronounced when the torque is greatest. The characteristic thus shows a number of slightly divergent torque-current curves. Curves of efficiency and power factor at various voltages in function of the speed were laid down. In the efficiency curves the higher branch corresponds to lower speeds when the voltage is lower, so that even though the efficiencies be not particularly high, the motor always works under favorable conditions, its speed being generally lower when the voltage is kept lower. The power factor is shown to be high when the speed is above the lowest figures.

This motor was geared to one of the ordinary cars used by the Edison Company, of Milan, for city service, replacing the direct-current equipment consisting of a motor (0.7 ton), a controller (0.072 ton), and the rheostats (0.08 ton). The weight of the fully-equipped car was 6.7 tons and of the stripped car, 5.85 tons. The single-phase motor installed weighed 0.8 ton and the controlling transformer 0.5 ton, making a total of 7.15 tons. To save time a standard 40-kw transformer was used for controlling, though one of 14 kw, weighing 0.25 ton, is sufficient, giving a total weight of 6.85 tons for the fully-equipped car.

The circuits on the car are shown in Fig. 1. The line from the trolley has a switch, *I*, on one platform, then passes to the other platform, where the controller is placed, then through an ammeter, A_1, a fuse, *v*, another switch, and then to an auto-transformer, and finally to earth. One brush of the motor, *R*, is earthed and the other brush goes to the field, *E*, thence to the handle of a controller, *T*, which takes current from different points of the transformer winding. These points are five in number, corresponding to 80, 100, 120, 140 volts, with a 500-volt supply. On the trial the passing of the five points was made with absolutely non-sparking. It will be seen that the five points are running points; for stopping, either of the two switches is opened; of course, the controller, as designed for practice, has a dead section for stopping. Through a switch, *C*, the fields are reversed to run in the opposite direction. An ammeter, *A*, showed the current in the motor, and a voltmeter, *V*, the voltage. All testing instruments in the car were of the hot-wire pattern. A special circuit from trolley to earth carried the incandescent lamps, *L*, of the car.

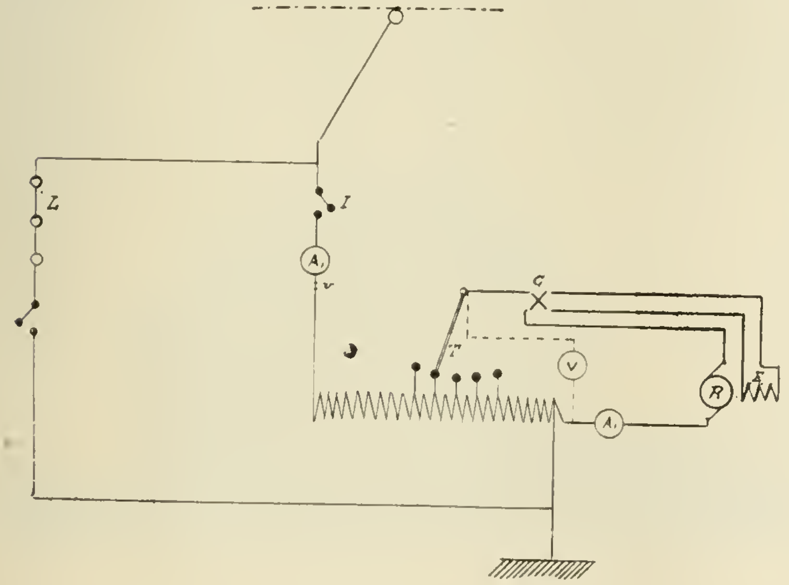


FIG. 1.—DIAGRAM OF CAR CIRCUITS.

The usual way of gearing the motor was adopted, a standard pinion (14 teeth), geared to a 67-teeth wheel (4.78 ratio). The diameter of the car wheels was 77 cm. A Kapp accelerimeter was fixed on the car, while for measuring the speed several methods were used, the final and most exact one being to get it indirectly from current and voltage through the test curves of the motor itself.

The generating station is near the laboratory in the Edison Company's works at Porta Volta, and contains a 60-hp, 3,600-volt, three-phase induction motor belted to an old eight-pole alternator with rotating armature, that gave a frequency of 18 at 270 r.p.m. The exciter was an old type Edison dynamo with a slender upright field.

The voltage of the alternator was raised from 90 volts to about 550 by an auto-transformer. The instruments were a hot-wire ammeter, a Thomson integrating wattmeter, and a Siemens wattmeter, which was replaced after some nights by one of the excellent Olivetti recording wattmeters specially arranged for the experiments. Another voltmeter showed the line voltage, which varied from 575 volts on open circuit to about 520 volts when the car was running.

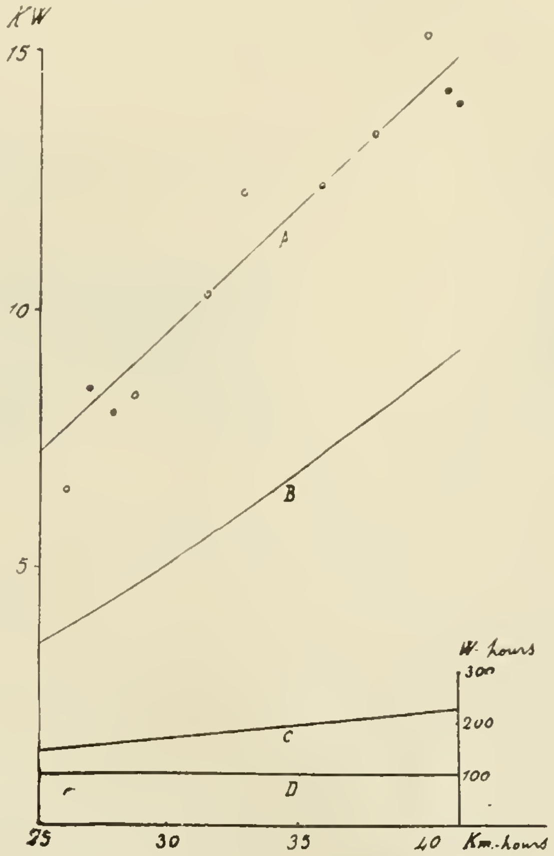


FIG. 2.—ENERGY CURVES.

The greatest number of runs was made during the night on the municipal line connecting the Monumental Cemetery with the new Musocco Cemetery. When the ordinary traffic was stopped the Musocco and the Cagnola sections were disconnected from the continuous-current system and the alternate current was fed in. The track had Vignoles rails for its whole length—about 5 km.—with a considerable number of switches and several curves of small radius. A crossing over a railroad railway has a grade averaging 25 per cent. for 225 metres on each side, and the whole line has an average grade of 2 per cent. from Musocco to the Monumental Cemetery.

The test runs began on June 29, 1903, and continued for ten nights. The last two nights' runs were made through the city of Milan, over the tramcar lines (Phœnix rails) with a trailer, through Bramante-Principe, Umberto Vincenzo, Monti-Monforte, and nearly the whole of the outer circle. The total mileage of the car was about 200 km. Not the slightest difficulty was experienced with the electric equipment, and it is remarkable that even the grade and curve at the Central Railway station were passed over, though not very easily, by the car with full load and one trailer, though, owing to the drop of voltage of the generator, the motor received only 95 volts instead of 160 volts.

The very first tests showed very smooth speeding up, and there was the same absence from sparking as in the laboratory tests. The satisfactory commutation was chiefly apparent in starting, when the motor in every way behaved better than the corresponding continuous-current traction motor. Some little sparking occurs from time to time, when the full voltage is fed, but not more than is usually observed in a good standard traction motor. The infrequent sparks did not show the color or the light of an arc, resembling rather carbon particles torn away from the brushes. As a matter of fact, the 200-km. run left the commutator perfectly clean and smooth, with the same appearance as it showed at start, and the brushes showed no measurable wear.

The car was lighted with the same lamps that were on the ordinary 500-volt circuit—six incandescent lamps in series. The slightly higher alternating voltage made them burn more brightly than usual; the fluctuations of the pressure were not very noticeable, and would disappear altogether by the use of standard lamps of 50 volts or less, instead of 100 volt lamps.

The object of the tests was, on one hand, to determine the general working of the motor with respect to its specific qualities for traction use, and on the other to measure how much power the runs and the starting absorb, in comparison with standard continuous current equipments.

With these objects the runs were of two different classes. During one simultaneous reading of the instruments were taken, together with diagrams from the Olivetti wattmeter, which gave the power necessary to keep up the various speeds when once attained. These runs had very few startings—in fact, only those that were necessary. On other runs frequent stops were made and thus an exact knowledge obtained of the starting data. The readings from the integrating wattmeter at the end of the runs showed the difference due to a given number of startings in comparison with the energy absorbed by a run without startings. The same course was carefully followed with another car equipped with a four-turn standard General Electric 52 motor.

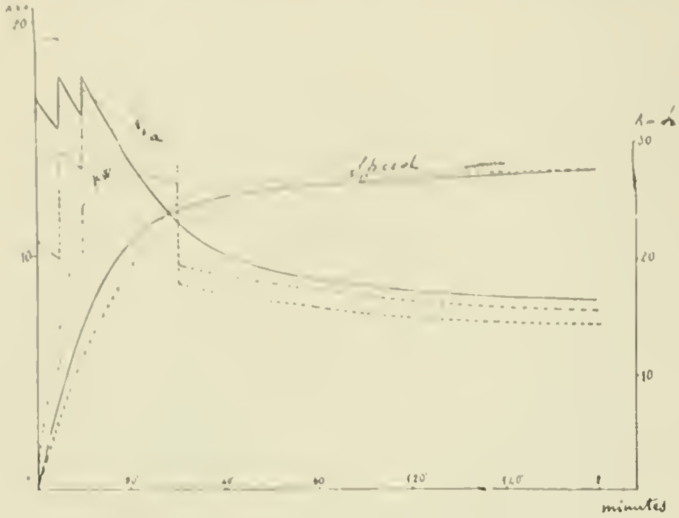


FIG. 3.—ACCELERATION CURVES.

The results are not of a very high degree of accuracy; in fact, no traction experiments can be entirely accurate owing to the difficulty of getting exact simultaneous readings, and to the complex elements of the experiment. The experiments are, however, trustworthy so far as they go, and show satisfactory concordance with results arrived at by other methods.

In Fig. 2 the line, *A*, shows the power at the generating station that is necessary for a 10-ton, single-phase car, on a level straight track, at speeds between 25 and 40 km. per hour. This curve is averaged from all the experiments, and is the collective result of the Siemens wattmeter readings at measured speeds, and of the Olivetti diagrams. The experimental points are rather dispersed, but not more than was anticipated from having a track with many grades and with few short, straight sections on which a constant speed could only be kept up a short time. The *B* line shows the power given by the motor, and is obtained from *A*, taking account of the line loss, the transformer loss and the efficiency of the motor (given the voltage and the speed).

The line, *C*, gives the energy in watt-hours per 10-ton car-km. from the motor; line *D* gives the energy dissipated per car-km. in mechanical friction—that is, after subtracting the air resistance. This last was computed considering the shape of the car and taking advantage of the coefficients found in the latest experiments (Finzi and Soldati on air resistance). Thus, mechanical friction absorbs 10 watt-hours per ton-km., of which about 0.5 is gear friction. This leads to a traction coefficient of 3.48 kg. per ton, a very normal figure for a level straight track and for Vignoles rails.

The paper contains a comparison between single-phase and direct-current motor acceleration based on the composite results from various experiments, made some in one, some in the opposite direction, to eliminate the influence of the average 2 per cent. grade.

On a city tramway system a maximum speed of 22 km. per hour is necessary between successive stops to get an average speed of 17 km. per hour, and the comparison is made on this basis, with almost the same acceleration for the two test cars. A speed of 22 km. per hour on an average acceleration of 0.25 meter per second is found for the single phase motor, and 0.28 for the General Electric 52. Even after starting a lower absorbed power is found for the single phase (though its efficiency be a trifle lower) on account of the resistances the General Electric 52 still has in series with it. When the power curves are integrated for each motor to a 22 km. speed, for the single phase, 9.4 watt hours per ton are found, and for the General Electric 52, 12.35 watt hours per ton. If the integration is referred to a 23.5 km. speed, which both motors attain in the same time, but in a slightly greater distance with the General Electric 52, the figures become, for the single phase, 10.6 watt-hours per ton, and for the General Electric 52, 14.85 watt-hours per ton. If these figures are modified to correspond to the 22 km. speed, they become, for the single-phase, 9.35 watt-hours per ton, and for the General Electric 52, 13.1 watt-hours per ton. The theoretical amount of energy required for starting to the 22-km speed would be 6.6 watt-hours per ton.

The following data, from those experiments, correspond to an average speed about the same, but with different accelerations:

Distances.	Weight, tons.	Average speed.	Maximum speed.	No. of starts per km.	Watt-hours per ton km.		Watt-hours per start per ton.
23.6	7.78	21	25	1.02	43.1	11	11.6
10	9.05	20	22	0.33	33.2		
10	9.45	23.5	25	0.26	34.6		
20	8.21	17	21	1.35	37.2	10	
10	7.78	17.4	22	2.03	43.2		

The acceleration was computed by taking into account the slowing-downs and assuming three slowing-downs to one stopping. The last figures have no great value *per se*, because a small error in measuring the maximum speed between two stops is enough to vary the results appreciably; however, they coincide well enough with the figures as obtained from test curves, if the line and transformer losses are taken into account.

The watt-hours per ton for starting with continuous current (12.2 to 13 to a 22-km. speed) are much lower than M. Blondel accepts from the examination of various tests. M. Blondel assumes the empirical formula, $V^2/30$, which would give in the present case 16 watt-hours. But even the figure used shows a 25 per cent. economy in favor of the single-phase system, which means much when it is considered that the power absorptions for starting on a city thoroughfare are 50 per cent., and sometimes as much as 65 per cent., of the whole consumption of current.

The wattmeter diagrams taken at the generating station showed, for the single-phase system (9.45 tons), 4,250 watt-hours, or 45 per ton-km.; and for the direct-current system (9.65 tons), 6,750 watt-hours, or 70 per ton-km. The difference is due, partly to the fact that, in order to remain within the speed limits established (and which correspond to those of a city traffic) the direct-current motor had almost always to work with resistances in series. But even this shows the advantage presented in similar conditions by the monophase motor, which allows very wide range of velocities without lowering the efficiency at normal speed.

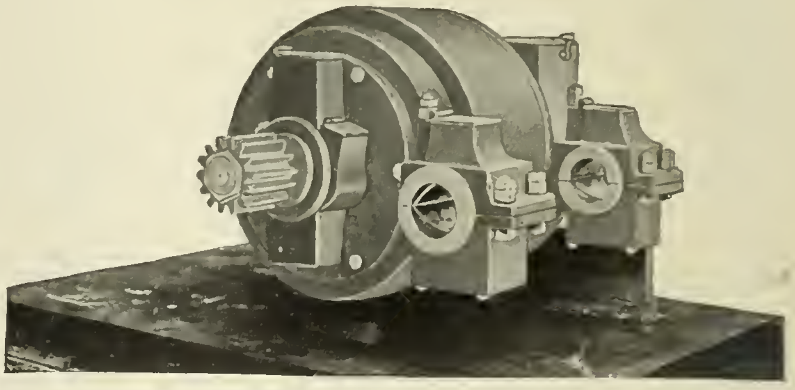


FIG. 4.—FINZI SINGLE-PHASE RAILWAY MOTOR.

As to the power factor, it varies between rather wide limits, according to speed and voltage. The characteristic curves of the motor give the standard startings an average power factor of 0.7. On the other hand, if wattmeter diagrams are compared with the instantaneous current and voltage figures at the station during the run, the aggregate average power factor (for line, transformer, motor) is 0.8, varying between limits of 0.6 and 0.95.

Recent Electrochemical Developments.

REDUCTION OF METALS AND ALLOYS.

It has been frequently found by experimenters that when an oxide of a metal whose temperatures of reduction and volatilization are nearly the same, is mixed with sufficient carbon to combine with the oxygen, is heated to the temperature of reduction, the main resulting product is not the metal which is wanted, but a carbide. The reason is thought to be that the metal becomes volatile as soon as it is formed and combines with free carbon present in the mixture. In a patent granted to Mr. F. J. Tone, engineer of the Carborundum Company, of Niagara Falls, these disadvantages are overcome by maintaining proper conditions of temperature, proper distribution of heat, and proper arrangements of the charge.

The method may be described by its application to the production of silicon for a mixture of silica and carbon. The constituents are finally subdivided and thoroughly mixed and the design of the furnace is such that the discharge of heat is over a wide zone (as opposed to localized heat) so that the progress of the reaction is relatively slow and the best conditions are maintained for agglomerating the particles. The most even temperature possible is maintained throughout the zone of reaction, to prevent the silicon from being volatilized as soon as formed, and the charge is so arranged in the furnace as to allow globules of reduced silicon to drop by gravity out of the zone of reaction to a lower portion of the furnace.

It is evident that for these purposes an arc furnace would be unsuitable. Mr. Tone, therefore, employs a resistance furnace, a vertical section of which is shown in Fig. 1. The heating resistance in the center of the furnace is made up of carbon blocks piled together with intervening spaces. The charge is fed into the furnace at the top and as the silicon is reduced it sinks down into the cooler portion of the furnace and finally into the receptacles at the bottom, where it solidifies as a metallic block.

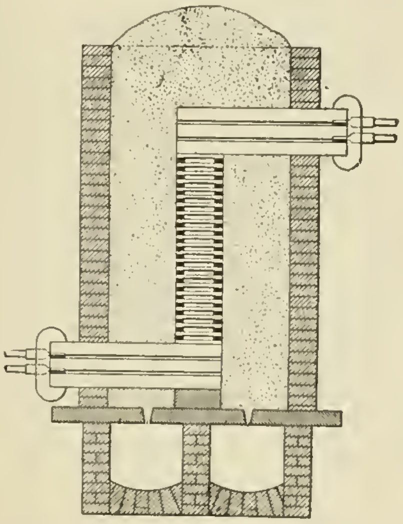


FIG. 1.—VERTICAL SECTION OF TONE FURNACE.

INTERRUPTER.

A patent granted on November 24 to Mr. T. A. Houghton, of Rochester, N. Y., refers to an improvement of the Wehnelt type of interrupter for the purpose of allowing adjustment within wide limits. The cathode is made in form of a worm through which a continuous stream of cold water is run in order to keep the temperature down to the proper point. The anodes are made adjustable in order to be able to vary the area of exposed surface. The anode remains stationary (except during any adjustment), while the interruption is caused in part by the movement of an insulating member which shields the anode from the electrolyte. A plurality of anodes is used in order to increase the range of frequency of interruptions.

BATTERY INVENTION.

A patent granted to Mr. J. Bijur, of New York City, refers to a form of Plante plate which is claimed to be cheap and to have all the advantages of the more expensive forms. No other metal is used than lead or lead and antimony, anything else, for example, tin-lead solder, being objectionable. Each plate contains several panels, a magnified view of a part of a panel being given in Fig. 2. It will be seen that the finished plate consists essentially of a great many lead strips, *s*. The plate is made by arranging as many groups of strips, *s*, as may be desired, with or without short bars, *b*, of lead of the same length as the strips at intervals in the groups. The groups are arranged in a mould and heated nearly to the melting temperature of lead. Then melted lead superheated considerably above the melting point, preferably at about red-heat, is deposited in the intervals to form the ribs, *v*, the essential point of the process being that the melted lead is hot enough to fuse the ends of the strips.

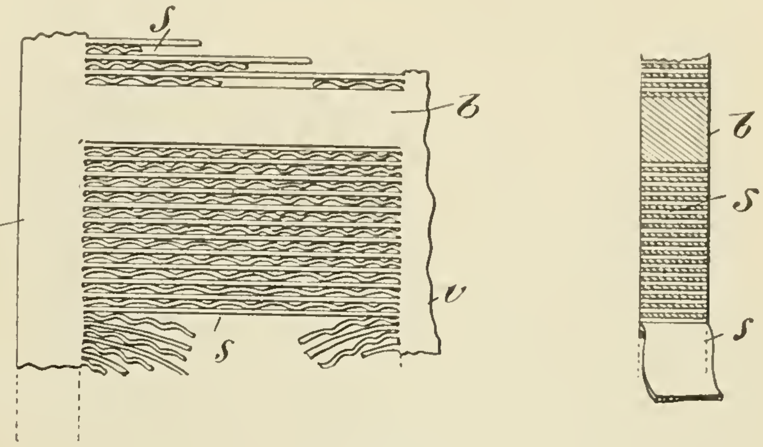


FIG. 2.—BIJUR STORAGE BATTERY PLATE.

A patent granted to Mr. F. W. Buehne, of Freiburg, Germany, refers to an accumulator plate which consists of a felted mass of cut filaments of metal, compressed along lines ranged to form a support, and an open grid for supporting the active mass. The felted mass is made from fibres obtained by a process formerly patented by the inventor.

A patent granted to Mr. W. Heym, of Berlin, Germany, relates to a pocket battery made up of two holders of celluloid containing the active mass and metallic lead strips. These holders have a contraction near the top. In the manufacture of the cell oxides of lead are used as active mass. The space between the two celluloid holders is filled with an electrolyte for charging the cell. After the cell has been charged, the formative electrolyte is removed and replaced by a gelatine electrolyte. The cell is sealed above the contraction. It is not intended to recharge such a battery after it has once been discharged.

A patent granted to Mr. P. Kennedy, of New York City, refers to mechanical details of a flexible conductor for connecting the positive terminal of one cell with the negative terminal of another cell in a battery.

A patent granted to Mr. W. L. Winters, of Chicago, refers to the structural arrangement of various cells in a battery by means of which the different cells can be connected together in a desirable way with but little trouble.

Jernegan in Manila.

The Rev. Prescott F. Jernegan, who achieved considerable notoriety in this country a few years ago through his promotion of a so-called process for extracting gold from sea water, is, according to a story received in Boston lately, teaching school in Manila. Jernegan organized the Electrolytic Marine Salts Company and attempted to dispose of 10,000,000 shares of stock at $1 per share. It is stated that he sold about $700,000 worth of the stock, $338,000 of which he reserved for himself. He disappeared in the summer of 1898 and after his departure it was discovered that his method of extracting gold from the sea was by secretly substituting gold impregnated mercury for pure mercury in a machine lowered from a wharf at Lubec, Me. A diver was sent down at night and placed the mixture in the machine. When the gold had been extracted from the mercury, it was cast into bricks and forwarded to Boston to be admired by stockholders. After Jernegan left America he appeared in Vienna and returned $85,000 to his victims.

Electric Power Distribution.

At the recent annual meeting of the Society of Naval Architects and Marine Engineers, Mr. W. M. McFarland, acting vice president of the Westinghouse Electric & Manufacturing Company, read a paper entitled "Electricity in Manufacturing Plants," in which the advantages of the electric drive are cogently set forth.

In considering the subject of individual driving, Mr. McFarland says that while considered alone and for the individual tool, the individual drive is ideal; yet the objection will occur to any practical man that the enormous multiplication of small motors means increased complication and greatly increased cost. He believes that the judgment of more conservative engineers is favorable to individual driving where the power will be, say, from 5 to 10 hp and upwards, and for group driving where the tools require less than these amounts. In any large plant there are numerous small tools, such as drill presses, screw-cutting machines, light lathes, etc., which are in any case located together, and where it is perfectly easy to drive them as a group. The average power required for such a group will be quite uniform, and when they are group-driven a moderate-sized motor, with its relatively high efficiency, can be used with a fairly steady load, thus contributing to the efficiency of the general system, as well as of the particular group, and materially reducing the first cost of the installation.

One case which Mr. McFarland mentions where individual driving is obviously a necessity is that of portable tools, and the electric drive has made it possible to use portable tools on a scale that was previously unthought of. As the individual parts of machinery have increased in size in recent years, there has been more and more a tendency to take the tool to the work rather than the work to the tool. Indeed, in many cases careful investigation has shown that the time spent in setting these large pieces of work ready for the different tools to operate upon them was actually longer than the time occupied in useful work. In several large establishments in the country, including the Westinghouse works, which latter, it is believed, has the largest example at present, a section of the largest erecting bay has a floor which is a huge bedplate, practically the same as the table of a planer very much enlarged. This is carefully leveled and supported on massive concrete foundations. The portable tools, slotters, boring mills and milling machines are made with heavy frames having large flat bases made perfectly true. The result is that the tools will work either exactly perpendicular or exactly at right angles to the floor plate. In the Westinghouse works, however, as an application of the most advanced system of laying out work, a special form of surveyor's transit is used, and it is determined when the tool is brought up to the work whether it is in absolutely correct alignment or not, and if it is found at all out it is easily adjusted by wedges. The largest of these portable tools weighs twenty-five tons, a figure which would have been considered a very respectable one for stationary tool ten years ago. In some cases the motor can be readily stowed inside the frame of the tool, and in others it is attached outside.

Mr. McFarland expresses the opinion that if the induction motor had been the first to enter the field there probably would have been no room for argument concerning its merits for power distribution, as these are so great that there would have been little incentive to develop anything else. It happened, however, that although the alternating current was the first, as it is the natural product of any machine without special commutating devices, it was some time before a commercially practicable alternating-current motor appeared, and the direct-current motor, being first in the field and being undoubtedly meritorious, acquired the vogue which always comes to that with which people are familiar.

Mechanically the induction motor appeals at once to every practical man as the better device. The coils of wire are entirely stationary, while the rotating part consists of discs of sheet steel enclosed by massive composition end rings, which latter are connected by stout bars of copper bedded in slots in the steel sheets. The direct-current motor, on the contrary, has its coils movable as well as stationary, and, while these do not often give trouble, they are not so simple and mechanical as the rotating part of an induction motor. The direct-current motor has an additional feature which is entirely absent in the induction motor, the commutator and brush holder. These are the parts requiring most attention and the ones most liable to give trouble, although the modern methods of design and manufacture have reduced this to a minimum. The induction motor is about as simple as a grindstone or a pulley, because, as already stated, the rotating part is exceedingly strong and mechanical, and it has no connection, either electrical or mechanical, with the stationary part, except in the bearings, and as long as these are kept properly oiled there is no chance for trouble. The absence of a commutator does away with all danger of sparking, and hence renders it peculiarly adapted for use in such places as carpenter shops, powder mills and other places where sparking is absolutely inadmissible.

A very natural inquiry may at once arise from those not familiar with the subject, as to whether this great simplicity of the induction motor is not accompanied by a low efficiency. So far from this being the case, the efficiency of the induction motor is fully equal to that of the direct current motor, and, indeed, is slightly better over most of the range of its capacity. Thus far it might seem that everything is so greatly in favor of the induction motor that there could be no room for choice; but the usual type has, from some points of view, one defect, namely, it is a constant-speed motor, and many of the foremost advocates of individual tool driving want a motor whose speed can be varied through a wide range. From this point of view the direct current motor is superior, but the extent of the superiority depends almost entirely on the degree of importance which is attributed to securing variable speed from the motor itself without the intervention of belting or other mechanical means of varying the speed. It is entirely possible to make an induction motor whose speed can be varied, but in this case the extreme simplicity of the type is lost on account of the slip rings, which are used to enable the variable speed to be obtained by throwing resistance into the circuit. These, of course, while exceedingly simple and not so complicated or liable to derangement as the commutator of a direct-current machine, do add a slight additional complication. In the New York Shipbuilding Company and also in the steam engineering plant at the Brooklyn Navy Yard, the simplest type of induction motor is used, and the variable speed is obtained by means of belts and cone pulleys, which method is entirely satisfactory and gives an adequate range of speeds with extreme simplicity.

Another method of power distribution which has been used with decided success and simplicity is the three-wire system from a single generator in connection with field regulation, which enables the speed of the motor to be varied sufficiently to meet all practical purposes. The three-wire system is obtained by utilizing a special generator somewhat resembling a rotary converter; that is, in addition to the brushes and commutator furnishing direct current, leads are brought out from the armature winding to two or more slip rings placed upon the armature shaft. From these slip rings alternating current is taken, and if this is passed through an auto-transformer, and a lead is tapped from the middle of the transformer coil, this lead will always have a potential midway between that of the terminals on the direct side of the machine, thus securing at the motor two voltages, one equal to twice the other. By field regulation the speed can be varied through a ratio of about one to three, so that with this variation combined with the two voltages of the three-wire system we get a range of six speeds, which, in general, will be amply sufficient.

In the comparison of the two general classes of motors, one of the special advantages of the induction motor was not mentioned, namely, that from its construction there is no danger from a short circuit, because the bars in the rotating part are purposely short-circuited. Further, this motor will stand being brought to a full stop for a moment with the full current upon it without any resulting damage, while such an occurrence with a direct-current motor would certainly burn out the insulation, if not doing still greater damage. As a result of this it is not necessary to fit circuit-breakers or fuses to take care of these motors. In the small sizes the motor can be started up by simply closing the circuit by means of an ordinary switch, and in the larger sizes practically the same thing is done, as a two-throw switch is used in connection with an auto-starter, which is simply a small transformer arranged to give half the line voltage in starting up, the object being not so much the protection of the motor itself as to avoid the demand for a large amount of current from the generating system, as the starting current without the transformer would be somewhat more than twice full-load current. In the case of the direct-current motor it is, of course, necessary to start through the rheostat, so that the full voltage only comes on when the motor is up to speed.

While the electrical system of transmission secures a material reduction in the cost of power, this, after all, is not its greatest recommendation. The greatest benefit comes from the elasticity of the plant consequent upon its use. There is no longer any necessity for the rigidity of arrangement which obtains with shafting and belting, so that if it becomes necessary to rearrange the plant at any time the expense is reduced to a minimum. In the New York Shipbuilding Company's plant, for example, many of the tools being absolutely self-contained were not secured to foundations at all, and could be moved to any position desired, although these tools are not of the kind ordinarily considered as portable.

The paper gives the results of a test of the economy resulting from the substitution of electric for steam driving, made at the Westinghouse Air Brake Works, at Wilmerding, Pa. These works consist of a number of large detached buildings, and their old system of power transmission was from a separate boiler plant to individual small engines scattered about the various shops. Nearly five years ago they decided to install an electric drive consisting of alternating-current generators driven by Westinghouse-Parsons steam turbines, supplying induction motors.

There were originally a number of small steam engines which drove the tools on the group system, the engines being connected to moderate lengths of shafting. When the motors were introduced the number of groups was nearly doubled, this of itself being a decided improvement. The same boilers were used for the tests, which consisted of first running the shops several days and nights with the engines, and then for several days and nights with the motors. Both coal and water were carefully measured, and the saving as a result of the electric drive is about 32.5 per cent. Of course, it is not claimed that any such saving as this could be counted on in cases where the plant is relatively small and so disposed as to permit of the use of a very economical power plant driving well-designed and well-cared-for shafting. The actual saving in coal per day of twenty-four hours was about 40,000 pounds, or twenty short tons, and it will readily be seen that where coal costs $3.00 or $4.00 a ton this would mean a very respectable figure. The saving, however, did have a very marked effect from the fact that with the engines the capacity of the boiler plant had been about reached. As will be noted from the figures quoted, the reduction in steam consumption was about 30 per cent., which, of course, left a large reserve power in the boilers.

As to the best frequency for alternating-current power distribution, the paper states that a good deal depends on the extent of the plant and whether the lighting circuits are to be the same as the power circuits or not. For many reasons 25 cycles are most suitable for driving motors, but this is too low to give satisfactory service with arc lights, and also rather low for incandescent lamps. In such a case it may be desirable either to use an independent generator at 60 cycles, or perhaps a motor-generator set, or even to make the exciters large enough to supply direct current for lighting.

Accidents on Paris Underground.

It is reported from Paris that there were two accidents on the Metropolitan Electric Underground Railroad on November 30, somewhat similar to the great disaster of August 10, but there was no loss of life. In each case a car was burned between stations on account of short-circuit and the dry condition of the wood of the cars, causing the passengers to seek for escape along the tracks. As the accidents occurred in open stretches of track, the dense smoke escaped, and the dangers of suffocation were averted. The first reports had it that another disaster had occurred and much excitement was caused throughout the city.

Sun Spot Storms.

The recent remarkable magnetic storms have been freely attributed on good scientific authority to "sun spots," while various other terrestrial disturbances have been ascribed to the same remote origin. There seems no doubt of the fact that the presence of the sun spots is closely associated with the magnetic condition of the earth, and although many electrical storms are purely local, many of the great magnetic storms of the past half century have been found to coincide with sun spot periods. Profs. Young, Langley and Pickering are now cited as of the opinion that in this and other respects sun spots "don't count for much," at least, when it comes to disasters, for which they have been held responsible.

Novel Automatic Switchboard Telephone.

A new automatic telephone switchboard of the "mechanical operator" type has appeared in a patent of the issue of November 24, and notwithstanding the fact that it may probably never come into extended use, the method of carrying out the switching operations is sufficiently ingenious to merit fairly detailed explanation. Heretofore there has been but one example of this type of automatic switchboard in the design of which the inventor's chief object was apparently the abolition of electromagnets, the functions usually performed by these being transferred to most complicated mechanical devices. In this new switchboard no such extremely complicated devices are used, but means are resorted to which, though novel, may strike some people as almost as objectionable.

The whole system may be described best in reference to the diagrammatic drawings shown in Fig. 1, and by describing the completion and "taking down" of a connection. To this end, consider that the station shown at the upper right-hand corner desires communication with the station at the end of the line 200, passing out the left upper corner of the cut. Now, each subscriber is provided with a set of code stencils such as are shown in the upper middle of the cut, one such stencil being needed for each subscriber. Having selected the proper one and having inserted it in a slot in his selector device, he turns the crank, 27, of this latter and then releases it. At once the drum, 20, begins a slow rhythmic motion under control of the escapement, 28, the peripheral teeth of the drum feeding the stencil by engaging the middle row of holes. Two brushes connected to oppositely poled batteries, 23 and 24, trail the stencil contacting with the drum wherever a side perforation such as 35 appears.

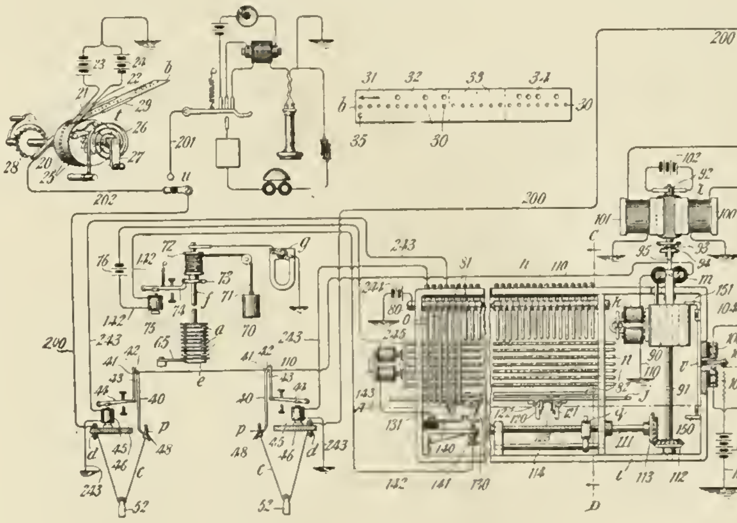


FIG. 1.—VANSIZE AUTOMATIC TELEPHONE SWITCHBOARD.

Now, as the stencil begins its motion perforation 35 allows an impulse to be sent to the central office, this impulse reaching ground through plug *p*, its carriage, 40, and eventually the magnet, *m*, shown black. This magnet, *m*, is mounted upon the end of a carriage, 90, and travels therewith. The carriage, 90, is driven by a screw, 91, which passes through it. At *x* is shown an electric motor, the shaft of which engages the screw, 91, through a friction coupling sufficiently tight to revolve the screw and drive the carriage, 90, except when the armature of magnet *m* is dropped into a locking notch, 94, of the screw end of the coupling. The motor being in operation, say right-handedly, when our impulse arrives in magnet *m*, it at once starts the screw upon the magnet, the armature being lifted from the locking notch, and as this armature proceeds with the driven carriage it of course clears the notch on the fall following the cessation of the first current impulse.

There is a second magnet secured to carriage 90, and this is *k* in series with *m*. Now *k* responds to impulse of polarity opposite from those affecting *m*, and so, while *k* does not respond to battery 24, neither will *m* respond to battery 23, connected intermittently by perforations, 33. These impulses from battery 23 arrive in magnet *k* as this latter is proceeding across the ends of the series of bars *n*, and they are so timed in relation to the starting or first impulse, that certain of the bars, *n*, are translated in response to the magnet according to a predetermined code, exactly after the manner of the locking bars of a railway switch tower. The result is that by the time the carriage, 90, has proceeded to the limit of its forward motion the proper code for the desired number has been set, this code consisting of a continuous slot beneath that one of the sheet metal fingers, 81, connected to the desired subscriber's line.

This finger falls into the slot and thereby closes a circuit from battery 80, through magnet 45 of the connecting device. This magnet is one of a large circle of magnets, one for each subscriber, all connected to plug carriages so designed that any plug may be caused to strike in the center of the circle, exactly as the type bars of a typewriter strike a single position in response to their keys. The central striking point for the various plugs is at *e*, where there is a jack plate, *a*, waiting to receive the plug.

While all this has been going on, the carriage, 90, has struck the tapper, 150, and through the connected reversing switch has reversed the motor field to run the carriage back. Also has the nut, *q*, indirectly closed contact 140 to energize magnet 75, with the result that shaft *f* is permitted to revolve 180°, swinging the inserted plug away from point *e* and placing a second jack at *e*. Still another operation has taken place. Magnet 143 has restored all the bars, *n*, to the normal position.

As the screw, 90, continues motion in the reversed direction, a second set of impulses begin to arrive from battery 23. These set the bars *n* for the admission of the finger of the calling line, and just as for the called line, so will the plug of the calling line be inserted in the jack now at *e*. However, as the shaft, *f*, makes its second rotation of one-half turn, the bottom circular jack plate becomes released from its shaft and falls to a plate not shown in the figure, but lying just below the horizontal plane of the plugs, thereby leaving a new jack plate at the end of shaft *f* ready for the next connection.

Before proceeding to the method of disconnecting we must go back a step to observe the manner of signaling. A grounded generator, *g*, is shown connected to shaft *f*. This, of course, sends current out to the called line the instant its plug touches the jack plate, *a*. As soon as the second plug touches the jack plate of course the calling party is rung to signify "connection completed."

Now for the disconnection. The stationary plate upon which the jack plates fall is heated by a gas flame playing against its under surface. This, of course, heats the jack plates lying upon it and by a peculiar construction of the jacks causes them to release both plugs after a pre-determined time of conversation. This peculiar construction of jack embraces a pair of springs held closed against their normal tension by means of a fusible wax globule, which melts at the proper time.

This disconnection scheme will be regarded by some as most inadequate, for no provision is made to keep successive jack plates from falling upon each other and becoming insulated, thermally, from the hot plate. Another bad feature, from the telephone man's standpoint, is the liability of running out of jack plates. Mr. W. B. Vansize, of New York City, well known as an inventor and patent attorney, is the inventor of this machine.

New Telephone Patents.

NEW SWITCHBOARDS.

Two new switchboard patents have recently appeared, the one aiming to do away with connecting cords and plugs and the second to use them even to a greater extent than customary. The first of these patents is granted to Isidor Kitsee, of Philadelphia, while the second is granted to C. S. Exley, of Iowa. In Mr. Kitsee's switchboard a combined jack and plug is used with a dummy hand plug to move the connecting plug within its jack. Behind the jacks are arranged a series of conducting plates serving as connectors. These are adapted to take positions such that the two plugs for any connection will always select the first one not in use. In carrying out his invention Mr. Kitsee has embodied so much apparatus that it is doubtful if it can be turned to any practical use.

In Mr. Exley's switchboard each subscriber's line terminates in a cord and plug. The plug is normally kept in a jack to which the line drop is wired. Pairs of connected jacks serve as connecting circuits. The fact that the cord is usually the most vulnerable part of the switchboard counts against this system, as subscribers would be cut from service too often by defective cords.

RECEIVER FOR USE IN WIRELESS TELEPHONY.

A receiver for use in the wireless transmission of both telegraph signals and articulate sounds based upon the principle of the capillary electrometer has been patented by Andrew Plecher, of Bristow, Va. One form of this apparatus is shown in Fig. 1, in which wire 1 is the receiving wire to be connected at will to electrometer *O* or electrometer *R*. As may be readily seen, if the filament of mercury in electrometer *O* rises sufficiently it will close the local bell circuit. On the other hand, if the filaments of electrometer *R* rise, raising thereby the surface of the mercury in the bulb, the diaphragm, *R'*, will respond to the increased air pressure beneath it, and its vibration will be heard at the ear tubes. Now capillary electrometers can be designed to respond with promptness to almost infinitesimal changes of potential, and we, therefore, have at once a sensitive receiver. The inventor prefers as his lower electrode a small quantity of mercury within the vessel containing the electrolyte. He states that the preferred electrolyte is a solution of potassium cyanide with one per cent. of silver cyanide and 10 per cent. of potassium hydrate.

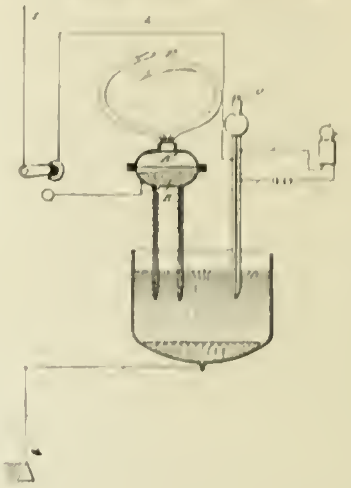


FIG. 1.—PLECHER WIRELESS TELEGRAPH OR TELEPHONE RECEIVER.

COIL TERMINAL.

The difficulty of securing terminals in coil heads in a manner such that they will not loosen in response to heat conducted from a soldering iron, is well known to telephone men. Many types of terminal have been tried, but all seem to have this failing. The next best thing to having a terminal that will not loosen is to have one, the loosening of which will be of no moment. Such a terminal is described in a patent issued to Richard Varley and assigned to the Varley Duplex Magnet Company. This terminal is simplicity itself and its construction is amply evident from Fig. 2.

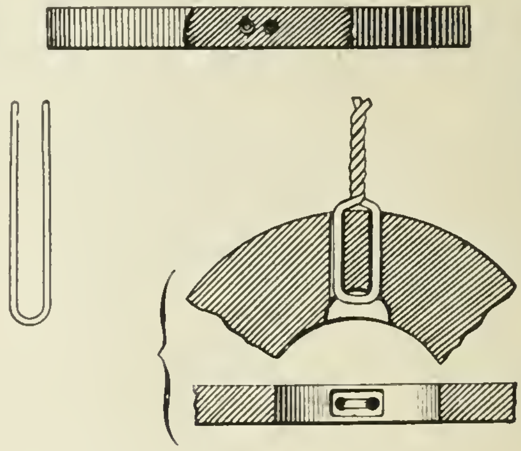


FIG. 2.—VARLEY COIL TERMINAL.

ALTERNATING-CURRENT TELEPHONE.

The above seems a rather curious title for a patent, as surely all telephones are alternating-current apparatus. What the inventor has to describe is a transmitter producing alternating currents in the induction coil primary, or better primaries, for two induction coils are used. Two diaphragms are also used attached by tension rods to a lever, so that the amplitude vibration of the diaphragm will be multiplied at the microphonic contacts situate at the extremities of the lever. The arrangement of primary circuit with reversed battery and duplicate transmitter buttons is that well known, the novel feature consisting in the insertion of two pairs of microphonic contacts in the secondary circuit. These are so wired to the induction coil secondary circuits as to accentuate the effect of that coil responding to an increased primary current and thus tending to prevent confusion from the superposition upon the secondary or receiver circuit of impulses of opposite polarity. Fig. 3 shows the arrangement of parts *A A*, being the line or receiver wires. Andrew Plecher, of Bristow, Va., is the patentee of this device.

MISCELLANEOUS TELEPHONE ACCESSORIES.

The remaining patents for consideration include various telephone appliances. One describes a parallelogram transmitter arm such that the diaphragm always remains vertical or in the position of maximum efficiency. This is the invention of A. Gamache, of East Clifton, Canada. A second is a further development of J. D. Peachey's burglar alarm attachment. The improvement over the arrangement described by us some weeks ago seems to lie in forming the weight which draws the receiver from the hook, so that it may be used as a box for the alarm bell, which both the central office operator and the house owner hear.

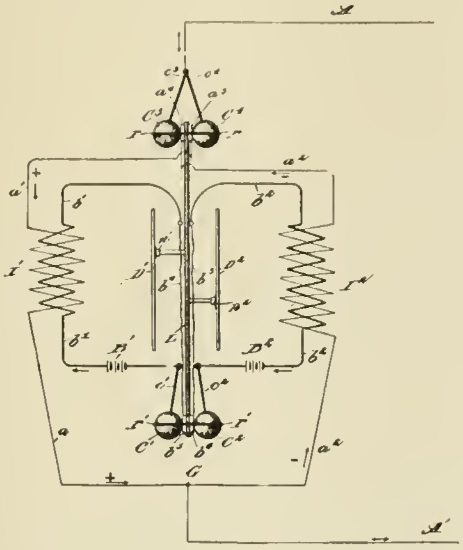


FIG. 3.—PLECHER ALTERNATING-CURRENT TELEPHONE.

An electric cut-out, the invention of S. W. Miller, of Rochester, an electromagnetic switching device, and a writing pad for use with desk stand sets; this, the invention of G. M. Urie and A. A. Markam, complete the list.

Chicago Independent Telephone Convention.

Plans are being made actively in Chicago for the convention there next week of the Interstate Independent Telephone Association. The headquarters will be at the Auditorium. The officers of the Association are: C. E. Hull, president, Salem, Ill.; I. A. Frazer, vice-president, Connersville, Ind.; E. M. Coleman, secretary, Louisville, Ky.; J. W. Layne, treasurer, Carthage, Mo.; C. E. Tripp, Auditorium, has charge of exhibit space. The programme which has already been announced is as follows: Tuesday Morning, December 8, 9 to 12—Reception of members and friends by the Executive Committee and officers at the secretary's headquarters. Tuesday Afternoon, December 8, 2 to 5—Address of welcome, Hon. Carter H. Harrison, Mayor of Chicago. Response and annual address by president, Senator C. E. Hull, Salem, Ill. Report of the secretary. Report of the treasurer. Selection of Executive Board. Selection of Nominating Committee. Revision of Constitution and By-Laws. Adjournment. Wednesday Morning, December 9—The officers and Executive Board will take charge of the delegates this morning from 9 to 12 in visiting exhibits. Wednesday Afternoon, December 9, 2 to 5—"Should the Territory of the Interstate Independent Telephone Association Be Enlarged, and if so, Why?" Hon. John Van Nortwick, Appleton, Wis. Discussion. "Are Our Telephone Periodicals Sufficiently Careful as to the Business Relations Sustained by Contributors?" W. H. McDonough, New York City. Discussion. "Standardization of Apparatus," Prof. J. C. Kelsey, Purdue University. Discussion. "Standardization of Construction," W. C. Polk, Kansas City, Mo. Discussion. "Competition between Independent Companies and Farmers' Mutuals." O. Rex, North Manchester, Ind. Discussion. Thursday Morning, December 10, 9 to 12—"Independent Toll Line Systems, and Is the Time Ripe for Merging?" J. S. Bailey, Jr., Toledo, Ohio. Discussion. "Where Should the Line of Demarcation Be Drawn between Independent Operating and Manufacturing Companies, and the Bell Company?" Hon. Henry A. Barnhart, Rochester, Ind. Discussion. "What Should Be the Representation in the Connection of the Interstate Independent Telephone Association in Voting?" Mr. Prewitt, Winchester, Ky. Discussion. "Who is Who? What Are the True Ear Marks?" Hon. Theodore Gary, Macon, Mo. Discussion. Election of officers. Thursday Afternoon, December 10, 2 o'clock on. Officers and Executive Board will entertain the delegates. A banquet is to take place during the week.

Coming Chicago Meetings of the A. I. E. E.

The Executive Committee of the Chicago branch of the American Institute of Electrical Engineers has arranged for a meeting to be held at the rooms of the Western Society of Engineers Tuesday night, December 8, at which time Prof. W. E. Goldsborough, chief of electrical exhibits of the Louisiana Purchase Exposition, will deliver an address on the electrical features of the St. Louis World's Fair. Another distinctively Chicago meeting, which will be held some time during the winter, is to be devoted to automatic telephone exchanges, a subject which is of particular interest just now in view of the inauguration of the new automatic telephone exchange service in Chicago, Dayton, Ohio, and Grand Rapids, Mich. Papers have been partially arranged which will take up the engineering details of the automatic telephone exchange as it exists to-day and also a broad engineering consideration and analysis of the subject of automatic as compared with manual exchange systems. Chicago has abundant telephone engineering talent to have an excellent telephone meeting of this kind, and as every effort will be made to have the subject considered as far as possible from the engineering standpoint without commercial prejudice, there seem to be good prospects for a substantial addition to the fund of information as a result of the meeting. The Chicago branch will probably hold a number of other meetings during the year for the discussion of subjects taken up at the New York meetings when the subjects are of such a nature as to be of interest to Chicago members.

CURRENT NEWS AND NOTES.

AMERICAN ELECTROCHEMICAL SOCIETY.—The next general meeting of the American Electrochemical Society will be held in Washington, D. C., April 7, 8 and 9, 1904.

ELECTRIC SMELTING PATENTS.—It is stated that following the recent decision sustaining the Bradley electric smelting patents, an understanding has been arrived at between the Pittsburg Reduction Company and the Electric Smelting & Aluminum Company, the owners of the Bradley patent, whereby the former will be licensed to manufacture aluminum under these patents. This arrangement included a settlement for past royalties and also with respect to litigation involving the Hall patents, which had been decided in favor of the Pittsburg Reduction Company, and later reopened.

LARGE WESTINGHOUSE TURBINES AND GAS ENGINE.—There are now in process of construction at the works of the Westinghouse Machine Company several 5,000-kw steam turbines and a 3,000-hp gas engine. The former are being built for use in the New York and Pennsylvania tunnel plant and in the power house of the Philadelphia Rapid Transit Company. The turbo-generators will supply three-phase current at 25 cycles and 13,000 volts, the speed being 750 r.p.m. The gas engine will have two sets of tandem cylinders with pistons connected to cranks displaced 180°. Each cylinder will be double-acting, the crank effort thus corresponding to that of a double-cylinder steam engine.

NEW YEAR GREETINGS.—At midnight on December 31, 1902, the United States Naval Observatory flashed an instantaneous New Year's greeting throughout the country by means of a system of signals. On January 1 next, at the exact second of the beginning of 1904, Washington time will be flashed by the observatory to all points in the world having the necessary telegraphic connections, if the permission and cooperation of foreign Governments, which have been asked for, can be secured. The connections will include North, Central and South America, Europe, Asia, Africa, Australia, the Philippines and all the insular possessions of the United States, with the exception of Samoa. The time necessary to transmit the signal will be accurately taken by every station to which it is to be sent. Last New Year's the signal traveled more than 3,000 miles in six one-hundredths of a second.

THE SOCIETY OF MEXICAN ELECTRICAL ENGINEERS has been organized in the City of Mexico. The officers are: President, Roberto Jofre; vice-president, Luis A. Lavie; treasurer, Teodulo Ba[illegible]; secretary, Manuel Gallegos.

CAPE TOWN INDUSTRIAL EXHIBITION.—An exhibition with this title is to be held at Cape Town, South Africa, in November and December, 1904, and January, 1905, under distinguished auspices. The site is Green Point Common. The London offices are at Palmerston House, Old Broad Street. Space is $1.25 per square foot. The grounds are to be lighted by electricity and a plant will be put in for that purpose.

A "DEAD" MAN BROUGHT TO LIFE.—A partly successful attempt was recently made at Cleveland to resuscitate a man who had been electrocuted by a live wire. Adrenalin was administered by three physicians after the man had been "dead" three hours. Within fifteen minutes his heart beat slightly and the blood began to course through his body. Shortly after, however, all signs of life disappeared. The doctors state that had they begun their experiment two hours earlier they would have been successful.

DE FOREST IN ENGLAND.—A cable dispatch from London, of November 28, says: The experiments with the De Forest wireless telegraphy system were carried out to the entire satisfaction of the British postal representatives this week across the Irish Sea, between Howth and Holyhead, a distance of sixty-four miles. Messages were transmitted at the rate of thirty and thirty-five words a minute, the replies being received quicker than by the ordinary telegraph. Although a Marconi station was close to the De Forest installation at Holyhead, there was no noticeable interference with the messages.

NEW YORK ELECTRICAL TRADES SOCIETY.—The eighth annual meeting of the Electrical Trades Society of New York will be held on Tuesday, December 8, at Muschenheim's Arena, No. 41 West Thirty-first Street, New York, at 6 o'clock P.M. There will be reports read, addresses and the regular election of officers. An informal dinner (business dress) will follow the annual meeting, at 7:30 P. M. Dinner tickets, two dollars each. Mr. Avery P. Eckert, the secretary, requests that he be promptly notified by any one who proposes to be present at the dinner, which promises to be a very enjoyable affair.

N. E. L. A. PHOTOMETRICS.—In regard to the abstract issued by the National Electric Light Association and noted already in these columns, pertaining to photometric work, Prof. C. P. Matthews writes us: "In the abstract of the fourth progress report of the committee on photometric values of arc lamps, of the National Electric Light Association, an unfortunate clerical error appears in the matter of the relation of candle-power to voltage in the single-glower Nernst lamp. In the sentence: 'A special test given in the report shows that a change of 1 per cent. in the voltage makes in this particular case a change of more than 14 per cent. in the candle-power.' Value should be 6.38 per cent."

THE NATIONAL ELECTRIC LIGHT ASSOCIATION has had so many requests from non-members for the report of the Chicago meeting now in press, that, owing to the distribution having been unavoidably delayed until the year is nearly ended, it has been decided to present a copy of this book to all companies making application for membership for the year 1904, provided their applications are received before the end of this year. A number of applications have already been received on this basis, and there is every indication of a large increase in membership within the month remaining. A copy of the recent valuable report of rates for lighting and power will also be sent to new members. It is suggested that companies intending to join make early application, as both editions are necessarily limited, and are likely to be soon exhausted.

NEW YORK ELECTRICAL SOCIETY.—The Society had an excellent meeting on Monday, November 30, when Mr. W. D'A. Ryan, of the General Electric Company, delivered an admirable address on "Practical Problems in Lighting and Illumination." President Carty was in the chair, and over two hundred members were present, the lecture being delivered at the Hebrew Technical Institute, to which the society was very cordially welcomed by Mr. L. B. Marks, in behalf of the trustees. The room was beautifully illuminated with the aid of the Ryan diffuser and enclosed arcs. The lecture dealt broadly with questions of light distribution for various purposes and the merits or demerits of the different kinds and forms of light; and offered many valuable and pertinent suggestions, that were eagerly caught up. The lecture, which was accompanied by many skillful experiments and demonstrations was kindly repeated by Mr. Ryan the next day, for the express benefit of the 250 youthful students of the Institute.

TELEPHONE SUBSCRIBERS' LISTS.—In an interesting article on the subject of "Mail Advertising," Mr. J. N. P. Cramer is quoted in *Printers' Ink* as bearing testimony to the value for such purposes of the lists of telephone subscribers in rural districts: "Some of the little independent lines built by farmers for their own communities are only fifteen miles long. They have perhaps 100 subscribers. The subscribers' list of such a line gives names that have been hard to get heretofore, as they are in no directory. The rural telephone sorts out the influential classes in every community, and lists of names made up from telephones are excellent for high-class propositions. I should call such names the very best that could be secured for investment advertising. So far as I know we are first to compile such a list. We began a few months ago. The telephone directories have been difficult to get and have cost us a pretty penny. We now have 50,000 names in New England, 150,000 in New York, 20,000 in New Jersey, 80,000 in Pennsylvania, 100,000 in Ohio and 200,000 in other eastern States."

SUN SPOTS, SHOWERS, SHOCKS.—The Abbé Moreux, director of the Bourges Observatory, has written a letter to the *Paris Temps,* in which he attributes the phenomena noted to the sun spots. He says: "Already this year, on March 26 and 27, there were magnetic disturbances which I had predicted. During their activity sun spots are accompanied by aurora borealis, magnetic derangements, deviations of the compass, seismic movements and earthquakes. We are now traversing a maximum period of sun spots, such a period as recurs but once in every thirty-three or thirty-five years. This maximum will continue for about two years, during 1904 and 1905, and we must expect more frequent aurora borealis, great magnetic disturbances, earthquakes over vast areas and numerous explosions of firedamp in the mines. Moreover, the solar activity will far surpass the point attained at the last maximum period of sun spots, in 1893, and with this augmentation of solar heat evaporation from the ocean will be greater. In consequence we are going to have a rainy period lasting perhaps up to 1912."

ATMOSPHERIC NITROGEN FIXATION.—United States Consul-General F. H. Mason writes from Berlin as follows: "The gradual but ultimately inevitable exhaustion of the known nitrate deposits of South America lends a growing interest to the methods which have been devised for obtaining a supply of nitrogen for fertilizing purposes from the inexhaustible storehouse of the air. That this can be done as a scientific process has long been known. The first method was by passing a current of air over red-heated copper, whereby the oxygen combined with the metal to form oxide of copper, leaving the nitrogen free. At first the nitrogen thus produced was fixed by combination with calcium carbide to form nitrate of lime (Kalkstickstoff) or calcium cyanimide, a combination of lime, carbon and nitrogen, which had all the essential properties of a nitrate fertilizer. But as the use of calcium carbide rendered the product unduly expensive, a method was sought which would employ a substitute for that material, and this was found by Dr. Erlwein, who brought the nitrogen into combination with a mixture of powdered charcoal and lime in an electric furnace. The product of this combination is a black substance containing, besides the lime and carbon, 10 to 15 per cent. of nitrogen, in perfect condition to be used as a fertilizer. From the experiments thus far made with this new artificial nitrate—which is known in commerce as calcium cyanimide—it appears that its nitrogen acts upon plants quite as effectively as that contained in a proportionate quantity of nitrate of potassium or sodium nitrate (Chile saltpeter). The scientific problem of obtaining nitrogen for fertilizing purposes from the atmosphere would seem, therefore, to be satisfactorily solved. Whether it can be done on a very large scale and at a cost which will make it economically available for general agricultural purposes remains to be demonstrated by practical experience."

HOSPITAL TROLLEY CAR.—At Utica, N. Y., last week, a special trolley car was run over the street-car line from Mohawk village to convey a hydrophobia patient to the hospital.

WISCONSIN WATER POWER.—The United States Geological Survey has just completed an investigation of available water powers along the Chippewa River between Chippewa Falls and Flambeau, Wisconsin, and finds that in this distance of about 42 miles there is a total fall of 243 feet. Only a small part of this is used. The Chippewa Falls Lumber and Boom Company has a plant at the Falls which develops about one-third of the available 7,000 hp. Another company is now at work developing the power at Jim Falls, where there is a head of 33 ft. Points at which there are excellent chances for development are Eagle Rapids, with a 30-ft. drop; Brunne Falls, a fine site for a dam, with about the same head, and Point Creek Rapids, Coltons Rapids, and Chevally Rapids, each with 5-ft. fall. The field work of the Survey was done by Mr. F. T. Fitch, who made a complete map of the river, showing all the islands, rapids and falls, noting at the same time the exact height of the water at the top and the bottom of each fall.

FIRE ALARM SYSTEM.—To Mr. A. J. Woodworth, of Sparrows Point, Md., is to be credited a fire alarm system just patented which is going beyond the ordinary devices and appliances, includes means for operating detonators so as to arouse a whole community where no regular fire service exists. The second claim reads: "In an alarm system, a normally closed outer circuit including a relay, alarm boxes in said outer circuit, normally open primary and secondary inner circuits, means for closing the inner circuits when the outer circuit is opened, a solenoid having a movable core in the secondary inner circuit, means operated by the movement of said core in one direction for instituting the sounding of the detonator and means operated by the movement of the core in the opposite direction for stopping the sounding of the detonator upon the sounding of the detonator, and means operated by the movement of the core in the opposite direction for stopping the sounding of the detonator upon the energization and deenergization, respectively, of said detonator-actuating solenoid.

ELECTRICALLY-HEATED HANDLE.—Mr. R. A. Fliess, a young electrical engineer who has for some time past given special attention to automobiles and storage battery work, has taken out a patent on an ingenious little device for heating handles electrically. Anybody who has ever manipulated an automobile knows how numb and deadened the hands will become in cold weather; and this is true, moreover, of other handles to be worked in the open air. The Fliess handle comprises an electrical conductor forming a heating device, and a core made of a bad conductor of heat located inside the heating section, the outer surface of the core being glazed or polished to reflect the heat outwardly. Such a core would be, for example, porcelain with annular ribs and spaced apertures, enclosed by German silver wire as the conductor. The current supply is, of course, readily drawn from the batteries and a small supply suffices to keep the fingers comfortably warm.

SHARPENING RAZORS.—Mr. Theron Davis, of New York, has patented a plan for sharpening edged tools in a magnetic fashion and illustrates the idea as applied to razors. It is a well-known fact that when examined under a microscope the finest edge will appear as a succession of somewhat ragged teeth. Now, when these teeth are in proper alignment the edge is in condition to do good work, and if the infinitesimal teeth are laterally or otherwise displaced the result is what we call "dullness." The invention affords a simple device which can be applied to any razor or other edged tool and which when in position will by magnetic attraction cause the particles constituting the edge of the tool to turn into the proper alignment for the best cutting. Mr. Davis has found that because of the tendency of magnets to draw to the poles, where a magnet is applied to a cutting edge that is held opposite the poles the tendency is to improve only parts of the edge; but by magnetizing an edged tool and then holding a bar of soft iron or other attractive matter opposite the edge the magnetic attraction is exerted all along the edge, and so a uniform sharpening is obtained.

ELECTRIC POWER IN FRANCE.—Discussing hydro-electric development in France, Mr. J. C. Covert, United States Consul at Lyons, France, says: "France is a country where a large aggregate industry is carried on by individuals in their families, and an effort is being made to furnish these classes with electrical power in their households. It is backed by heavy property owners who feared that the application of steam or electricity in large factories would deprive them of tenants, and they have leased electrical appliances to their tenants, to be paid for by easy installments. In Lyons one of the most populous quarters of the city would be entirely deserted if the weavers could not enjoy the advantages of electrical power in their competition with steam-impelled machinery. In the Department of the Puy-de-Dôme, around the city of Thiers, in the neighborhood of a small stream—the Dore—hundreds of families have small outfits of machinery, with which they make knives. Upon the first proposition to erect a large factory to replace these little family establishments some enterprising men in the neighborhood, moved by philanthropy and the desire to prevent the industry from moving to other quarters, set to work to secure electrical power for the community, and now their machinery is run by electricity brought from a distance of from 50 to 75 km (31 to 46 miles). The manufacture of silks and velvets by steam-propelled machinery in France has driven the hand loom out of thousands of households in Lyons, notwithstanding the struggle to introduce electrical power into family service. The looms have been transferred to the country into farm houses, where they can be utilized in the winter and in weather unseasonable for out-of-door work. In farm houses for a distance of 100 miles around Lyons men, women and children put in their odd hours at work on a loom, generally manufacturing cheap mousselines and the finest of silk velvets. It is proposed to connect many of these isolated looms with a current of electricity, thus introducing power, light and heat into the poorest households of the country."

CONTROL OF ELECTRIC MOTORS.—Mr. Arthur C. Eastwood, of Cleveland, Ohio, has worked out and patented a method to limit the torque transmitted by a motor so as to avoid strain on the receiving apparatus or structure, as well as to arrest the motion of a load operated upon while permitting the armature of the driving motor to continue in rotation and furnish the predetermined maximum torque. An illustration would be the operation of ore buckets, say with a driving and a clutch motor. For example, considering the driving motor to be in operation, its armature will turn the revoluble field frame of the clutch motor around its armature, and such action will generate current in the armature, which current will react with the revolving field frame, so as to cause the armature itself to revolve in the same direction as the field frame, though it will lag behind it by an amount sufficient to generate the necessary current to keep the load connected to it in motion. The current thus generated passes through the separate field winding of the driving motor, and as the load increases, so as to cause the armature to lag behind the field by a greater amount, the current generated will increase in magnitude, still further strengthening the field of the driving motor. As a result the armature of the driving motor is caused to slow down, as is also the rotating field frame of the clutch motor. The further increase of the load continues to increase the amount of slip between the armature and field of the clutch motor until finally a point is reached where the field member will just represent the requisite amount of the slip. In such case the speed of the armature of the motor will be zero, and the load will be at rest. It will be thus seen that when a certain critical load is reached the armature of the clutch member will come to rest while, however, the field frame is still being rotated, though at a comparatively low speed, by the driving motor. The clutch motor will thus be acting as a generator, and the current generated will be limited in amount by the resistance of the armature, the connections and the separate series field winding of the driving motor, together with an adjusting resistance. This maximum or critical current may be varied by varying the amount of this adjusting resistance, which, however, will not require changing after once being fixed so as to limit the current to a predetermined amperage. In the meantime the driving motor will require from the supply mains just sufficient current to compensate for the loss in the system and to hold the load from slipping, so that although the clutch motor acting as a generator will be delivering its maximum current when its armature is stalled the amount of energy required from the line will as a whole be quite small, since said current from the clutch motor is at a very low voltage, just sufficient to force it through the resistance of the armature, connections, separate field winding, and fixed resistance.

LETTER TO THE EDITORS.

Choice of Wattmeters.

To the Editors of Electrical World and Engineer:

SIRS:—Referring to the article by the undersigned in ELECTRICAL WORLD AND ENGINEER, dated November 21, I would direct attention to the fact that the editorial on the subject of this article on page 828 is rather unfortunately worded when it states that "The meter which has the largest driving torque per watt, and the largest full load torque will be the meter which is less likely to retard seriously at light load through undue mechanical friction." This is entirely opposed to one of the points brought out in the article, which states that "It is only by keeping the moving parts as light as possible and the torque relatively high that the best results are obtained."

Thus your editorial would have been more nearly in line with the writer's meaning if it had stated that "The meter which has the largest driving torque per unit weight of movement, providing this weight is not excessive, will be the meter which is least likely to retard seriously at light load through mechanical friction."

NEWARK, N. J. PAUL MACGAHAN.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Compounding of Alternating-Current Generators.—HEYLAND.—An article in which the author gives the theory of his new system of compound synchronous machines which has been evolved from his older method for compounding non-synchronous machines. Machines of this new synchronous type have already been built by Kolben. The author shows that the behavior of his new machine may be represented by diagrams quite similar to those for the non-synchronous machine. The new generators are ordinarily synchronous machines, of the well-known type with stationary armature and revolving pole system, and may be imagined to have been evolved from his former non-synchronous machines by assuming that the rotor is provided with a single phase (instead of polyphase) winding. It is then possible to go a step further and replace the non-synchronous rotor by a pole wheel, the single-phase winding by a pole winding. This pole winding is distinguished from an ordinary pole winding only in so far as it consists of several wires in parallel and is connected in a corresponding way to a commutator to which the exciting and compounding current is directly supplied as single or polyphase alternating current. The author first discusses the compound machine. In the same manner as it is done with the non-synchronous machine, the commutator is supplied with the exciting end load current. From the diagrams developed it is concluded that the compounding is just as perfect as in the non-synchronous machine. This result is said to be confirmed by Kolben's tests. The author then discusses the method of self-excitation of these machines without compounding. Direct shunt excitation is used with alternating currents, the brushes being set in an advanced position. It is then possible to insure that for a load with a phase difference below a certain limit there is no voltage drop. The voltage remains approximately constant and even increases slightly with increasing load. Besides this voltage regulation, these machines have all other practical advantages, especially the saving in material in common with the compound machine and are even simpler than the latter because there is no compounding transformer. As generators they render exactly the same service, for instance, in the case of existing plants which already have a good regulation of voltage, or in the case of larger central stations in which the variations of voltage are generally slight.—*Elek. Zeit.*, November 5.

Speed Regulation of Direct-Current Motors.—BROADBENT.—An article in which the author claims there is a tendency in the American technical press to overesteem the point of speed control for ordinary work, and to boom special systems. A recent article of Hemingway (ELECTRICAL WORLD AND ENGINEER, October 3) is quoted, in which the variation of magnetic density of the field magnets is made use of. The present author thinks that such machinery would be too expensive. Multiple voltage and similar systems, although probably not increasing the cost of the motor itself, increase the cost of the installation as a whole, as well as the cost of upkeep. He points out that simplicity has a commercial value and that standard motors can be bought in the open market in England in which a speed regulation of 2 to 1 can be obtained by means of a shunt rheostat control; nor is there any difficulty, apparently, in obtaining the ratio of 3 to 1 by the same means. This method he thinks will be satisfactory for general work.—Lond. *Elec. Rev.*, November 13.

REFERENCE.

Compensated Series Motor.—OSNOS.—A theoretical article illustrated by diagrams. Of all single-phase commutator motors, known at present, the compensated motor may be the most interesting one. In the bipolar type it has two pairs of brushes. One pair of brushes is connected in series with the stator winding (as in the ordinary series motor) and a line which would connect them is perpendicular upon the axle of the stator winding. The other pair is short-circuited in the direction of the axle of the stator winding. The author first gives a graphical theory of this motor. Among the various results, derived by him, is the following on the influence of the air-gap. For the same phase difference and under otherwise identical conditions, the number of revolutions of the motor must be the larger, the greater the air-gap. Reversely, for the same number of revolutions and under otherwise identical conditions, the primary phase difference is the greater, the greater the air-gap. The article closes with the development of the analytical formulas of the motor. —*Elek. Zeit.*, November 12.

POWER.

Drainage by Electricity.—An account of an electric power transmission scheme in connection with a drainage and sewage disposal system near Birmingham. Two steam generators, aggregating about 175 hp, will generate 2,300-volt, three-phase currents of a frequency of 50, which will be transmitted over the overhead transmission line, 5 miles in length, and will be tapped at eight points along the route, at each of which a small sub-station will be erected, containing step-down transformers for reducing the pressure to 200 volts. At four sub-stations centrifugal pumps, directly connected to induction motors, are to be installed for the purpose of pumping the water from the main culvert, running the whole length of the estate, on to the land. In all 14 motors ranging from 2 hp to 28 hp, are to be provided, and a number of them will drive farm machinery or machinery used in connection with the treatment of sewage.—Lond. *Elec.*, November 6.

Removing Water from Peat.—A note on a recent trial made in London with a new process for converting peat into the equivalent of coal of high calorific value. "Peat, said to contain 70 to 80 per cent. of water, was placed in a perforated cylinder, which was rotated so as to throw off free water. An electric current of 220 amp. at 200 volts was then passed through the peat, and this, according to a circular describing the process, generated heat of a particular kind, which drove off the remaining or latent water. We have been informed, however, that the action was an electrolytic one, the current splitting up the cell, driving off the latent water, and leaving all combustible material behind." Some inconsistencies in the claims of the inventors are pointed out.—Lond. *Elec.*, November 6.

TRACTION.

Single-Phase Traction.—A long editorial in which, after some notes on the Lamme and Finzi motors, the writer says that "a most simple solution of all the difficulties" has been found in the Eichberg and Winter motor, in use on the short Spindlersfelde road, near Berlin, already noticed in the Digest. "We have satisfied ourselves that the claims made for this motor are perfectly justified, but at present we are not at liberty to go into constructive details." In outward appearance the motor does not differ materially from the well-known General Electric direct-current motor. The outside dimensions for any given power are practically identical. All the standard direct-current controlling apparatus, either of the ordinary series parallel or the multiple-unit type, including the automatic switches, which have proven so successful, are applicable to the alternating-current system, "the only difference being that, to all intents and purposes, there are no resistances, and that the number of controller contacts for giving variations in speed is less in the alternating than in the direct-current system." The power factor at normal speed is unity, and as that for the lowest starting speeds is very little below 0.8, the average power factor for the complete system will probably be in the neighborhood of 0.9, which is practically as good as what is now obtained where rotary converters are used. The efficiency is practically the same as that of an equivalent direct-current motor, and the average acceleration obtainable is quite as good, with the additional advantage that the rate is as nearly as possible uniform during the total period of acceleration, which is not the case with direct-current motors. The motor may easily be changed from a series to a shunt machine. The motors are so arranged that the commutator only takes a low-pressure current, the voltage of which, however, may be as high as 600 volts if desired. The high-pressure current need not pass through any transforming device, and its voltage, except for insulating reasons, can be raised as high as wished. Any frequency can be used as far as the motor is concerned. At present a frequency between 25 and 40 is used and has given perfect satisfaction. The writer is very enthusiastic concerning the future of the motor. "There is nothing of an experimental nature about it, and the controlling devices are identical with the well-known apparatus used in continuous-current traction. This discovery will mark a new era in the application of electricity to main lines, for the results so far obtained practically solve the traction problem. This, however, is not all, as the motor is so simple in construction and regulation and so versatile, that in the near future it should undoubtedly displace not only continuous-current motors, but all polyphase motors as well. Polyphase installations appear to be doomed, and we may even see a return to single-phase distribution at 25 or 50 cycles for all purposes."—Lond. *Elec. Rev.*, November 13.

Conestoga Traction Company.—An illustrated description of an extensive system of city, suburban and interurban lines extending throughout Lancaster County, Pennsylvania, and connecting Lancaster, Columbia and the other principal points in that section as well as furnishing local service. It comprises a large number of lines that were organized independently, but have gradually been consolidated into one general system. Recently a number of improvements have been undertaken, including the construction and equipment of a large power house, several sub-stations, and the rearrangement of the transmission and distribution system. The power house will contain three steam-driven, 1,000-kw alternators, which are of the engine type, with rotating field designed for operation at 25 cycles, three-phase, developing 1,000 kw at 7,500 volts under normal conditions. The current is used for lighting, power and railway work, the greater part of it, of course, being employed in the operation of the railway system. A separate building, entirely independent from the main power house, has been designed for housing the transformers, the lightning arresters and the high-tension apparatus. An underground tunnel between the main power house and this transformer station carries the cables from the switchboard to the transformers. In addition to the sub-stations at the principal points of distribution the company has fitted up a portable sub-station of 250-kw capacity with step-down converters, circuit-breakers and arresters, which can be utilized at any point on the road where there is an unusual demand for power.—*St. R'y Jour.*, November 7.

Tramway Sub-Station.—A description of a sub-station, designed to furnish power to cars operating between Kittery, York Beach and Dover, on the Portsmouth, Kittery & York Street Railway, and to act as an auxiliary to the existing station at Kittery Point, and in conjunction with the company's storage battery at Long Beach. Current is supplied to the sub-station at 10,000 volts over a three-phase transmission line. The equipment at the station comprises a 200-kw, twelve-pole, 550-volt, 60-cycle, three-phase rotary converter, running at 720 r.p.m., and three 76-kw stationary transformers with a two-panel switchboard. The primary voltage is 11,000 and the secondary 391. The transformers are oil-cooled, and are operated without oil switches.—*St. R'y Jour.*, November 7.

Ball Bearings for Tramway Motors.—A note on recent tests made by the Berlin tramway company with two tramway motors fitted with ball bearings. The results are said to have been so satisfactory that the company has decided to introduce such motors on a large scale and has given orders for 100 similar machines. Although by their adoption a saving in friction losses of about 1 per cent. is effected, the chief advantage of the ball bearings lies in the direction of economy in lubricants and the ease with which these are applied. The wear of the balls and ball races is said to be "very small."—Lond. *Elec.*, November 6.

REFERENCES.

Economy of Tramways and Electric Traction without Rails.—Hecker.—On the basis of statistical data the author had previously developed an empirical relation between the number of inhabitants in a district and car-kilometers per year, also a relation between the latter and the income. He now uses these relations to calculate tables which shall enable one to decide whether in a given district an electric tramway will pay, or only electric traction without rails or neither system.—*Elek. Anz.*, November 8.

Laying Tramway Rails.—Sattler.—The first part of an article, illustrated by diagrams and giving some mechanical details of the method of laying tramway rails, especially with wood or asphalt pavement.—*Elek. Anz.*, November 15.

Installations, Systems and Appliances.

Spain.—Blumenthal.—An article on electric central stations in Spain. On account of the scarcity of coal for making gas, only the largest cities are provided with gas works. Before the introduction of electric light, petroleum and oil were the chief illuminants in Spain. In recent years, however, electric light has come into very extensive use, not only in the houses of the more prosperous classes, but quite generally throughout the towns. There were installed 6,575 kw in 1880, 12,762 kw in 1890, 78,475 kw in 1901, and at present about 100,000 kw. This represents 5 watts per inhabitant. (In Germany 438,772 kw were installed in 1902, i. e., 7.5 watts per inhabitant.) There are about 1,000 central stations in Spain, and the development of electric lighting has been especially rapid in Madrid and Barcelona. In the larger cities the three-wire, direct-current system is mainly used with 220 volts between the outers, some plants using, however, alternating current. In Madrid 16,600 kw of machines and 17,700 kw of storage batteries are installed, so that 66 watts are installed per inhabitant (against 48 watts per inhabitant in Berlin). Since 1890 the development of water power has steadily increased, alternating current being mostly generated and transmitted to a number of different towns. The keynote of all these installations is simplicity of arrangement. Nothing is installed that is not absolutely necessary. For instance, no attempt is made to keep the pressure at the consumers' terminals constant; the voltage in the station is maintained constant, so that the voltage at the lamps varies according to the load. For distribution the two-phase system (Fig. 1) is widely used, since it has the advantage that it can be resolved into two single-phase systems, so that the larger towns can be provided with two feeding points. Many mills have hydro-electric power plants, the current being used by them during the day for power purposes and sold in the evening to towns in the neighborhood. There are no meters in use. To control to some extent the current consumption by the customers, automatic circuit-breakers are often installed which interrupt the current when more than a certain number of lamps are lighted simultaneously. But these devices are mostly very ineffective and often do not break the circuit at even double the current for which they are set. The financial return of the electric stations are high, a dividend of 30 or 35 per cent. being nothing unusual. The methods of house wiring are very crude. Some high-tension transmission plants have recently been erected. Three such plants of the Hidroelectrica Iberica Company are in course of erection and

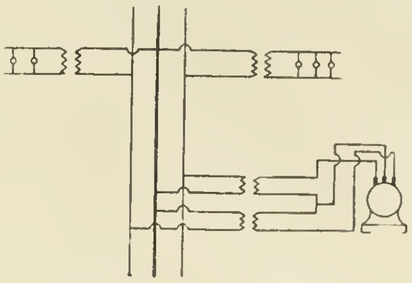


FIG. 1.—TWO-PHASE DISTRIBUTION.

one, in which currents are generated at 30,000 volts, will soon be opened. A company has recently been formed to develop nearly all the water powers of the Province of Catalonia, with an aggregate of 100,000 hp. Municipal plants are nearly unknown in Spain, the stations being owned by private companies. Gas engine plants begin to find more and more favor. Electric traction is still largely undeveloped, although a few cities have extended networks of tramways.—*Elek. Zeit.*, November 5.

Wires, Wiring and Conduits.

REFERENCE.

Cables.—Schmidt.—The conclusion of his article in which he gives illustrated notes on the construction and manufacture of direct and alternating current, low tension cables and on recent progress in the manufacture of high tension cables. The article is concluded by a table of cables made for 6,000 volts or more. Only seven German cable works are, however, considered. The list comprises 55 installations of cables, among them 16 for 10,000-volt, single-phase alternating current; 3 for 15,000-volt, single-phase; 1 for 20,000-volt, single-phase (Cartagena, Spain), and 1 for 50,000 volts (Exposition in Duesseldorf).—*Elek. Anz.*, November 8.

Electro-Physics and Magnetism.

Demonstrating and Measuring Radioactivity.—Strutt.—A description of a simple apparatus which exhibits in a striking manner the dissipation of negative electricity from radium by the cathode rays evolved by it, and the accumulation of a positive charge. A glass tube, *a*, with thin walls, is hermetically sealed and contains the radium preparation, as shown in Fig. 2. It is suspended from above by the quartz rod, *b*, while from its lower end hang a pair of gold or aluminum rods, *c c*. The glass tube, *a*, is smeared over with a conducting coating of phosphoric acid, and the whole system hangs from the stopper, *d*, of the glass bulb, *f*. Strips of tinfoil, *e e*, at the sides of the bulb are connected to earth. As long as there is air in the bulb no divergence of the leaves is observed, since the radium rays make this air a conductor. But if a good vacuum be made in the vessel, the leaves soon begin to diverge, owing to the loss of negative electricity by the radium. This divergence increases until the leaves touch the tin-foil strips. When this happens the leaves are discharged and collapse, and the cycle recommences. With a weak radium preparation, the author obtained a full divergence in about 20 hours. But with a more active preparation the cycle can be completed in course of a lecture. The time in which the cycle is completed is, of course, an indication of the degree of radioactivity of the substance in *a*.—From *Phil. Mag., November*; in Lond. *Elec.*, November 13.

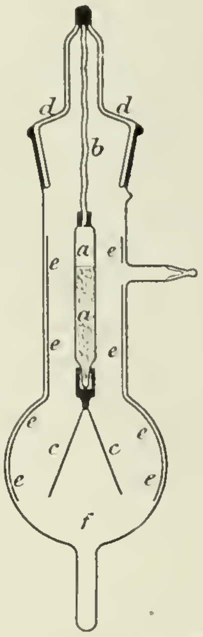


FIG. 2.—MEASURING RADIOGRAPHY.

Spontaneous Heat Emissions of Radium Salts.—Some editorial notes on a recent letter, published by Rutherford and Barnes in *Nature*. They found that the heat emission is proportional to the α radiation with which it varies directly. Only 25 per cent. of the α radiation, however, comes directly from the radium itself, while the remaining 75 per cent. is due to the radioactive emanation occluded by the salt and continuously generated by the radium. The authors, therefore, perform the following experiment: They measure the heat emission from 30 mgm. of radium bromide. Then, by heating the substance, they drive off all but a few per cent. of the occluded emanation, and condense the latter in a small glass tube cooled in liquid air. The tube is then sealed up and contains all the emanations which the radium has lost. They now find that the heat emissions from the radium has been reduced to 30 per cent., while the glass tube containing the emanation emits heat to the extent of 70 per cent. of that of the original radium. As time goes on and more emanation is produced by the radium, the heat effect from the latter increases gradually, while that from the emanation decays gradually. The actual amount of emanation obtainable from 30 mgm. of radium bromide is quite invisible and unweighable, and has so far only been detected by its radioactivity, and the phosphorescence and ionization produced by the latter. Yet 70 per cent. of the heat emission of a radium salt is due to this invisible amount of gas. This result cannot be explained on the view that the radium gains its heat from an external source, whereas the disintegration theory of Rutherford and Soddy leads directly to its prediction. On that theory the energy of radioactivity is derived from the internal energy of the atom liberated when it breaks up into smaller systems.—Lond. *Elec.*, November 6.

REFERENCES.

Permanent Magnets.—Emde.—A communication referring to a former statement of Busch, who claimed that from all experiments made with permanent magnets the conclusion must be drawn that a permanent magnet is not to be considered as the seat of a certain number of lines of force, but as the seat of a certain magnetomotive force. The present author shows that this would lead to the result that a formula which is considered to be correct and which is very often used, must be wrong. He points out that our ideas on "true magnetism" are still vague. The question has not yet been conclusively answered, what in a "permanent magnet" is quantitatively permanent when the magnetic reluctance is changed.—*Elek. Zeit.*, November 12.

Temperature and Ionization.—McClung.—An account of an experimental investigation as to the manner in which the ionization of air by Röntgen rays is affected by the temperature. As far as his experiments go, no such effect was observed.—From *Proc. Cambr. Phil. Soc.*, October 21; Lond. *Elec.*, November 6.

Electro-Chemistry and Batteries.

Electricity Direct from Carbon.—Lorenz.—A summary of the present state of the problem of converting chemical energy of burning carbon directly into electricity. Slow combustion involved in the electrolytic process such as in an ordinary voltaic cell suffers under three disadvantages—viz., the slowness of the reaction between carbon and oxygen at ordinary temperatures, the impurity of the carbon, which gives rise to complicated hydrocarbons in solution and the necessity of using the highly-priced conducting forms of carbon instead of ordinary coal. These circumstances lead to the adoption of a gaseous "electrode" consisting of carbon monoxide, as in the cells of Bucherer and Borchers. In these, however, the currents obtained cannot be proved to result from the further oxidation of the carbon monoxide. Indeed, the existence of carbon monoxide ions has yet to be demonstrated. Another but more indirect way of utilizing the energy of carbon is that suggested by Nernst, in which carbon is used for regenerating other cells, such as a Daniell cell, by the reduction of the zinc sulphate. Another method proposed by Nernst is to heat an accumulator having a negative temperature coefficient until its e.m.f. disappears and then let it cool. Dolezalek has, in fact, obtained an e.m.f. of 0.6 volt between two lead accumulators having a difference of temperature of 90°. The problem is theoretically soluble, but will require much detail work for its final solution.—From *Mit. Phys. Ges.*, Zurich, No. 5; in Lond. *Elec.*, October 30.

Carbon Cell.—Jone.—A long illustrated description of a cell which is called a "coal battery" for the reason that when the cell is discharged and then restored to its original condition by chemical means, nothing has been used up except coal and the oxygen of the air. The cell has a positive electrode of tin and negative electrode of carbon, with mercuric oxide as depolarizer. The latter is contained in a porous carbon cup. The electrolyte is a hot aqueous solution of caustic potash. When the cell discharges the tin electrode is oxidized to stannous oxide, while the mercuric oxide is reduced to mercury. The cell is restored to its original condition in the following way: A reduction furnace is provided for reducing the oxide of tin to metallic tin, the waste gases from this furnace being utilized for heating the cell. The mercury is converted into nitrate by treatment with nitric acid and the nitrate of mercury is then broken up by heat into mercurous oxide and nitrous vapors. By oxidizing the latter in the presence of steam and atmospheric oxygen, the nitric acid is regenerated. The e.m.f. of the cell is 1.06 volts. The efficiency of the entire cycle with apparatus of several hundred horsepower capacity, is estimated as 66 per cent. of the energy of the coal consumed. Mr. Jone has been working on this for some years.—*West. Elec.*, November 21.

REFERENCES.

Electrodeposition upon Aluminum.—Fischer.—Some notes on depositing metallic films upon ordinary aluminum. Coatings of copper, silver, nickel, zinc and tin may be obtained directly upon aluminum, but films of gold, "brass" and arsenic are best applied upon substrata of copper, nickel or silver. Aluminum coated with copper or silver can be "oxidized," and there will be no danger of the deposit coming off; but the use of hot liquids and more particularly the hot solutions of alkali sulphates must be avoided or the deposit may blister. If the aluminum has been tarnished by the exposure to air, it must be cleaned.—From *Chemiker-Zeitung;* Lond. *Elec. Rev.*, October 30.

Ferro Metals.—Rossi.—An article on the ferro metals and their manufacture in the electric furnace. The reduction of the ores by means of carbon or aluminum is discussed and the properties and uses of the various ferros, and especially of ferro-titanium, are discussed in detail.—*Iron Age*, November 12.

Units, Measurements and Instruments.

Measuring the Wave Length of Electric Oscillations.—Doenitz.—An illustrated description of an instrument for measuring the wave length of electric oscillations, devised especially for use in connection with tuned wireless telegraph systems. The accuracy of such measurements depends mainly upon the conditions of damping; the smaller the damping of the measuring instrument and the smaller that of the oscillating system under test, the more exact is the measurement. A circuit, containing self-inductance and capacity, is tuned to a distinct frequency, which depends in a simple way upon that self-inductance and capacity. Such a circuit with the inductance L_1 and capacity C (Fig. 3) may be charged from an induction coil, *J*.

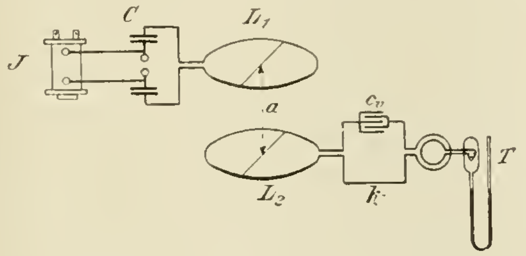
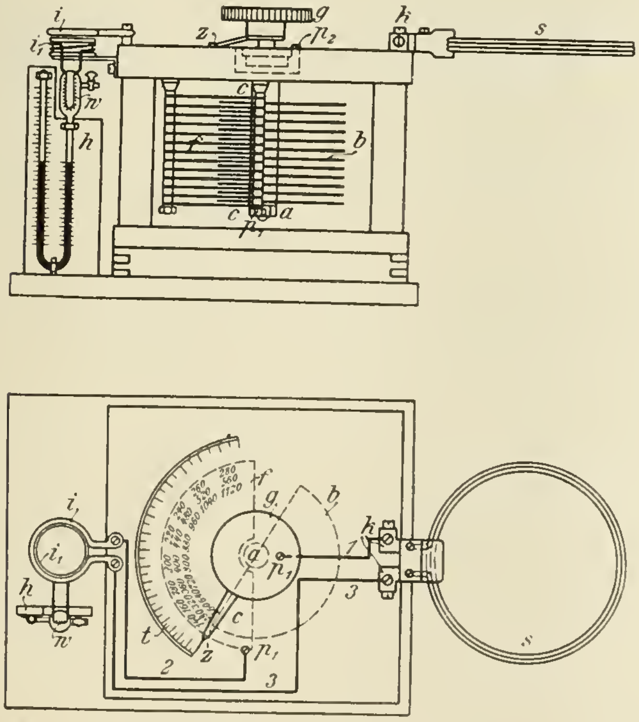


FIG. 3.—MEASURING WAVE LENGTHS.

When the condenser, *C*, discharges through an air-gap, electric oscillations of a distinct frequency are produced. A second circuit, which contains the variable capacity, *cv*, and self-inductance, L_2, is set into oscillations by the inductive action of L_1 upon L_2 and the current flowing in the second circuit is measured by a very sensitive hot-wire instrument, *T*. If the oscillation in the first circuit ($C L_1$) remains the same, the current produced in the second circuit (in which *cv* and L_2 may now also be assumed to be kept constant) depends upon the distance *a* between L_2 and L_1. If *a* is very small ("strong coupling") the resonance circuit reacts back upon the primary circuit and the resonance curve is distorted. It is, therefore, better to make *a* not too small. There is a certain distance, *a*, for which the amplitude of the current in the secondary resonance circuit (L_2) becomes a maximum. This distance, *a*, represents what the author calls a "loose coupling" between the primary and secondary circuits. If, now, this distance, *a*, is kept constant, and if the oscillations in the primary circuit are left unchanged, then in order to get resonance in the secondary circuit (which manifests itself by a maximum deviation of the hot-wire instrument, *T*), it is necessary that the product, $L_2\,cv$, has a certain value, so that if L_2 is increased, *cv* must be diminished. If the hot-wire instrument shows that the condition of resonance exists and if the values of L_2 and *cv* are known, then the wave length of the oscillation may be easily calculated. This is the principle upon which the author's instrument is based, which is shown in Figs. 4 and 5. *s* is a self-inductance and the arrangement is made that *s* may be easily replaced by coils of other values of self-induction. *c* is a condenser, the capacity of which can be changed within wide limits. *h* is the hot-wire instrument; in order to get readings of suitable value in the measurement of wave lengths of different size, this instrument is excited by the induction and the distance between the secondary windings, i_1, from the primary winding, *i*, can be changed at will. This hot-wire instrument serves only for indicating the condition of resonance, which is indicated by a maximum reading of the instrument. The capacity, *c*, is an adjustable condenser in a case filled with paraffine oil; it contains a fixed set of parallel plates, each having the area of a half circle, and all being connected to the pole, p_1. Connected to the other pole, p_2, is another set of similar plates, which can be revolved around the axle, *a*, and can thus be brought to a greater or less extent into the intermediate spaces between the plates of the other set. In this way the value of the capacity of the condenser can be widely varied. The capacity, *c*, and perhaps also the self-inductance, *s*, are changed until the hot-wire instrument indicates the condition of resonance; the wave length may then be easily calculated from the measured values of *c* and *s*. The arrangement of the instrument to make its use easy in practice is described in detail.—*Elek. Zeit.*, November 5.



FIGS. 4 AND 5.—PRINCIPLE OF INSTRUMENT FOR MEASURING WAVE LENGTHS.

Induction Coil.—Armagnat.—A long article, illustrated by diagrams, on the forms of the currents in induction coils. The author discusses a number of curves obtained by means of the Blondel oscillograph with various induction coils. These curves show the usefulness of Blondel's instrument and also emphasize the incompleteness of theories on this instrument and the great complexity of the phenomena. Some conclusions, drawn by the author from his observations, are as follows: The damping of the first oscillation is due to sparks, both primary and secondary ones. Hysteresis apparently plays an important part in the damping of the later oscillations. The oscillations are not simple, at least not always, since they are the sum of various oscillations of different period and damping. The secondary current delays the demagnetization and can become troublesome for the perfect operation of the interrupter. The e.m.f's induced in both circuits depend—all other things being equal—upon the resistances opposed to the sparks, and not on the maximum value of the primary current, as long as the latter is above a certain value. —*L'Eclairage Elec.*, November 14.

Recording Mariner's Compass.—Fabry.—An illustrated description of an instrument devised by Heit, for automatically registering the course of a vessel. All deviations of the compass are automatically recorded by electromagnetic means.—*L'Ind. Elec.*, October 25.

Telegraphy, Telephony and Signals.

Telephony for the Transmission of Newspaper Reports.—A note stating that the use of the telephone—instead of the telegraph—is now being introduced commercially for the transmission of newspaper reports. A recent two hours' speech of Chamberlain at Birmingham was thus transmitted to London and while the speech was concluded at 10:05 P.M. an edition with a verbatim report of the speech was issued in London at 10:32.—Lond. *Elec.*, November 6.

Wireless Telegraphy.—The first part of an article giving brief abstracts, often illustrated by diagrams, of patents granted since 1901, in various countries on the subject of wireless telegraphy.—Lond. *Elec.*, November 6.

Miscellaneous.

Radium and Cancer.—A note on a recent report of Exner on the treatment of cancer by radium. In nine cases under observation radium has effected very considerable abatement in the cancerous swelling, and in two of these cases the swelling has not reappeared, although five months have elapsed since the treatment. In one case, where it was impossible to operate for cancer in the palate, radium had effected considerable improvement, the swelling having been reduced to a minimum. Exner concludes that in cases in which an operation is possible this course is preferable; but the radium treatment is advisable in cases where an operation is impossible.—Lond. *Elec.*, November 6.

British Electrical Engineering Statistics. DIGBY.—The first part of a statistical article on the import and export trade of the United Kingdom so far as "electrical goods" are concerned. Several tables and diagrams are given showing the variation of the export trade from the United Kingdom during the last 10 years. The general tendency of the article seems to be to show that opinion held by many Englishmen—that England has lost her proper position in the manufacture and supply of electrical machinery—is too pessimistic. In an editorial note it is said that the Board of Trade returns, upon which the tables are based for the most part, cannot always be relied upon for proper classification, and that the figures given for imports of electrical goods are undoubtedly too low. The article is to be continued.—Lond. *Elec.*, November 6.

New Books.

ATLANTE DI MACCHINE E CALDAIE. By Salvatore Dinaro. Milan: Ulrico Hoepli. 80 pages, 112 illustrations. Price, 3 lire.

This little volume is somewhat unique, both as a specimen of book-making and of editorial work. The first 110 pages consist of a similar number of full-page diagrams, reproduced from dimension drawings and are evidently accurately to scale. The plates treat exclusively of steam apparatus, showing sections of various kinds of boilers, furnaces, boiler settings, methods employed in boiler construction, steam gauges, valves of all kinds, blowers, steam pumps, indicators, steam whistles and finally assembled steam engines. Then follow 80 pages of concise descriptions of the various plates which are so compressed as to be definitions rather than descriptions, and would be readily comprehended only by those who are skilled in the art. As a handbook for the draughtsman occupied in designing steam machinery the book will be found an exceedingly desirable companion.

DIE MONTAGE ELEKTRISCHER LICHT UND KRAFTANLAGEN. By H. Pohl. Hannover: Gebruder Janecke. 272 pages, 328 illustrations. Price, 4.40 marks.

This is a handbook for the power station designer and operator, chiefly directed to illustrating the methods of installing electrical apparatus in electric light and power stations. There is little discussion of the merits of various kinds of apparatus, for the intention of the book is to show how to install and not what to install. It is very completely illustrated with half-tones, from a number of the largest German stations, together with reproductions of the floor plans and switchboard drawings from which these plants were constructed.

The data upon switchboards, together with plans and instructions for wiring between generators and other station apparatus is particularly worthy of attention. Full illustrations are given of the methods used in bringing circuits into the building and the precautions which should be taken in installing the conductors.

In style the book is chiefly descriptive, although there is considerable valuable tabular matter of a statistical nature. It is not a book for the beginner, but for the practicing electrician.

TELEPHONY. PART IV. CONSTRUCTION OF AERIAL LINES. By A. V. Abbott. New York: McGraw Publishing Company. 277 pages, 143 illustrations. Price, $1.50.

This interesting and valuable book constitutes Part IV of the series which Mr. Abbott has been contributing to the pages of ELECTRICAL WORLD AND ENGINEER, and which are now being reduced to book form. There will be six parts in the book series, and the present section deals specifically with pole lines. It might seem that this subject was more or less hackneyed, but Mr. Abbott has brought to bear upon the theme a vast amount of special information, and has illustrated his book with a large number of new cuts and diagrams. The various topics treated include the poles as such, discussion as to timber used, questions relating to iron and copper wires, estimates and costs of the work, cross arms and pins, guy wires, etc., comparisons between the costs of overhead and underground work, and other details of a like nature, in regard to which the book may be said to embody all the latest and best practice. Telephonic work represents the two extremes of pole line construction in goodness and badness, and Mr. Abbott's book sets a standard not only as to what may be avoided, but as to what should be copied and insisted upon. It is encouraging to believe that in telephonic work the lighter and flimsy construction of earlier years is rapidly disappearing, so that at no distant date telephone aerial circuits as a whole will compare favorably with those employed in any other class of electrical transmission. The book is well printed and has a complete table of contents and list of illustrations, as well as an excellent index. The parts now printed in this series include the location of central offices or exchanges, underground conduits, the cable plant, and the present section on aerial lines. The parts that are to follow will deal with the sub station or subscriber's apparatus and switchboards, and central office apparatus. When complete the series will present an encyclopedic review of the practical telephonic art of the day.

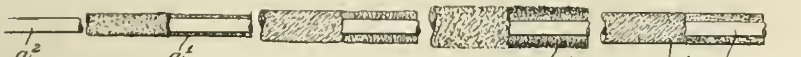
Fire-Proof Wire with Homogenous Insulation.

By WILLIAM H. EASTON, PH.D.

The most important function that is required of an electrical insulator is that it shall insulate. In view of the vast number of materials that offer sufficient resistance to the electrical current to be used as insulators and in view of the universal use for which such substances have been employed, it may seem a little absurd to say that the present insulators are not fulfilling their primal duty under such conditions to which they are constantly subjected. All varieties of conditions have appeared to which insulators must conform and in the majority of cases the demands have been met to entire satisfaction. From the Pacific cable to the finest wire used in the most delicate instrument, the whole ground seems to have been covered—water, frost, pressure have been guarded against with entire success—the heaviest known currents have been confined within conductors without damage to the dielectric—indeed, almost every adverse force has been successfully combated with except one, and that is heat. While admirable in all other respects, the insulations used generally to-day are singularly defective in offering any resistance to a temperature much above the boiling point of water, and in consequence there is scarcely a mechanism of whatever kind in which the electric current is used that does not have to be guarded with the greatest care lest a sudden overheating should destroy the insulation upon the wire and render the apparatus useless. Considering the commonest materials that are used for insulating wires—cotton, silk, rubber, paraffin, etc.—it is seen at once that all are of an extremely inflammable nature, and more than this, are rendered unfit for use at temperatures far below the point where they would burst into flame.

It is to fill this gap that the Heany fire-proof wire has been devised and manufactured. No one with the least experience in electrical matters can fail to see the great importance of a wire that heating cannot injure. Defective insulation is said to be the greatest stumbling block to electrical progress, every failure of the insulation being another argument for the use of a steam or gasoline engine that has no such delicate material within its makeup. Cotton is the chief among insulators for many reasons, but cotton must contain 15 per cent. of water to be flexible and strong. When dried out it is brittle and can be crumbled. Now, there is nothing easier than for a conductor carrying a current to become heated. In dynamos and motors, where perfect insulation is absolutely essential, and where in many ways the highest type of electrical development and use is found, such heating is an invariable consequence of their use. The flow of a current through a conductor, as all offer resistance, always produces heat—unnoticeable in some cases, but intense enough to melt the most unfusible conductors in others. Motors and dynamos in use always become heated to a slight degree, and this has the effect of drying out the cotton, rendering it brittle as mentioned above. Now, even with the most careful use, cotton in this condition will not support forever the pressure it must bear within a coil, and it becomes crushed, a short-circuit is developed and in a second the whole coil burns out. But how frequently does a more serious accident bring such a machine to an abrupt end? Loss of time and money are only the lesser evils of this occurrence—the worst being the loss of prestige of electrical machines in general. What is true for motors and dynamos is true for all electrical devices. Measuring instruments, arc lamps, telephones, telegraphs, etc., all have to undergo the same risk of being destroyed, no matter how well protected, for nothing is "fool-proof," and no one can say where the lightning will strike next. There is also another and a more serious aspect of the case. While such insulators are easily destroyed they are also among the chief of destroyers by fire.

These are the main considerations that have called the Heany fire-proof wire into existence, and though to withstand heat is the main purpose in its manufacture, none of the other properties of insulation must be neglected. The covering employed must be strong, flexible and moisture-proof, as well as offering a high resistance to the current. To do this requires a total departure from the usual methods of insulating wire. The Heany insulation consists of a fibrous web so cemented together and so treated by heat and pressure that it not only forms a compact, homogeneous mass in itself, but forms a chemical union with the copper wire, and this union is strengthened by heating, no matter to what degree. The accompanying cut shows the method by which this insulation is applied. A^2 is the copper wire, a^1 a chemical adhesive upon which the fibre is placed in a flocculent form, A^1 gives the completed wire after being firmly compressed and the constituents united by heat. All this is done in one operation and it may be mentioned that this insulation is not more costly than a double nap of cotton and less in thickness, and the diameter shows a deviation of not more than 0.002 of an inch when measured by a micrometer.



SECTIONS OF FIRE-PROOF WIRE INSULATION.

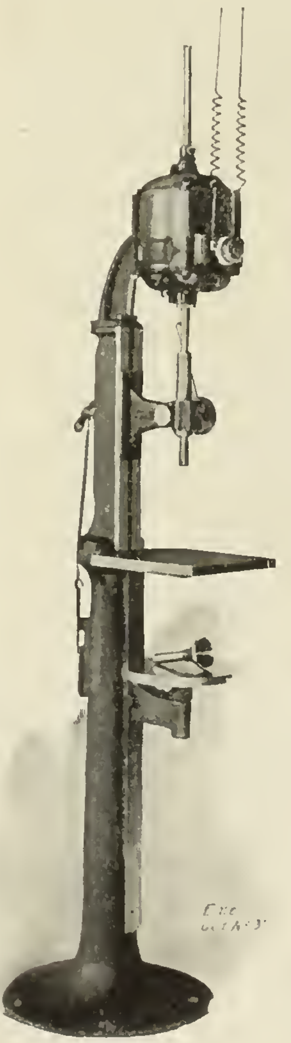
This insulation is practically indestructible. It is very strong and perfectly flexible, withstanding bending and twisting that will break the wire before it parts, without cracking, dripping or peeling off. Weathering for months does not injure it, nor can heat, cold, water or acid cause it to lose its flexibility and strength. It cannot be crushed on the wire by winding in coils and resists abrasion admirably. Its most important property is its ability to withstand heating without injury. As it contains nothing that is inflammable, it cannot burn or carry flame, and it will resist temperatures that will cause the copper within to melt before breaking down. A coil in Mr. Heany's laboratory at York, Pa., has been heated red-hot once a day for several months by a heavy alternating current and still remains perfect, while long before red heat is reached the coil becomes hot enough to set fire to wood, paper, etc., showing that a temperature sufficient to set fire to the building containing the motor used does not harm the insulation in the least. In the official test, the wire was made red hot for thirty minutes with 45 amp. and then finally the conductor fused, but before this there was no break-down. This means that no accidental overload can in any way injure the insulation on the wire in coils and the immense value of this property must be evident to every one who has had any experience in electrical devices.

Another great advantage lies in the fact that a minimum sized wire may be used in all electrical apparatus—such as motors, generators, solenoid and magnet, etc.—the fusing of the wire and the protection of the building alone being considered in calculation of the factor of safety. For example, let us say No. 16 wire will carry the current and do the work well, but yet for the safety of the cotton insulation No. 14 wire must be used, as a smaller conductor will heat much more readily than a larger one in case of accident. With the use of the present insulation, however, smaller wire may be employed, saving 30 per cent. or more of the weight of metal and reducing the machines and instruments to one-third in size. Here we have a great saving in first cost, and the absolute assurance that burning out is impossible, and that since mechanical accidents to a motor are of rare occurrence compared to the frequency of damage to the insulation, the machine will, speaking generally, have to wear itself out before it ceases action, and is transformed from a rather doubtful to an exceedingly reliable piece of mechanism. The insulation is also moisture-proof; that is, short of running the machine under water, no harm can come to a motor from dampness, no matter of what degree, and it may also be said here that the ohmage resistance of this insulation has proven to be higher than that of ordinary cotton-covered wire.

For line wire, etc., where an absolutely water-proof wire is demanded, the wire described above is taken to another machine, where it is run through a bath that covers it with a material that renders it perfectly water-proof, and this in turn is protected by a braid. The composition used for water-proofing is peculiar in that it is entirely fire-proof, and as it is perfectly flexible, the excellent qualities of the magnet wire are in no way deteriorated and a perfect wire is obtained. The line resists abrasion very strongly and is perfectly incapable of burning or carrying flame. Wire of any size may be covered, the machines are simple, easily built and can be superintended by a boy or girl, and are capable of turning out 400 pounds of No. 14 B. & S. gauge wire per day per machine.

Slate Drill Press.

An interesting illustration of the advantages of electric drive is found in the Emerson slate drill press herewith illustrated. This outfit consists of the slate sensitive drill press in combination with an Emerson direct-current motor, which has a special compound winding of a standard ¼-hp enclosed frame, and while requiring no more current than a 32-cp lamp when running free or with small drills, it has ample power for work within the range of this tool. It is robustly constructed, well protected from dirt and chips, and will stand ordinary rough usage without requiring attention or repairs. Owing to the specially-compounded shunt and series field, this motor is connected direct from line to binding posts without starting box, being started and stopped from a small two-pole snap switch within convenient reach of the operator. The rush of starting current is cared for by the speed-regulating coils of the motor itself, and the proportions of this field are such that if the motor should be stopped entirely by a drill sticking in the work, or by the use of too large a drill, no damage to the motor would result. This special winding also enables the motor to automatically adjust its speed to the size of the drill in the chuck and the material being drilled. Speed regulation is obtained by the motor itself and is entirely automatic. A motor with a higher initial speed is furnished for use where a large proportion of the work is to be with small drills, but the regular motor is best adapted to general tool room use; and the range of speeds above given covers a wide variation in size of drills and in material. This motor will handle work up to the full capacity of the drill press, and in fact will drill in cast iron with a ⅝-in. drill, although not recommended for such heavy use.



SLATE DRILL PRESS.

The simplicity and automatic features of this combination, admirably adapt it to general shop use, and its convenience and accuracy make it invaluable for tool room and fine experimental work. It may be placed and operated in any place where 110 or 220-volt direct current is available, but it is not recommended for 500-volt circuits, as this pressure is too high for such a small motor, and the operator might be in some danger from possible grounds in the circuit. The apparatus is built by the Emerson Electric Manufacturing Company, of St. Louis.

New Motor-Car Equipment of the Central London Railway.

For some eighteen months or more two experimental trains, each consisting of two motor cars and four trailer cars, equipped with the multiple unit control system, have been on trial on the Central London Railway. With the exception of a modification at one end to suit a truck carrying two 75 hp motors, the motor cars are practically identical with the ordinary cars.

Briefly, there are only two methods—omitting the single car acting independently—of operating heavy electric passenger traffic, namely, (1) the locomotive system and (2) the multiple unit system. The former follows steam precedents and possesses practically the same limitations, while the latter is a method of train operation and control by means of which cars are equipped with motors and motor controllers individual to each car. The advantage of this system is that any number of these cars may be connected to any number of cars similarly equipped, or with any number of cars which have no motors, to form a train of any length and operated from as many points as desired, through a controlling line common to all cars. In other words, every motor car is a unit, and any combination of motor cars and trailer cars may also be considered a unit which can be operated from either end and joined with other units.

By this method of train operation locomotive shunting operations are abolished, trains can be reversed at any cross-over and traffic concentrated on any part of the road. An important feature of this system, also, is the complete absence of vibration and strain where tunnels and elevated structures are concerned. The directors of the Central London Railway, finding that with these multiple-unit trains vibration was entirely eliminated, and that by their adoption they could lengthen the trains considerably, decided to use them for the complete working of the line.

The new trains are made up of five ordinary and two motor cars. The motor trucks, which are of the equalizer type, carry two British Thomson-Houston 125-hp motors. The motors are of the solid-frame type, the field magnet being a single casting supported by two bearings on the truck axle and a lug resting on a bracket, which is riveted to the transom.

To facilitate access to the armature the magnet frame is provided with openings at each end. These openings are closed by circular castings. The armature has ventilating ducts, 39 slots, with 10 conductors per slot, and is series-wound.

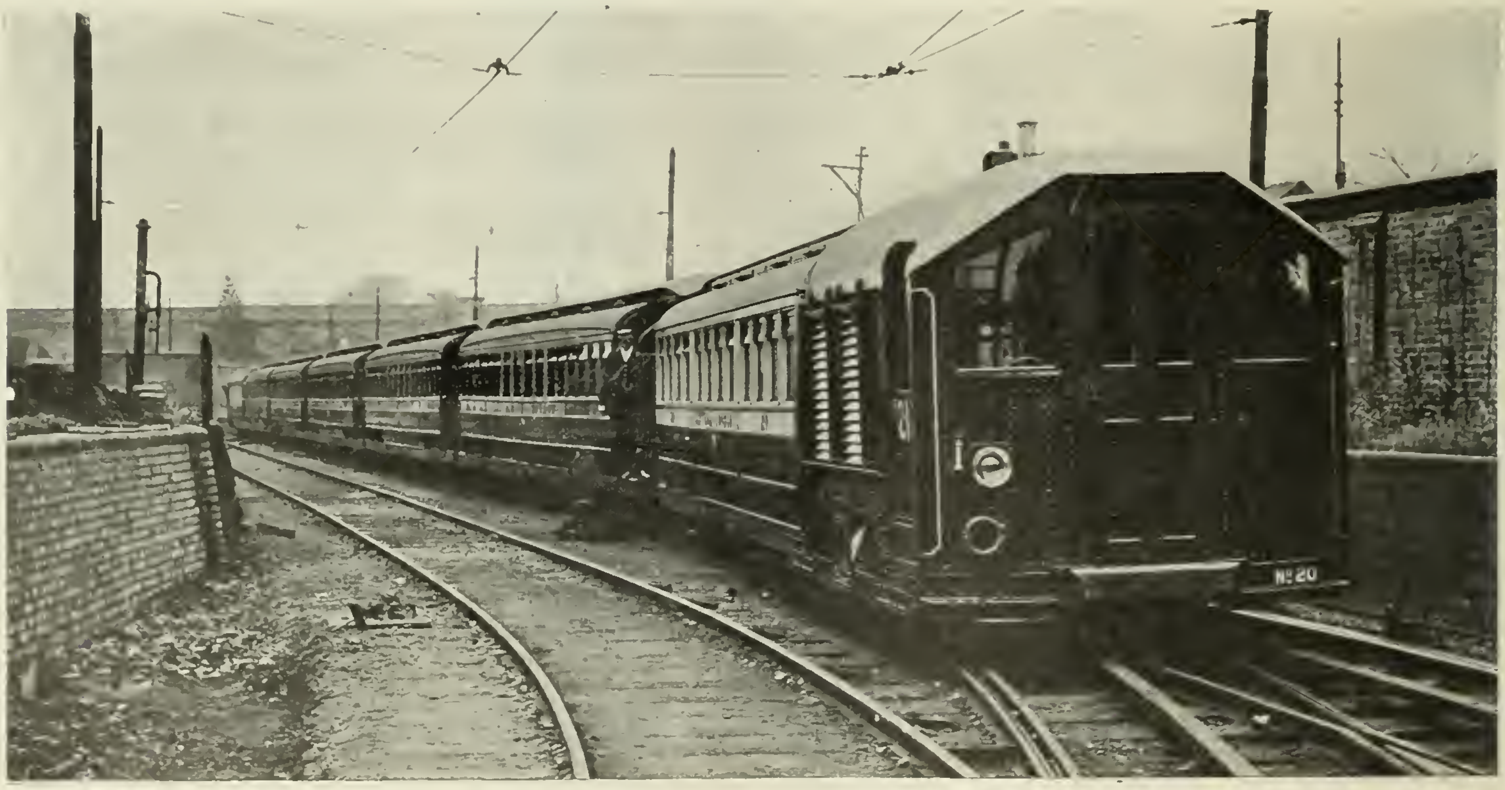


Fig. 1.—Fire-Proof Electric Train on Central London Railway.

Each motor weighs 4,375 pounds, including gear, 2,040 pounds of which are borne by springs, and with 200 amp. at 500 volts each gives a tractive effort of 3,150 pounds at a speed of 14½ miles an hour, measured at the tread of the wheel (which is of 34 in. diameter). The temperature rise after a day's service of 10 hours is about 30° C. above atmosphere.

The collector shoe is of chilled iron suspended from the truck by four links. The truck supporting the passenger end of the carriage is, to all intents and purposes, the same as that of the trailer carriage, save that it has a wider wheel and carries a collector shoe like that on the motor truck.

The master controllers, contactors, reversing switches, resistances and the various other apparatus on the Central London trains, are carried on the driving platforms of the motor cars. The contactors are carried on an angle steel frame inside the cab, and below them are located the reversing switch and rheostats.

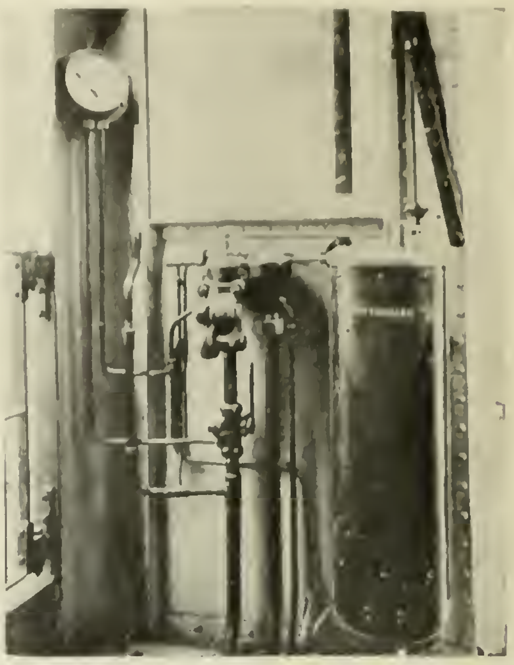


FIG. 2.—CONTROLLER AND BRAKE MECHANISM.

A slate panel behind the driver carries switches and fuses for the main motor circuit, control circuit, lighting and air compressor circuit. The motor circuit connections on the switchboard are of bare copper rod, while those of the control circuit are of asbestos-covered wire.

The air compressor, main reservoir, tool chest and sand boxes are situated on the opposite side of the cab to the switchboard. A series motor directly drives the compressor, which compresses 20 cu. ft. of free air per minute, and is provided with an automatic governor, which cuts off the current when the reservoir pressure reaches 90 pounds per sq. in., and switches it on when the pressure falls to 80 pounds.

The master controller, as mentioned above, is situated on the driving platform, together with the apparatus for operating the air brake, as are also the ammeter, voltmeter, air pressure guage and hand brake wheels.

Each motor car with the full complement of passengers weighs 23 tons, 16½ tons of which are supported by the motor truck and 6½ tons by the truck at the passenger end of the car. The trailer cars have a seating capacity for 48 passengers, the motor cars for 42.

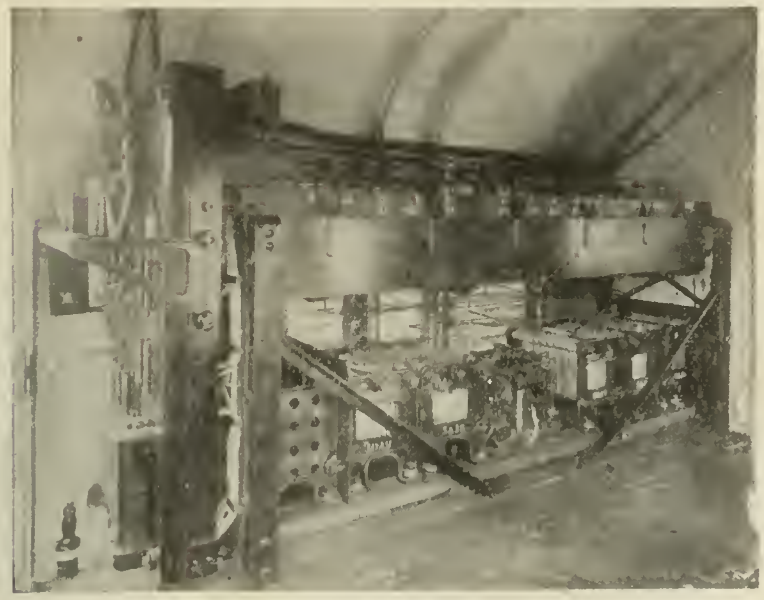


FIG. 3.—CONTROLLING MECHANISM ON PLATFORM.

The underframe of the motor car is bent over the top of the motors and carries a car body similar to those on the trailer cars, but somewhat shorter. The cab is constructed entirely of steel, the floor being of checker plates, which are hinged in order to give access to the motors. Every precaution has been observed to obviate fire hazard.

The weight of one of these seven-car multiple-unit trains is 132.5 tons, while a seven-car train with gearless locomotive weighs 159.6 tons. The operation of trains by the multiple-unit system is of the simplest character, and the officials of the company describe it as being perfect in every respect.

Modern Types of English Alternators.

Although a great deal of pioneer work in the alternating-current field has been done in England, and of a very creditable character, it is the fact that of late years during the period of development of electric light and traction systems by means of polyphase current, English managers and consulting engineers have felt compelled to order abroad a very large proportion of the necessary alternating-current machinery. To remedy this situation, Dick, Kerr & Company, whose direct-current generators and motors are already so well known, have recently devoted considerable attention to the newer class of apparatus and have lately been producing at their Preston works, alternators of the largest size, not merely for England but for the world at large.

Though starting comparatively late in the manufacture of polyphase machinery, English shops have not been entire losers for, by a process of selection, they have been able to avoid many features of design which did not specially commend themselves. In other words, it has been possible, by utilizing the experience of foreign manufacturers, to adapt and adopt designs which are more suitable for local conditions. Among the orders for polyphase plants which Dick, Kerr & Co. are completing, may be mentioned the following:

London County Council, two 1,500 kw (alternating), twelve motor generators, each of 300 kw and three motor generators, each of 50 kw. Horndean Tramways, two motor generators, each of 200 kw. Portsmouth Corporation, two motor generators, each of 200 kw. Sydney, one alternator, 300 kw; two alternators, 600 kw; six motor alternators, 300 kw. Stalybridge, three alternators, each of 500 kw. Malvern, two alternators, each of 100 kw. Fulham, one alternator, 600 kw. Osaka, one alternator, 210 kw. Durban, one alternator, 500 kw. Lakefield Portland Cement Co., Ontario, Canada, one alternator of 1,000 kw; one alternator of 450 kw. Shawinigan Water & Power Co., Montreal, Canada, one alternator of 3,750 kw. Metropolitan Electric Supply Corporation, eight motor alternators, each of 500 kw. And amongst other orders may be mentioned complete plant comprising generators and sub-station machinery for the electric equipment of the Liverpool & Southport division of the Lancashire & Yorkshire Railway, Leeds & Wakefield Light Railway, Tokio Electric Tramways.

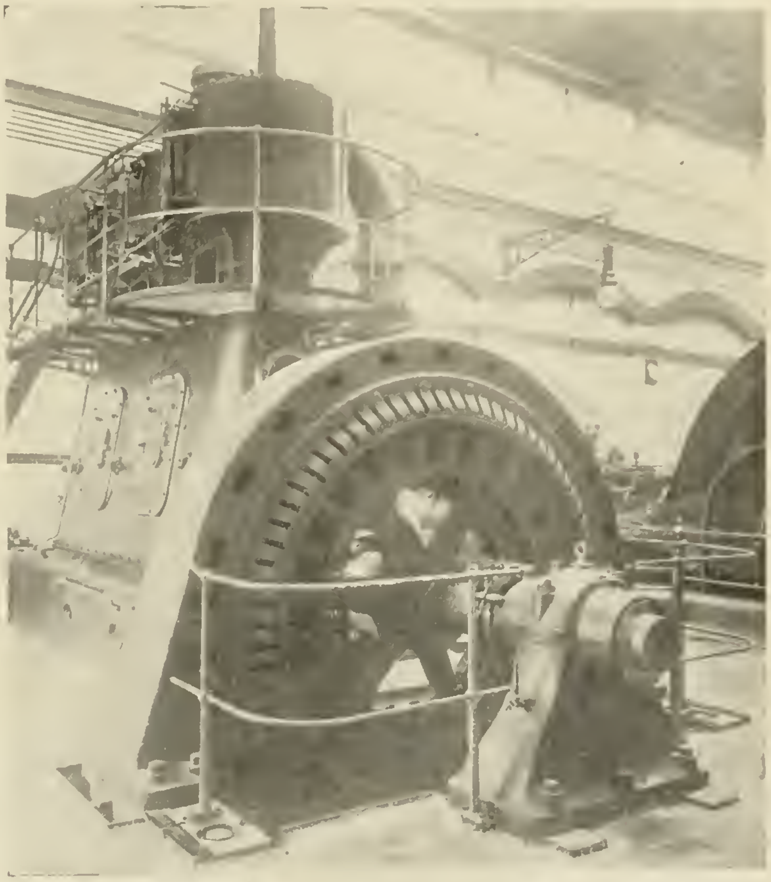


FIG. 1.—ALTERNATOR FOR FULHAM ELECTRICITY WORKS.

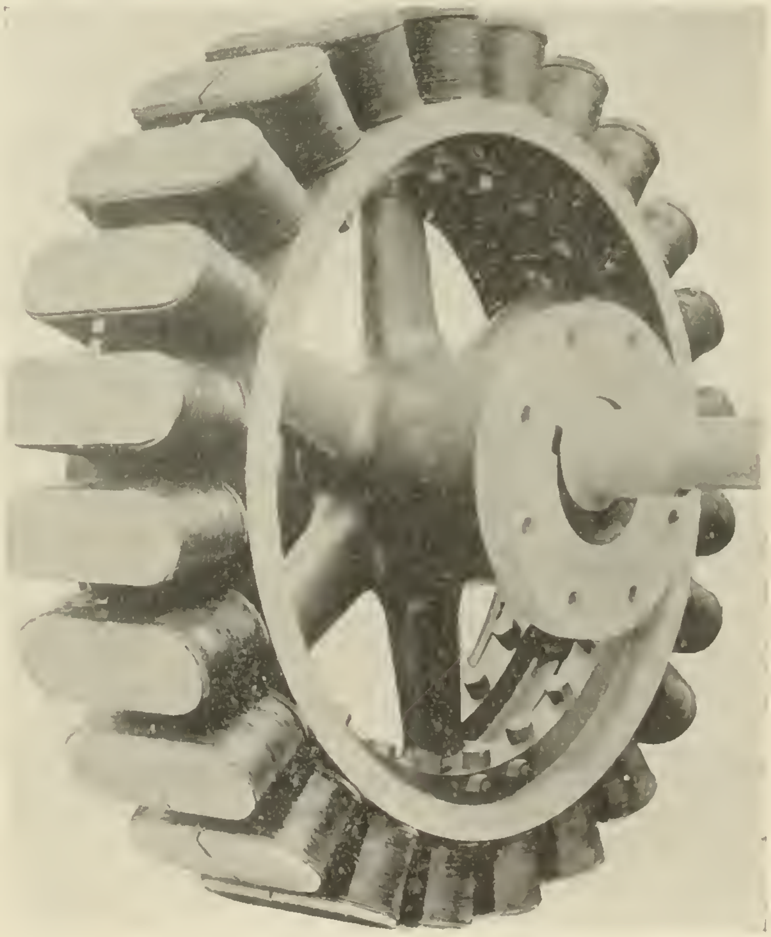


FIG. 2.—ROTOR FOR FULHAM ALTERNATOR.

In the design of polyphase alternators, necessarily some regard must be paid to the purpose for which they are to be used, and though the variations essential to meet such conditions are only of a minor character, they affect to a considerable extent the performance of the machines under working conditions. It is the adequate meeting of such conditions which determines the success of a design. In general, however, the following description covers the main features of the Preston alternator. The rotor spider is made of cast-iron, and of strong design, the hub being provided with a flange for bolting to engine flywheel. It is invariably pressed on to the shaft by hydraulic pressure, and then key seated. On the spider rim, dove tailed laminations are fixed by means of machined bolts and cast-iron flanges, the pole pieces being then bolted on. The laminations are built up in such a way that ample spaces are provided at defined positions, the number and size of ventilating spaces being dependent on the width of the stator. The pole pieces are made of laminated steel, held together between two cast steel end plates of strong construction. The upper part is T shape, in order to securely hold the field coils in position. The lower part of the pole piece is dove-tailed for fixing on the rim of the rotor, it being then held in position by means of keys. The removal of field coils is effected by sliding the pole piece from the dove-tailed groove parallel to the shaft without disturbing any other part of the machine, such an arrangement being of extreme convenience not only when it is necessary to remove a field coil, but also for the removal of a stator coil. It should be added that the design and shape of the pole pieces gives a distribution of lines of forces in the air gap to produce an approximately sinusoidal shaped wave of e.m.f.

In the winding of the field coils it is obviously a mechanical advantage to use edge-wound strip and whenever the excitation voltage permits, the field coils are wound with a single layer of copper strip wound edgewise, and insulated between the turns by means of specially prepared fibrous material. The external surface of the windings is left practically bare, being protected merely by insulating varnish which allows a rapid radiation of heat.

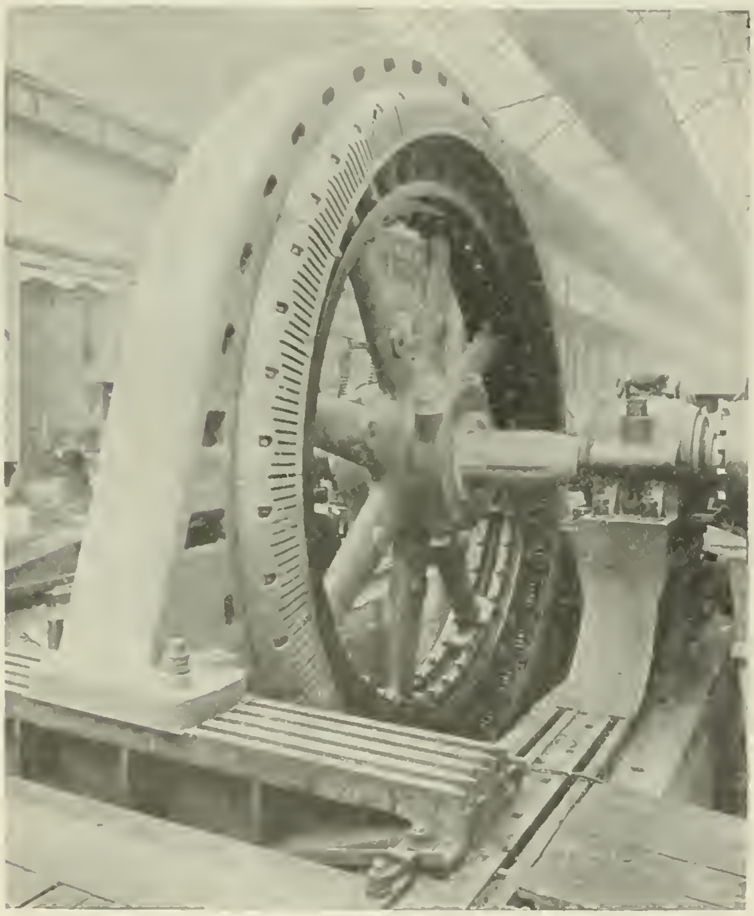


FIG. 3.—1,500-KW GENERATOR FOR YORKSHIRE & LANCASHIRE RAILWAY.

The stator frame, even in the largest type, is built in two halves, which are securely bolted together by means of finished bolts. The lower half of the frame is provided with feet which rest upon the foundation bedplate. In the larger size machines the lower part of the underframe is provided with a special screw for vertical and horizontal centering of the stator relative to the rotating field. The frame is made of high-grade cast-iron, and is designed to allow complete ventilation of the laminations, and at the same time to secure rigidity of the frame.

The core is made up of thoroughly annealed soft iron laminations, the individual laminations being well insulated from each other, to minimize eddy current losses. The laminations are held in position in the frame by means of retaining machined bolts. The winding is formed of separate coils, thoroughly insulated, having great rigidity, and a well-defined mechanical shape. The coils are former wound, and embedded in rectangular slots, and held in position by wooden wedges, and can be easily and quickly replaced. A lower half of a machine is shown in Photo 161, while Photo 162 shows the assembled coils in position.

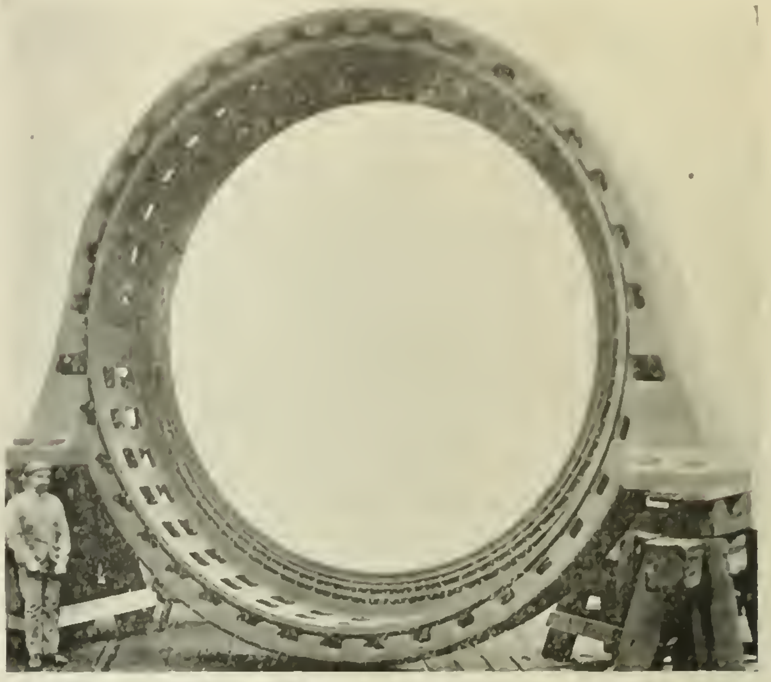


FIG. 4.—ALTERNATOR FOR LONDON COUNTY COUNCIL.

The connections between the stator coils are made by means of highly insulated cables, and are easy to trace and locate. The coils are protected outside the laminations by means of a cast-iron shield, cast in sections, bolted to the frame and easily removable. This shield is of a perforated design, and does not interfere with the ventilation of the stator winding.

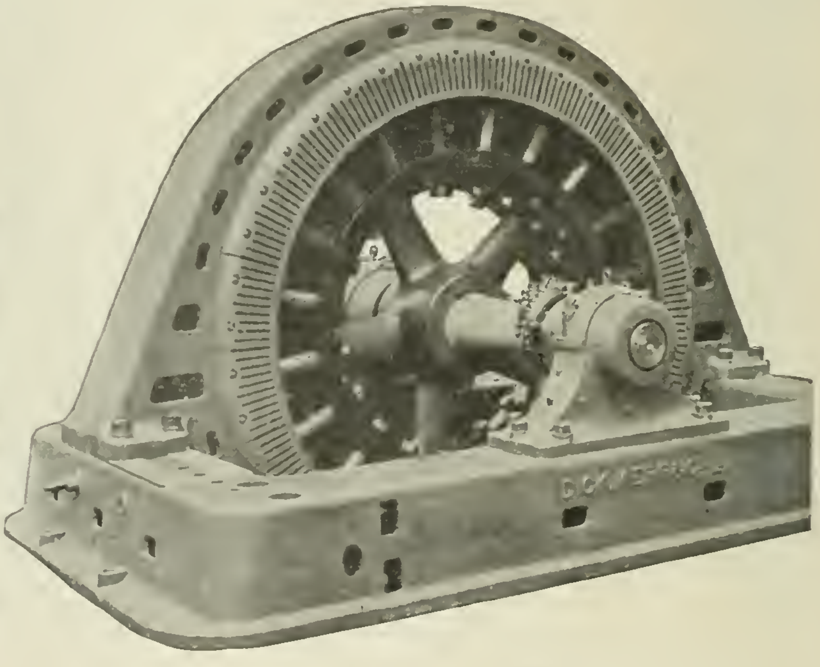


FIG. 5.—4,000-KW ALTERNATOR FOR SHAWINIGAN FALLS POWER CO.

The collector is composed of rings of suitable metal, fixed to the shaft next to the rotor by means of a spider and insulated pins, ample provision being made for free air circulation round the same. The brushes are made of carbon, of ample surface, are in duplicate, and can be set and replaced while the machine is running. The brush-holders are so constructed that the current will not pass through moving joints or tension springs, and will allow for tension adjustment. The support is made of cast-iron, of light design, fixed in an advantageous position.

One of the machines here shown is a 1,500-kw, 3-phase alternator, which is part of the plant for the electrification of that portion of the Lancashire & Yorkshire Railway between Liverpool and Southport. It is to be coupled to a horizontal engine by Yates & Thom, of Blackburn, and gives its full output at a voltage of 6,600, and a periodicity of 25. Another is a 2-phase generator of a capacity of 3,750 kw, which has been constructed for the Shawinigan Falls Power Company, Canada. It is to be coupled to an Escher Wyss turbine, running at 180 revs., the periodicity being 30 and the voltage 2,200. Quite a number of machines have been built at Preston for export to Canada, and it is worthy of record that English manufacturers should be now in the position of being able to export polyphase machinery to the colonies, to Australia, Japan, South Africa, India and other places abroad, as indicated by the above list and by some of the accompanying cuts.

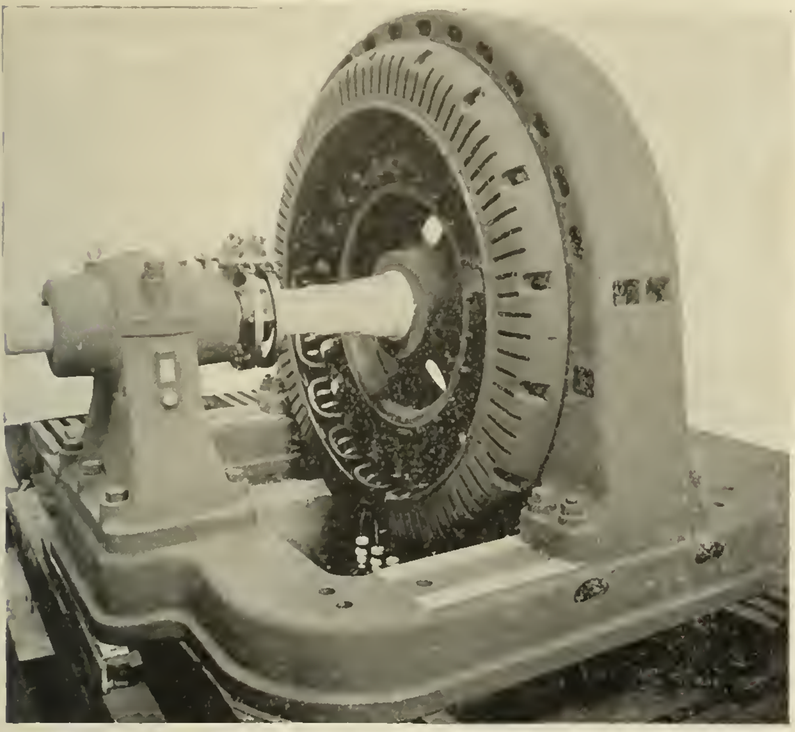


FIG. 6.—ALTERNATOR FOR LAKEFIELD, CANADA.

It remains to be added, that the alternators have been constructed to the designs of Mr. A. P. Zani, who possessing experience in alternator design gained both in the United States and on the Continent, has been enabled to develop his ideas in the direction of sound mechanical design and efficiency of performance.

Rehabilitation of a Flooded Power Plant at Kansas City.

Although it was completely submerged for several days during the memorable flood, this year the mechanical plant of the Cudahy Packing Company, at Kansas City, Mo., is running as perfectly as ever with absolutely no indications of the damp experiences it has so recently passed through. The engines and boilers were naturally well adapted to withstand the effects of a soaking, and after the accumulations of mud and rust had been removed they were easily restored to running conditions. The generators, on the other hand, by construction less protected, required a somewhat more rigorous treatment before they were in shape to operate. That they were saved at all reflects great credit to the means employed and the sound construction and efficient insulation of the machines.

The plant is a comparatively modern one, having been installed but a little over three years ago. The engine room accommodates two large steam-driven ammonia compressors, used in connection with the refrigerating system, and two direct-connected engine-generator units each consisting of a Buckeye horizontal engine and a Crocker-Wheeler direct-current generator. The set shown in the accompanying illustration has a capacity of 350 kw, and the other, not shown, is similar but smaller, having a capacity of 200 kw. The information regarding the flood and the manner in which its after effects were removed, is given by the chief electrician of the plant, Mr. C. O. Fitch.

Mr. Fitch states that, starting on a level with the lower fields on May 31st, the water rose very rapidly until it reached a height of about 12½ ft., indicated on the photograph by the heavy line along the walls. It remained at this level for forty-eight hours, and then fell very gradually, taking ten days to reach the floor line. As the water subsided the engineer and his assistants made their way about the engine room on a raft, and with a force pump kept the mud washed off from the exposed parts of the machinery. Finally, when it became possible to stand on the bottom with high rubber boots on, the mud, which was about 2½ ft. deep on the floor, was removed from around the engines and generators, and the washing process continued down with the descending water level until the latter was well below the floor and the lowest parts of the machines. When the water and mud were out of the way, housings of double thickness matched flooring were built over the generators, and steam coils were placed under them along the bottom at each side. They were then left for a week with live steam turned on day and night, after which, while still enclosed, the generators were slowly revolved for a time. The housings were then torn down, the generators thoroughly cleaned and the brush yokes and studs taken apart and brightened up, especially at all points of electrical contact. For the first trial the machines were brought up to full voltage very gradually, and the load applied by degrees as different parts of the plant were started up. From the outset no difficulties of any sort were experienced, and the machines have been running satisfactorily ever since.

Besides the generators there were twenty-two motors, ranging in sizes from 1½ to 75 hp, which were in the water for about the same period. These were either taken apart and carried to the engine room to be baked out in one of the housings there, or in the case of the larger sizes (two of 50 hp and one of 75) were housed where they stood and treated in the same manner as the generators. These also are all running at the present time and doing their regular work, apparently none the worse for their drenching. Probably the most remarkable feature of all is that neither the generators nor motors have suffered even so much as an increase in their maximum heating temperatures, or a loss of efficiency.

SUBMERGED GENERATOR.

Fire at Bullock Works.

The Bullock Electric Manufacturing Co., Norwood, O., had a fire on Nov. 28 in its No. 2 shop, containing punch presses, annealing ovens, forges, etc. The plant there was partially destroyed, but the tools were not seriously injured. The company has already erected temporary sheds over the tools, and there will be no delay in filling orders on hand, or that may be received. Shop No. 2 is being rebuilt forthwith on a larger scale. The loss is fully insured.

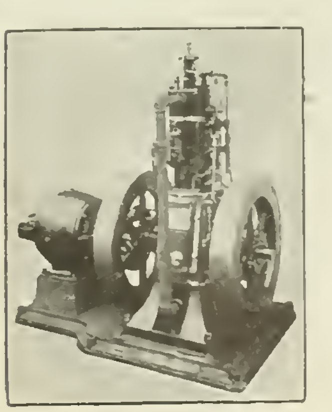
American Metal and Machinery Exports.

Machinery forms by far the most important feature in the exports of American iron and steel manufactures. The various classes of machinery which can be separately stated, are locomotive engines, stationary engines, fire engines, electrical machinery, sewing machines, typewriters, shoe machinery, cash registers, laundry machinery, printing presses, and pumping machinery. Aside from these, however, is a great group of machinery which is not stated in separate items in the export returns, owing to its variety and the large number of different classes of machinery included. This single group of "machinery not separately classified" grew from ten million dollars in 1892 to over twenty millions in 1902. The next largest item under the general classification of machinery is electrical machinery, which was only separately classified in 1898, amounting in that year to two million dollars, and in 1902 to nearly five and a half millions. Sewing machines, which amounted to two and a quarter millions in 1889, were over four millions in 1902. Typewriters, which were only separately stated in 1897, amounted in that year to less than one and a half million dollars, and in 1902 to nearly three and a half millions.

Locomotives increased from one and three-fourths millions in 1892 to five and a half millions in 1900; but owing to the great demand of the home market upon the manufacturers of the United States, fell to three and one-fourth millions in 1902. Metal-working machinery, which was not separately stated prior to 1898, grew from four and one-half millions in that year to over seven million dollars in 1900; pumps and pumping machinery is next in order in the class (machinery), a little over two million dollars; cash registers grew from $813,000 in 1900, the first year in which they were separately stated, to $1,144,062 in 1902, the other classes of machinery ranging downward in their relative order of magnitude, shoe machinery, printing presses, stationary engines, laundry machinery and fire engines.

Thus machinery alone formed in 1900 fifty-five million dollars' worth of the exports of iron and steel manufactures out of a grand total of $121,913,548 of iron and steel manufactures exported in that year, or nearly one-half of the total. This statement of "machinery" does not include agricultural implements, bicycles, telegraph and telephone instruments, or other articles not exclusively or chiefly of iron and steel. Adding only those items of machinery included under iron and steel manufactures, it may be said that the exportations from the United States of machinery as a group amounts to about $75,000,000 annually. Next in order after machinery is the group locks, hinges, and other builders' hardware, amounting to six million dollars; wire, over five millions; pipes and fittings, five millions; steel rails, nearly five millions; tools, three and one-half millions; structural iron and steel, three millions; boilers and parts of engines, nearly two millions; castings, one and one-half millions; and other articles ranging downward in their relative value, wire nails, firearms, pig iron, steel bars, stoves and ranges, bar iron, steel sheets and plates, wire rods, saws, cut nails, iron sheets and plates, tacks, scrap iron, cutlery, safes, car wheels, tin plates; hoop, band and scroll iron billets, ingots and blooms, and iron rails.

Single Cylinder Gas Engines for Dynamo Operation.


GAS ENGINE AND DYNAMO.

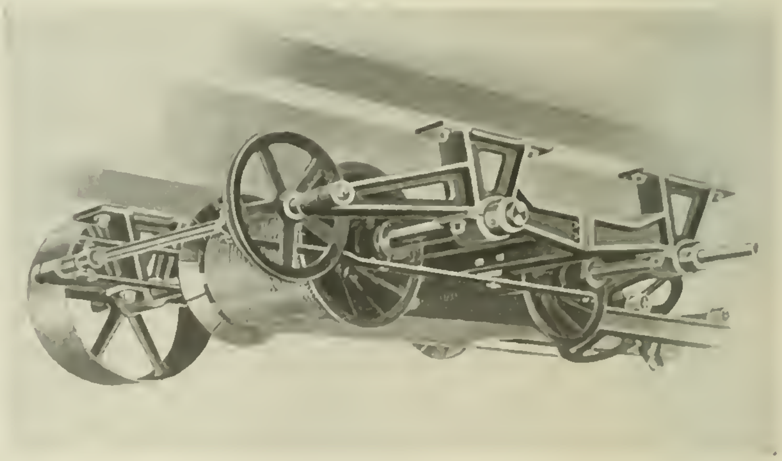
The use of a gas or gasoline engine that will give regulation sufficiently close for connection with a dynamo is a point that has been considered for many years. A machine which has recently been put on the market of the single-cylinder type is, it is asserted, unsurpassed, except in the case of some very large engines with multiple cylinders. This engine was designed and patented by Leon de Tissandier, M. E., a member of the Savage & Love Co., Rockford, Ill., who are the sole selling agents. It was made expressly for use with dynamos either direct connected or belted, for incandescent lighting in residences, country houses or hotels or for battery charging. Its uniformity of speed is remarkable under varying loads.

The engine may also be adapted for machine shop practice, or any other place where power is used with loads varying between wide limits. The engine is substantially made of the best materials in generous proportions; and by the use of special machinery it is possible to guarantee absolute interchangeability of parts. The machines are comparatively inexpensive. The manufacturers have had twenty years' experience in this class of work.

Variable-Speed Rope Transmission.

The use of rope for transmission purposes has of late years assumed a position of considerable importance. One of its chief advantages is that the relation between the two shafts, between which power is transmitted, is not fixed within such comparatively narrow limits as is the case with belt drives. This feature has been taken advantage of in the Sturgess variable speed rope transmission, which we illustrate. This transmission is used for driving paper and textile machinery, machine tools, etc., or for any other purpose where a speed-changing device is required.

In nearly all other forms of speed-changing devices short belts are used. It has also been a difficult matter to compensate properly for the variations in length of such belts, due to the fact that the length of a belt when passed around two expandable pulleys, the sum of whose diameters are constant, is not uniform unless the shafts are a great distance apart. Moreover, it has been a difficult matter to make a pulley which would expand or contract and give a positive driving diameter. The use of a rope on the American system, having a tension carriage, obviates, it is said, the above difficulties.


VARIABLE-SPEED ROPE TRANSMISSION.

The transmission illustrated herewith has two shafts, each carrying a pair of cones, the hubs of which are embraced by collars attached to a pair of controlling levers, which are pivoted at a point midway between the two shafts. These levers are operated by a right and left hand screw, which may be rotated by a hand wheel, chain or rope wheel, or any other convenient connection designed for this purpose.

In the face of the cones are milled a number of dove-tailed slots which receive the dove-tailed ends of a number of segments, forming the periphery of the pulley. In these segments grooves are turned of proper shape to receive the rope. All the corners and edges where the ropes enter and leave the segments are well rounded off and smoothed. The thrust from the cones is received on large size ball bearings. The bearings being of the ring-oiling type the power absorbed by the transmission is small and its efficiency consequently high. The milling of the slots is an operation requiring great exactness and care, for which special machinery has been designed and constructed.

The speed variation obtainable is 5 to 1. As the pulleys are capable of high rotative speed considerable amounts of power can be transmitted with apparatus occupying comparatively small space. The transmission is made in hanger, standard or wall-bracket forms, in sizes from 1 hp to 150 hp. The tension carriage is constructed according to regular practice but may be arranged in a variety of ways to suit local circumstances. In the smaller sizes this is incorporated in the design of the counter shaft, in the larger sizes being made separate.

This transmission device is manufactured by the Sturgess Governor Engineering Company, of West Troy, N. Y., builders of the Sturgess water wheel governors.

Canadian Pacific Railway Shops, Montreal.

These shops are designed and equipped for work which does not vary in character and is adapted to the tools installed. Most of the latter are used for services that vary so little that they can be most economically operated by the constant-speed electric motors, which, in most cases, have been installed for them. The work in the machine shop has been divided into different general classes, such as wheel finishing, moving parts, like links, pistons, valves, etc., heavy turning, boring and planing. Brass finishing and other light work is done in the gallery and the erection of heavy parts is done in one of the side aisles. By this arrangement variable-speed motors have been dispensed with and in a total of about 200 electric motors only 15 are of variable speed.

The system adopted is three-phase, 600-volt current without transformers. This gives 550 volts at the motors and has the advantage of requiring about 10 per cent. less copper in the conductors. There are three 500-kw, three-phase, 600-volt and one 375-kw alternating generators made by the Canadian General Electric Company, each of them driven by a separate direct-connected 750-hp engine of new type Corliss valve gear, making 150 r.p.m. and built by the Robb Engineering Company, Amherst, N. S. All motors, except those otherwise mentioned, are of from 5 to 50 hp of the induction type, three-phase, 550-volt machines made by the Canadian General Electric Company. The fifteen direct-connected motors have a speed variation of 4:1 and are on the three-wire system, using 110 and 220-volt current. The contract for them has not yet been let, but will probably be awarded to the Canadian General Electric Company.

There is a standard three-phase switchboard with four generator distributing and exciter panels of the General Electric type. Outside wiring is done with overhead construction, bare copper main feeders running from roof to roof. In the building is a mixed system of open porcelain cleats and slow-burning waterproof wire on the ceilings, and Richmond conduits and rubber-covered wires on the side walls. Panel boxes are supplied, however, for every 10 kw of lighting and for every 100 hp of motor wire. There are 110-volt enclosed arc lamps of the Canadian General Electric make for shop illumination supplemented by standard 16-cp incandescent 110evolt lamps. There are approximately 400 arc lights and 3,800 incandescent lights in the yards and shops. In the passenger car shops the lights are spaced equi-distantly and low-tension arc lamps are installed on account of their economy and better results for general illumination. In the yards there are 50 enclosed series arc lamps of high potential.

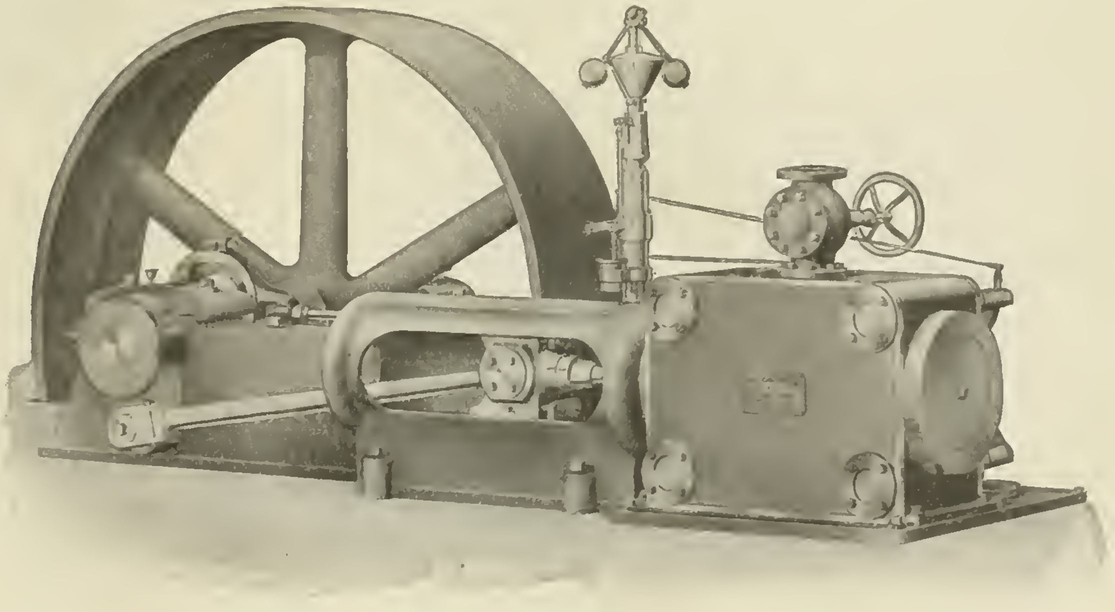
Yard transportation is provided by the 10-ton, 77-ft. span girder crane in the midway and the 10-ton, 57-ft. span girder crane at right angles to it, which distribute materials back and forth between the iron foundry and machine shop, and are each operated by three direct-current, 220-volt motors of 25 hp for the hoist and 8 hp for traversing. There is also a yard transfer table operated by a 20-hp, 550-volt motor. The shops are equipped with a complete telephone system for a 75-drop switchboard and 50 telephones, connected to the long-distance wires. They are metallic circuit, with motor-generators for ringing and self-restoring drops.

The electrical department of the Canadian Pacific Railway Company is installing all of the electrical wiring. The general office at the plant is wired throughout with conduit concealed work, and in every room there is a belt line of wire running around the oak walls near the ceiling behind oak molding which can be removed and a light connected to it at any point without disturbing the line. In the shops the small machine tools are arranged in groups, which, in most instances, are operated by a motor seated on an overhead platform between the roof trusses. As already noted, Mr. C. H. Hines has recently been appointed electrical engineer for the company. The Canadian Pacific is one of the most progressive railroad systems on this continent, and its present utilization of electricity in its shops is but another indication and proof of the fact. It has been rumored or understood that the company does not intend to stop short at equipping its Montreal shops with electric power, but will fit up other of its shops in like manner.

New Allis-Chalmers Standard Reynolds Corliss Engine.

We illustrate herewith a new Corliss engine which is being brought out by the Allis-Chalmers Company from the designs of Irving H. Reynolds. The field of Corliss engine design has been so fully worked over in the past, and the accepted designs have become so simple that no strikingly novel designs are to be expected. The present machine, however,, represents the experience of twenty-six years, and combines all of the desirable elements. Engines of the type illustrated are being built in seven sizes, ranging from 50 to 500 hp, and are designed for steam pressures up to 150 lbs. They are built of somewhat shorter strokes than have heretofore been customary in Corliss engines, with the idea of economizing in space and making the construction more rigid. The speeds are also somewhat higher than usual, ranging from 110 to 150 r.p.m., although these speeds are not higher than those at which the Reynolds-Corliss engines of older design are frequently operated.

The frame is cast in one piece with the slide, the construction being of the box type, resting on the foundation for its entire length. The main bearing shells are bored into the frame, thus insuring a solid bearing and also permitting the easy removal of the shells by rolling them out around the shaft. The slide is of the barrel type with bored guides. The crosshead is fitted with babbitt-faced shoes with wedge adjustment. The piston rod is screwed into the crosshead and held firmly with a steel lock nut. The cylinder is of the round-cornered type, fitted with double-ported steam and exhaust valves, lagged with planished steel. The cylinder is set on a cast-iron base plate, which extends under the valve gear, serving as a drip pan.



CORLISS ENGINE.

The valve gear is of the usual Reynolds Corliss type, the wrist plate being of skeleton pattern and fitted with a new type of disconnecting device which, while clamping the hook rod firmly, is very easily detached by hand. The dash-pots are of differential plunger type without leathers or packing of any kind. The regulator is of the high-speed, weighted type, designed to control the engine within narrow limits of speed variation. The connecting rod is of steel with solid forged ends, fitted with bronze boxes, babbitt-lined on the crank-pin ends, the boxes being adjustable by means of screw actuated wedges. The crank is of plain type, polished on the face, and is protected by a planished steel oil guard, not shown in the cut.

The engines are fitted either with belt fly-wheels, as shown, or with square rim wheels where used with direct-connected generators. The crank and cross-head pins and main journals are of a size ordinarily used with heavy-duty engines.

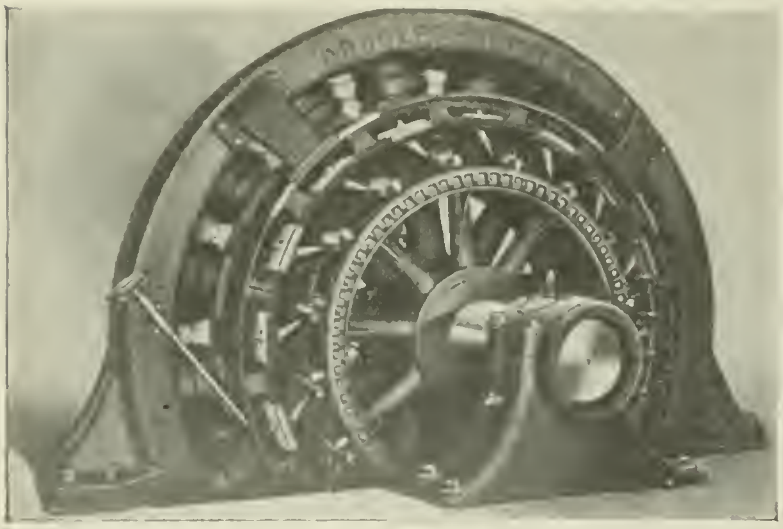
Stromberg-Carlson Rochester Plant.

The *Rochester Union and Advertiser* of November 13 gave an excellent illustrated description of the Stromberg-Carlson Telephone Manufacturing Company's plant in that city. The company is now enlarging this plant, and when the new building is completed the company will require the services of about 3,000 employees. Every modern facility for quick and economical production of apparatus in large quantities is being installed.

The Intramural Power Plant at the Louisiana Purchase Exposition.

One of the most interesting exhibits among many large and impressive power units in Machinery Hall at the Louisiana Purchase Exposition will be the electric generating equipment by the Crocker-Wheeler Company for the supply of power to the intramural railway. The plans for this plant provide for a generating capacity of 4,100 kw and the construction of the machine to furnish this power is well under way. This power will be supplied by eight units, each consisting of a standard Crocker-Wheeler railway type generator direct connected to the prime-mover, the sizes being as follows: Two of 600 kw capacity, running at 100 r.p.m., one to be driven by a Borsig 1,500 hp gas engine and the other by a Buckeye horizontal cross compound engine; three of 500 kw capacity, one to run at 100 r.p.m., and be driven by an engine built by the Murray Iron Works, and the other two to run at 135 r.p.m., and be driven by Brown Corliss engines; one of 400-kw capacity, to be driven at 150 r.p.m. by a Harrisburg horizontal tandem-compound engine, and one of 100 kw capacity, to be driven by a Doble water wheel at 700 r.p.m.

With the exception of the differences in size and details as to the proportions, the several generators are similar. The cast-iron magnet frame is of the internally-flanged type, parted on its horizontal diameter and bolted together by flanges on the inside. The poles are of mild steel cast welded into the frame giving a minimum magnetic reluctance and a maximum strength. The field coils are made up in two or three sections which are individually wrapped, taped and insulated, and separated from one another by small wooden blocks to improve the heat radiating qualities. To allow the removing or replacing of the coils the pole shoes are detachable. The armature is of the iron-clad type, consisting of a toothed core of laminated mild steel in the slots of which the windings are protected by wooden wedges fitting in notches near the tips of the teeth. Very careful attention is given to the insulation, the formed conductors being bound and shellaced and the slots lined with heavy insulation.



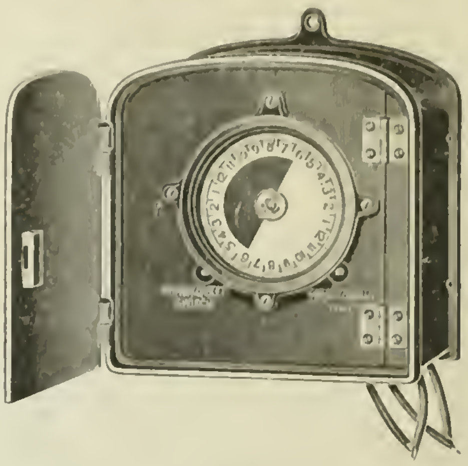
GENERATOR FOR INTRAMURAL RAILWAY, ST. LOUIS FAIR.

The commutators are constructed of high-grade drawn copper with ample surfaces to carry current without undue heating and to give a large radiating capacity. Each brush rigging consists of a rocker ring held by brackets bolted to the field frame, which in turn supports brush holder arms with independent brushes on each. The brush holders are of the parallel movement type characteristic of the Crocker-Wheeler apparatus. On each one four sets of laminated copper strips carry the current and control the movement of the brush from or towards the commutator, always maintaining the same angle with its surface. This causes the brushes to wear away evenly, and as they become shorter allows them to be extended and clamped in a new position without altering the surface of contact. The brush pressure is regulated by a helical spring, which does not carry current, and hence is less inclined to heat and vary its tension. When desired, the brushes may be lifted from the commutator and held away from it by a half turn of the adjusting screw. This is a feature that is especially useful when it is expedient to test individual brush resistances, or certain windings for grounds. To compensate for any inequalities among the magnetic circuits, the brush holder arms may be shifted independently or to secure the position of sparkless commutation. When the various circuits are in equilibrium, the entire rocker ring may be revolved by the hand wheel.

The plant will be of interest not only to technical men, but to the public in general, as in it are contained the three prime movers now used for the generation of electric power, steam, gas and water. The application of these units of motive power to generators of a variety of sizes will form a most interesting sight for exposition visitors.

Time Switch Box.

A compact and convenient form of time switch is shown in the accompanying cut, which illustrates the box of the Hartford Time Switch Company, of Hartford, Conn. It has a japanned iron case with double doors and is proof against dust and weather. The outer door is secured by a tumbler lock. It is wound once a week by an eight-day Seth Thomas clock mechanism. The switch automatically opens and closes the circuit at any predetermined time. When the automatic use of the switch is not desired, it can be instantly disconnected from the clock. The hand trip provides an independent means for operating the switch. The time for automatically operating the switch can be quickly and easily changed.

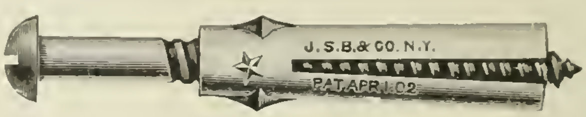


TIME SWITCH BOX.

The switch is of the rotary, double-contact type, with quick break of approved length. The operation is entirely mechanical and no magnets are used. By a special attachment the Hartford time switch can be arranged to light show windows or signs for two periods each night.

Solid Expanding Sleeve.

An improved solid expanding sleeve which is specially adapted for fastening securely telephone backboards, etc., in brick, stone and cement, has been brought out by James S. Barron & Co., of 200-206 West Broadway, New York City. It is shown herewith. It is made of one piece, and is equally suitable for screws with wood or machine threads, and with any number of threads to the inch. A detailed description is not necessary.



EXPANDING SLEEVE.

Conduit Contract, Manchester, Mass.

G. M. Gest, of New York, Boston and Cincinnati, has been awarded the contract for the installation of a complete conduit system by the Manchester Electric Company, of Manchester, Mass., the ideal seaside resort of many of New England's best and wealthiest families, whose beautiful mansions are all that artistic and architectural design can accomplish, surrounded here and there by well-kept pretty farms, ranging in size from 50 to 100 acres each. The fact that so large a system is now being installed, requiring nearly a quarter of a million feet of conduit, and covering fifteen miles of streets, in what one might call a country residential place, is to say the least "unique."

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Continued steadiness and strength characterized the railway stock market during the week, notwithstanding the dullness, persistent hammering and weakness in the neglected and less prominent industrial stocks, which were the principal objects of bear attacks. Money rates were firmer, but this had little effect on the general market. United States Steel shares were quiet. They acted independently of other industrials and efforts to depress them were less successful. The traction stocks were steady to strong with continued talk about a possible combination of such interests in Greater New York. Brooklyn Rapid Transit made a net gain of 1 point for the week's business, closing at 39½ after having touched 38⅜, the lowest point of the week. Metropolitan Street Railway also responded to the favorable influence and made a net gain of 2⅛ points, closing at 116⅝. The extreme quotations for this stock were 114, the lowest, and 117⅜, the highest. General Electric showed some weakness and closed at 154½, this being a net loss of ½ point. The lowest point was 152 and the highest 155⅛. Westinghouse common closed at 138, and preferred 170, the former being a net gain of 1 point. Western Union made a fractional gain, closing at 85⅛. Following are the closing quotations of December 1:

NEW YORK.

	Nov. 24	Dec. 1		Nov. 24	Dec. 1
American Tel. & Cable......	77	75	General Electric.	152½	156
American Tel. & Tel........	125	126	Hudson River Tel...........	..	..
American Dist. Tel....	26	25	Metropolitan St. Ry.........	115⅝	117¾
Brooklyn Rapid Transit ...	38⅝	39¾	N. E. Elec. Veh. Trns........	..	..
Commercial Cable.	140	145	N. Y. & N. J. Tel............	..	..
Electric Boat.	23	21	Marconi Tel................	..	..
Electric Boat pfd...........	48	45	Western Union Tel...... ...	84¾	88
Electric Lead Reduction.. .	⅝	⅝	Westinghouse com....	137	140
Electric Vehicle............	5½	5½	Westinghouse pfd..........	167	170
Electric Vehicle pfd.	8	8			

BOSTON.

	Nov. 24	Dec. 1		Nov. 24	Dec. 1
American Tel. & Tel	25	126	Western Tel. & Tel. pfd....	79	80
Cumberland Telephone....	*115	*115	Mexican Telephone.........	1⅛	1⅛
Edison Elec. Illum..........	*241	241⅛	New England Telephone. .	120	120
General Electric............	152	155	Mass. Elec. Ry..	17½	19
Western Tel. & Tel	7¾	7½	Mass. Elec. Ry. pfd.... . .	76	77

PHILADELPHIA.

	Nov. 24	Dec. 1		Nov. 24	Dec. 1
American Railways.........	41	40	Phila. Traction..	95	95
Elec. Storage Battery.. ...	47	49	Phila. Electric	5⅞	5⅞
Elec. Storage Battery pfd.	47	49	Phila. Rapid Trans.........	11½	11⅛
Elec. Co. of America.	..	7⅜			

CHICAGO.

	Nov. 24	Dec. 1		Nov. 24	Dec. 1
Central Union Tel.	..	..	National Carbon pfd........	87	87
Chicago Edison.............	..	..	Metropolitan Elev. com.....	17	17
Chicago City Ry....	164	165	Union Traction	5	5
Chicago Tel. Co	..	..	Union Traction pfd.........	28	28
National Carbon	19	20			

*Asked

BELL TELEPHONE EXPENDITURES.—It has been estimated in Boston that the new cash requirements yearly for the American Telephone & Telegraph Company, i. e., the whole Bell telephone system, reach $30,000,000, and that this must largely or wholly be raised in New England. The *Boston News Bureau*, discussing this, says: "The Bell companies to-day are giving too good a service for money received; in other words, rates are too low, and they must be advanced. Then again, it must not be forgotten that the American Company issues stock upon which it pays 7½ per cent. dividends to take up securities which net the company an average of less than 6 per cent. The balance of its income must be made up from royalties, now reduced to a minimum, and from the earnings of long-distance lines and supplies. There are few people who correctly understand the instrument statement which the American Company issues each month. This statement in reality represents every instrument in use, including switchboard telephones and dead heads, and official telephones and many furnished at reduced rates. Two instruments are reported for each subscriber. On January 1, 1903, the company reported connected 1,277,583 telephone subscribers, and in the hands of licensees 3,150,320 instruments, but the subscribers using two each would utilize 2,555,976 of these instruments, showing 594,344 instruments not used by subscribers, or over 18 per cent. of the total amount outstanding. Most of these are probably subscribers' extension sets. Another large item in connection with the business not usually taken into consideration is the fact that in order to gain the use of 515,262 instruments, the net gain this year to date, the company had to put out 923,978 and take back 408,716. It has always been the experience of the licensee companies that in order to gain one subscriber they must put in two and take out one. It is certain that the tendency of telephone rates in this country is not downward, because the tendency is continually to increase the burden and work of the telephone. In some places, a few years ago, a telephone operator could attend to the calls of 75 or 100 subscribers; now the same operator can attend only to the needs of 25 subscribers, and in some places the calls of less than 10 subscribers have to be grouped together under one operator for proper attention."

U. G. I.—It is stated from Philadelphia that the declaration of a dividend of ¾ of 1 per cent. on Paterson & Passaic Gas & Electric stock is but the beginning of immediate and regular returns for the United Gas Improvement Company on several groups of its investments in Northern New Jersey gas properties. The Paterson & Passaic Gas & Electric dividend is made under guarantee, and dividends will this year also be declared on the stock of the Essex & Hudson Gas Company and the Hudson County Gas Company, under the terms of similar leases made with the same guarantor—the Public Service Corporation Company, of New Jersey. The interest of the United Gas Improvement Company in each of the three gas companies—the Paterson & Passaic Gas & Electric Company, the Hudson County Gas Company and the Essex & Hudson Gas Company is a majority of the stock, which, by the way, was received in consideration of its guarantee on certain underlying obligations. The dividends which the United Gas Improvement Company, as owner of a majority of the stocks of these three companies will receive are on an increasing sliding scale, and the importance of this item of guaranteed income is evidenced by the fact that at the maximum rates, or 8 years hence, the United Gas Improvement Company will receive from this source over $770,000 per annum. This is an amount equal to more than one-fourth the amount required to pay the 8 per cent. stock dividend on the entire $36,725,000 United Gas Improvement stock outstanding, or $2,938,000.

HARTFORD LIGHTING INTERESTS.—According to advices from Hartford, Conn., a deal by which the Hartford City Gas Light Company will shortly pass into control of the United Gas & Electric Company of New York, as a holding corporation, is nearly completed. A majority of the stockholders of the Hartford Company are said to have accepted an offer for the exchange of their stock, share for share, for the preferred stock of the holding company, with 20 per cent of the common stock of the new company thrown in. The stock of the Hartford Company is now $750,000, and is rated at 200. Under the proposed change, the holding company will have a capital of $1,500,000, of which one-half will be preferred stock on which a guaranty of 8 per cent dividends is given, and the other half will be common stock.

DIVIDENDS.—The Chicago City Railway directors have declared the regular quarterly dividend of 2¼ per cent., payable December 30. The first dividend that the San Francisco Gas & Electric Company has been able to pay since the time Claus Spreckels opened war upon it has been declared, it being at the rate of $2.50 per share, amounting in all to about $350,000. Now that "the cruel war is over," this corporation having bought up its rivals at an expense of many millions in bonds, new stock and cash, the company has an assured ample revenue, and the board of directors concluded that the giving of a dividend without further delay to the patient stockholders would be a good stroke of policy.

Commercial Intelligence.

THE WEEK IN TRADE.—Retail trade was stimulated in all seasonable lines by the continued cold weather. Manufacturing industry shows some weak spots. One hundred thousand cotton mill hands of Southern New England have quietly accepted lower wages; 15,000 employees of paper mills are idle at present, partly because of dull trade, but also because of low water in the streams, and in Colorado, Wyoming and Utah strikes, accompanied by violence, curtail production, limit industry and interfere with distribution. There are some favorable features among the industries, however. There is a better tone in iron and steel production, although shutdowns are numerous; foundry iron is in rather better demand and a good deal of iron has gone abroad as ballast for cotton ships. Finished products are rather dull and domestic buyers are somewhat reserved, but the extension of a reduction in railway freights to other lines of iron and steel give prospects of a large future export business. Other metals are dull, with copper and lead weak. In copper prices further declined and there was no improvement in the demand. The official quotations, which have been reduced are as follows: Lake, 12¾ to 13c.; electrolytic, 12⅝ to 12⅞c.; casting stock, 12½ to 12¾c. Building is somewhat restricted on account of the advanced stage of the season, lumber is quiet for domestic trade, but export demand is active, and hardware continues good, all things considered. The business failures for the five business days ending with November 26, as reported by *Bradstreet's*, numbered 167, against 234 the week previous, and 182 the corresponding week of last year.

FREIGHT AND FOREIGN TRADE.—The Foreign Trade Association of America, which was chartered recently under the laws of the State of New York, to promote the export trade of the country, held its first regular meeting this week. The subject under discussion was the recent concession of 33⅓ per cent granted to the United States Steel Corporation by the Trunk Line Association on freight rates on manufactured iron and steel products for export. The feeling among other manufacturers is that this is a discrimination against other classes of manufactured products, and resolutions were adopted calling for the appointment of a special committee, to be known as the Export Rate Committee of the Foreign Trade Association of America, authorized to employ independently the ablest counsel and rate experts and to collate information "tending to cause rates for export business to be reduced to a basis more in harmony with actual requirements." The following officers were elected, to serve until January 12, when the first annual meeting will be held and officers elected for 1904: President, Aristides Martinez, of Longman & Martinez; first vice-president, W. C. King, of the General Chemical Company; second vice-president, R. R. Fogel, of R. R. Fogel & Co.; treasurer, William M. Hollins, of H. B. Hollins & Co.; secretary, W. E. Simpson, editor of the *Banker and Miner of Mexico*. These officers also constitute the board of directors.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company instrument statement for the month ended October 30 and since December 20 compares with the month ended October 30 and the period from December 20 in previous years as follows:

	1903.	1902.	1901.
Gross output	111,749	92,601	95,655
Returned	49,885	37,155	23,374
Net output	61,864	55,446	72,281
Since Dec. 20:			
Gross output	923,978	900,935	778,826
Returned	408,716	383,844	324,663
Net output	515,262	517,091	454,163
Total outstanding	3,665,582	3,042,697	2,406,979

RAILS FOR MEXICAN TRACTION COMPANY.—The Mexican Traction Company, of which M. R. McAdoo, 15 Wall Street, New York, is president, and in which James B. Oliver, Julius Bider, Reuben Miller, Sr., James H. Park and Frank B. Smith, of Pittsburg, are primarily interested, has awarded the contract to the Pennsylvania Steel Company for rails to be used in the construction of its lines in and around Mexico City. In addition to the Banos road and the various concessions which have already been noted in these columns, the company has received a franchise permitting of the building of 10 more miles of lines in the streets of the Mexican capital down past Chapultepec, to one of the principal suburbs. The power house equipment, as previously mentioned exclusively in Electrical World and Engineer, will be of Westinghouse manufacture.

AUTOMOBILE TRADE.—It would appear that statistics from 85 per cent. of the automobile manufacturers in the United States to September 3 indicate that the actual sales for the year 1903 will be 11,000 cars, valued at $12,000,000. This is double the business of 1902, to which must be added the foreign importation of 200 cars valued at $800,000. The importation of foreign cars is about the same as last year. Trade in foreign-made cars is probably at its maximum and will slowly decline, as the American manufacturers are rapidly supplying the demand. It is predicted that the business of 1904 will double that of this year. Just how large a percentage of this business consists of electric automobiles is not known. Some estimate it at only 10 per cent., or say $2,000,000 a year, which seems high or low, depending on the point of view.

NEW ENGINEERING AND CONTRACTING FIRM.—The electrical engineering and contracting firm of Muralt & Co., 25 Pine St., N. Y., has been formed for the purpose of handling contracts for alternating-current work and for the electrification of steam roads. The firm includes Carl Leonard de Muralt, formerly associated with the General Electric Company; Union Elektricitäts Gesellschaft, of Berlin, and Brown, Boveri & Co. His partner is Ellwood Hendrick. The new concern proposes to make a specialty of export trade, particularly in Mexico and South America, and is already figuring on some substantial contracts for the equipment of hydro-electric plants. They will act as representatives for Brown, Boveri & Co. on this side.

WIRING FOR HOSPITAL BARRACKS.—Sealed proposals, subject to the usual conditions, will be received until 3 p. m., December 23, 1903, for furnishing the labor and material for the construction, pumping, gas piping, heating and electric wiring of a brick hospital at Whipple Barracks, Arizona. Plans, specifications and other information can be had there, and in the offices of the Chief Quartermaster, San Francisco, Cal., and Denver, Colo., and Constructing Quartermaster, Fort Leavenworth, Kan. Envelopes containing proposals should be indorsed "Proposals for Hospital at Whipple Barracks, Arizona," and addressed to Charles C. Walcutt, Jr., Constructing Quartermaster.

SAO PAULO SYSTEM TO BE EXTENDED.—The Sao Paulo Tramway, Light & Power Company, Limited, is about to extend its operation in Sao Paulo, Brazil. Further equipment is to be installed in the large hydraulic plant on the Rio Tiete, which has Stilwell-Bierce & Smith-Vaile turbines and General Electric generators. The company has made an offer to the municipality of Sao Paulo with a view to constructing cold storage plants. The company, which is composed of Canadian capitalists chiefly, William Mackenzie being president, will find all the necessary capital. The plant, it is proposed, will revert to the municipal authorities without charge, at the expiration of twenty years.

LOOMIS-PETTIBONE.—The Loomis-Pettibone Gas Machinery Company, 52 William Street, New York, has decided not to begin construction operations for the present at the huge plant which it was contemplated to build at Elizabeth, N. J. The Crossley (British) gas engines, which the Loomis-Pettibone people have the American rights to build, will be turned out in the meantime, at the Holthoff Machinery Company's plant at Cudahy, Wis. This concern is controlled by the Loomis-Pettibone Company. The Cudahy plant will be extended at a cost of some $150,000. The company is negotiating for the installation of some large gas engines in Mexican mines.

CONDUIT FOR BELGIAN AND RUSSIAN TELEPHONE SYSTEMS.—The H. R. Camp Company, of Aultman, Ohio, has just secured an important contract for single conduit for the Brussels (Belgium) telephone and telegraph system. The contract was secured through G. Ernest Woodman, of 27 Chancery Lane, London, a partner of Jabes F. Cummings, who is now in St. Petersburg superintending the laying of the conduit for the municipal telephone and telegraph system. Some 1,500 tons of the conduit have already been shipped from the Raritan (N. J.) plants controlled by the National Fire-Proofing Company.

MORE ELECTRIC TRACTION FOR HONOLULU.—The Honolulu Rapid Transit & Land Company, which operates about 20 miles of electric lines in Honolulu, has acquired the Hawaiian Tramways Company's horse car system, 12 miles long. The latter is a British enterprise. Part of the existing lines will be immediately converted to electric motive power. The general manager and purchasing agent of the new interests is W. H. Pain. His headquarters are in Honolulu.

CANADIANS IN MEXICO.—With reference to negotiations already noted in this department a dispatch from the City of Mexico says that the large electric light and power plant and franchise of the Siemens-Halske Company, of Berlin, in the City of Mexico, has been acquired by the Mexican Light & Power Company. The latter is composed of Canadian capitalists who are building a greater electric generating plant and transmission lines near the City of Mexico.

LIGHT RAILWAY FREIGHT YARDS.—MacKenzie, Quarrier & Ferguson, 114 Liberty Street, New York, have secured a contract from the Pennsylvania Railroad for a 300-hp tandem compound Harrisburg engine for direct connection to a Sprague 200-kw. generator. The outfit is to be utilized for lighting the freight yards at Greenville, N. J. A contract is expected to be closed within the next few days for a good-sized lighting outfit to be shipped to Australia.

EQUIPMENT FOR NATIONAL FIRE-PROOFING PLANT.—The National Fire-Proofing Company, Broadway, Maiden Lane Building, New York, is to electrically equip its new Raritan (N. J.) plant, which is located two miles above Perth Amboy, and was formerly known as the Raritan Hollow Porous Brick Plant. The plant was burned down last summer. The contracts will be let through the general superintendent, Mr. J. C. Rossi.

ENGINE FOR INDIAN LIGHTING PLANT.—The Reeves Engine Company, of Trenton, N. J., has been allotted an order by the Union Trading Company, of Madras, India, for a 300-hp vertical cross compound engine for direct connection to a 200-kw. generator, for installation in a lighting plant.

SUPPLIES FOR GERMANY AND JAPAN.—The export commission house of Richter, Otten & Co., 81 Pine Street, New York, has a number of fair-sized orders and inquiries in hand for electrical supplies, etc., for shipment to Germany and France.

MORE TROLLEY FOR NEW YORK.—The Metropolitan Street Railway Company desires to operate with the trolley on the West Street water front of New York City, but must obtain the consent of two-thirds of the abutting property owners, and Mr. Hawkes, as Dock Commissioner, in behalf of the city, has power to give consent for all the water front property. The company claims that sub-surface conduits are impracticable under West Street because of the tide. It has sent to property holders a circular letter setting forth its attitude in the matter, and telling what it has done in an attempt to improve the service. It is stated that after trying storage battery cars and compressed air cars without success, the company offered a reward of $50,000 for an available system, but was unable to secure one. Permission is asked for the installation of a system of cars which can be fitted with both overhead and underground trolley. It is objected that the overhead wires might be troublesome on West Street, inasmuch as that is one of the most crowded thoroughfares in the city, with thousands of pedestrians and array of heavily laden trucks, some with burdens piled as high as fifteen feet from the pavement. As to the effect of the tide upon an underground trolley conduit, it is pointed out that the mean average tide rise is five feet along West Street, but there have been records of nine feet.

TRACTION IN ST. LOUIS.—The Western Electric Company, of St. Louis, well known in the electrical manufacturing and supply field, has applied for a franchise in the city of St. Louis for an elevated subway railway. This road will run from Third and Washington Avenue, underground, to between Seventeenth and Nineteenth streets, where it will then come out above the surface in an elevated, west to the city limits, terminating on the Watson Road. The route of the present franchise asked will be from Third and Washington Avenue under St. Charles Street, to probably between Seventeenth and Nineteenth Streets, then in an elevated structure over St. Charles Street, Bell and Fairfax Avenues, west to Taylor Avenue and south over Taylor to Manchester Avenue, then west over Manchester, Clayton, Berthold, Billon and McCausland avenues to the city limits on the Watson Road.

THE CHICAGO SUBWAY.—President Wheeler, of the Illinois Telephone & Telegraph Company says: "We are pushing the construction of our tunnels and rails in the downtown district post haste, as we wish to commence delivery of freight to wholesale houses, etc., by July 1, 1904. Few people realize the vastness of our enterprise. Thirty railroads enter Chicago within a radius of 1½ square miles, and the freight cars of this giant aggregation of roads will run along our tunnels. It is a novel enterprise taking the place in Chicago of the East and North rivers in New York. In our telephone department we are only aiming at the moment to give an entirely private service to business men. We have installed 2,500 telephones up to date. When our tunnel system is complete we shall have 20 miles of rails laid."

CANADIAN CORUNDUM.—The Corundum Refineries Company has been organized at Buffalo with $1,000,000 capital to work large deposits of corundum found near Toronto. Buffalo will be the headquarters of the concern. The incorporators and officers are John N. Scatcherd, Buffalo, president; John H. Tilden, Hamilton, Ont., vice-president; John E. Conway, Buffalo, treasurer; J. H. Jewel, Toronto, secretary; Charles R. Huntley, of the Buffalo General Electric Company; William H. Rankine, of the Niagara Falls Power Company; James A. Roberts, New York; W. Van Duzen and H. H. Dewart, Toronto, and H. P. Coburn, Hamilton, directors. The output of the company's mines for the first two years has been taken up already, it is said, in Boston.

NEW YORK CENTRAL ORDERS.—A number of details were given in these columns last week as to the order placed by the New York Central Railroad with the General Electric Company for eight turbo-generator units of 7,500 hp., and 30 electric locomotives of 2,200 hp. each. Mention was also made of the order for Babcock & Wilcox boilers. We were able to illustrate the turbo-generators, giving dimensional details. These 8 will be raised to 10 or 12 ultimately, for the two proposed power plants. The boiler order will reach a capacity, it is said, of 48 boilers, each of 628 hp, or a total of 30,144 hp. They will be equipped with super-heaters; and Worthington surface condensers have been ordered from the International Steam Pump Company of New York.

AUTOMOBILE SHOW.—According to the list issued the Automobile Show, to be held at Madison Square Garden January 16 to 23, promises to be the greatest industrial exhibition ever held in that building. The demand for space required a special allotment by Frank W. Sanger, of the Madison Square Garden Company; S. A. Miles, of the National Association of Automobile Manufacturers, and General George Moore Smith, of the Automobile Club of America, who had the matter in charge. There will be 152 exhibitors, occupying 239 spaces. No one concern is given more than four spaces. Of this number eighty-eight are builders of complete vehicles. About fifty concerns were unable to secure space.

PLANT FOR YTU, BRAZIL.—A contract has been entered into by the Light & Power Company, of Ytu, Brazil, for the installation of an electric transmission plant for the power house on the River Tiete, at a place called Cachoeria das Lavras, situated about one kilometer from the center of Ytu. The hydraulic machinery is to be furnished by the Lidgerwood Manufacturing Company, and the electric machinery by the Westinghouse Electric & Manufacturing Company. A. W. Foster is consulting engineer, Dr. Luiz Marinho de Azavido electrician, and Franklin Hatch hydraulic engineer for the Lidgerwood Manufacturing Company.

GAS ENGINE AND GENERATOR FOR JAPAN.—The Mackay Engineering Company, Singer Building, N. Y., has been awarded a contract for equipment to be installed in a plant at Kobe, Japan. The engine will be a Walrath gas one of 125 hp capacity, built by the Marinette (Wis.) Iron Works Manufacturing Company. It will operate on illuminating gas, and will be direct connected to a generator of 75 kw. capacity, made by the Akron (O.) Electric Manufacturing Company. The Mackay people anticipate the closing in their favor within the next week or so of three contracts for lighting equipments for Santiago, Cuba.

GOULD STORAGE BATTERY ORDERS.—The Gould Storage Battery Company, New York City, Mr. W. W. Donaldson, sales manager, reports the following recent orders: New York, New Haven & Hartford Railroad Company, two plants of 55 cells each, to be used for lighting the stations at Bristol and New Britain, Conn. These installations are replacements of batteries of other makes. Narragansett Electric Lighting Company, Providence, R. I., positive plates with an aggregate capacity of 320,000 amp.-hours as replacement of the original installation of other makes, which have been in use for some years.

SUPPLIES FOR THE LONDON COUNTY COUNCIL.—Birck & Hickman, of Whitechapel Road, London, which concern represents the British interests of several American manufacturers of machinery, supplies, etc., and is one of the largest handlers on the other side, has been chosen, among others, to supply the London County Council with electrical supplies for the coming year. As the L. C. C. is constructing extensive lighting and power plants, etc., in the British metropolis and suburbs the orders which will eventually reach manufacturers on this side are likely to be very gratifying.

SOME INTERESTING CUTTER ORDERS.—The Cutter Electric & Manufacturing Company, of Philadelphia, has just taken a large contract for triple-pole circuit breakers and Keystone instruments for direct current. The equipment is intended for the light and power plant at the St. Louis Exposition. Another interesting order calls for 150 individual arm circuit breakers with hand switches for the large switchboard, which the H. Krantz Manufacturing Company, of Brooklyn, is building for installation in the Metropolitan Life Building, Madison Square, New York.

SOME MAGNET WIRE ORDERS.—The Magnet Wire Company, 80 William Street, New York, has just been awarded a contract by the Interborough Rapid Transit Company for a 1,500,000 c.m. cable. The Pittsburg (Pa.) Railways Company has ordered a good-sized lot of No. 00 trolley wire. The San Antonio (Texas) Traction Comapny has requisitioned for a fair-sized quantity of No. 0, and the Chambersburg, Greencastle & Waynesboro (Pa.) Street Railway Company is to be supplied with a considerable lot of weatherproof fire and trolley wire.

THE NORTHERN ENGINEERING WORKS, crane builders, Detroit, Mich., report among recent sales electric cranes of from 5 to 25 tons capacity to the following firms: Gerst Brothers, St. Louis; Olds Gasoline Engine Works, 3 cranes; Omaha & Council Bluffs Railway Company; American Steel & Wire Company; Green's Car Wheel Company, and hand-power cranes of equal capacity to Cambria Steel Company, Jackson & Church, Indianapolis & Cincinnati Traction Company, besides several other smaller electric and hand-power cranes.

TRUMBALL SPECIALTIES FOR THE PACIFIC SLOPE.—The Trumball Electric Manufacturing Company, 136 Liberty Street, under the management of J. D. Watson, reports receipt of substantial orders for its specialties—switches principally—from Los Angeles, San Francisco, and other points on the Pacific slope. The company is bringing out a new cord adjuster and pendant switch, for which there are several orders waiting.

MINE ELECTRIC HAULAGE.—The Blackwood Coal & Coke Company, of Blackwood, Wise County, Va., is contemplating the installation of a 400-kw. three-phase, 6,600-volt system for distribution to rotary converters for electric haulage, etc., in its mines recently opened up at that place. Mr. J. Blaine Replogle has accepted a position with the concern as electrician.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. General meeting, Washington, D. C., April 7, 8 and 9, 1904.

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Ave., Detroit, Mich.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, St. Louis, 1904.

American Street Railway Association. Secretary, T. C. Pennington, 2020 State Street, Chicago.

Association of Edison Illuminating Companies. Secretary, W. S. Barstow, New York City and Portland, Ore.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., 1904.

Chicago Electrical Association. Secretary, W. B. Hale, 242 South Jefferson Street, Chicago.

Colorado Electric Light, Power & Railway Association. Secretary, George B. Tripp, Colorado Springs, Col. Annual meeting last Wednesday in October.

Connecticut State Street Railway Association. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

Engine Builders' Association of the United States. Secretary, F. P. Ide, Springfield, Ill. Next meeting, December, 1903.

Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

Illinois State Electric Association. Secretary, H. E. Chubbuck, LaSalle Ill.

Indiana Public Utilities Association. Secretary, A. M. Barron, Indianapolis, Ind.

Independent Telephone Association of the United States. Secretary, Frank G. Jones.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Piehardt, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, Ill., December 8, 9 and 10, 1903.

Iowa Electrical Association. Secretary, W. S. Porter, Eldora, Ia.

Iowa Telephone Association. Secretary, C. C. Deering, Des Moines, Ia. Annual meeting, Des Moines, March 8, 1904.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ind.

Maine Street Railway Association. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

National Arm, Pin & Bracket Association. Secretary J. B. Magers, Madison, Ind. Next meeting St. Louis, July, 1904.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting St. Louis, Mo., September 14, 15 and 16, 1904.

New England Street Railway Club. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

National Electric Light Association. Secretary, Ernest H. Davis, Williamsport, Pa. Next meeting, Boston, Mass., May or June, 1904.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, Milwaukee, Wis., Jan. 20, 1904.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, Ohio.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, C. J. Miller, Canton, O.

Southwestern Electrical Association. Secretary, J. L. Ellis, Oklahoma City, Okla. Next meeting, Dallas, April or May, 1904.

Southwestern Gas, Electric & Street Railway Association. Secretary, Frank E. Scovill, Austin, Texas.

Street Railway Accountants' Association of America. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

Street Railway Association of the State of New York. Secretary, W. W. Cole, Elmira, N. Y. Next meeting, Utica, N. Y., Oct. 11 and 12, 1904.

United Electrical Contractors' Association of New York State. Secretary, William J. Davis, Ithaca, N. Y. Next meeting, New York City, January 19, 1904.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

General News.

THE TELEPHONE.

NASHVILLE, ARK.—A new switchboard and the addition of 50 miles of toll line is contemplated by the Nashville Telephone Company. Eureka apparatus is used here, and there are 180 subscribers, who pay $1.50 per month for residence and $2 for business service.

WASHINGTON, D. C.—It is understood that an agreement has just been reached between the Telephone Subscribers' Association of the District and the Chesapeake and Potomac Telephone Company, by the terms of which the proceedings instituted several years ago to enjoin the telephone company from refusing service to those who declined to pay rates higher than those prescribed by the act of Congress of June 30, 1898, will be discontinued.

INVERNESS, FLA.—Seventy two subscribers are furnished with service by the Florida Telegraph & Telephone Association. The company proposed building 25 additional miles of toll line in the near future.

ATLANTA, GA.—The Southern Bell Telephone Company has petitioned the City of Atlanta for the privilege of placing its wires underground on a number of the principal streets.

ROBERTS, ILL.—The Lyman Telephone Company has been incorporated with a capital stock of $5000. The directors are C. Anderson, F. S. Diller and G. W. Madden.

GIBSON CITY, ILL.—The Gibson Home Telephone Company has been incorporated to operate a telephone and telegraph system; capital, $25,000. Incorporators: A. L. Phillips, B. G. Schlosser, H. A. Hall.

PANA, ILL.—A company of local capitalists, consisting of Warren and C. T. Penwell and B. Beckenheimer, has bought controlling interest in the Pana & Christian County Telephone Company, with a mileage of 25 miles. Mr. Beckenheimer is president.

DE WITT, ILL.—The Farm & City Telephone Company has recently closed a contract with the Interstate Telephone & Telegraph Company to secure connection with Springfield, Peoria and all northern and western cities. The Farm & City Company operates 6 exchanges with 1000 subscribers, and expects to change all its circuits to metallic. It expects a growth of 40 per cent in the near future. It uses Sterling apparatus. Mr. B. F. Wasson is president.

LASANTVILLE, IND.—Steps have been taken in this city to displace the Bell telephone system by installing an independent system.

EVANSVILLE, IND.—The Cumberland Telephone Company has reduced its rates for residences for individual metallic circuit with long distance equipment from $3 to $2.50 per month; two-party line, same equipment, $2 per month.

INDIANAPOLIS, IND.—The Mitchell Telephone Company has filed articles of incorporation. The capital stock is $30,000. The principal office and exchange will be in Mitchell. L. W. Spencer, Wm. McKeane, A. H. Hostetter, C. W. Coleman and Wm. Raney are the incorporators.

RENSSELAER, IND.—The largest farm in Indiana is owned and operated by B. J. Gifford and contains 32,000 acres in the northern part of Jasper County. In addition to twelve miles of railroad, his own engine and cars to draw his produce to Chicago, he maintains village stores, warehouses, cold storage plants (schools by public money), churches and over 350 tenement houses, all of which are connected by a complete system of telephones which in turn is connected with the long-distance lines.

TERRE HAUTE, IND.—One of the principal questions discussed by the delegates to the Municipal League Convention held in this city last week was the power to compel companies to bury their wires in the absence of a provision in the franchise. An attempt is being made by the authorities of Richmond and other cities in Indiana to compel electric companies to place their wires underground. The opinion prevailed that the companies can be compelled to bury their wires whether it is provided in their franchise or not. The cost of putting wires underground in a territory covering one square mile was estimated to be about $45,000. A number of Indiana cities have added a clause to the franchise granting an extension providing for the placing of wires underground. In Ft. Wayne, Terre Haute and Indianapolis the franchises provided for placing wires underground. South Bend has a district of four square miles in which the wires are underground.

RIVERTON, IA.—Local parties propose to buy the telephone exchange or construct a new system.

SIOUX CENTER, IA.—The Hawarden Telephone Company has been granted a franchise for a telephone exchange.

MARSHALLTOWN, IA.—A farmers' mutual telephone company has been organized at this place with D. N. Blair as president.

MILLER, IA.—The Ellington Telephone Company has been formed in Ellington township to build a telephone line to Miller.

PALMER, IA.—The Farmers' Mutual Telephone Company proposes a line from Pomeroy to Pocahontas and connect with Palmer and Rusk.

WATERLOO, IA.—The United States Telephone & Telegraph Company will rebuild the local telephone exchange at a cost of $100,000. Cable has been ordered for the work.

SIOUX CITY, IA.—The Sioux City Telephone Company will expend $350,000 in installing a local system, erecting a three-story fireproof exchange building, putting in a conduit system, etc.

WATERLOO, IA.—The Waterloo City Council has granted R. A. Davidson a 20-year franchise to operate an independent telephone system in this city.

ALBION, KAN.—The Albion Telephone Company has been incorporated with a capital stock of $1000.

OWINGSVILLE, KY.—The Owingsville Telephone Company is being formed by local people and an exchange will be installed some time in the near future.

PORT JEFFERSON, N. Y.—The North Shore Telephone Company, with a capital of $7500 was organized by electing the following directors: Frank H. Tuthill, of Rocky Point; W. A. Davis, of Mount Sinai; Postmaster C. A. Squires, of Echo; J. H. Davis, H. T. Bayles, John E. Overton, Charles V. Platt and Ralph J. Hawkins, of Port Jefferson, and Thomas N. Bayles, of Stony Brook. It is proposed to run a local line from Smithtown to Wading River, with a central at Port Jefferson, and give an unlimited service to all subscribers, except business places, at $10 a year. Business places will be charged $15.

NEWBERRY, MICH.—The council has granted a franchise to the Michigan Telephone Company which will install an exchange. The project for a municipal telephone system has been abandoned.

HOKAH, MINN.—The Hokah & Mound Prairie Telephone Company has been organized here and will soon commence the construction of a farmers' telephone line into Hokah.

GILLAM, MO.—The Gillam Telephone Company has been incorporated with a capital stock of $2500. The directors are W. T. Swinney, R. N. Ayers and others.

LAWRENCE, NEB.—The Lawrence Telephone Company, of Lawrence, has filed articles of incorporation with the secretary of state. The capital stock is $1000. The company will operate a telephone system in Nuckolls and adjoining counties.

STEUBENVILLE, OHIO.—The Island Creek Telephone Association has been organized here by the election of D. S. Carr as president.

URBANA, OHIO.—The Urbana Telephone Company contemplates extensive improvements. The switchboard capacity is to be enlarged and new telephones installed.

ZANESVILLE, OHIO.—The Zanesville Telephone Company has been incorporated with a capital stock of $10,000. The directors are J. B. Rhoads, S. M. Winn and others.

PLEASANT HILL, OHIO.—The Pleasant Hill Telephone Company operates a 100-drop American switchboard, and has 125 subscribers. Some additional farmers' lines are projected.

LORAIN, OHIO.—The council has granted a franchise to the Ohio Telephone & Telegraph Company to install a Bell exchange here in opposition to the established independent company.

CEDARVILLE, OHIO.—The Cedarville Telephone Company has elected these directors: R. E. Kerr, O. E. Bradfute, F. W. Turnbull, J. H. Andrew and D. Bradfute. The company is planning improvements to its system.

ROCKFORD, OHIO.—The Rockford Toll Line Telephone Company is operated in connection with the Rockford Telephone Exchange Company, which latter has 160 subscribers. The company uses a 200-drop Sterling switchboard.

MEDINA, OHIO.—A Eureka 350-drop switchboard is operated by the Medina Telephone Company, which has 300 subscribers. The recent growth of the company has been good, and Mr. W. B. Croft, the secretary, reports a fair outlook.

CAMBRIDGE, OHIO.—The Cambridge Home Telephone Company's switchboard capacity is 200 drops (American type) and 600 lamps (North). There are 550 subscribers, who pay $18 and $24 per annum each. The company owns 70 miles of toll line.

CROOKSVILLE, OHIO.—The newly organized Crooksville Telephone Company has elected the following officers: J. B. Rhoades, president and general manager; H. A. Skidmore, secretary, and Wm. Harris, treasurer. The company has secured a large number of subscribers and is planning to purchase material and install an exchange in the near future.

MANSFIELD, OHIO.—Mansfield people have bought about $200,000 worth of the stock of the Mansfield Telephone Company heretofore owned by the Federal Telephone Company, of Cleveland. The officers of the company are S. N. Ford, president; J. L. Baxter, vice-president; M. D. Ward, secretary-treasurer. The company is doing a very extensive business and it is the intention of the new owners to make important improvements.

TILLAMOOK, ORE.—The Tillamook Telephone & Telegraph Company has 161 miles of toll line, with several more to be built. The exchange at Tillamook operates Eureka apparatus and has 180 subscribers. The demand for telephone service is very good, almost greater than the company is able to supply.

RURAL VALLEY, PA.—The Armstrong Telephone Company operates an exchange at Rural Valley and one at Dayton, Pa. J. H. Foster is superintendent.

APOLLO, PA.—There are 175 subscribers to the service given by the Apollo Telephone Company, which uses Stromberg-Carlson apparatus. It charges $1.50 per month.

CARMICHAELS, PA.—The Carmichaels Telephone Company reports a steady increase of business. It is contemplating extending its lines. At present there are 160 subscribers. A North switchboard and Stromberg-Carlson telephones are used. The rates are $12 and $18.

CORAOPOLIS, PA.—A Kellogg 150-drop switchboard is in operation here by the Pittsburg & Allegheny Telephone Company. Two new trunk lines to Pittsburg are projected. Unlimited service to all exchanges in Allegheny County is included in the annual charge of $58 for residences and $72 for business. Mr. George Jackson is general manager of this exchange.

BEDFORD, PA.—In three years the Bedford County Telephone Company has paid for itself and made improvements. It is contemplating a line of 13 miles to Hyndman, connecting with western Maryland, giving it Cumberland and 1500 subscribers on its line. The growth of the company has been very rapid, and it numbers at present 350 subscribers, who pay $12 per annum each.

JOHNSTOWN, PA.—The Johnstown Telephone Company has 2000 subscribers. The system has been growing at the rate of 500 subscribers per annum. Kellogg apparatus is employed. The company is building the Pittsburg-Johnstown Long Distance Telephone Company's lines, under the direction of Mr. William S. Paca. This line it is expected will be completed by December 15, 1903.

CAMBRIDGE SPRINGS, PA.—Four hundred subscribers and the investment paying 10 per cent. is the record of the Cambridge Springs Telephone & Telegraph Company, which was organized seven years ago. Cambridge Springs has a population of 2000, and has connection with Cleveland and Olean. It expects to have long-distance connection with Buffalo soon. Ten miles of toll line are projected.

PROVIDENCE, R. I.—Important alterations in the central exchange of the Providence Telephone Company on Union Street are under consideration. Its capacity will be doubled or trebled; the common battery system will be adopted and at least two stories will be added to the present building, making five stories available for telephone purposes, excepting the first floor on the front which will be occupied by storekeepers.

WHITE LAKE, S. D.—Local men are arranging to establish a telephone system at this place. The improvement is much needed as this is the only town between Mitchell and Chamberlain that has no telephone system.

WEBSTER, S. D.—Starting with 75 subscribers two years ago the Webster Telephone Company now numbers 235 in the city and 85 in the country. A 300-drop Kellogg board is operated.

YANKTON, S. D.—The Farmers Co-operative Telephone Company has been formed by the farmers of the northern part of Yankton County. The officers are Hon. John M. Larson, president; Hans Hanson, treasurer; Albert Klath, secretary. The company has purchased the lines now in operation between Center Point and Viborg and expects to further extend the lines until the farmers of the entire northern part of the county are connected.

SAN ANGELO, TEX.—From 85 subscribers to 395 to-day and from no toll lines to 550, in four years, is the record of the San Angelo Telephone Company. A Kellogg switchboard of 610 drops capacity is installed at this exchange.

NAVASOTA, TEX.—The Navasota Telephone & Construction Company operates in Grimes County. Stromberg-Carlson instruments are used; there are 175 subscribers, who pay $3 for business and $1.50 for residence service per month.

RICHARDSON, TEX.—A meeting has been called of the stockholders of the Richardson Telephone Company for the purpose of selling its exchange to one man, as it is believed this will be more satisfactory than the mutual plan under which the company has been working. There are 90 subscribers with prospects of a steady increase.

WAXAHACHIE, TEX.—The Ellis County Independent Telephone Company operates exchanges at Ennis and Waxahachie. The two exchanges are connected by toll lines. Business in Ennis is always good, the exchange there having 400 subscribers. The Waxahachie exchange numbers 340 subscribers. The company has toll connection with every post office in the county, also lines to Ft. Worth, Cleburne, Hillsboro and Waco (Tex.), aggregating some 300 miles.

PRICE, UTAH.—Six switchboards, two of which will have a capacity of 500 drops, will be installed within the next three months by the Price Telephone Company. The lines of this company take in Carbon and Emery Counties. Fifteen miles of toll line are to be added to the system.

FAIRVIEW, UTAH.—The Fairview Telephone Company has in view a consolidation with a system in Castle Valley. This would give the consolidated company a system of considerable importance.

PETERSBURG, VA.—Considerable extension of toll lines is planned by the Petersburg Telephone Company. This company was organized in 1902 and has now 820 subscribers. It has recently purchased valuable real estate on the principal business street and as soon as the lease on the present location expires it will put in an up-to-date system.

MILWAUKEE, WIS.—The West Shore Telegraph & Telephone Company is seeking a franchise in this city.

CADOTT, WIS.—Mr. O. J. Jensen, owner of the exchange at this place, has 139 subscribers with 67 miles of toll line. Standard Telephone & Electric apparatus is used.

WASHINGTON, WIS.—The Loretto & Logansville Telephone Company, of Washington, Sauk County, capital stock $550, has been incorporated by R. C. Bremzer, Albert Prouty, Mike Flemming and seven others.

WALWORTH, WIS.—The Walworth Telephone Exchange Company began business in December, 1900, and operates a Kellogg switchboard of 100-drops capacity. The outlook is considered good for a fair increase.

WAUSAU, WIS.—The system of the Wausau Telephone Company is being changed to full metallic; a new board is being installed, and the office is being moved to the Heineman Block. The subscription list now numbers 600. An increase to 1000 is looked for.

EDGERTON, WIS.—If present plans mature, it is the intention of the Edgerton Telephone Company to occupy a building of its own and to install a new switchboard to take care of the growing business. Standard apparatus is used; there are 260 subscribers, with the prospect of 25 more this coming winter.

DURANGO, MEX.—Henry Lanvelt, who is said to represent a syndicate of Ohio capitalists, is investigating the situation here with the view of establishing a new telephone exchange here. He also proposes to build long distance telephone lines on the Pacific coast of Mexico.

OTTAWA, ONT.—Tests are being made of simultaneous telegraph and telephone service on the wires of the Canadian Pacific Railway between Ottawa and Montreal.

ELECTRIC LIGHT AND POWER.

BENTON HARBOR, ARK.—W. L. Cooper, Mayor, states that the city would grant an electric light franchise to responsible parties and assist them in the way of taking street lights, etc.

PETALUMA, CAL.—The California Central Company will construct here a 500-hp auxiliary steam plant.

BIGGS, CAL.—The election held here to incur an indebtedness of $12,000 for a municipal water system and electric light plant was carried.

SAN DIEGO, CAL.—Chas. L. Sumner, of Toledo, Ohio, and associates are interested in the construction of an electric light plant in San Diego.

SAN FRANCISCO, CAL.—The plant of the Independent Electric Light & Power Company has been turned over to the San Francisco Gas & Electric Company by Claus Spreckels, who took $5,000,000 worth of the other company's bonds as a part of the payment for his electric and gas plants. J. F. Lawless is now general manager of the San Francisco Gas & Electric Company. H. A. Woods, who has been superintendent of the independent electric power plant will remain in charge of that plant for some time and will hold a position with the purchasing company. The San Francisco Gas & Electric Company now owns all of the electric lighting plants of the city with the exception of those of the Mutual Electric Light Company and the Central Light & Power Company and has also a monopoly of gas lighting.

NEW HAVEN, CONN. The Board of Aldermen has voted to award the contract for lighting the city streets for three years from Jan. 1, 1904, to the American Lighting Company, of Baltimore, Md.

ATLANTA, GA.—The Atlanta Water & Electric Company has borrowed $1,500,000, mortgaging all of its property to the Knickerbocker Trust Company, of New York, with which company the loan was negotiated.

MOLINE, ILL.—The People's Power Company has secured the contract for lighting the streets for five years at $65 per light per year for 210 lights or more.

DIXON, ILL.—The City Council has granted the Dixon Power & Lighting Company a contract to substitute for the present 85 gas lights in the city, 100 incandescent electric lights of 25-cp.

PANA, ILL.—At a special meeting of the City Council Nov. 24, the city arranged to have the city streets lighted. The city will pay $6 a month for each light. This is an increase of $1 a month over the old schedule.

SPRINGFIELD, ILL. Don. E. Dietrich has been appointed receiver for the Chester Light, Water & Ice Company. The receiver was appointed on application for Union Trust Company, of New York, which holds the bonds of the concern.

CHICAGO, ILL.—Mayor Harrison has declared that the city will enter the electric lighting field at once in competition with the gas and electric companies. The attempt to enter the field by selling to corporations and private individuals electric current made in the municipal plants, it is expected, will result in an appeal to the courts by the big lighting corporations. This, Mayor Harrison declares, is what the city would invite, as it will determine its right to deal in public necessities.

HAMMOND, IND.—The Hammond Illuminating Company has changed its name to South Shore Gas & Electric Light Company.

COLUMBUS, IND.—Bids will be received by City Council Dec. 14 for the construction of an electric light plant, with a capacity of 125 lamps. The probable cost is placed at $10,000.

INDIANAPOLIS, IND.—Judge Anderson, of the Federal Court, has appointed the Indiana Trust Company receiver for the East Chicago Light & Power Company and the Lake County Light & Water Company. The receiver will take charge of and operate both plants.

DURANT, IND. TER.—It was voted Nov. 16 to issue $89,000 bonds for water works and an electric light plant.

OGDEN, IA.—The question of issuing bonds for a municipal lighting plant here will be voted on.

ALTOONA, IA.—It is reported that the Interurban Railway Company proposes to furnish electric light for this town.

GIRARD, KAN.—The state auditor has registered an issue of $20,000 bonds for an electric light plant.

AUGUSTA, KY.—Bids will be received Dec. 11 by W. C. Wittmeier, City Clerk, for an electric light franchise.

BORDEN, KY.—The Citizens' Electric Light Company has been organized at Borden with J. H. Durham, president; C. F. Stevenson, secretary, and C. E. Bierley, treasurer.

SEBAGO LAKE, ME.—The Sebago Lake Lighting Company has been organized at Portland to generate and distribute gas and electricity; capital, $10,000. D. D. Tripp is president; J. H. Rich, treasurer, both of Sebago Lake.

GRAND RAPIDS, MICH.—Edw. M. Deane & Co., of Grand Rapids, will expend about $50,000 in improvements. This company recently purchased the plant of the Citizens' Gas Light Company, of Grand Rapids, and the plant of the Vincennes Electric Light & Power Company, of Vincennes. W. B. Wales, of Grand Rapids, is engineer in charge.

LABELLE, MO.—The citizens on Nov. 21 voted to issue bonds for the purpose of installing an electric light plant.

LEXINGTON, NEB.—The City Clerk writes that the city is open to propositions for the construction of an electric light plant.

IRVINGTON, N. J.—The Committee on Public Lighting has been authorized by Council to inquire into the matter of municipal ownership of a public lighting plant.

HACKENSACK, N. J.—A fire which started shortly after midnight on Nov. 26, destroyed the lighting plant of the Hackensack Gas & Electric Light Company, on the Hackensack River. The damage will amount to more than $50,000. The building destroyed was about 40 feet wide and 120 feet long. It contained much valuable machinery, which was entirely destroyed. The station will be immediately rebuilt.

GENEVA, N. Y.—The Geneva Power & Light Company, of Geneva, has secured the contract of lighting the city for five years at $75 per year for 107 arc lamps, and $20 per year for 4[illegible] incandescent lamps.

OXFORD, OHIO.—The village council has decided to issue $3500 bonds for an electric light plant.

COLUMBUS, OHIO.—The board of public service is advertising for proposals on the material and work necessary to complete the municipal lighting plant.

TOLEDO, OHIO.—The old hydraulic canal at Perrysburg has been sold to St. Louis parties who will install a $150,000 plant for generating current for lighting and power.

MECHANICSBURG, OHIO.—T. J. Long, who owns an important water-power right at Mechanicsburg, has applied to the council for a franchise to erect a power plant and light the town.

ATHENS, OHIO.—The council has entered into a contract with the Erner-Hopkins Company, of Columbus, for the material and work in erecting a municipal lighting plant. A [illegible] hp engine and a 150 kw generator will be installed and current will be supplied for 80 arc lights and 2000 incandescent lamps. The contract price is $13,740.

CORAOPOLIS, PA.—Bids are wanted Dec. 7 for $20,000 water works and electric light extension bonds.

GLEN CAMPBELL, PA.—A charter has been granted to the Giant Electric Light, Heat & Power Company, of Glen Campbell, with a capital of $10,000.

JEFFERSON, TENN. G. A. Moody has petitioned for a franchise for an electric light plant.

COLUMBUS, TEX.—John A. Cook and Sealy B. Moody, of Lagrange, Ill., have in contemplation the construction of an electric power plant near Columbus.

SALT LAKE CITY, UTAH.—Meetings of stockholders of the Utah Light & Power Company and the Consolidated Railway Company will be held here on Dec. 15, with a view to effecting a consolidation of the two companies and the expectation is that the union will be consummated by the first of next year. Improvements will be provided for to the extent of from $200,000 to $300,000 annually for a number of years. It is expected that no money will change hands in the deal, which is to be made for the mutual interest of both companies. The new company will merely exchange stock for certificates of the older companies on an agreed basis.

WENATCHEE, WASH.—The Lamb-Davis Lumber Company has secured a franchise for water works and an electric light plant.

CONCONULLY, WASH.—The Pinnacle Mining Company is making extensive improvements here, and among other things will erect a power plant about 1½ miles from the mine. The power will be derived from the falls on Toat's Coulee Creek.

NEENAH, WIS.—John I. Beggs, president of the Milwaukee Electric Railway & Light Company, representing a Milwaukee syndicate, is about to ask for a franchise to light this city.

BLACK RIVER FALLS, WIS.—Mayor Bright, on behalf of the city, has taken option on the water power, power house and several buildings for $25,000. The object is to have the city control the power so that it can run its own electric light plant and water pumping station.

SANTA FE, N. M.—The Capital Light & Power Company is a recently organized corporation which will build a large electric power plant near this city. Mr. A. R. Gibson, of this city, is the promoter of the enterprise. Work has already been commenced on the plant and contracts let for lines which will be strung to Las Vegas, Albuquerque and other points to convey electrical power. The power for the plant will be generated from the waters of the Pecos river.

OTTAWA, ONT.—Regarding the oft-reiterated stories of the fear that the natural features of Niagara Falls will be destroyed by the commercial demands at that locality, Mr. J. W. Langmuir, of the Canadian Park Commission, says there is no occasion for such alarm so far as the Canadian government is concerned. He says: "The artistic value of the Falls, I believe, has been improved by the work done in conformity with the concessions granted by the commission on this side. Eighty-five per cent of the total water fall passes over the Canadian side. This gives us ample control of the situation. We have granted concessions approximating 400,000 horse power. The full supply of water may not be utilized for a century." The volume of water passing over the Canadian Falls cannot be diminished to any appreciable extent by the commercial concessions now granted. On the other hand Mr. Langmuir thinks there is danger of all the water now passing over the American Falls being diverted when the concessions there are fully utilized.

OTTAWA, ONT.—The Ontario Legislature, at its last session, passed an act empowering a commission of five persons to enquire into and report upon a scheme for vast power supply to a group of Ontario municipalities. The commission is encountering some difficulty in securing the services of a competent expert electrician to act as the fifth member of that body. It will cost $10,000 to secure a preliminary report alone on the power question, to enable the municipalities to work out the problem before them. Some 50,000 horse power, it is estimated, will be utilized immediately by 20 towns and cities which have already manifested a disposition to participate in the power scheme. At least half of this power will be used in Toronto, and the balance will be distributed over western Ontario. It is stated that the plant for generating and distributing the power could be ready in three years. The commission figures on 50,000 horse power for immediate use only, but that amount does not comprehend the enormous development, industrially, that will cover the Ontario peninsular when the practicability of the plan has once been demonstrated. The power will be drawn from Niagara Falls. It is calculated that a horse power, now costing $40 to develop, can be secured by the scheme proposed for not more than $15.

The Electric Railway.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has let the contract for an addition to the power house, which will cost with equipment over $200,000, thus adding 5000-hp to the present capacity of 9000-hp. The new engines alone will cost $56,000 and will be furnished by the Brimingham Machine & Foundry Company.

ATLANTA, GA.—A mortgage has been filed by the proposed Atlanta and Marietta Electric Railway Company to the Guaranty Trust Company, of New York, to secure a bond issue of $600,000 to cover the cost of the projected electric railway between the places named.

DIXON, ILL.—The contract for building the Dixon, Rock Falls & Southwestern Railway has been awarded to Maffee, Carter & Company, of New York City. The plan of the company is to build an electric railway from Dixon to Rock Falls.

CHICAGO, ILL.—The Blue Island, Riverdale & Hammond Street Railway Company has been incorporated; capital stock, $50,000. Incorporators and first board of directors: Wm. R. Owen, August W. Miller, John F. Noel, Henry Schanze and Michael J. Corcoran, all of Chicago, Ill.

CHICAGO, ILL.—The strike of the employees of the Chicago City Railway Company, which began on Nov. 12, was ended on Nov. 25. The 1500 members of Division 260 of the Amalgamated Association of Street and Electric Railway Employees of America voted to accept an agreement made with the officials of the Company in the Mayor's office, and they returned to work on Thanksgiving Day, Nov. 26. The substance of the agreement is as follows: Wages, company and men agree to arbitrate; present scale to be set aside and the actual worth of labor to be estimated without regard to wages paid at present. This may raise some wages and lower others. Routing of Cars—Two propositions made; men may take choice. One is a minimum of eight hours and a maximum of eleven, all within the limit of fifteen hours. The other alternative is an opportunity to earn ten hours' pay in fifteen hours. Closed shop—Company retains the right to discharge, discipline and hire its men without interference of the union in any way. Shop to be open to union and non-union men alike. Employment—Company will take back all of its striking employees except those who have been found guilty of violence since Nov. 1. This includes those who went on sympathetic strikes.

RICHMOND, IND.—C. N. Wilson, of the Columbia, Greensburg & Richmond Traction line, has asked the County Commissioners for a franchise through the county. The line will follow the Centerville route from Connersville to Richmond.

RICHMOND, IND.—It is semi-officially announced that the Indianapolis & Eastern Traction Company will ask the Commissioners of Wayne County for a franchise from Dublin to Richmond, that it may have its own line from Indianapolis to Richmond.

ANDERSON, IND.—The City Council has granted a franchise to Wallace B. Campbell for an electric railway from Anderson to Lebanon. He states that be now has a franchise from all the towns and cities through which the line passes and much of the roadbed right of way.

ATTICA, IND.—An election has been ordered in Logan Township, Warren County, for the people to vote on the question of a 2 per cent subsidy for the Tipton, Frankfort & Attica Traction Company. The election will be held Dec. 8. The subsidy will probably be voted, as there is a great desire for the road.

CORYDON, IND.—The County Commissioners have granted to the Leavenworth Electric Railway a franchise through Harrison County. The company will build a line from New Albany to White Sulphur Well via Leavenworth. T. B. Elsworth is president of the company, and S. A. Beales, secretary. Both are residents of Leavenworth.

DAVENPORT, IA.—John U. May, who has been promoting an electric railway between Davenport and Clinton, has sold all his franchises and material to the Iowa & Illinois Railway Company, which is now at work constructing an electric railway between the two points. The latter company is promoted by Thomas Wilcox, of Des Moines.

TOPEKA, KAN.—A charter has been granted to the Topeka, Eskridge & Council Grove Interurban Electric Railway Company by the State charter board. The company is capitalized at $50,000, and is a local concern organized by merchants, business men and farmers along the route.

ARKANSAS CITY, KAN.—The City Council has granted to L. P. P. Northrup, of Arkansas City, and others, a franchise for the purpose of building an electric railway, light and power plant. Besides building in the city, the company will build an interurban road with Arkansas City as a center. It is the intention of the company to connect Winfield and Arkansas City and the Chilocco Indian School. St. Louis capital is said to be behind the enterprise.

LOUISVILLE, KY.—The Board of County Commissioners of Floyd County, Indiana, at New Albany, has ordered an election to be held Dec. 10 to determine whether or not the townships of New Albany and Franklin shall vote a subsidy of 2 per cent for the aid of the Louisville & Southern Indiana Traction Company in New Albany and Franklin Townships. Should the subsidy be voted, $206,000 will be realized from New Albany Township, and about $10,000 from Franklin Township. The money is to be used in constructing an electric railway from New Albany to Corydon.

BALTIMORE, MD.—It is said that at the coming session of the Legislature it is proposed to pass a "Jim Crow" law like that in Virginia, providing separate street cars, as well as separate compartments, for negroes in steamboats and on railroad trains running through Maryland.

AUGUSTA, ME.—Articles of association have been filed for the Lewiston & Kennebec Street Railway, to run from Lewiston, through Webster, Wales, Monmouth, Litchfield, West Gardiner to Gardiner, 21 miles. The incorporators are Sidney M. Bird and Maynard S. Bird, of Rockland; George W. Heselton, of Gardiner; John D. Clifford and Charles C. Benson, of Lewiston, and Edward W. Gross, of Auburn.

DETROIT, MICH.—The Detroit, Flint & Saginaw Railway Company has been organized, with T. E. Tarnsey, president; John A. Russell, vice-president and general manager; A. S. Nester, secretary, and Thos. G Sullivan, treasurer. The company will shortly incorporate, with $1,000,000 capital. Orders are said to have been placed for 13 miles of track.

CAMDEN, N. J.—The temporary obstacles placed in the way of the Camden & Suburban Railway Company from continuing its route to Trenton have been removed, and the line will probably be open for travel by Dec. 1.

JERSEY CITY, N. J.—The Interurban Traction Company, with a capital of $1,000,000, has been incorporated here by Frank Cook and R. W. G. Welling, of New York, and R. F. Tully, of Jersey City. The object of the company is to operate electric and steam railways.

NEWARK, N. J.—The Public Service Corporation of New Jersey has leased the Orange & Passaic Valley Street Railway Company for 900 years. According to the lease, the Public Service Corporation will pay to the lessor $3,000 on May 1, 1904, and the same amount every six months thereafter until Nov. 1, 1905. This amount will be increased yearly until 1913, when $18,000 will be paid and continued annually thereafter.

BROOKLYN, N. Y.—Tests are about to be made by the Brooklyn Rapid Transit Company in the carrying away of ashes and street sweepings of this borough by cars on the company's lines. The arrangement provides for 13 stations where the ashes and sweepings will be loaded on the cars. All this work will be done at night, and the refuse will be placed in large zinc buckets and carried to the swamp lands on Coney Island owned by the Brooklyn Rapid Transit Company.

WAPAKONETA, OHIO.—A reorganization of the Sandusky Southwestern Electric Railway was effected at the annual meeting when four of the officers and six directors were deposed. Officers were elected as follows: John Van Fleet, president; F. O. Oleson, vice-president and general manager; G. A. Smith, secretary, and Lyman Means, treasurer. The company has recently made a $2,000,000 bond issue, and the prospects for completing the road look very bright. Construction work has been started again.

YORK, PA.—Negotiations have been concluded between the York County Traction Company and the Wrightsville Turnpike Company by which the former will build its line between York and Wrightsville on the turnpike.

BEAVER, PA.—In order to obtain money with which to extend its lines to meet the West End line at Coraopolis and the New Castle Electric Railway at Mahoningtown, the Beaver Valley Traction Company has mortgaged its 15 miles of electric railway in the Beaver Valley to the Northern Trust Company, of Philadelphia, in the sum of $3,000,000. It is stated that the New Castle Traction Company will build from Mahoningtown to Wampum, a distance of 4 miles, to meet the Beaver Valley line. These extensions will make direct street railway communication between Pittsburg, New Castle, Youngstown, Warren, South Sharon, Sharon, Sharpsville and Beaver.

NASHVILLE, TENN.—The Nashville & Gallatin Interurban Railway Company has sold its property to the Nashville & Columbia Interurban Railway Company for $100,000. The deal was accomplished by the purchase by Thomas E. Perry, Jr., and H. A. Gross, of Pittsburg, of the interests of C. W. Ruth and Frank Haskell. The name adopted was the Nashville, Columbia & Gallatin Electric Railway Company. This company decided to retain the charter granted to the original companies, and to file amendments to these authorizing it to increase its capital stock from $100,000 to $3,000,000. Officers were elected as follows: Thomas E. Perry, Jr., president; H. M. Gross, vice-president, secretary and treasurer; E. J. Kent, chief counsel, and J. H. Connor, general manager.

BROWNSVILLE, TEX.—It is stated that a street railway system is to be built here. Lon Hill can give information.

SAN ANTONIO, TEX.—The strike of the employees of the San Antonio Traction Company is practically ended. A number of the strikers have applied for their old positions and have been taken back by the company. No concessions were granted the strikers by the company.

SALT LAKE CITY, UTAH.—Articles of incorporation have been filed by a local company to construct an electric railway from Ogden to Brigham City, a distance of 20 miles. The company has a capitalization of $200,000 and the officers are Thomas D. Dee, of Ogden, president; Hiram H. Spencer, vice-president, and Charles H. Kircher, secretary.

YORKTOWN, VA.—The Newport News & Old Point Railway & Electric Company has under consideration a plan to connect Yorktown with Newport News by an extension of its lines.

PARKERSBURG, VA.—The stockholders of the Parkersburg & Ohio Valley Street Railway Company are said to have made completed arrangements for financing their project. A construction company has been partially organized and a charter applied for.

VANCOUVER, B. C.—It is said here that the Seattle-Tacoma Electric Railway Company, which operates between Seattle and Tacoma, has decided to extend its line into Vancouver next year. The Great Northern Railroad, it is said, is trying to secure control of the Westminster Bridge so as to keep the tramway company from passing over the bridge, as the proposed electric line will compete with the Northern Company's road.

WINNIPEG, MAN.—Montreal and Toronto capitalists are about to form a company and apply for a charter to build an electric railway from Winnipeg to Brandon. The road will be for both passenger and freight traffic.

GUADALAJARA, MEX.—Charles Carroll and Charles Kratz, of St. Louis, Mo., have been granted a concession to build and operate an interurban electric railway from this city to Ranch Barranca, a distance of 54 kilometers.

MONTREAL, QUE.—The City Council has voted not to grant a thirty years' extension of the franchise of the Montreal Street Railway Company.

NEW INDUSTRIAL COMPANIES.

THE TOLEDO AUTOMATIC FENDER COMPANY, capital $10,000, has been incorporated by Frank J. Gentsch and others.

THE ROCKWOOD ELECTRIC COMPANY, of Rockwood, Somerset County, Pa., has been incorporated with a capital of $20,000.

THE STERLING ELECTRIC COMPANY, Troy, N. Y., has been incorporated, capital $10,000. Directors. J. K. P. Pine, J. J. Child and H. E. Northrup, Troy.

THE SELF ILLUMINATING SIGN COMPANY, New York, has been incorporated, capital, $10,000. Directors: C. M. Becker, C. L. Davis and T. M. Clancy, New York.

THE INSTANTANEOUS NEWS COMPANY, New York, has been incorporated, capital, $50,000. Directors: J. J. Dooley, F. C. Barnes and A. N. Webster, New York.

THE FORD AUTOMOBILE COMPANY has been incorporated at St. Louis, Mo., by Jordan W. Lambert, Lewis Spindle and Samuel B. McPheeters. The capital stock is $2000.

THE CONTINUOUS TRANSIT SECURITIES COMPANY has been incorporated to equip railways and moving platforms; capital, $500,000. Directors: A. P. Cobb, D. L. Gallup, H. A. Stickney, New York.

THE INTERNATIONAL ELECTRIC METER COMPANY, of Chicago, has been incorporated; capital, $10,000, to manufacture electrical specialties. Incorporators: W. W. Cheney, Jr., Samuel Solomon, O. C. Peterson.

THE ELECTRO DYNAMIC COMPANY has been incorporated at Bayonne, N. J., to manufacture electric motors; capital, $50,000. Incorporators: Augustus Treadwell, Burgess S. Cruden and Edward P. Kingsland.

THE COLUMBIA POWER COMPANY, of Minneapolis, has filed articles of incorporation for the purpose of constructing electric motors and engines. The incorporators are William S. Herber, S. Edward Woodbury and Fred W. Bates.

THE ELECTRIC BLOCK SIGNAL SEMAPHORE COMPANY has filed articles of incorporation in Jersey City, N. J. The capital stock is fixed at $250,000. all paid up. The incorporators are Henry M. Protest and Mortimer M. Kinsey.

THE TYRON ELECTRIC SUBWAY COMPANY, with principal office at Gloversville, N. Y., has been incorporated to maintain subways; capital, $10,000. Incorporators: John Martin and George Green, Gloversville, N. Y., and J. G. Edwards, Glen, N. Y.

THE STARK TELEPHONE, LIGHT & POWER SYSTEM, manufacturer of electrical appliances, has been incorporated at Toronto, Ont. Capital, $1,000,000. Provisional directors: A. M. Stark, Gideon Grant, Edward Kilner, J. C. Gardner, Andrew Dods, Jr.

THE SUPERIOR ELECTRICAL & MANUFACTURING COMPANY, Jersey City. N. J., has been incorporated to manufacture electrical apparatus; capital, $100,000. Incorporators: Worthington H. Ingersoll, Hamburg, N. J.; Frank J. Higgins, Wm. F. Midlige, Jersey City, N. J.

THE NATIONAL TELEPHONE LOCK COMPANY has been formed at Washington, D. C., for the purpose of manufacturing and selling coin-operating telephone locks. The incorporators are R. K. Van Mater, W. C. Dashiell, L. A. White and C. L. Bradford, and the capital stock is $250,000.

THE MONARCH ELECTRIC MANUFACTURING COMPANY, capital stock $10,000, has been incorporated at Warren, Ohio, by J. F. Kistler, Wm. Michael, J. W. Slater, C. H. Sager, Frank Myers, S. J. Parks and G. C. Reeves. The company will manufacture incandescent lamps. The board of trade of Niles, Ohio, has submitted a proposition to the promoters to locate the factory in that town. Under certain conditions the town offers to furnish a factory rent free, to be deeded to the company after a term of years.

LEGAL.

ATMOSPHERIC ELECTRIC TROUBLES.—In a recent suit against the Phœnix Light & Fuel Company appealed to the Supreme Court of Arizona, the court held that a company furnishing electric power is not guilty of negligence because in carrying its wires into a building it fails to insulate against electricity having its origin in the clouds or atmosphere.

INTERFERENCE IN STRIKE.—In the City of Waterbury eight young men have been sent to jail to serve ten months' sentences for participation in the riots attending the street-car strike disturbances. These young men were not on strike and had no interest in the issues raised between the company and its employees. The riots in which they participated were of a most violent and destructive character.

TELEPHONE FRANCHISE.—In an appeal to the Court of Appeals of Kentucky, in the suit of Maraman vs. Ohio Telephone Company, the point up related to the Ky. St. 1899, § 3699, providing that no ordinance or resolution shall be passed by cities of the sixth class, granting any franchise, until five days shall have elapsed after its introduction, nor at any other than a regular meeting of the board of trustees. It was held by the review court that where an ordinance authorizing the advertisement and sale of an exclusive telephone franchise, and another ordinance ratifying a sale to plaintiff had under the first ordinance, were both passed at the same meeting at which they were introduced, the franchise so granted was void.

INJURY FROM TELEPHONE WIRE.—In an appeal by the Cumberland Tel. & Tel. Company to the Court of Appeals of Kentucky, the decision in favor of plaintiff's administrators was reversed. Deceased took refuge from an electric storm under the porch of a store. He placed his back against an iron grating over a window and was subsequently killed by lightning which struck one of defendant's telephone poles near the store and was conducted to the porch by a wire negligently maintained over the metal roof thereof, and from the roof to the iron grating, and thence to deceased. It was held on appeal that deceased was a bare licensee in the place where he was killed, and that defendant owed him no duty to properly maintain the wire.

CONTROL OF ELECTRIC POWER.—The Supreme Court of New York State in the action between the Hudson River Power Company and the Glens Falls Portland Cement Company had to consider the question of an assignment of right to use power. The power company contracted to supply the cement company with electric energy for five years on monthly payments, the energy to be used in and upon the premises of the cement company. Thereafter the cement company assigned such contract to a lighting company, without the consent of the power company, the lighting company intending to use such energy on its premises and in its business generally, in a manner that would bring it in competition with the power company. It was held that such assignment without the consent of the power company did not give the lighting company the right to use the current in its business, nor entitle it to compel specific performance by the power company.

REMOVAL OF TELEPHONE POLES.—The city of Bradford, Pa., filed a bill to compel the New York & Pennsylvania Telegraph & Telephone Company to remove its poles and wires from the streets which it had occupied for more than 21 years without objection, after an expenditure of about $100,000. Many resolutions of the city council had given permission for the erection and use of the poles and cross-arms on the streets. In consideration of the privileges, the city had obtained a right to the use of the poles for the carrying of the fire alarm system, and had also levied licenses and pole taxes, and had used telephones furnished by the company down to the date of the hearing, and had regulated by ordinance the manner in which the poles should be erected under the direction of the street committee of council or the city engineer. The lower court having dismissed the bill, the Supreme Court of Pennsylvania on appeal by the plaintiff city held that the bill was properly dismissed for laches.

OBITUARY.

MR. O. S. WILEY.—We regret to note the death of Osgood S. Wiley, Nov. 30, at Orange, N. J., after a brief illness, aged 48 years. Mr. Wiley was an electrical engineer. He was also at one time manager of the Orange district of the New York & New Jersey Telephone Company. He had been in poor health for over a year, but it was only recently that his ailment had taken a dangerous turn. Mr. Wiley is survived by a widow and three sons.

EDUCATIONAL.

UNION COLLEGE AT ST. LOUIS FAIR.—The directors of the School of Electrical Engineering at Union College, Schenectady, N. Y., are considering the advisability of having an exhibit at the St. Louis Exposition, and the probabilities are that such an exhibit will be made.

PERSONAL.

MR. N. C. MARSHALL, of Vancouver, B. C., has been appointed western manager of the Marconi Wireless Telegraph Company.

MR. GANO S. DUNN, chief engineer of the Crocker-Wheeler Company, of Ampere, N. J., has just returned home from a trip across the Atlantic.

MR. W. H. HARVEY, consulting engineer, Memphis, Tenn., is preparing plans and specifications for a $20,000 light and water plant which Belzona City, Miss., is to install.

MR. C. A. MOORE, of Manning, Maxwell & Moore, returned to New York last week on the *Cedric*, whose reported loss at sea caused a temporary anxiety for his welfare among hosts of friends.

MR. W. A. LOMOFF, of St. Petersburg, who is connected with the Westinghouse interests in Russia, is now on a visit to this side. At present he is at the East Pittsburg plants of the Westinghouse people.

MR. J. H. TRUMBULL, general manager and treasurer of the Trumbull Electric Manufacturing Company, of Plainville, Conn., was married, Nov. 28, to Miss Maud P. Usher. They have gone to Washington to spend their honeymoon.

MR. R. PERCY SELLON, who has been spending a fortnight in this country on business connected with large contracts for Otis elevators which he represents in the English directorate, sailed for home last Saturday apparently very well pleased with the results of his trip.

MR. F. NEUGEBAUER, for several years resident manager of the Siemens & Halske Company in Mexico City, whose plant has been taken over by the Mexican Light & Power Company, Limited, has been appointed resident manager for the latter concern in the Mexican capital.

MR. J. B. ALLEN.—The board of directors of the Allis-Chalmers Company, at a recent meeting, elected John B. Allen, of Chicago, a vice-president and general manager of the company, making him the active and responsible manager in charge of manufacturing, selling and general operations.

JUDGE J. M. THOMAS, past president of the Independent Telephone Association of America, and long a leader in the independent telephone movement, has, we regret to state, been quite ill lately, having been confined to his bed for the past two weeks under the doctor's care. He is now convalescent and expects soon to resume his professional duties.

SMITH-COFFIN.—Mr. Jesse M. Smith, the well-known consulting mechanical and electrical engineer was married at Nantucket, Mass., on Thanksgiving Day, Nov. 26, to Miss Annie Coffin, daughter of Mrs. Charles Henry Coffin. Mr. and Mrs. Smith will reside in New York City where Mr. Smith is now practicing his profession.

MR. F. S. PEARSON, vice-president and general manager of the Mexican Light & Power Company, Limited, has just returned to New York from a trip to Mexico, whither he went recently to inspect the progress made in the construction of the huge Necaxa plant which is to generate power for transmission to Mexico City and the El Oro mining district.

MR. A. N. CONNETT, C. E., who is now associated with the London electrical engineering and contracting firm of J. G. White & Company, has been in this country on a brief visit home and to see his son, who is at the Rensselaer Polytechnic Institute. Mr. Connett sailed this week for England, where he now feels very much at home and where he has been engaged on some very important traction contracts.

MR. G. MARCONI.—An article in the *London Times* makes note of the successful experiments of Mr. Marconi for the British Admiralty and navy during October and November between Gibraltar and Poldhu, as well as between the latter station and the battleship *Duncan*, in the Bay of Biscay. Some very good results were obtained although the Rock and the whole of Spain intervened between the two signalling points.

DR. HANS GOLDSCHMIDT, of Essen-Ruhr, Germany, will read a paper on his invention in alumino-thermics and its application to metallurgy and engineering before the members of the American Society of Mechanical Engineers at the Stevens Institute at Hoboken on Dec. 3, at 3 p. m. A number of experiments will be made, including the welding of a girder rail and of a tube. Details of this work have already been given in our columns.

MR. CARL HERING has been nominated on the official ballot of the Engineers' Club of Philadelphia for the presidency of the Club. A book of electrical data compiled by Mr. Hering will soon issue from the press, which work should be of great value from the author's exceptional acquaintance with the periodical electrical literature of the past ten years, during which period and until recently he conducted the Digest of this journal.

MOREHOUSE & MORRILL have established themselves as electrical engineers and contractors in the Crossley Building, San Francisco. The firm comprises Herbert H. Morehouse and Grant A. Morrill. They have had an experience of some twelve years in Central America in installing and managing long and short distance transmission plants for light and power, and have developed several hydraulic properties. They have also installed and operated some telephone systems.

MR. JOHN I. BEGGS, of Milwaukee, who has been elected general manager of the Union Electric Light & Power Company, of St. Louis, is president and general manager of the Milwaukee Electric Railway & Lighting Company. Mr. Beggs will divide his time between Milwaukee and St. Louis. He contemplates inaugurating many new methods in the management of the Union Electric Light & Power Company, and the building of a new power plant is being done under his personal supervision.

ZANGWILL-AYRTON.—The marriage took place in London, on Nov. 26, of Mr. Israel Zangwill, the distinguished dramatist, novelist, and "Zionist," to Miss Edith Ayrton, daughter of Prof. W. E. Ayrton, F.R.S., the well-known electrical engineer and technical educator. Miss Ayrton, who is an authoress of some note, has a large American circle of friends, and visited this country with her father some years ago, when they were entertained by Mr. Nikola Tesla and others. It is hoped that she and her husband may soon revisit these shores. The wedding in London was attended by a number of prominent people in the social, artistic and literary worlds.

MR. CHARLES CHURCHILL, managing director of Charles Churchill & Company, Limited, of London, Manchester, Birmingham, Newcastle-on-Tyne and Glasgow, which concern represents the British interests of more than 100 American manufacturers of machine tools, etc., sailed for Europe on the Cunarder *Lucania*, Nov. 28, after a visit of seven weeks' duration on this side. On the eve of sailing Mr. Churchill received a cable from the London office stating that the outlook for business was very encouraging. Mr. Charles Churchill, Jr., will come over in the early spring and manufacturers on this side can look forward to securing some good orders then. Mr. Churchill expects to pay this country another visit next fall.

MR. C. N. DUFFY, who for some months past has held the position created for him of Comptroller of the Interurban Street Railway Company, of New York City, has returned to Chicago and resumed his former position of auditor of the Chicago City Railway, which owing to the complications in its affairs and its relationships with the city found his skill and experience absolutely indispensable at this juncture, and insisted upon recalling him. Mr. Duffy has been doing splendid work in New York, and President Vreeland was most reluctant to let him go, but the results already accomplished by Mr. Duffy rendered his retirement less serious than it would otherwise have been. Mr. Duffy's departure is viewed with deep regret by a host of New York friends.

MR. PAUL HUDSON, publisher and managing director of the *Mexican Herald*, the English financial and leading newspaper in Mexico City Republic left for home last week after several weeks' visit to this country, making a quasi government and administrative investigation of the recent electric power, lighting and traction projects which are being subsidized and encouraged financially by President Porfirio Diaz and the Mexican Government, including the great power and lighting plant of the Guanajuato Company in which John Hayes Hammond is largely interested. While here Mr. Hudson had occasion to bring before prominent New York capitalists several important projects for developing electrical possibilities for power in the mining regions which are so plentiful in the mountains of Mexico.

Trade Notes.

CENTURY ELECTRIC COMPANY.—The H. E. Lindsey Electrical Supply Company, of St. Louis, Mo., has just changed its name to the Century Electric Company.

JEFFREY MFG. COMPANY, Columbus, Ohio, has issued a handsome catalogue, No. 52, devoted to its Jeffrey coal washing machinery, illustrating and describing it in detail. The catalogue contains also data with regard to its other appliances and apparatus, including that of an electrical character.

SUPPLIES WANTED.—Mr. Cyrus Laurence, 1501 Franklin Street, Campbello Addition, Jacksonville, Fla., has requested catalogues and price-lists relating to line cutouts, porcelain insulators, wood cleats, porcelain cleats, cleat covers, single and double pole knife switches, lamp sockets, plugs, fuses and incandescent lamps.

THE CENTRAL ELECTRIC COMPANY, Chicago, reports an exceptionally good business on Nernst lamps and Westinghouse wattmeters during the past few weeks. The company is carrying a large complete assortment of both of these lines in Chicago stock, and is therefore in a position to assure its customers of prompt shipment.

NORTHERN ELECTRICAL MFG. COMPANY, of Madison, Wis., has brought out a new motor booklet devoted to its B frames, a new size built to meet the demand for a Northern motor smaller than those heretofore manufactured by it. The pamphlet describes in detail the standard features of the apparatus. These motors are practically miniature representations of the company's standard spherical motors.

FORCED DRAFT.—The Buffalo Forge Company, Buffalo, N. Y., has issued a handsome little pamphlet on the subject of its forced draft apparatus. The advantages and availibility of forced draft are comprehensively discussed, and there are several views of plants installed with the Buffalo forced draft apparatus. Other illustrations show the various styles of fans used in this work, Buffalo engines, etc. Another pamphlet issued by the company is devoted to an equally clear description of its steel pressure blowers. It is also completely illustrated.

MR. W. F. WARNER, of Muncie, Ind., has issued a little circular showing three illustrations of his arc lamp for series circuits. These illustrations show the lamp for indoor and outdoor use, and the working parts of the lamp with the casings removed. In his circular Mr. Warner speaks of his long experience in the electric lighting field and the need for enclosed arc lamps for high tension circuits. Mr. Warner made the lamp primarily for his own use and finding how successfully it worked he is manufacturing it for circuits where generators are the old 9.6-amp. machines.

THE VIADUCT MFG. COMPANY, of Baltimore, is calling attention to the new Skirrow telegraph switchboard. This new type of board is designed to provide a switchboard for intermediate offices, and is so arranged that every switch or connection that could possibly be required might be made by anyone of ordinary intelligence and without any electrical knowledge whatever. It is so constructed as to be practically fireproof, possessing high insulation. The Viaduct Company is making specially good telephones of the latest design, and a line of district messenger boxes and fire alarm boxes.

COPPER TERMINALS.—Mr. Charles D. Shain, of New York City, well and long known in the electrical field, has returned to it again and is now introducing new copper terminals. He says that these were originally designed to meet a great want in the automobile field, and the concern has been extremely successful in meeting that want, so that these terminals are now in use in nearly all prominent machines. It has found a demand for these terminals in the electrical field and many of the large electrical supply houses are carrying them in stock. Mr. Shain will be glad to receive and answer inquiries in regard to this excellent specialty.

THE GREEN BOOK OF HARDWARE.—The well-known hardware specialty house, Smith & Hemenway Company and Utica Drop Forge & Tool Company, of 296 Broadway, New York, publisher of the Green Book of Hardware Specialties—a catalogue so well-known that little more need be written of it—has subdivided this book into four sections, uniquely and attractively printed on a green French folio paper. These sections, "Glaziers," "Electrical," "Razor," and "Caster" were printed in compliance with the request of many customers, to get up a catalogue small enough to be conveniently carried in the pocket. This progressive firm is ever on the alert for an attractive catchiness in its advertising, and in these subdivisions of the Green Book has got out something that is not only attractive but useful, and the light paper on which they are printed makes them fit so snugly in the pocket that they are always carried, and constantly used for reference.

FACTORY EQUIPMENT.—The second edition of catalogue No. 115, the condensed general catalogue of the B. F. Sturtevant Company, Jamaica Plain, Mass., has gone to press and will very soon be ready for distribution. A few pages in this revised edition have been devoted to factory and industrial railway equipments, a new departure of this enterprising concern. The outgrowth of the success attained in equipping their new plant at Hyde Park, Mass., was the manufacture of this new line of products. Work is fast nearing completion upon the new power plant of the company at Hyde Park. This bids fair to be one of the most complete plants of its kind in the country, special care having been taken in connection with every detail to secure the highest efficiency and the most modern equipment. The plant will comprise four water tube boilers, with stokers supplied by Sturtevant forced draft, an economizer with Sturtevant induced draft, and a complete outfit of Sturtevant generating sets, together with condenser, air compressor, etc. The Sturtevant exhaust head is used for separating the water and oil from the exhaust steam.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 24, 1903

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

744,706. BLOCK SIGNALLING SYSTEM AND APPARATUS THEREFOR; James I. Allison, St. Louis, Mo. App. filed Aug. 30, 1902. Details of an electric automatic system.

744,707. STATIC ELECTRICAL MACHINE, Thomas Archer, Woodside, N. Y. App. filed June 23, 1903. The openings at the center of the glass disk have polished solid edges to prevent breaking.

744,716. SIGNAL FOR RAILWAYS; Willis C. Bryant, Elizabeth, N. J. App. filed Mar. 1, 1902. Details of a system especially adapted for tunnels, the signals being placed on the locomotive.

744,726. SHARPENER FOR EDGED TOOLS; Theron Davis, New York, N. Y. App. filed Sept. 24, 1902. (See Current News and Notes.)

744,735. TELEPHONE EXCHANGE; Charles S. Exley, Clarke County, Ia. App. filed Aug. 20, 1902. (See page 926.)

744,736. ELECTRIC SWITCH; Charles E. Felt, Pullman, Ill. App. filed April 21, 1902. A push switch in which the motions on opening and closing are quick, regardless of how rapidly the button is pushed.

744,739. ELECTRICALLY HEATED HANDLE; Robert A. Fliess, East Orange, N. J. App. filed Jan. 29, 1902. (See Current News and Notes.)

744,758. POCKET BATTERY; Wilhelm Heyn, Berlin, Germany. App. filed Aug. 15, 1903. (See page 923.)

744,770. TROLLEY; Levi L. Leathers, St. Albans, Me. App. filed April 22, 1903. Guard arms rising above the wheel are allowed to yield when a cross wire is encountered and afterwards returned to their normal position.

744,773. ELECTROMAGNET; David L. Lindquist, Yonkers, N. Y. App. filed July 14, 1903. An electro-magnet having a number of coils symmetrically disposed around a central axis, the individual axis of each coil being parallel to the central axis; the magnet is used with alternating currents.

744,817. PROTECTED SWITCH MECHANISM; August Sundh, Yonkers, N. Y. App. filed July 14, 1903. The switch lever is in a box having a flexible side, which is moved externally to actuate the lever.

744,818. ELECTRIC CONTROLLER; August Sundh, Yonkers, N. Y. App. filed Aug. 5, 1903. An electrically controlled circuit closer, a device for mechanically preventing the movement thereof to close the circuit, and electromagnetically controlled devices for actuating said device to permit the circuit closer to operate.

744,829. RAIL JOINT; George A. Weber, New York, N. Y. App. filed March 18, 1903. This patent and those following in the same name, cover the details of construction of an insulated rail joint, involving a peculiar arrangement of chairs, fish-plates and insulation.

744,832. INSULATED RAIL JOINT; George A. Weber, New York, N. Y. App. filed April 15, 1903. See preceding patent.

744,834. INSULATED JOINT; George A. Weber, New York, N. Y. App. filed April 15, 1903. See patent No. 744,829.

744,835. RAIL JOINT; George A. Weber, New York, N. Y. App. filed April 17, 1903. See patent No. 744,829.

744,849. FIRE-ALARM SYSTEM; Albert J. Woodworth, Sparrows Point, Md. App. filed July 3, 1902. (See Current News and Notes.)

744,895. STORAGE BATTERY PLATE; Joseph Bijur, New York, N. Y. App. filed Aug. 14, 1900. (See page 923.)

744,897. MEANS FOR DIRECTING ELECTRIC WAVES FOR USE IN WIRELESS TELEGRAPHY; Ferdinand Braun, Strassburg, Germany. App. filed Feb. 19, 1902. (See page 919.)

744,904. MAIL BOX ATTACHMENT; John R. Clark, Dahlgren, Ill. App. filed April 15, 1903. The dropping of mail in the box actuates an electrical indicator or alarm.

744,911. ELECTRIC LIGHT SWITCH; Ernest L. Etheridge, Brooklyn, N. Y. App. filed Oct. 9, 1902. A switch adapted for cutting a lamp into or out of circuit, the lamp being inclosed in a steam-tight and water-tight casing and the switch being manipulated through a stuffing box.

744,923. MEANS FOR CONTROLLING ILLUMINATED ANNOUNCEMENT AND DISPLAY SIGNALS; Robert E. Lippincott, Worcester, Mass. App. filed Aug. 15, 1902. An electric sign switch operable by finger keys to display any word, letter or character desired.

744,924. ELECTRICAL SWITCH; Henry Lomax, Ralph Lomax and John Tomlinson, Darwen, England. App. filed Oct. 19, 1902. Details.

744,926. ELECTRIC CONDUCTOR; Albert E. Lytie, Chicago, Ill. App. filed April 20, 1901. A suspension connector consisting of a tube having internally threaded ends and a lateral, threaded external lug.

744,936. RECEIVER FOR WIRELESS TELEGRAPHS OR TELEPHONES; Andrew Plecher, Bristow, Va. App. filed Jan. 17, 1903. (See page 926.)

744,946. AUTOMATIC TELEPHONE EXCHANGE; William Baldwin Vansize, New York, N. Y. App. filed April 22, 1903. (See page 925.)

744,957. INCANDESCENT ELECTRIC LAMP BASE; Joseph E. Casey, Providence, R. I. App. filed July 20, 1903. To hold the center contact of a lamp base firmly in position, it is provided with a diametrical flange which engages with a groove in the porcelain disk.

744,974. ELECTRIC HEATER; James F. McElroy, Albany, N. Y. App. filed May 1, 1903. The core of the heater has two longitudinal passages, one for the retaining rod and the other for the return wire of the winding.

744,989. GALVANIC BATTERY; David L. Winters, Chicago, Ill. App. filed Oct. 5, 1903. (See page 923.)

745,010. INDICATOR FOR ROTARY SNAP SWITCHES; Monroe Guett, Hartford, Conn. App. filed Aug. 28, 1903. A lettered dial is movably attached to the cover of the switch and is engaged by the shaft so that the words "on" and "off" are properly displayed.

745,011. HANDLE FOR ELECTRIC SNAP SWITCHES; Monroe Guett, Hartford, Conn. App. filed Sept. 23, 1903. The invention resides in a handle of insulating material having a yoke so embedded within it that the inner edges of the legs of the yoke extend into the socket and receive the notched head of the stem and the plate which holds the spring under tension upon the stem.

745,019. TELEPHONY; Isidor Kitsee, Philadelphia, Pa. App. filed March 7, 1901. (See page 926.)

745,020. TROLLEY CONTROLLER; Walter B. Leecraft, Denison, Tex. App. filed Jan. 31, 1903. A fluid under pressure is used in connection with automatic mechanism operating when the trolley jumps from the wire to pull down the pole.

745,033. UNDERGROUND CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; Andrew H. Angle, Philadelphia, Pa. App. filed July 3, 1902. The conductor sections are movable, the shoe forcing them downward to make connection with the feeder.

745,046. MOUNTING FOR THE COILS OF VOLTMETERS OR SIMILAR INSTRUMENTS, Charles W. Farquharson and Oscar I. Adelman, Chicago, Ill. App. filed Aug. 3, 1903. The mountings comprise fixed bearing pins at the ends of the core and jewels secured to the coil frame having their bearings on the pins.

745,049. TELEPHONE TRANSMITTER SUPPORT; Auguste Gamache, East Clifton, Canada. App. filed Nov. 24, 1902. (See page 927.)

745,077. RHEOSTAT; Walter A. Sherlock, San Francisco, Cal. App. filed Jan. 16, 1903. A double ended plug having a resistance material inserted between the ends and adapted for connection with any two sockets so as to interpose the resistance in the circuit.

745,114. LIGHTNING ARRESTER, Charles E. Nichols, Columbus, Ohio. App. filed April 6, 1903. A metallic tube through which a stretched wire passes centrally the tube being grounded.

745,122. REDUCTION OF METALS AND ALLOYS; Frank J. Tone, Niagara Falls, N. Y. App. filed Jan. 22, 1902. (See page 923.)

745,127. TROLLEY; Harry M. Williams and John W. Woomer, Pittsburg, Pa. App. filed Sept. 5, 1903. The guard arms carry auxiliary wheels in case the wire leaves the main wheel.

745,128. ELECTRICITY IN ELECTRIC THERAPEUTICS AND ELECTRIC TREATMENT; Louis Williams, Seattle, Wash. App. filed Nov. 4, 1901. A mattress or massage instrument having exposed contacts distributed over a surface to deliver broken current to the surface treated.

745,155. COMBINED SWITCH AND FUSE; George E. Clark, Detroit, Mich. App. filed March 11, 1903. A switch bar is formed by an inclosed fuse, the tube of which is provided with a large number of perforations to prevent heating of the fuse by the normal current.

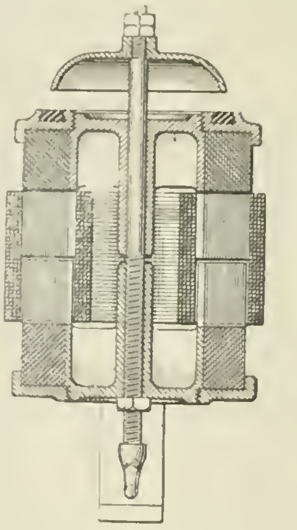
745,157. MEANS FOR OPERATING MOTOR VEHICLES; Clyde J. Coleman, New York, N. Y. App. filed Feb. 11, 1901. A small motor is used to start the engine after which the engine is connected to the driving gear and the small motor cut out.

745,168. SYSTEM FOR CONTROL OF ELECTRIC MOTORS; Arthur C. Eastwood, Cleveland, Ohio. App. filed July 16, 1903. (See Current News and Notes.)

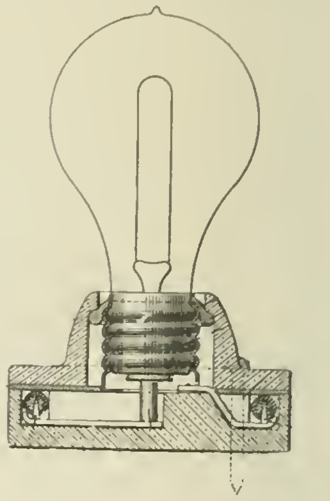
745,173. ELECTRICAL RECEPTACLE; Philip H. Fielding, New York, N. Y. App. filed May 29, 1902. A modification of the "Fielding" receptacle wherein the conductors are impaled upon brads to avoid removing the insulation, the construction being also weatherproof.

745,193. FLEXIBLE CONNECTOR FOR BATTERIES; Patrick Kennedy, New York, N. Y. App. filed June 30, 1903. (See page 923.)

745,194. REGULATOR FOR ELECTRIC CURRENTS; Patrick Kennedy, New York, N. Y. App. filed July 8, 1903. A regulator for car lighting currents wherein electro-magnets in lieu of solenoids, are used for controlling the pawls of the ratchet devices which operate the arms of the rheostat.



744,773. Eletro-Magnet.



745,173. Electrical Receptacle.

745,235. TELEPHONE ALARM SYSTEM; John D. Peachey, East Orange, N. J. App. filed Aug. 14, 1902. (See page 927.)

745,264. SURGICAL APPLIANCE; Albert V. Todd, Denver, Colo. App. filed May 29, 1903. An electrical device for treating the male organs.

745,274. ACCUMULATOR PLATE; Friedrich Wilhelm Buhne, Freiburg, Germany. App. filed Oct. 6, 1900. (See page 923.)

745,277. ELECTRIC TRAIN SIGNAL; William J. Hare and James P. Hare, Toronto, Canada. App. filed July 11, 1902. Details.

745,279. TYPE PRINTING TELEGRAPH; Frederick H. W. Higgins, London, England. App. filed Aug. 11, 1902. The impelling pallets for the escapement of the type wheel, are caused to strike quick sharp blows, which, it is claimed, increases the rapidity of operation.

745,280. CURRENT INTERRUPTER; Thomas A. Houghton, Rochester, N. Y. App. filed April 1, 1903. (See page 923.)

745,284. INSULATOR; Fred M. Locke, Victor, N. Y. App. filed May 5, 1902. Several petticoat shells are superposed in a manner to provide air chambers between them.

745,285. ELECTRIC RAILROAD BRAKE; John S. Lockwood, Kansas City, Mo. App. filed April 21, 1903. An electric brake in which a single helix actuates the rail and wheel shoes.

745,292. ALTERNATIVE CURRENT TELEPHONE; Andrew Plecher, Bristow, Va. App. filed Feb. 25, 1903. (See page 927.)

745,294. INCANDESCENT LAMP SOCKET; Guy H. Proctor, Somerville, Mass. App. filed Sept. 15, 1902. Details.

745,307. FLUID PRESSURE MECHANISM; John P. Coleman, Swissvale, Pa. App. filed May 21, 1902. This patent and those following relate to systems for operating railway signals by means of fluid pressure and electrically actuated valves and locking devices.

745,308. RAILWAY SIGNAL; John P. Coleman, Edgewood, Pa. App. filed Dec. 6, 1902. See preceding patent.

745,309. RAILWAY SIGNAL; John P. Coleman, Edgewood, Pa. App. filed Dec. 10, 1902. See patent No. 745,307.

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Moonlight Tables for 1904 .... Supplement

MOONLIGHT TABLES.

This year, as for many years past, Mr. H. W. Frund, the well-known central station manager, has prepared for us moonlight tables for street lighting work, to be used in 1904. With the present issue we furnish these tables in the wonted form of a supplement. We are glad to know that this effort is very much appreciated by our numerous central station readers. Extra copies may be obtained on application to the business department of this journal.

◆

SINGLE-PHASE ELECTRIC TRACTION.

Elsewhere we print a paper by Mr. Paul M. Lincoln discussing the relative merits for certain traction service of direct and single-phase alternating currents, which forms the most valuable contribution to the general engineering side of the subject which thus far has been made in this country. As the views of Mr. Lincoln may be assumed to reflect those of one of the two great companies in this country controlling the manufacturing side of the electric railway industry, the paper for this reason has a special interest and importance. One of the most remarkable features to be noticed in the growth of the electrical industry is the manner in which, when the industry apparently seems to have settled down to a normal growth along well-defined lines, a new development suddenly occurs which reveals an unexpected prospect of further fields to conquer. Two years ago single-phase electric traction had no standing except with a few engineers who were quietly working on the problem of the single-phase commutator motor, and whose faith has been so amply justified by recent developments. Beginning with the announcement of the Arnold and the Lamme single-phase railway systems, and followed by the Winter-Eichberg and Finzi developments in Europe, single-phase traction has, particularly during the past few months, assumed an interest and importance that at present make it overshadow everything else of the kind in the electrical field. The paper of Mr. Lincoln, to which we shall return in another issue, furnishes evidence that the interest which has so rapidly sprung up is not without reason. While it does not specifically pronounce in favor of the single-phase system as against the present direct-current system, yet so far as essentials are concerned, the comparison is decidedly favorable to the former; and as it is based upon a survey of the entire situation with a consideration of all the factors involved, both technical and commercial, its message is one that carries conviction with it. This is a great electric traction era.

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THE INDEPENDENT TELEPHONE CONVENTION.

We are able to furnish our readers this week by telegraph a lengthy account of the Independent Telephone Convention, which is still in progress as we go to press. It would appear that the convention has as usual attracted considerable attention and is likely to be attended by good results. It is evident that the body could not stand still in these stirring times of telephonic progress, and a quite considerable programme is outlined both in the presidential address of Mr. Hull and in the secretarial report of Mr. Coleman. The latter, in his report, presents, moreover, some figures which are quite striking as to the relative capitalization of the Bell interests and the Independent interests, claiming a capitalization per subscriber under the Bell system of $417, and of only $100 per subscriber under the Independent régime. It strikes us, however, that these figures are a little bit open to question. We have seen it stated, and our own observa tion would confirm it to some extent, that in a great many of the Bell companies the capitalization per subscriber runs between $200 and $250, instead of over $400, as stated by Mr. Coleman. Moreover, it will, we believe, be conceded that the Bell systems represent a great deal more in the way of investment in the shape of underground wires and elaborate exchanges than the Independents yet do, except in a few of the larger cities, it being a universally recognized fact that the Independent movement has worked up the cheaper subscriber and has conferred a great boon on the public by placing the telephone in the hands of those who were not reached by the Bell system or covered by the Bell rates. The extent to which this movement has gone is well exemplified in Mr. Coleman's own statement, that in the commonwealth of Iowa alone there is the extraordinary number of 1,200 independent telephone companies.

◆

THE FINZI MOTOR.

Recent reports indicate that Dr. Finzi has developed in his alternating current railway motor, a machine that possesses some very remarkable properties. It is the more interesting in that it is a reversion to the series type, modified for alternating current work by laminating the poles, designing for low inductance and using high-resistance commutator leads. So far as the data now before us show, the excellence of the result is almost wholly due to skillful design and not to any radically new features. It is certainly a notable feat to have replaced a standard direct-current railway motor on a standard car by an alternating-current motor and to have obtained anywhere nearly the same working qualities after the change. But this Dr. Finzi seems to have done, and his motor is said to have run with very slight sparking and at good efficiency. Its power factor anywhere near full speed is high, although undeniably low in starting. Still, in the experiments tried the acceleration attained was sufficient to meet the requirements and the volt-amperes were not much greater with the alternating than with the direct-current motor. We are not disposed to be over enthusiastic on the results of a few tests, but it certainly looks as if this alternating motor deserved respectful consideration, like the Winter-Eichberg motor described some weeks since, and concerning which we shall have more to say later. With these and the alternating motors developed by American companies, there is material at hand for practical work. We have often expressed the opinion that alternating motors for traction are highly desirable in view of the matter of distribution to large systems, and it is certainly encouraging to have promise of machines not only capable of use in interurban work, but of competing with direct-current apparatus in ordinary tramway systems. We hope the new motors will be given an early trial on a practical scale. In the case of the Winter-Eichberg system this is not far distant, a contract with rigorous guarantees having, we learn, lately been closed by the Union Electricitäts Gesellschaft for the equipment of a Belgian railway.

◆

CONSERVATIVE VIEWS OF THE ZOSSEN TRIALS.

These pages were among the first to insist upon the great importance of the high-speed railway trials at Zossen from the engineering standpoint, and we have not been chary in expressions of appreciation for the brilliant work of the German engineers who brought them to such a successful conclusion. Now that the technical achievement has entered into electrical engineering history, to which it furnishes one of its finest pages, the question arises, What will be the practical outcome? On this point a definite conclusion must, of course, await data—now entirely lacking so far as the general engineering public is concerned—on the costs of road construction, equipment and operation. In certain circles in Germany, however, there is much skepticism as to the future bearing of the Zossen work, and having presented the optimistic side, we feel that currency should also be given to the conservative view as held by some competent German engineers and perhaps by most State railway officials.

According to these, the only positive result which the Zossen tests have shown is the certainty that present roadbeds and track construction are far from being suitable for speeds above 90 to 100 miles. Previous to the Zossen experiments there was no real doubt that speeds up to and above 125 miles could be attained, and the real question, which remains undetermined, was whether such speeds could be utilized in practice. Practical test has shown that there is rapid deterioration of the road structure under high speeds, and it is, therefore, held that the question has been settled negatively, at least for the present. While it might be claimed that a track of the requisite strength for high speed railways could be built, this involves installing entirely new roads for high-speed service, which service would not permit any other kind of traffic on the same line. The roadbed for such work could not be built by using a dirt sub-construction with wooden ties and gravel ballast, but must be built massively throughout of brick and cement. Moreover, to insure safety the outward and return tracks must be at least 30 ft. apart on account of windage from passing trains. It is held that the cost of a road of this construction and width of way between Berlin and Hamburg would be so enormous that its realization is out of the question for years to come. To make it even fairly profitable at least 60,000 passengers would have to be transported daily, and traffic of the necessary volume cannot be looked for even between the largest German cities. While these views reflect the opinion of men who probably have had opportunities for a closer view of the Zossen experiment than the general engineering public, yet nevertheless until the complete data of these trials are available, and particularly until information as to the roadbed and track and the manner in which they held up under the trials, is published, the question of high-speed traction will remain an open one. It is sincerely to be hoped that the Research Syndicate under whose auspices the trials were conducted will see fit to make public a complete report on the subject, especially since the absence of full information is apt to fortify the skeptical opinions we have noted.

◆

ECONOMY IN PUBLIC LIGHTING.

A recent number of *Engineering* contains a most instructive study in public lighting made for the city of Westminster. It includes tests of the various illuminants there used both as to their actual candle-power and their cost. The list includes arc lamps and various forms of gas burners, ranging from mantle burners worked under high pressure down to common flat flame burners of the type generally discarded in this country. The report containing the data is the fifth quarterly report on the subject, so that the public lighting may fairly be said to be under systematic test, a condition rarely fulfilled in American cities. The costs are reduced to a candle-power-year basis and range from 92.6 cents per candle-year for the flat flame gas burners down to 18.8 cents for the best arcs and 18.24 cents for the intensive mantle burners. Perhaps the most striking fact brought out is the relatively uneconomical result attained by the ordinary mantle burners, which have been so industriously exploited in this country. The cost per candle-year for these lamps was just about 34 cents, or roughly, 50 per cent. more than the average cost with arc lamps. This increase seems to be mainly due to the high cost of maintenance which amounted to between $5 and $6 per year for each burner. It is to be hoped that the Westminster mantles were kept up better than is the custom here, else such figures would be doubly discouraging. Street service seems to affect mantles very rapidly, and while a street lighted with mantle burners often presents a most alluring appearance at its first public view, a visit some weeks later is quite certain to give an impression of greenish dinginess that is extremely depressing. The Board of Aldermen are usually "first-nighters" while the citizens in general have to take the performance as it goes.

Tests such as we are quoting are excellent so far as they go, but they fail to take into account the quality and distribution of the light, both very important factors in its general worth. The advocates of mantle burners generally raise their voices bravely to shout for uniform distribution and drop them to a sepulchral whisper when speaking of quality. It is beyond question that a large number of low-power lamps will distribute light more uniformly than a few powerful radiants, but the general result in the street is seldom improved by uniform distribution unless the lighting is planned on a very liberal scale. If a certain fixed minimum is the criterion of good illumination in a street, the common candle would have some claim for consideration. On the other hand, if the criterion be maximum brilliancy, then the bigger the individual units the better. In actual street illumination neither of these criterions is sufficient. The brilliancy should be everywhere above a certain minimum, but beyond that an effect is to be produced which must be judged upon its merits. It is a well known fact that this general effect depends upon many things besides candle-power. For instance, it has been shown by experience that enclosed arcs which burn very steadily can replace with excellent results open arcs of materially greater power. The general effect gains from the steadiness and slight better distribution more than it loses by the decrease in total light. This matter of general useful effect has a much stronger influence than is commonly supposed, and there is no doubt that photometric measurements have small weight with those who pay the bills as compared with the effect on the streets which is apparent to the eye.

Judged in this way, the advantage generally lies with the more powerful radiants, and the mantle gas burners of the ordinary kind make a very poor showing indeed. If economy be not their merit they have no other, and this Westminster (London) showing leaves little good to be said of their economy. What the intensive mantle burners may do remains to be seen, but even they give small promise of sufficient economy to compete actively with the best arcs.

◆

Electric Railways of the United States.

We have commented more than once on the Census Office Bulletin on Street and Electric Railways, which, notwithstanding its statistical form, is so replete with live interest to all connected with the interest it represents that to these its pages are more absorbing than the latest novel. Almost every table tempts one to deductions, and even the habits of different sections of the country may be uncovered by analysis of forbidding columns of figures. At each study new incidental points appear. For example, the figures show that in the South Central States each inhabitant takes a little over one ride per month, while in the North Atlantic States he takes a ride every third day. Consequently, the street-car go-about tendency of the Yankee is some eight times greater than his south-central relative. Another interesting deduction is with relation to the figures of casualties. Though these in 1902 reached the formidable total of almost 50,000, of which about 2½ per cent. were fatal, an examination relieves any misapprehension as to the serious bearing of these statistics. Restricting ourselves to passengers, which form 27,000 of the total, if we assume each ride in a car to average half an hour, then each person would expect to ride day and night for about 11 years before getting injured, and for more than a thousand years before getting killed. The average street car is, therefore, a safe place to stay in. It is only the occasional street car that is so fatal.

There is nearly enough single trolley track in America to encircle the globe. Each mile of single track in 1902 earned on the average $11,000 per annum, or about one dollar per foot of single rail. Each single-track mile cost about $6,300 per annum to operate, or about 57 per cent. of the average earnings. There were about six employees per mile of track, excluding salaried officers, and about 27 passenger cars. This means about 2¼ men per car installed. Dividing the 4,800 millions of passenger fares collected by the number of cars, each car installed provided on the average 80,000 passenger rides per annum, or 220 per diem. In 1890 the cars were only about half as numerous, and the cars per mile were 4, or averaged ¼ mile apart, being thus more crowded than they are now; the number of employees per car was just about the same as at present, while the annual passenger rides per car were about 62,000, or 171 daily. By the large extension of the trolley system the annual road earnings per man employed increased from $1,280 in 1890 to $1,850 in 1902. With the aid of the improved electric machinery each man at work was able to do nearly 50 per cent. more service to the community, as judged by the returns paid by the community. Some share of this increase should, however, be attributed to increase in population.

Half of the passenger cars, nearly half of the track, and more than half of the paid-passenger rides occur in the North Atlantic States; while the greatest rate of increase on relatively smaller numbers is found in the South Atlantic States. Each inhabitant of the United States takes, on the average, a street car ride 63 times a year, which is twice as often as he, she or it did in 1890. This means at present rather more than one car ride per week. The prime motor machinery installed in 1902 amounted to nearly one million kilowatts, of which only about 4 per cent. was hydraulic, 96 per cent. being in steam engines. There were on the average about three engines in each power house, and each engine averaged 400 kw. The dynamo machinery installed aggregated approximately the same total as the engine power. About one-sixth of the dynamo installation was of the alternating-current type, and five-sixths direct current. Each power house contained on the average four generators of 300 kw each, the average size of the alternating current being 400 kw and of the direct-current machines 250 kw. The total output was such that all the generators installed would supply it, if worked at full load for seven hours daily. The largest installation of any one operating company was 60,000 kw. The total passenger car-mileage for the year 1902 was over one billion car-miles, or more than enough for one car to reach the planet Saturn at his greatest distance from the earth.

Glancing at labor again, as tabulated, the industry employs over 140,000 men directly, apart from those who are employed in making supplies. These men receive about $88,000,000 annually in salaries or wages, representing about $625 annually per man. The total wages of the street railway system of the United States amount, therefore, to about one-quarter of a million dollars daily. Practically all of this industry belongs to the applications of electricity, and represents the outcome of the last fifteen years of electrical progress. In these fifteen years about one million kilowatts of electric dynamos have been built and installed. If the average car equipment of motors be rated at 33 kw, the total amount of motor capacity constructed and installed in the same time is about two millions of kilowatts, not counting the amount that has been worn out or discarded. If a monument were needed to the success and benefits of modern engineering in general and of electrical engineering as a particular branch thereof, in meeting the demands of the age, we might justly point to this report as containing the credentials of the subject for the honor.

The Money Value of Technical Training.

Mr. James M. Dodge, in his presidential address at the recent meeting of the American Society of Mechanical Engineers, took as a text "The Money Value of Technical Training." For convenience of comparison he outlined the actual progress made by four groups of men working in the mechanic arts—the unskilled labor group, the shop trained or apprentice group, the trade school group and the technical school group. The wages received by each during different periods is capitalized on the basis of 5 per cent., and the result plotted in the form of curves.

The laborer reaches the maximum, corresponding to a capitalized value of $10,200, at the age of twenty-two, his line thereafter remaining horizontal. The apprentice entering the machine shop at the age of sixteen represents a capitalized labor value of $3,000 at starting, which amount increases to $9,000 at the age of twenty and $13,200 at the age of twenty-one and a half years. His line then deflects toward the horizontal and at the age of twenty-five the potential value becomes $15,800, at which the line has already become horizontal. Observations show that 5 per cent. of the apprentices acquiring a machinist's trade rise above this line of the average man, while 35 per cent. follow the line closely; during the period of training 20 per cent. leave of their own accord to work in other shops and 40 per cent. are found unworthy or incompetent and probably never rise to the $15,800 line.

The trade school man enters the machine shop at the age of nineteen, when he can demand a salary of $12 a week, equal to that of the apprentice at twenty-one years of age, and he very frequently makes his employment profitable to his employer. The three years in school have increased his potential value from $3,000 to $12,000, a gain of $9,000. He has thus caught up with the apprentice entering the shop at sixteen and who has been working for five years. By the time the regular apprentice is earning $15.80 per week, the trade school graduate is getting $20 with a potential value of $20,000, or $4,200 greater than that of the shop-trained man. The trade school line continues at substantially the same angle up to an earning capacity corresponding to a potential value of $22,000, when it tends toward the horizontal.

The technical graduate at twenty-two years of age receives a starting wage of $13 per week, or the same amount earned by the regular apprentice at the age of twenty-one and a half, and by the trade school graduate at the age of nineteen and a half. However, the regular apprentice is overtaken in six months and the technical graduate reaches the maximum of the apprentice class pay nearly one year before the latter. Progress continues and the line of the technical graduate crosses the line of the trade school graduate in three years' time, and then continues to diverge from the latter with an earning capacity regularly increasing and a corresponding augmentation of potential or invested value until at the age of thirty-two, or ten years after entering upon practical work, his potential value is $42,000. In other words, six years of preparation have enabled the technical graduate to distance the shop-trained man and the trade school graduate overwhelmingly.

The reason that higher education, other things being equal, carries with it the ability to earn high wages is that, consciously or unconsciously, these men are directing and making it possible for a large number of laborers, shop-trained men and trade school graduates to perform useful work. For this ability and knowledge the technical man receives his pay. Apprentices have made and will make in rare instances a better showing than the average technical man, and many of our greatest men have by their sheer force of character, excellence of brain fibre, persistence and self-education, risen to pre-eminent positions independent of all regular systems, and the same is true of the trade school graduate. Mr. Dodge says, however, that he is dealing with the average of each class, taken from actual statistics, with an earnest desire to ascertain the facts without any frequency of mention of the outcome. It may be stated as a truism that every man pays for the amount of bossing he requires and every man's wage increases in proportion to his ability to act as the boss or foreman of himself and others. The highest wages are paid to the man through whose ability the largest number of other men may be most profitably employed. He does his work with his brain. Thus, on the one hand, we see under a slave system manual labor receiving no wages, and on the other mental labor receiving the highest reward. A practical man performs his work within the radius of his arm; a technical man within the radius of his brain. This fact is, however, even to-day, realized by a few, and it is gratifying to know that the number is increasing.

Mr. Dodge, in his address, also considered the value of technical training in the organization and management of manufacturing plants and enterprises and a time not very far distant when it will be almost universally recognized that establishments should be trained as well as individuals, and that the marvelous development in scientific shop practice and management will do for the manufacturer fully as much as technical training is doing for the individual.

Actinium and American Radium.

Sir William Ramsay is reported to have said in his recent lecture that American radium has no radioactivity. This is contradicted by authorities in this country. Prof. Alexander Hamilton Phillips, professor of chemistry at Princeton University, has examined a quantity of carnotite, an ore of uranium, which is being mined by the Welsh Lofftus Uranium Company, of Buffalo, which is at present endeavoring to furnish radium from an American ore. Prof. Phillips analyzed twenty-five pounds of the Colorado mineral and obtained from it one gram of radium-barium chloride of an activity of 1,500. He made photographs of keys and other objects, proving its actinic properties. The radioactivity was finally determined by Prof. Adams, of the physical department of Princeton, who measured the activity by means of a Wilson gold leaf electrometer, and also with the pith balls, there being no doubt as to the activity being quite 1,500. Prof. Phillips also stated that some of the radium said to have been extracted by the Buffalo people was not radioactive, due possibly to the fact that the radioactivity was lost in the chemical operations.

Dr. George F. Kunz states that he himself had been able to cause phosphorescence in a 15-karat diamond by means of a recent sample received from the Welsh-Lofftus Company. On the other hand, some of the Buffalo radium recently tested at Columbia University showed no radioactivity.

In this connection, Dr. Kunz makes an interesting statement with regard to some actinium recently received here, and says: "This actinium was a preparation of the oxide, with an activity of 10,000 (uranium being taken as unity), prepared by Dr. Debierne and sent to me through the courtesy of. Prof. P. Curie. The emanations from it seemed most profuse, and although it had been exposed for two weeks in a paper package, yet they were as energetic at the time of its arrival and one week after as they could have been at any time. The substance is wonderfully radioactive. In the few experiments that I have made upon it I found that, like radium, it causes the diamond to phosphoresce, and exerts the same action as radium upon willemite and kunzite, with the possible exception that the emanations from the small quantity of the substance seemed to become luminous before they touched the willemite itself. The surface affected measured two square inches, many times the surface of the actinium. The effect produced on willemite was somewhat different from that due to radium. The luminescence apparently penetrated the willemite, and at the same time it almost seemed as if a luminous emanation left the material. It was also found, on applying some powdered and granulated willemite to the inside of a closed jar twelve centimeters high, and placing this over the actinium, which was in a paper, that the emanations made luminous the entire interior of the jar. On the other hand, they do not appear to possess the penetrating power through glass that the radium compounds show, for in the same experiment they failed to affect the willemite on the outside of the jar, although the glass was only one and one-half millimeters in thickness. A platinum-barium-cyanide screen immediately responded when the actinium was held against the black paper on the back. The abundance of emanations from the substance, rather than their penetrative quality, seemed to be its characteristic. One of the properties of actinium which Prof. Curie mentions in his letters is the emission of many emanations which last for some minutes. This feature of endurance was not observed. On the other hand, a peculiarity of actinium, as compared with radium, is that the emanations, although more profuse, disappear in a few seconds. Another marked feature is a certain visibility or materiality of the emanations. This has already been referred to in some of the experiments above described in connection with willemite. If actinium is placed in a paper over a screen of the phosphorescent sulphide of zinc (Sidot's blende), the screen will become illuminated, and on slightly blowing, so as to produce a current of air, the light is carried along the screen with the emanations."

Interstate Independent Telephone Convention in Chicago, December 8, 9 and 10.

(*By Special Telegrams to* ELECTRICAL WORLD AND ENGINEER.)

IN accordance with the announced programme, the Interstate Independent Telephone Association began its convention on Tuesday, December 8, at the Auditorium, Chicago. The first session began in the afternoon and was called to order by Mr. C. E. Hull, president, of Salem, Ill. There was a large attendance. The Mayor, Mr. Harrison, sent an official representative, who welcomed the convention to Chicago because it represented the independent element in the industry, and who called attention to the fact that for the first time one could now call up the Mayor and the police department by independent telephone in Chicago.

A committee was appointed to draw up resolutions of regret in regard to the late H. C. Rainey.

President Hull then delivered an interesting address. He congratulated the members on meeting again in the city that saw the birth of the Association. He urged as important matters demanding attention the revision of the constitution, the establishment of permanent headquarters, standing committees, and in general a more closely knit organization.

Secretary Coleman's report stated that this year the telephone manufacturers had abandoned the customary entertainment and the Association committee had, therefore, itself taken the matter in hand and arranged for that feature. He gave statistics for the industry, stating that the investment of the subsidiary Bell telephone companies was $373,585,609, and of the long-distance system $28,000,000 in bonds and $131,628,000 in stock. There were 1,277,983 Bell subscribers, giving a capital per subscriber of $417. For the independent investment he claimed 2,000,000 subscribers and 200,000,000, or only $100 per subscriber, as capitalization. Iowa was the banner independent State, with 1,200 companies. Mr. Coleman said that in the past sympathetic public sentiment against the "Bell monopoly" had worked wonders for the independents; but now something more than that was needed to sustain the independent spirit and insure growth. Years ago the Bell tactics and plan of campaign had been to buy up independent exchanges, later to buy important centers, later to control toll lines, and last of all to get control of large manufacturers of telephone apparatus. He held that some plan to bring members of the Association into more compact business relations should be put into operation at once. Enthusiasm, while important, would not make a solid and enduring organization. There must be a movement started for more thorough business co-operation. Bureaus for patent protection, general information and standardization were strongly urged and the finances of the Association should be so arranged as to permit the entire time of a competent man being given to the conduct of a permanent office.

A committee of nine, one from each State, was appointed to consider the secretary's report and draw up a new constitution embodying these suggestions. It consisted as follows: Indiana, H. A. Barnhart; Iowa, J. S. Bellamy; Ohio, W. Gay Jones; Illinois, C. B. Cheadle; Minnesota, E. H. Moulton; Kentucky, Mr. Matthews; Michigan, C. E. Marsh; Missouri, J. M. Kennedy; Wisconsin, W. F. Goodrich; President Hull, ex-officio.

Prof. W. E. Goldsborough, of the electrical department of the St. Louis Exposition, invited the next convention to the fair, and outlined the plans of other electrical bodies and of the International Electrical Congress.

A special committee consisting of L. A. Frazee, C. M. Bandy and W. Gilford Thompson was appointed to learn the prospects of independent telephone toll connection with Chicago over the automatic exchange circuits of the Illinois Telephone Company, and to ask President Wheeler of that company to appear before the body in order to make a statement on the subject and the prospects.

The convention was invited to visit the Illinois Automatic Exchange Works. No session was held on Wednesday forenoon.

At the session on Wednesday afternoon the committee appointed to confer with the Illinois Telephone Company reported the results of its visit to President Wheeler, who had stated that the company in the spring would begin trunk lines to the outskirts of the city from its central automatic exchange. When these were completed it would take up the matter of toll connections with any company having good circuits and apparatus. As soon as ready the company would be anxious to connect with outside companies, but it was not ready at the present time.

The classification of freight rates was briefly discussed by the convention. It was shown that dry batteries now pay at the same rate as wet, but it was naturally held that they should not do so, as they were not so breakable and were, therefore, easier of transportation by the railroads.

A discussion arises on the question whether companies having toll connections over Bell telephone lines should be admitted to membership. This important topic which has already been before the association, brought on a very lengthy and animated discussion, but nothing definite was done, and the question was finally referred to the committee on credentials. The committee which had been appointed on reorganization reported that the present constitution and by-laws were inadequate. It recommended that pending a complete revision of the constitution making sweeping changes, a temporary constitution be enacted and that the association should be incorporated without capital with $5 dues and an additional tax if and when necessary. It was also recommended that there should be uniform toll line contracts between members and uniform exchange rates based upon the number of telephones in operation. Messrs. Hull, Rex, Coleman and Barnhart were recommended as a permanent committee to effect plans for carrying out the organization.

A very interesting paper was then read by the secretary from Prof. J. C. Kelsey, of Purdue University, on the subject of "The Standardization of Telephone Apparatus," and a paper was also presented by W. C. Polk, of Kansas City, on "The Standardization of Telephone Construction." With regard to the suggestions presented involving the adoption of standard specifications and the advocacy of a board of engineers to advise regarding apparatus and methods of construction, it was stated that the reorganization committee was considering the establishment of a board of engineers to work out such standard specifications as would enable good long-distance toll service between various independent companies. Both papers were referred to the reorganization committee. The two papers were both discussed at considerable length, the variety of practice in the independent field presenting innumerable points of view on the various questions involved.

Mr. H. D. Critchfield, formerly of Cleveland, and well known as one of the pioneers in the independent ranks, appeared before the convention as representing the Illinois Telephone Company, with which he has been connected for some time past. He gave an outline of the work that has been done in connection with the enterprise known as the Automatic Chicago Exchange, details of which have already been given in ELECTRICAL WORLD AND ENGINEER. He said that 21 miles of tunnel were completed in the Loop district for telephone cables, freight and other public utilities. He also stated that the stockholders of the Illinois company controlled absolutely the Automatic Electric Company, building what was formerly known as the Strowger apparatus, so that customers were absolutely insured a supply of apparatus. In the spring, as had already been intimated, the company would build toll lines out into the surrounding country and connect with other independent companies. Mr. Critchfield insisted, however, that such companies desiring connection with Chicago must have first-class apparatus and equipment. No toll service would be given into Chicago until good service has been assured. When questioned upon the subject, Mr. Critchfield stated that the Illinois Telephone Company was absolutely independent of the Bell. Its plans were for 92 miles of tunnel ultimately. The present exchange was in a temporary building, but the permanent new exchange building would be put up on ground which would be vacant next spring. Probably toll line connections would be ready for service into Chicago next fall.

The paper of Mr. H. A. Barnhart, of Rochester, Ind., to be presented on Thursday, is more or less of an attack on the Bell organization, and states that independents cannot hope to compete or cope with the centralized Bell power if the independent business continued to be carried along on the ancient loose-jointed method of everyone for pimself. Mr. O. Rex, of North Manchester, Ind., presented a short paper without any very specific ideas or recommendations on "Competition Between Independent Companies and Farmers' Mutuals." He advises a friendly attitude toward the mutuals and suggested aiding them with helpful suggestions in regard to their work.

Mr. Prewitt, of Winchester, Ky., presents a paper outlining a political scheme of organization for independent telephonists. He advocates dividing the country into telephone districts disregarding State lines, taking the larger cities as centers, including the territory that is tributary from a telephone standpoint. He would organize each district into an association. The National organization should include a Senate and a House of Representatives, and each local company should have representation in both.

At the Thursday session the report of the nominating committee was adopted and the following officers were elected: H. A. Barnhart, Rochester, Ind., president; E. H. Multon, Minneapolis, vice-president; E. H. Coleman, Louisville, Ky., secretary; A. B. Conklin, Aurora, Ill., treasurer. Executive Committee—C. E. Hull, J. S. Bellamy, O. Rex, R. Valentine, W. G. Jones, H. G. Conger, W. Matthews, C. E. Wells and J. G. Splane. There was no meeting in the afternoon, but a banquet in the evening. (Special dispatches giving details of exhibits will be found on page 976.)

STANDARDIZATION OF APPARATUS.

Prof. J. C. Kelsey, of Purdue University, read an interesting paper entitled "Standardization of Apparatus." After showing how steam railroads, owing to interchange of traffic, were compelled to standardize their equipment, and how a similar condition was brought about in the case of telegraph companies, he said that telephone systems are naturally sure to encounter the same situation. The telephone subscriber is no longer confined to a limited district, and since he may desire to talk to a neighbor one mile or four miles, or one thousand miles distant, there is a growing necessity for a standard system whereby any through connection can be made, with efficient apparatus at both sending and receiving ends.

Experience has already decided the gauge of the telephone transportation track. It is a metallic line, composed of No. 8 B.W.G. copper wire. Whatever the locality its characteristics are in general the same. It is a well known fact that this line must be transposed and well balanced to be quiet under all disturbing conditions. If of considerable length, it becomes very sensitive to unbalances, and upon connection with a local exchange subscriber will quickly prove the unbalanced condition of the local switching apparatus, which would never be disclosed by a short toll line, or a purely local line. But if this toll line extends into territory where trolley wires, high-tension and electric light wires abound, it developed still more decided characteristics. It becomes supersensitive, and may be said to be looking for trouble. The unbalance that the long unexposed toll line would not detect will now be disclosed by a roar so great as to forbid conversation.

As the interurban lines, with their accompanying high tension wires, invade the country, every exchange operator will inevitably experience this changed condition of his toll lines. His local lines and switching apparatus, which once gave him good toll service, will be rendered comparatively useless, as the oversensitive toll line will not permit of the least unbalance. If this oversensitive line connects with an exchange using series drops in circuit, the connection will be too noisy for use. If it connects with a common return system, great noise will result. If it connects with a metallic exchange, with lines having bad joints and careless structure, the connection will also be too noisy for use. If it connects with a well-balanced metallic system, using cheap, or poorly-designed transmitters, poor transmission will result. If it connects with a common battery system, using twenty volts battery pressure, the connection is noisy, and the signals are rendered inoperative. The same condition will apply to the forty-volt common battery system. Therefore, in view of the great number of independent exchanges, it is not likely that every exchange owner will consent to the making of radical changes. He will consent to any moderate change that will ameliorate conditions, and, luckily, the repeating coil, if properly designed, will accomplish the result.

General standardization does not mean that each and every system shall be manufactured by the same company. Every company can manufacture standard drops, relays, ringers, generators and other devices. A standardized system is one, if applied to local battery, that will operate in direct conductive relation with the standard toll line without the least noise due to unbalance, thereby giving absolute sway to the voice tones. To attain this efficiency, a system would have to have balanced and well-insulated metallic lines, 1,600-ohm bridging bells, 1,000-ohm clearing-out drops, and open-circuit generators. The absence of repeating coils and series apparatus would be quite conspicuous. However, if it is necessary to have a grounded party enter the standard exchange, a suitable repeating coil should be placed in circuit between the terminal arrester and the line jack. As to a suitable repeating coil, there is more difference in repeating coils than in any other telephone apparatus.

A standard common-battery system is one that will give a quiet line connection, and efficient transmission between the long-distance points. But, strange to say, at this very moment, there is an idea gaining ground that common-battery transmission has not come up to standard. As a result, one will find many companies maintaining local battery stations for long-distance service. It is an unfortunate condition, and he was compelled to admit the justification of the idea. The blame does not rest upon the system, because all transmitters have a central source of energy, for no reason can exist why a common-battery transmitter cannot be made just as good as a local battery transmitter. Nor is it a question of battery voltage, for on local service one cannot tell the difference between ten, twenty or forty volts, transmission being satisfactory in all cases.

In explanation, a comparison will be made. It is conceded that a local battery induction coil must have comparatively few turns in the primary, and a great number of turns in the secondary, in order to transmit a small amount of current at a high pressure and avoid the losses which would result from heavier current and low e.m.f. We will all admit that if this induction coil had equal turns on secondary and primary, we could not look for very good results on long-distance service. This is precisely the difficulty the common-battery systems are contending with. They either use repeating coils of equal windings, of no potential raising power, or condensers with the effect exactly the same, and then expect a low e.m.f. to transmit the voice currents to great distances. For the e.m.f. of common-battery voice currents is low, very low, and it is safe to say that it does not exceed the primary voltage of local battery instruments. If it is necessary in local battery practice to raise this low primary voltage to a high secondary voltage, running up into hundreds, why is it not necessary for the common-battery systems to adopt the same practice? Common-battery systems can be easily standardized, and the subscribers deserve it, for they do the bulk of the long-distance business.

Long-distance service has caused the cry for standardization. The American Telephone & Telegraph Company has heeded the cry and is bending great energies toward this necessary state. The independent interests must also heed the cry. They have successfully fought local conditions, and the long-distance field is the battleground of to-day. Manufacturer and operator alike must turn from local conditions and look toward their neglected long-distance field. Toll business offers opportunities for revenue that should not be neglected. What operator would refuse to lease each side of his toll line for telegraph purposes at from ten to twenty dollars a year-mile, and still retain the integrity of his telephone privileges? And how many operators know how to accomplish this result, and to what manufacturer of telephone apparatus can they look for reliable information and standard apparatus? Truly, the operator has fought his licensee competitor with great odds against him, as far as a source of knowledge and experience is concerned.

A satisfactory standardization of apparatus can be attained when each and every telephone operator can have the means of finding out what apparatus is standard. The only institutions who have the power to name the standards are the various state, interstate and national associations. Let the Interstate Association take the initiative and name a standardization committee, composed of engineers of various companies, empower them to make tests, and report the same at the next convention, or to encourage the annual meeting of the engineers and traffic managers of the operating companies, the consulting engineers, and engineers of the manufacturing companies, under the auspices of, and at the time of the interstate convention, with plenty of time for papers, reports of tests, discussions and expression of opinion. He believed that meetings of this kind will do more to bring order out of chaos, to establish a uniformity of local and long-distance practice, and bring about a general standardization than any other process. The hope of standardization in independent circles lies in a combination of individual effort on the part of the engineer. Let all companies cheerfully pay his expenses to the annual convention. Results will justify it.

Interurban Electric Traction Systems—Alternating Versus Direct-Current.

BY PAUL M. LINCOLN.

ELECTRIC traction is peculiarly an American institution; that is, it has found its widest application in American communities and has been developed chiefly by American engineers. In America practically every town of over 5,000 inhabitants is provided with an electric traction system. In other parts of the world it is only larger centers of population that are so provided.

Practically all the traction work in America has been done by direct current. The alternating-current traction system, although it has received considerable attention from American engineers, has not until recently been favorably considered by them. In Europe, on the other hand, the alternating-current traction problem has received a large amount of attention. The polyphase induction motor has been developed by European engineers for traction purposes, and a number of installations have been made in Europe with apparatus of this character. American engineers have consistently refused to adopt the polyphase induction motor for traction purposes on the ground that it is not suitable for that purpose. The principal reasons for this stand are two in number:

(1) That the polyphase induction motor is inherently a constant-speed motor, and, therefore, not adapted to traction purposes. Continual change of speed is one of the characteristics of traction work. The direct-current series motor is peculiarly adapted to this class of work because it is inherently a variable-speed motor. At one definite speed the polyphase motor is an efficient machine, while at all other speeds the efficiency cannot be greater than the ratio of the actual speed to the synchronous speed. For instance, if the actual speed at which a given induction motor is working is 10 per cent. of its synchronous speed, the power utilized is at most only 10 per cent. of the power put in. In traction work a large part of the work done is necessarily at speeds below the maximum attained, and at these lower speeds the maximum economy that can be obtained from induction motors is necessarily small.

One expedient used by European engineers to reduce this source of loss is the use of motors in concatenation or in tandem; that is, the secondary of one motor is fed into the primary of another on the same car. If the pair of motors thus concatenated are wound for the same number of poles, this expedient has the effect of making the synchronous speed of each of the pair of concatenated motors one-half that which it is when not in concatenation. It is equivalent in direct-current practice to throwing two shunt motors in series. Up to the half speed point, therefore, there is a gain of economy by this arrangement; by winding the two concatenated motors for different numbers of poles, more than one point of maximum economy can be secured between zero speed and full speed, but this arrangement has the disadvantage of being able to use but one-half the total motor capacity above half speed, while the greatest expenditure of energy takes place above half speed.

In order to secure the advantages of concatenation, however, it is necessary to add largely to the weight of the electrical apparatus. European practice has been to equip cars with four motors, two main motors and two others used only while the car is below half speed. Above half speed the motors are running idle and are doing no useful work. The energy required to take care of the additional weight is an offset against the energy which is saved by concatenating the motors. For long runs this expedient would probably be detrimental, since the energy taken up to transport the extra weight would be more than equivalent to the energy saved at the start.

(2) The second reason against the use of polyphase induction motors for traction purposes is the necessity for providing at least two overhead conductors. If the track is not used as one of the conductors, then the necessity arises of using at least three overhead conductors. Maintenance of insulation on such overhead conductors when they are at high voltage is naturally a difficult problem—much more difficult than to maintain the insulation between a single conductor and ground, as would be the case in the single-phase system.

American engineers, instead of endeavoring to adapt the unsuitable induction motor to traction purpose, have devoted their energies to the development of a suitable alternating-current motor. The idea of using a series motor operated by alternating current is not new. The only alternating-current, single-phase motors which have a characteristic suitable for electric traction purposes are those of the commutator type. In no other type of motor are the speed and torque characteristics such as to be suitable for traction purposes. In the commutator type alternating-current motor, the speed and torque characteristics are practically identical with these characteristics in the direct-current series motor. As early as 1893, extensive experiments were made by the Westinghouse Electric & Manufacturing Company, on this class of motors. In fact, the experiments went so far as the equipment of a car with two motors of this type and the car was put into actual operation. Moreover, the frequency and voltage for which the motors were designed was practically the same as those for which the more recent motors were designed. These early motors were considerably smaller in capacity, however, and the trolley voltage was less. Further, the method of controlling the speed was by control of voltage. Although the early motors were successful as motors, the alternating-current system as a system was not thought at the time of sufficient importance to continue the developments along this line. In other words, the time was not yet ripe for the development of this system. Interurban electric traction work, such as exists to-day, was not at that time thought of, and this is in my opinion the peculiar field for the alternating-current traction system.

In considering the general problem of electric traction, the question naturally arises: What is gained by the use of alternating over direct current? and the converse of this question also naturally arises: What is it necessary to sacrifice in order to obtain the benefit of alternating-current traction? An analysis of the advantages and disadvantages of these two systems may be of interest. Although many of the following points have been treated in previous papers, particularly that of Mr. Lamme before the American Institute of Electrical Engineers, in September, 1902, it is hoped that with a repetition of some of the plans mentioned will be borne.

The principal advantages of alternating-current electric traction over direct current are as follows:

(1) Limits to trolley voltage are removed.
(2) Avoidance of rheostatic losses.
(3) The necessity for rotary converter sub-stations abolished
(4) Manual attendance at the sub-stations done away with
(5) Danger of electrolysis by return current avoided.

To take up these points more in detail:

(1) *Voltage Limit Removed.*—The greatest item of cost in the electrical equipment of interurban traction systems as they exist to-day is that of secondary distribution. This item of cost usually varies somewhere between 25 per cent. and 50 per cent. of the total for electrical equipment, and is usually much nearer the latter figure than the former. Six hundred volts at the motor in a direct current traction system is practically the limit at which present designers and manufacturers are willing to guarantee their operation, except in some special cases. This necessarily limits the voltage fed into the secondary distribution system to, say, 700 as a maximum. The consequence of this comparatively low voltage is naturally a high cost for conductors of this secondary distribution. The alternating-current system, providing as it does the possibility of greatly increasing the voltage of the distributing system, thus cuts down largely the cost of this distributing system.

Another point which militates against the use of direct current is the fact that when large motor units are used it is difficult to collect the great amount of current for their operation. For this reason, as well as an advantage in cost, trolley construction has been largely replaced by the third rail for interurban work. By raising the voltage of the secondary system, the current taken by a locomotive may be reduced, and consequently the difficulty with collecting devices may be made to disappear.

(2) *Rheostatic Losses Avoided.*—In the direct-current system the voltage at the car is practically constant, and while the counter e.m.f. of the motors is building up the excess voltage must be taken up by resistance. At the start, therefore, a comparatively large rheostatic loss occurs. With the alternating-current system, on the other hand, the voltage at the car may be controlled by suitable means and the rheostatic loss thus avoided. When stops are few and consequently runs are long, the rheostatic loss in the direct current system is a small proportion of the total, and, therefore, under these conditions this advantage of the alternating-current system is not so greatly marked. With short runs, on the other hand, and consequently frequent starts, the rheostatic loss with the direct-current system amounts to a considerably greater proportion of the total loss and the alternating-current system, therefore, can have the greater advantage.

Figs. 1 and 2 show the superposed kilowatt curves for a car equipped in one case with direct-current motors and in the other with alternating-current motors. The weight of the direct-current car is 35 tons and of the alternating-current car about 18 per cent. greater. The length of run is two miles in each case, and the schedule speed 30 miles per hour. Were it not for the saving of rheostatic loss, one would expect that the alternating-current equipment being 18 per cent. heavier would take 18 per cent. more power. The actual difference in the areas under the curves, however, shows about 10 per cent. more power in the alternating current than the direct current on account of avoiding rheostatic loss in the alternating-current equipment. If the run were for about one mile instead of two, the consumption of power would be about equal, and for runs of less than one mile the alternating-current power consumption would be less.

(3) *Necessity for Rotary Converters Avoided.*—The cost of sub-station equipment constitutes one of the large items in the cost of the electrical equipment of an interurban road. In this sub-station equipment by far the largest item of cost is the rotary converter. In the alternating-current equipment the rotary converter has no place, thus avoiding not only a large item of cost, but also one of the largest items of the loss of power.

(4) *Attendance at Sub-Stations Done Away with.*—The direct-current rotary being a piece of revolving machinery, of course requires manual attendance at the various sub-stations. Alternating-current sub-stations consists of transformers only, and therefore require attendance only for the purpose of operating the switches. Making the switching devices entirely automatic in their operation avoids the necessity of attendance for this purpose. A still further refinement is the use of distant controlled switches operated from a central point, say the main power house. Electrically-operated switches have already been developed to be operated from a distance of several hundred feet, and no reason exists why this distance of operation cannot be extended to 20 to 30 miles by proper design. By including in such a switch-operating mechanism also a signalling device, by which the position of the switch is made known at the central point, the switch-operating system becomes complete, and no necessity exists for attendance at the alternating-current sub-stations for any purpose except occasional inspection. There is, of course, an expense in connection with installing such a system of operating switches electrically, but it bears no comparison to the expense of manual attendance.

(5) *Electrolysis.*—Electrolysis of parallel conducting systems is generally recognized as one of the most serious dangers in connection with present direct current trolley systems, and the fact that an alternating current system avoids this danger entirely need only be mentioned in order to be recognized as a marked advantage.

So much for the advantages which accrue to the alternating-current system. Now the question arises: What points must be sacrificed in order to obtain these advantages. The disadvantages which necessarily accompany the use of the alternating-current traction system are as follows:

(1) Additional weight.
(2) Difficulty of operating on existing lines.
(3) Increased rail loss.
(4) The fact that an active e.m.f. exists between field turns.
(5) Possible interference with telephones.

Now suppose we take up the above points in detail.

(1) *Additional Weight.*—An alternating-current motor of a given capacity is necessarily somewhat heavier and somewhat more expensive than a direct current motor for the same capacity. This difference in the motor, however, does not constitute the total difference in weights of equipment. In order to make use of the advantages of high trolley voltage, the alternating-current equipment should preferably be provided with a step-down transformer on the car. Also, in order to obtain the advantages of avoiding the rheostatic losses, some provision must be made for controlling the voltage on the car. The transformer, the voltage-control apparatus, and the greater weight of motors make the alternating-current equipment necessarily heavier than the direct current. Although this difference need not, and in many cases will not, be as great, the example cited later in this paper (18 per cent.), still a difference in weight will always exist detrimental to the alternating-current equipment. This greater weight of the alternating-current equipment is one of the items on the debit side of the ledger.

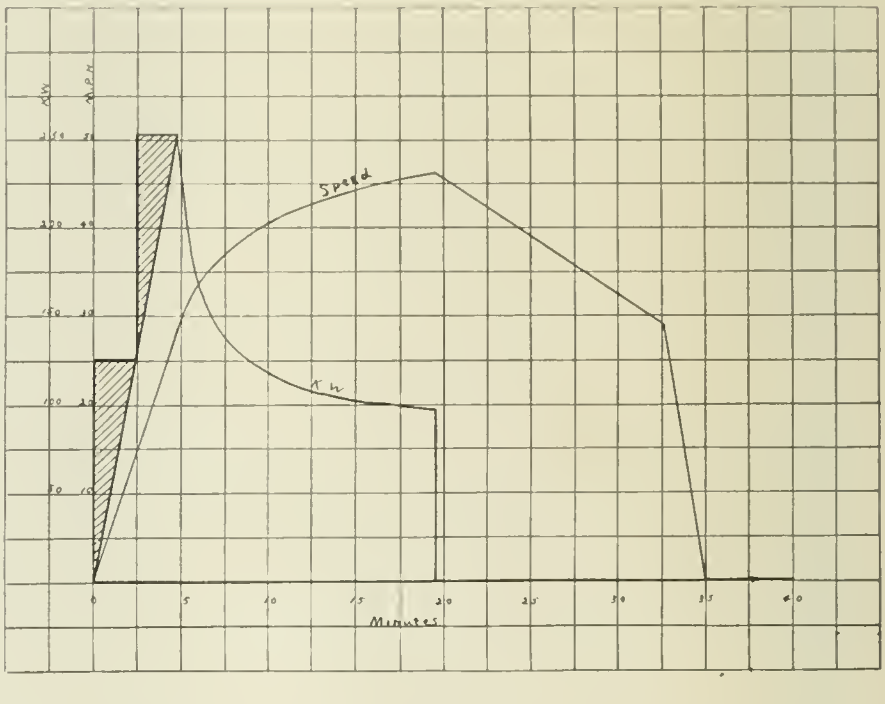

FIG. 1.

One of the most attractive methods for controlling the voltage on the motors is the use of an induction regulator. The principal advantage over other forms is that it does not require the interruption of the current and is, therefore, of particular advantage in large equipments. It is this problem of breaking the current that forms not only the greatest difficulty with direct-current equipments of large capacity, but also one of the largest items in the deterioration account. The induction regulator has the disadvantage of adding considerably to the weight, and in equipments of comparatively small size where the difficulty of current interruption is not great, will probably be replaced by some other method of voltage control, such as loops or commutated coils on the car step-down transformers.

(2) *Difficulty of Operating on Existing Lines.*—Practically all interurban roads run in and through cities on existing tracks and therefore must use the existing sources of direct-current power. In order to meet this condition, the equipment for an alternating-current interurban road must be so arranged as to operate on alternating

current outside the city and on direct current inside. Although this is entirely possible, it must necessarily prove to be a matter of considerable complication. It means in the first place the use of motors which can be operated by both direct and alternating current. This is entirely possible with the series alternating-current motor. It means in the second place that another system of control must be added to the car. This objection might, in part, be avoided by using rheostatic control for both the alternating-current and direct-current conditions, but the objection obtains that this method will deprive the alternating-current system of its advantages of saving rheostatic losses. Further, means will have to be provided for disconnecting all transformers when running from a direct-current system and reconnecting them when running from an alternating-current system. All these matters, although they mean a considerable amount of complication, are entirely possible. The most important part of the equipment—the motors—can be operated by direct as well as by alternating current.

(3) *Increased Rail Loss.*—Experiments have shown that with alternating current from 2,000 to 3,000 alternations, the actual loss which takes place with a given current through the iron rails is from three to five times that which the same direct current would give. The higher ratios of loss hold for the higher frequencies. At first thought this seems to be an important objection to the alternating-current system. But when it is considered that in order to utilize the main benefit of the alternating current, a higher trolley voltage is used and, therefore, smaller currents in the return conductor, the element of rail loss in an alternating-current proposition may be made even a smaller proportion of the total than in the direct current, in spite of this apparently large handicap. The rail loss with direct current is usually a small proportion of the total, and this with alternating current, at the trolley voltages which are usually considered, viz.:

(4) *Active E.M.F. Between Field Turns.*—The space that can be assigned to the motor for operating a car is necessarily limited. It is this limitation of space, in fact, which often forces the use of a four-motor equipment instead of a two-motor equipment, the available space not being large enough to allow the installation of motors, two of which are sufficient for the work. When we consider the alternating-current motor, the question of space available becomes still more exacting, first because the motor is necessarily heavier and, therefore, occupies more space than an equivalent direct-current motor; and, second, because of the active e.m.f. that exists between the field turns in the former and which, other things being equal, again requires additional space for insulation. In the matter of e.m.f. between field turns, the alternating and direct-current motors are quite different. The e.m.f. between the field turns of a direct-current motor is due simply to ohmic resistance, and a short-circuit between turns simply throws out of action the turns so short-circuited, and if not too severe, does not interfere seriously with the motor's operation. Between field turns of the alternating-current motor, on the other hand, there is an active e.m.f. similar to that between the turns of a transformer winding. A short-circuit between field turns in this motor, therefore, means a destructive short-circuit and an immediate interruption of a service from that motor. In other words, the effect of a short-circuit between field turns in an alternating-current motor has the same effect that a short-circuit between armature turns would have in either the alternating or direct-current motor. Roasting out of field coils is one of the most frequent causes of trouble in direct-current motor equipments, and it is realized that this matter of active e.m.f. between field turns in the alternating-current motor is a serious one. As an offset against this disadvantage of an active e.m.f. between field turns, the alternating-current motor possesses the advantage of being capable of operation at low voltage, thereby reducing the number of turns on the series field and increasing the proportionate space for insulation. The use of a step-down transformer on the car makes available any desired voltage at the motor. This existence of an active e.m.f. between field turns is the most serious obstacle to the use of high voltage on the motor. Even with low voltage, the alternating-current motor is laboring against the handicap of occupying more space than an equivalent direct-current motor, and the use of high voltage still further increases this handicap. The limitations of space do not apply to the transformer in anything like the same degree that they do to the motor, and no particular difficulty is anticipated in building a transformer for this work.

This limitation of available space for the motor and the existence of an active e.m.f. between field turns make it seem probable to the writer that the alternating-current railway motor of the future will be operated at low voltage and will receive its current from a transformer situated on the car.

(5) *Interference with Telephones.*—It is a question whether alternating current in the rails will interfere with telephones and similar instruments more than the direct current which they have to contend with at present. In any event, the amount of current in the rails can be reduced by the use of higher voltages so that this source of interference can be made less than it is with the present direct-current system. Further, means have been proposed whereby the current can be confined entirely to separate conductors provided for the purpose and not allowed to wander at will through any return circuit that may exist, as is the case with the direct-current system. This can be done, of course, only at the expense of erecting a separate system for the return currents and a system of series transformers whereby these currents can be confined to this return system. The alternating-current system therefore possesses the advantage of being able to use the rails for contact and still not allowing the alternating currents to escape at will through the earth. As a matter of fact, interference with other circuits by the alternating-current system is expected to be less than with the present direct-current system.

The engineer has been defined as a man who could do for one dollar what any fool could do for two. The engineer, in other words, stands for efficiency. It is he who accomplishes a given result with a minimum expenditure of effort and money. Suppose we apply this criterion to the comparison between alternating and direct-current systems: By which of these systems can a given service be rendered most economically? In order to answer this queestion, we shall assume a certain typical interurban road, ascertain the first cost by both systems and the cost of operating by both systems and compare the results. Suppose the typical road which we will assume to be as follows:

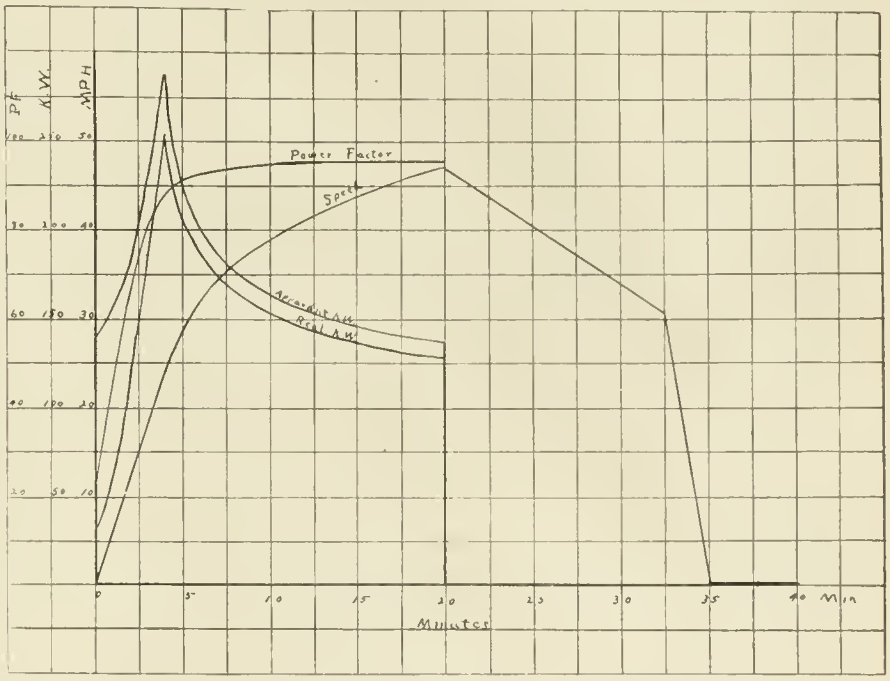

FIG. 2.

Length	60 miles.
Schedule speed	30 miles per hour.
Cars running half hour apart:	
Number of stops (that is runs 2 miles long)	30
Weight of direct-current car, complete	35 tons
Weight of alternating-current car, complete	41.3 tons

It may be noted here that the above difference in weight is not the minimum that can be obtained. A large part of the difference in weight comes, as previously stated, in the induction regulator, with which it is assumed the alternating car is equipped. Other methods of voltage control can be supplied which would be considerably lighter, but the induction regulator is selected on account of the advantages previously mentioned. The alternating-current system is, therefore, working under a handicap which is greater than would be the case if some other method of control were assumed.

Fig. 1 shows the speed-time and kw. hours curve of a direct-current car of 35 tons over the typical run. The equipment, gear ratio, acceleration, etc., are as follows:

Weight of car, 35 tons; equipment, two No. 50 C. Ry. motors; schedule speed, 30 miles per hour; average volts at motors, 550;

braking accel., 2 m. p. h. p. s., average kw., 67.2; mean 2 current per motor, 105 amp.; acceleration, 1.0 m. p. h. p. s.; gear ratio, 21 : 50; wheels, 36 in., run, 2 miles; stop, 30 sec.

Fig. 2 shows the same for an alternating current typical run, and in addition gives also the apparent kilowatts and power factor. Following are the data of this car: Weight, 41.3 tons; equipment, two 175 hp. ac. motors; gear ratio, 17 : 53; schedule speed, 30 miles per hour; stop, 30 sec.; braking accel., 2 m. p. h. p. s.; average kw., 73.9 real, 84.7 apparent; accl., 1.0 m. p. h. p. s.; wheels, 36 in; run, 2 miles, average volts at motor, 200.

It will be noted that the difference in power at the car is only 10 per cent. in favor of the direct current equipment in spite of the fact that the difference in weight is 18 per cent in favor.

The location of the power house is assumed in both cases to be on the line of the road midway between the termini, therefore 30 miles from each terminus. In each case also one of the sub-stations is located in the power house. In the alternating-current proposition the generators are wound for trolley voltage (3,000 volts) and feed directly into the trolley.

In each case also there are supposed to be four feeding points beside the power house, thus making the sub-stations 12 miles apart in both cases. Further, in both cases the secondary system is a single network thus gaining the advantage of two feeding points except beyond the end sub-stations. In neither system are secondary feeders figured on, the alternating-current being simply a 4-0 trolley wire throughout, and the direct-current a 60-pound conductor rail. In the latter system the high-tension line is supposed to be along the right of way of the road and the high-tension poles are utilized for supporting the trolley wire with a bracket construction. Recognition of the fact that the alternating-current car is the heavier and requires more energy is made and larger motors than on the direct-current car estimated on. In the direct-current proposition the generators, transmission line, etc., are supposed to be three-phase, naturally making necessary smaller transformers than in the single-phase system.

The following parallel columns give complete comparison of the power consumption, the losses in the various transmissions and transformations, the first cost of the apparatus used and an estimate of the operating expenses. The conditions are taken as nearly as possible to those in the typical road. Location will, of course, make differences in many of the items considered, but especially care has been used in estimating those items in which the two systems present a difference.

DIRECT-CURRENT RAILWAY SYSTEM.		ALTERNATING-CURRENT RAILWAY SYSTEM.	

POWER REQUIREMENTS.

Average K.W. at car in typical 2-mile run (fig. 1)	67.2 K.W.	Average real K.W. at car in typical 2-mile run (Fig. 2)	73.9 K.W.
No. cars running at one time	8	No. cars running at one time	8
No. sub-stations	5	No. sub-stations	5
Average No. cars per sub-station	1.6	Average No. cars per sub-station	1.6
Mean 2 amps. per car	185.3	Mean 2 apparent K.W. per car	129.0
		Mean 2 amps. per car (3,000 volts)	43.0
Mean 2 amps. per sub-station = m	279.0	Mean 2 amps. per sub-station = m	68.8
With sub-stations 12 miles apart, 80 lbs. track rail and 60 lb. 3rd rail, resistance between adjacent sub-stations is = r	0.90 ohms	With sub-stations 12 miles apart 80 lbs. track rail and No. 0000 trolley resistance between sub-stations allowing for increased rail resistance.	4.2 ohms
D.C. line loss per sub-station $\frac{r m^2}{6} =$	16.1 K.W.	Trolley and rail loss per sub-station $= \frac{r m_2}{6} =$	3.32 K.W.
Average K.W. per sub-station at cars = 67.2x1.6 =	107.5	Average real K.W. per sub-station at cars = 73.9x1.6 =	118.0
Average K.W. per sub-station at sub-station	123.6 K.W.	Average real K.W. per sub-station at sub-station	121.32 K.W.
		Per cent loss in regulator and car transformer	5.0%
Per cent loss in 3rd rail	15.5%	Per cent loss in trolley and rails	2.8%
Per cent loss in step-down transformers	3.5%	Per cent lost in step-down transformers	3.5%
Per cent loss in rotaries	10 %		
Per cent loss in high tension line	2.5%	Per cent loss in high tension line	2.5%
Per cent loss in step-up transformers	3.5%	Per cent loss in step-up transformers	3.5%
Total percentage loss from cars to P.H.	39.5%	Total percentage loss	18.4%
Average K.W. consumed by 8 cars at the cars	537 K.W.	Average real K.W. consumed by 8 cars at the cars	591 K.W.
Average K.W. at power house for 8 cars	750 K.W.	Average real K.W. at power house for 8 cars	700 K.W.
		Average apparent K.W. at power house, about	825 K.W.
Max. load per sub-station—worst condition 2 cars starting	560 K.W.	Max. load per sub-station—worst condition, 2 cars starting (say 275 apparent K.W. each)	550 K.W.
One 400 K.W. rotary will take care of this 40% overload		One 350 K.W. transformer will take care of this with 50% overload.	
Average load on rotary	30%	Average load on sub-station, about	40%
Rotary sub-stations are of sufficient size so that one can be cut out temporarily.		These transformers are sufficiently large to take care of road if one is cut out.	
Max. load on power house say	1200 K.W.	Max. load on power house In apparent K.W., say	1400 K.W.
Can be taken care of with three 400 K.W. generators—one for spare.		Can be taken care of with three 450 K.W. generators—one for spare.	

STEP-UP TRANSFORMERS

Seven 150 K.W. transformers—1 for spare.	Three 400 K.W. transformers—Load can be carried by 2 in case of emergency.

HIGH TENSION LINE.

One No. 6 B. & S. gauge line each way from power house 20,000 volt, 3-ph.		One No. 3 B. & S. gauge line each way from power house, 20,000 volt, 2-phase.	
Max. loss, about	8.25%	Max. loss, about	8.2%
Aver. loss, about	2.50%	Aver. loss, about	2.7%

SUB-STATION EQUIPMENT.

Five sub-stations in all—one in power-house.	4 sub-stations—power house feeds directly into 300-volt trolley.
Each of four sub-stations to contain:	Each sub-station to contain:
Three 135-K.W. step-down transformers.	One 350 K.W. transformers.
One 400-K.W. rotary converter.	
Switchboard.	Switchboard.
Step-down transformers omitted in power house sub-station.	

LOW TENSION DISTRIBUTING SYSTEM.

Entire length of track equipped with 60 lb. conductor rail.	Entire length of track equipped with No. 0000 B. & S. gauge trolley.

CAR EQUIPMENTS.

Each car equipped with two 150 H.P., D.C. railway motors and multiple control apparatus complete.	Each car equipped with two 165-H.P., A.C. railway motors with multiple control apparatus complete.

ESTIMATED FIRST COST OF ELECTRICAL EQUIPMENT.

POWER STATION:

Three 400 K.W. 25 cycle, 360 V., 3-ph., A.C. gens., at $6,500 each	$19,500	Three 450 K.W., 25 cycle, 3000 V., 1-ph., 2000 alt. gens. at $7,000 each	$21,000
Seven 150 K.W., 350 to 20000 V., self-cooling, oil-insulated trans., 25-cycle, at $1,225	8,575	Three 400 K.W., 17-cycle, 3000 to 20000 V., O.I.S.C. trans. at $2,500	7,500
Switchboard	4,500	Switchboard	3,800
	$32,575		$32,300

HIGH TENSION LINE.

48 miles of 20000 V., 3-ph. transmission line—No. 6 B. & S. gauge conductors at $900 per mile	$43,200	48 miles of 20000 V., 1-ph., transmission line—No. 3 B. & S. gauge conductors at $1,200 per mile	$57,600
Lightning protection	2,500	Lightning protection	2,000
	$45,700		$59,600

SUB-STATIONS.

12 135-K.W., 20000 & 360 V., 25 cycle, O.I.S.C. transformers, at $1,175 each	$14,100	4 350-K.W., 2000 alt., 2000 to 3000 V., O.I.S.C. transformers at $2,200 each	$8,800
5 400-K.W., 600 V., 25 cycle rotary converters, at $5,200 each	26,000	5 switchboards at $1,500 each	7,500
5 switchboards at $2,800 each	14,000	Auxiliary signaling lines for operating sub-station switches	7,500
	$54,100		$23,800

LOW TENSION DISTRIBUTION SYSTEM.

63 miles of 60 lb. conducting rail at $2,500 per mile installed	$157,500	63 miles of No. 0000 trolley wire in place at $900 per mile	$56,700
Bonding main track—63 miles at $400 per mile	25,200	Bonding main track 63 miles at $400 per mile	25,200
	$182,700		
		15 miles of pole construction, not including H.P. lines, at $630 per mile	9,400
			$71,300

CAR EQUIPMENT.

12 D.C. car equipments complete, consisting of 2 No. 50-C motors, with multiple control outfit, heaters and contact shoes, at $5,217 each	$62,604	12 A.C. car equipments complete, consisting of 2 165 H.P. motors, with multiple control outfit, heaters and trolley at $8,482 each	$101,774
Total first cost electrical equipment	$377,179	Total first cost electrical equipment	$308,774

ESTIMATE OF YEARLY OPERATING EXPENSES.

Direct-current System.		*Alternating-current System.*	
5 men at power house—2 shifts, aver. wage $900 per year	$9,000	5 men at Power house—2 shifts—aver. wage $900 per year each	$9,000
1 man at each of 4 sub-stations—2 shifts—at $900 per year each	7,200		
Fuel, water, oil, etc., at ½c. per K.W.-hour, 4,890,000 K.W. hp.	24,450	Fuel, water, oil, etc., at ½c. per K.W.-hour	23,050
Repairs and maintenance of power house (3% of cost		Repairs and maintenance or power house (3% of cost)	969

per year)	971		
Repairs and maintenance of H.T. line (5% of cost per year)	2,285	Repairs and maintenance of H. T. lines (5% per year)	2,980
Repairs and maintenance of 3rd rail (1% of cost per year	1,822	Repairs and maintenance of trolley (4% per yr.)	3,652
Repairs and maintenance of car equipments(12% of cost per year)	7,512	Repairs and maintenance of car equipments (10%)	10,177
Total yearly operating expenses	$55,404	Total yearly operating expenses	$51,256

NOTES ON THE ABOVE COMPARISON.

First Cost.—In the first cost of the two systems above compared no allowance is made for the fact that the alternating-current system requires less energy at the power house, and therefore will economize to a considerable extent in both engines and boilers. On account of the greater apparent kilowatts for this system, generators and transformers will be larger in capacity, but the engines and boilers need not be so great in capacity. So far as transformers are concerned, the alternating system has the advantage because it allows the use of considerably larger units than the direct-current, where three-phase transmission is necessary instead of single-phase, as is the case in alternating system. The alternating switchboards also have the advantage in that two switches per panel are required instead of three.

To render a given service over high-tension lines, more copper is required for a single-phase line than for a three-phase line, and this makes the copper for the alternating system somewhat more expensive than for the direct-current system. The largest difference, however, in the high-tension line items comes from the fact that the poles for the high-tension line are spaced sufficiently close to allow the trolley brackets to be supported from the same poles. In the direct-current system, the spacing need be only sufficient for the requirements of the high-tension line alone.

So far as sub-station transformers are concerned, the alternating system has the advantage of single-phase over three-phase in that larger units are used. By far the largest item of saving in substation equipment between the two systems is, of course, in the omission of rotary converters in the alternating system.

The greatest difference in first cost of the two systems is, of course, the great difference in the cost of the secondary network. A glance at the comparative values will show that this difference in the case we have considered amounts to nearly $100,000, and is therefore nearly 30 per cent of the total cost of the direct-current system.

In first cost the alternating-car equipments are, of course, considerably higher than the direct current. I would call attention to the fact, however, that the costs of the alternating-car equipment include an induction regulator. If some other style of regulator, such, for instance, as loops on the car transformers, has been figured upon, the cost of the alternating-car equipments might be diminished by something like 5 per cent.; that is, something over $6,000. The saving in weight by the same change and the consequent saving of power in the alternating system would amount to nearly 4 per cent. of that which has been figuring upon. In the item of maintenance of the control apparatus, however, it is believed that the induction regulator has the advantage in that it is not necessary to break the current in going from step to step.

The alternating-system throughout is figured on the basis of using a frequency of 2,000 alts. per minute (16 2-3 cycles). This frequency could be increased to, say, 3,000 alts. per minute (25 cycles) at the expense of, first, a considerably decreased power factor and consequently increased apparent kilowatts; second, increased generator and transformer capacity; third, increased line and rail loss, and, fourth, increased cost of motors. This difference might run the cost of the alternating-car equipment some 5 per cent higher than figured on. It will be noted that the great saving comes in changing from direct current to alternating current, and that a change in frequency within moderate limits affects a change by no means comparable with that which is affected by going to alternating current.

Operating Expenses.—In the labor item it will be noted that the main saving comes in that sub-station attendance is avoided by the use of the alternating system. In other respects the labor items will be the same. The fuel item for the alternating system is somewhat smaller than for the direct-current system, as the actual energy at the power house is less in the former case than in the latter.

Besides labor and power, the main operating expense for any interurban railway system comes in the items of repairs and maintenance. It will be noted that this item of repairs and maintenance has been included in the above comparison by assuming that it is a certain percentage of the first cost in each case. There may be some difference of opinion as to the percentage that should be assumed in the various cases of this item of repairs and maintenance, but I have endeavored to make the comparison between the two systems as fair as possible. It is not intended to include any item of depreciation in these repairs and maintenance figures. It will be noted that a marked difference is made between the maintenance of a third rail and trolley by allowing 1 per cent in the one case and 4 per cent in the other. The apparent discrepancy in allowing 5 per cent for the maintenance and repairs on the high-tension line and only 4 per cent for that of the trolley is explained by the fact that the 5 per cent on the high-tension line includes the repairs and maintenance and the supporting structure for the trolleys.

The matter of inspection of the alternating sub-stations is taken care of by allowing 6 per cent instead of 4 per cent, as in the direct-current sub-stations.

In the matter of repairs and maintenance of the car equipments, it will be noted that 12 per cent is allowed in the direct-current system and only 10 per cent in the alternating system. Even this difference in percentage allows $10,000 per year for the maintenance of the alternating equipments in the place of $7,500 for the direct current, or 25 per cent more for the former than for the latter. The alternating motors being lower in voltage and being protected from direct lightning discharges by the intervention of a transformer, ought to have at least a no higher maintenance bill than the direct-current motors. The number of motors in each case is the same. The alternating system, however, will require a certain amount of attention for the transformers and regulators. This item, though necessarily not based on experience, is estimated to represent the comparative conditions as closely as is possible at this time.

Grouping of Cells to Obtain Maximum Current.

By Dr. K. E. Guthe.

In two recent numbers of Electrical World and Engineer E. D. Pierce and W. J. Humphreys have given interesting proofs of the well-known condition for the arrangement of cells for maximum steady current.[1] It ought, however, to be pointed out that in the derivation of the formula the supposition is made that *the cells can be arranged in a simple parallel series, so that the internal and external resistances are equal.* This is frequently overlooked.

I believe the most practical equations for a given case are

$$p = \sqrt{N\frac{r}{R}} \quad \text{and} \quad E = e\sqrt{N\frac{R}{r}}.$$

where N is the total number of cells, each of e.m.f. e and internal resistance r, R the external resistance, p the number of parallel sections and E the e.m.f. of the combination. The maximum steady current is then $i = \frac{e}{2r}\sqrt{N\frac{r}{R}} = \frac{e\,p}{2r}$, a formula which may sometimes be useful. Thus only if $N\frac{r}{R}$ equals 1, 4, 9, etc., will we be able to arrange the cells in a simple parallel series so as to make the internal equal to the external resistance.

Should the numerical values not allow such an arrangement, Mr. Pierce advises that the total internal resistance be made as nearly as possible equal to the resistance of the external circuit. This is not quite correct, as may be shown by a concrete example. Let $N = 14$, $e = 1$ volt, $r = 2$ ohms, $R = 16$ ohms. If all cells are connected in series, the internal resistance, r', equals 28 ohms, the difference $r' - R = 12$ ohms and $i = 0.318$ amp. If we arrange the cells in two parallel sections, $r' = 7$ ohms, $R - r' = 9$ ohms, and $i = 0.304$ amp.

In fact, *if we restrict ourselves to a simple parallel series* the cells should be arranged in such a way as to make the ratio between the two resistances as nearly as possible equal to unity. It can be shown that for a given ratio $a = \frac{R}{r'}$ we obtain the same current as if we make $a = \frac{r'}{R}$.

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[1] E. D. Pierce, Electrical World and Engineer, Oct. 3; W. J. Humphreys, Oct. 24. Another simple proof may be found in Carhart's "Primary Batteries," p. 160.

Call the internal resistance in the first case r_1', in the second r_2'

Then $i_1 = \frac{s_1 e}{r_1' + R} = \frac{\frac{p_1}{r} e}{1 + a}$ and $i_2 = \frac{s_2 e}{r_2' + R} = \frac{\frac{s_2}{R} e}{1 + a}$,

$$r_1' r_2' = R^2 = \frac{s_1 s_2}{p_1 p_2} r^2,$$

$$\frac{N}{p_1 p_2} = \frac{R}{r} = \frac{s_2}{p_1},$$

and $\frac{p_1}{r} = \frac{s_2}{R}$, $\quad \therefore i_1 = i_2$.

For maximum current α equals 1.

In case it is impossible to make $r' = R$, it is often better to abandon the simple parallel series. Since I have not seen a treatment of the general problem in any of our text-books on primary batteries, it seems to be of sufficient interest to outline the method briefly in the following:[2]

The problem may be divided into two parts: First, to arrange a given number of cells to a given e.m.f. so that the internal resistance of the battery is a minimum, and secondly, to find for a given number of cells and a given external resistance the e.m.f. which will give a maximum current.

We can in general arrange a number of cells in many different ways so as to give a definite e.m.f. The battery will consist of a series of sections each with a certain number of cells in parallel. Suppose that in one of these sections there are p cells and in another $p + 2$ cells. The sum of their resistances is $\frac{r}{p} + \frac{r}{p+2} = \frac{2p + 2}{p(p+2)} r$ ohms. If we transfer one cell from the section with the larger number to that with the smaller number, the sum of the resistances becomes $\frac{2}{p+1} r$. But since $p \geqq 1$, $\frac{p+1}{p(p+2)}$ is always larger than $\frac{1}{p+1}$ and the second arrangement gives the smaller internal resistance. Similarly $\frac{r}{p} + \frac{r}{p+3} > \frac{r}{p+1} + \frac{r}{p+2}$, etc. The smallest resistance for a number of cells to be arranged so as to give a definite e.m.f. $= \alpha$ is, therefore, obtained by arranging them either in a simple parallel series or by grouping p in series with $p + 1$ parallel rows.

Such an arrangement is represented by the formula:

$$N = (\alpha - \beta)\, p + \beta\, (p + 1) = \alpha\, p + \beta.$$

After the value of α has been settled the arrangement we have to use is easily found. Let N be 9, $e = 1$ volt, $r = 2$ ohms. We desire to obtain minimum internal resistance with an e.m.f. $\alpha = 4$ volts. N divided by α gives $p = 2$ and the remainder $\beta = 1$. We have, therefore, in this case two parallel series, each with 3 cells, and three parallel series, each with 1 cell, an arrangement which may be represented by $s\, p = 3 \times 2 + 1 \times 3$. The internal resistance is:

$$r' = \left(\frac{\alpha - \beta}{p} + \frac{\beta}{p + 1}\right) r = 3\tfrac{2}{3} \text{ ohms.}$$

The second part of the problem consists in finding the best value of the e.m.f. $= \alpha$ for a given external resistance.

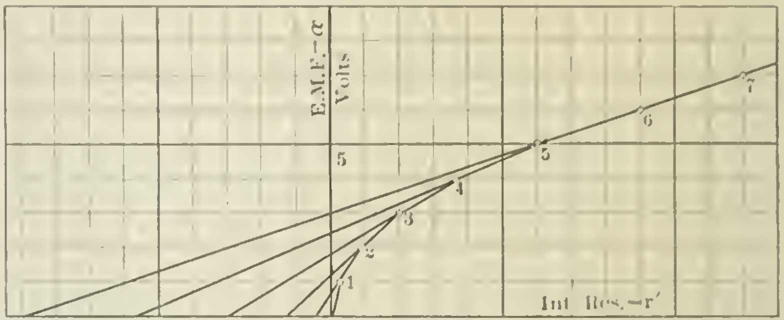
The method is most easily explained by a numerical example. Let, as before, $N = 9$, $e = 1$ volt, $r = 2$ ohms. For the different combinations we obtain the following table:

TABLE I.

α	1	2	3	4	5	6	7	8	9
p	9	4	3	2	1	1	1	1	1
β	0	1	0	1	4	3	2	1	0
r'	0.222	0.9	2.0	3.667	6	9	12	15	18
sxp	1x9	1x4+1x5	3x3	3x2+1x3	1x1+4x2	3x1+3x2	5x1+2x2	7x1+1x2	9x1

If we plot the α as ordinates and r' as abscissæ, we obtain a series of points 1, 2, ... 9, as shown in the figure.

It is apparent that, if the external resistance, R, equals the length, OR_n cut off on the negative X axis by the straight line through the points n and $n + 1$, the current is represented by the tangent of the angle, $OR_n n$ and this current will be the same for either $\alpha = n$ or $\alpha = n + 1$, while we obtain a larger current with $\alpha = n$, or $\alpha = n + 1$, according as R is smaller or larger than R_n. Thus for $0 < R < R_1$ the current is largest, if $\alpha = 1$ volt; for $R_3 < R < R_4$, if $\alpha = 4$ volts. We may, therefore, complete our table by adding the limiting values of R, which can easily be calculated from the equation,



GROUPING OF CELLS.

$$R_n = n\,(r'_{n+1} - r'_n) - r'_n.$$

TABLE II.

$\alpha =$	1	2	3	4	5	6	7	8	9
$R_n =$	0.456	1.3	3.0	5.667	9	9	9	9	∞

It can easily be shown that for $\alpha > \frac{N}{2}$ all points lie on a straight line cutting the X axis at $R = \frac{Nr}{2}$, and that, therefore, for all values of $R > \frac{Nr}{2}$ the best arrangement of the cell is a single series, the e.m.f. being equal to Ne.

To find the maximum current if R is smaller than $\frac{Nr}{2}$, calculate $\alpha = \sqrt{\frac{NR}{r}}$ and determine p, β and R_n for this and the two neighboring points. The limiting values of R will immediately show which combination is to be used. Let, for our given case, R be 4 ohms; α will be $\sqrt{18}$, or about 4. The values of R_n for the points 3, 4 and 5 show that the combination 4 will give us the maximum current $i = 0.522$ amp.

The statement I made above, namely, that for maximum current the ratio of the external to the internal resistance should be as nearly as possible equal to unity, does not hold in the general case. For an external resistance of 2.8 ohms the best arrangement is with $\alpha = 3$ volts, while the ratio of the two resistances is nearer unity if α equals 4 volts. The above rule, therefore, applies only if we restrict ourselves to grouping the cells in a simple parallel series.

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[2] This problem was first solved by Wassmuth in Carl's "Repertorium der Physik," 1878, p. 536 I shall follow him to a certain extent in my derivation of the formulae.

Montreal, the Greatest Centre of Transmitted Power. II.

By Alton D. Adams.

SUB-STATION WORK.

At the McCord Street sub-station the 4,000-volt, three-phase, 63-cycle current from the plant at Lachine Rapids is transformed for distribution to 2,400 volts. This transformation is effected by means of twelve transformers of 250 kw each, and four transformers rated at 1,000 kw each. The combined capacity of these transformers is thus 7,000 kw. The four transformers of 1,000 kw each are connected so as to change the current from three-phase on the primary coils to two-phase on the secondary coils.

At the Shawinigan sub-station in Maisonneuve, a suberb of Montreal, but not within the city limits, the three-phase circuit of three aluminum conductors delivers current at about 44,000 volts and 30 cycles. The generating plant at Shawinigan Falls, on the St. Maurice River, already described in these pages, delivers current to the transmission line at approximately 50,000 volts, but the loss in conductors reduces the terminal pressure to about that just stated for the sub-station. Each of the three conductors of the transmission line, after entering the sub-station, is connected to a series of 44 lightning arresters with six air-gaps each, giving 264 air-gaps between each line and the ground. Between the connection to lightning arresters and the connection to transformers two static interrupters are connected to each of the three high-tension wires. Each of these interrupters is single-pole, and rated at 50,000 volts, 26 amp., and 2,600 alternations per minute. From the interrupters the 44,000-volt circuit passes to five oil-cooled transformers, which are rated individually at 1,000 kw, with current at 30 cycles, and at 2,000 kw with current at 60 cycles per second. By these transformers the three-phase current is reduced from 44,000 to 2,400 volts, and then passes to five motor-generators that change the frequency from 30 to 63 cycles per second. As at first installed, two of these motor-generators delivered three-phase current at 63 cycles and 2,400 volts, and three of the motor-generators delivered two-phase current of the same frequency and voltage. It is the intention, however, to change two of the motor-generators so that the entire five will generate two-phase current. From these motor-generators the 2,400-volt, 63-cycle current passes to a switchboard in another part of the sub-station, and is thence distributed in part directly to customers of the Montreal Light, Heat & Power Company, and in part by passing through the central sub-station of that company. Under a 50-year contract between the Shawinigan Water & Power Company and the Montreal Light, Heat & Power Company all of the energy delivered by the former is received by the Montreal electrical supply system save that a short local railway has the right to use a maximum of 250 hp. The switchboard installed by the Montreal Light, Heat & Power Company is provided with motor-driven and manual oil switches that connect the 2,400-volt, 63-cycle bus-bars with the various service feeders. This switchboard is also provided with indicating volt and amperemeters and recording wattmeters. The five 1,000-kw, 30-cycle, oil-cooled transformers, already mentioned, that reduce the transmitted energy from 44,000 to 2,400 volts pressure are worthy of note for their large dimensions. The tank of boiler iron, filled with oil, that contains each of these transformers, is cylindrical in form, 15 ft. high, 7½ ft. in diameter, and contains 750 gallons of petroleum. Each of the five motor-generators that receive the current from these transformers is made up of three complete machines, a 2,400-volt, 30-cycle, three-phase, synchronous motor, a 2,400-volt, 63-cycle, two or three-phase alternator, and a 125-volt, direct-current exciter of 583-amp. capacity. These three machines are direct-connected and operate at the common speed of 450 r.p.m. The motor and alternator are both of the type with internal revolving magnets, and stationary armature coils. A solid coupling unites the shafts of the motor and alternator and the extended shaft of the latter carries the armature of the exciter. The exciter magnet frame is mounted on a solid extension of the alternator base. To secure alignment of the motor and alternator in each unit their bases are bolted to four 15-in. I-beams that are embedded in the concrete foundation. Each I-beam is 25 ft. long. The extreme width of each motor and alternator base is 11 ft. 2 in. From the bottom of the I-beams to the top of the motor frame the distance is 9 ft. 5¼ in. Over the three machines that make up each motor-generator unit the extreme length parallel to the shaft is 29 ft. 5 5/16 in. Each direct-current exciter furnishes current to the magnet coils of both the motor and alternator to which it is mechanically connected. In the sub-station with the five motor-generators just considered there is a smaller motor-generator made up of a 100-hp, 30-cycle, three-phase, 2,300-volt motor, direct-connected to an 85-kw, 125-volt generator. Current for this 100-hp motor is taken directly from the secondary side of the static transformers. When one of the large motor-generators is to be started, each of which is rated at 800 kw, the 85-kw generator is driven by the 100-hp motor, taking current from the secondaries of the static transformers, and the 125-volt direct current thus obtained is used to operate the exciter of the large motor-generator as a motor. As soon as the large motor-generator reaches its synchronous speed its motor is connected to the transformers that deliver energy from Shawinigan Falls, and the 85-kw dynamo is disconnected.

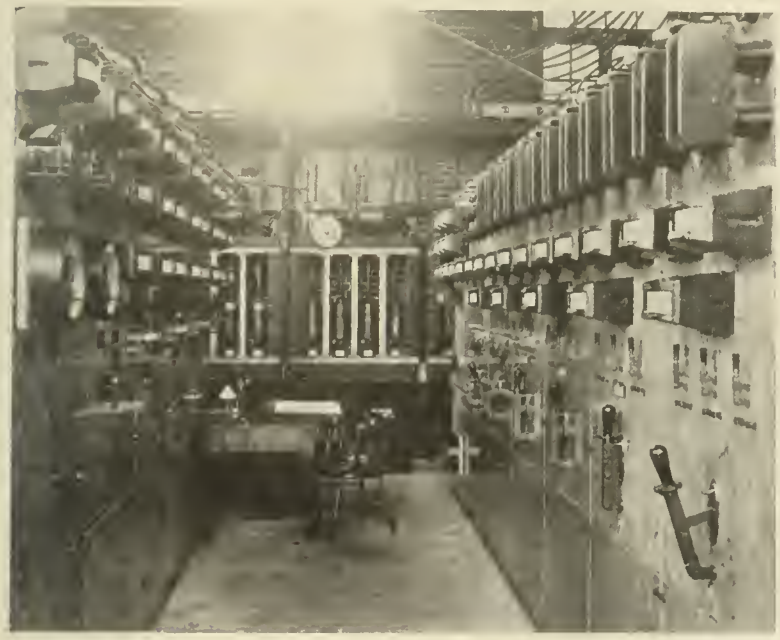


FIG. 9.—DISTRIBUTION BOARD AT SHAWINIGAN SUB-STATION.

The building for the Shawinigan sub-station is of brick, one story high, with a roof supported on steel trusses, and a concrete floor Internally the main building is divided into two parts by a brick wall parallel to its longer sides. In one of the two rooms thus formed the five 1,000-kw transformers are located, and in the other room are the motor-generators. On the ground the main building measures approximately 95 by 115 ft. A one-story brick wing at one side of the main Shawinigan sub-station contains the switchboard equipments through which energy is delivered to the lines of the electrical supply system.

THE CENTRAL SUB-STATION.

The central sub-station located in the block bounded by Ottawa, Wellington, Prince and Queen Streets is the largest and most important connected with the Montreal system of electrical distribution. To this sub-station come the high-tension transmission lines from the water power plants at Lachine Rapids, Chambly, while the Shawinigan system is also connected through the 2,300-volt feeders that come from the Shawinigan sub-station. Energy at 2,000 volts, 63 cycles two-phase from the McCord Street Station, and at 22,000 volts, 63 cycles, three-phase from Chambly, is transformed at the central sub-station to current at 2,300 volts, 63 cycles, two-phase, for general distribution. Ultimately, the equipment of main transformers at the central sub-station will comprise sixteen units of 2,750 kw each, and of these units ten are already installed, giving a present capacity of 27,500 kw. These transformers are of the air blast type, and were made by the Westinghouse Electric Manufacturing Company. Besides these main transformers receiving energy direct from the transmission lines, the central sub-station contains thirty transformers of 60 kw capacity each, for the operation of enclosed, alternating arc lamps in series for street lighting. Each of these transformers with its regulator delivers a constant, alternating current of 7.5 amp. and a maximum pressure of 4,000 volts. These constant-current transformers, which take energy from the main transformers at 2,400 volts and deliver it at any desired voltage up to 4,000, were made by the Western Electric Company.

Current for the 250 and 500-volt, three-wire system, which operates direct-current motors, is supplied by two motor generators at the central sub-station. Each of these motor generators is made up of a 300 kw, 2,400-volt, two-phase synchronous motor, and a 250 kw, 250-

volt, direct current generator These two synchronous motors draw their energy from the main transformers To maintain the pressure in the air chamber beneath the air-blast transformers, space has been provided on the main floor of the sub-station for four blower units, and three of these units are in position Each blower unit is made up of one 40 hp, 550 volt, two phase induction motor, of Westinghouse make, with a centrifugal blower with a 32 inch circular opening on each end of its shaft These blowers were made by the Sturtevant Company, and are intended to maintain a pressure of 1.8 inches of water per square inch

Provision is also made on the main floor for two motor-driven exciters to furnish direct-current to the magnets of the large machines, and also for an emergency set consisting of a 300 kw, 2,400 volt, two-phase synchronous motor direct connected to an alternator of equal capacity All of the transforming and converting apparatus just named occupies a central position on the main floor of the sub station, save the constant current transformers Ranged about three sides of the sub station in galleries and on one side at the main floor level are the high and low tension switchboards that receive, control and distribute the energy from the water power plants. In the gallery on one of these three sides are the marble and soapstone compartments that contain the knife switches for the high-tension lines from the water power plants From these switches the 22,000-volt, three-phase circuits pass to the primary coils of the main transformers. The secondary, 2,400 volt circuits from these same transformers go to the transformer panels and distributing board in the gallery on another side of the sub station, by the way of manually operated oil switches located in the same gallery. The gallery on a third side contains another portion of the distributing switchboard. Beneath the gallery on one side of the sub-station are the thirty constant-current transformers already mentioned, on the main floor. An arc lamp switchboard, connecting these transformers with the series circuits for street lighting, separates the space beneath the gallery last named from the central portion of the main floor, where the large transformers, motors and motor-generators are located. This arc switchboard is the only one on the main floor level. The fourth side or front of the sub-station, where the large, main entrance is located, is free from electrical apparatus, and starting from this side a traveling crane sweeps the entire central space of the main floor. This crane is driven by electric motors, and has a capacity of 30,000 pounds. It was built by the Niles Company.

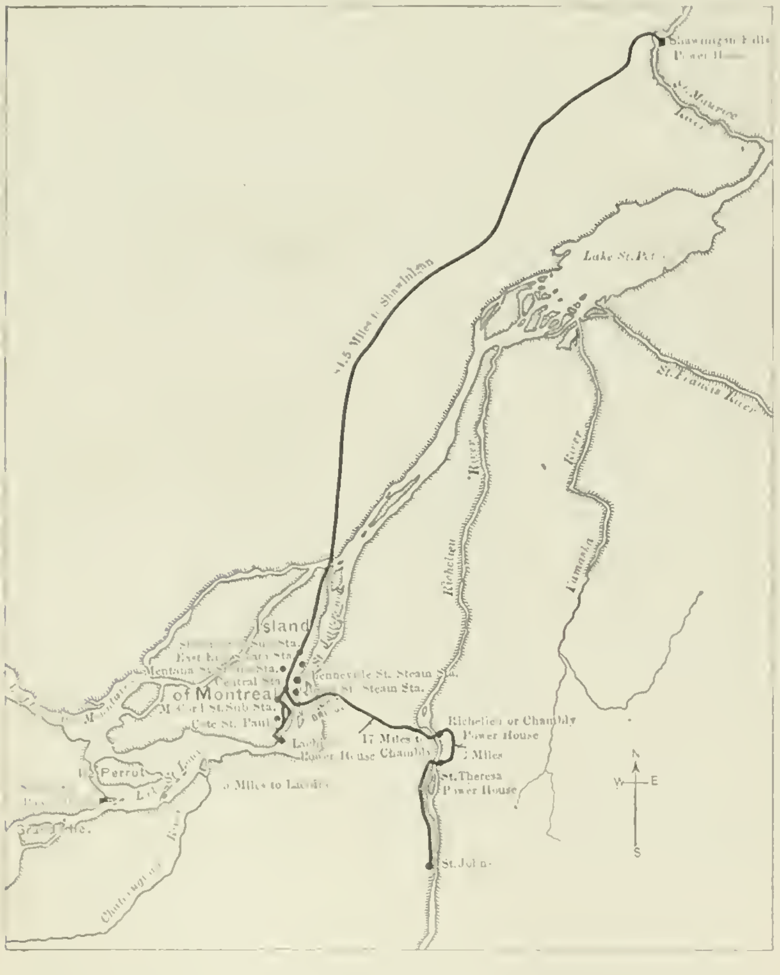


FIG. 10.—MAP SHOWING LOCATION OF WATER POWER PLANTS AND DISTRIBUTING STATIONS.

The building of the central sub station is one of the largest and best to be found anywhere for this purpose Because of the high voltage and great amount of energy entering this sub station, and its importance in the Montreal electrical supply system, it was located in about the center of a city block, so that a large, clear space was left between each of its outside walls and the public street The block of land in which the sub station is located measures 195 ft. 4 inches wide on Ottawa Street, 238 ft along Queen Street, at right angles to Ottawa Street, to Wellington Street, and 310 ft. 8 inches along Prince Street, parallel with Queen Street, to Wellington Street. In front the sub-station sets back 94 ft. from Ottawa Street; one side is 35 ft. 8 in. from Queen Street, another side is 56 ft. 8 in. from Prince Street, and the rear corner nearest to Wellington Street is 27.5 ft. therefrom. From the wall of the sub-station to the buildings on the opposite side of Queen Street is 73 ft. 10 in.; from the sub-station to the buildings on the opposite side of Prince Street is also 73 ft. 10 in., and the buildings nearest the rear corner on Wellington Street are 74 ft. distant. The vital importance of these figures may be appreciated from the fact that the central sub-stations is located in a solidily built business portion of the city. The sub-station building is one story high above the basement, nearly square in outline, of pleasing architecture, and as nearly fire-proof from foundation to roof as steel and masonry can make it.

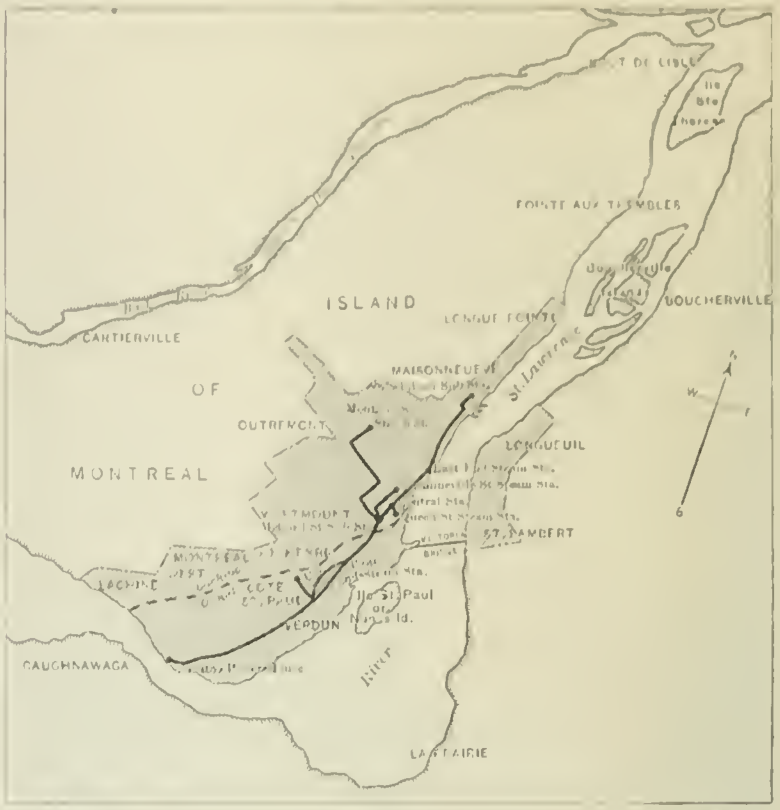


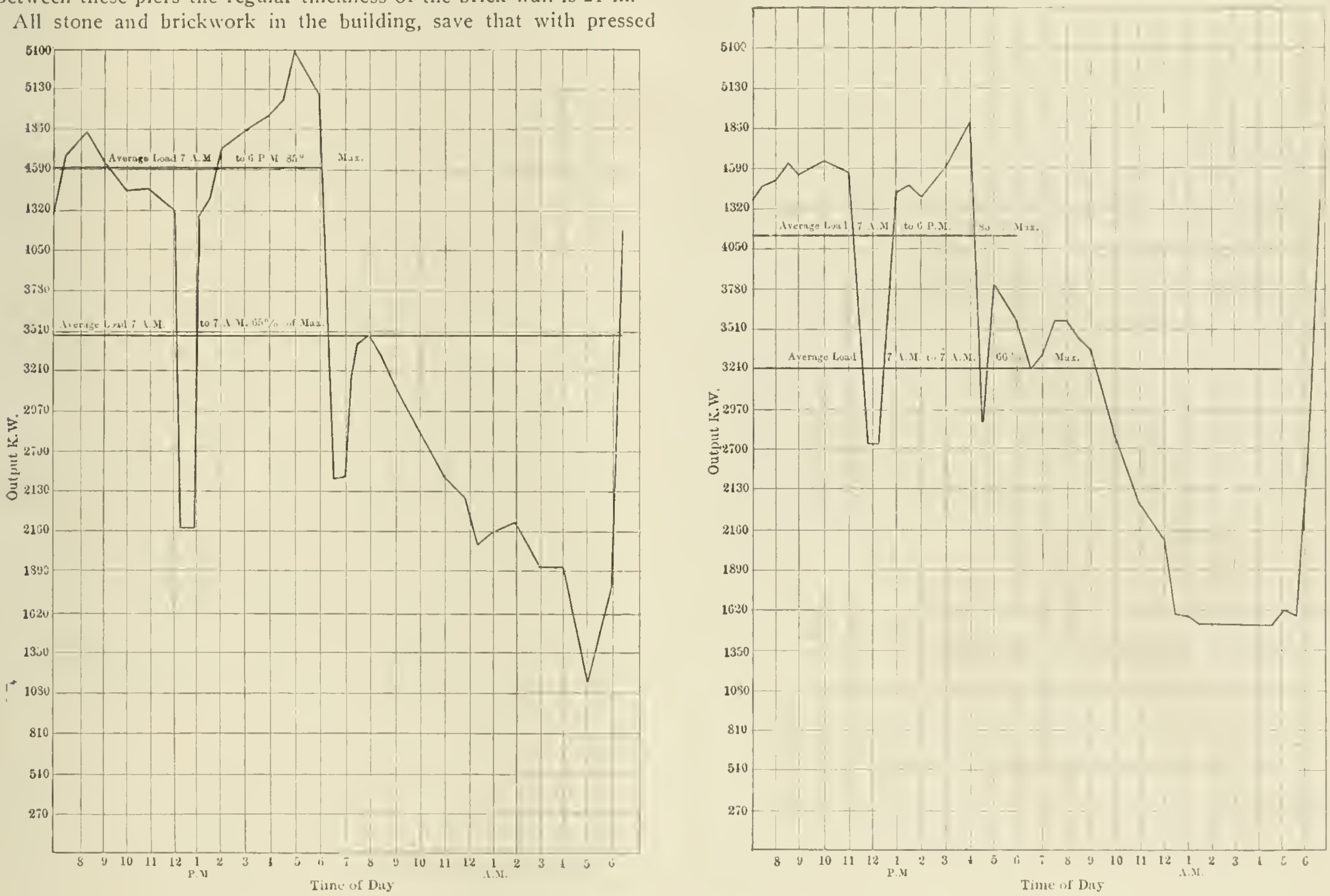
FIG. 11.—MAP SHOWING LOCATION OF SUB STATIONS AND THE DISTRICT COVERED BY THE SERVICE.

Inside the central sub-station at the main floor level the dimensions are 118 ft. by 122.5 ft., and from main floor to the lower cord of the steel roof trusses is 34.5 ft. The lowest part of the roof outside is 41 ft. above the main floor. At an elevation of 10 ft. above the main floor is the switchboard gallery that has been previously mentioned, which extends around three sides of the building. Another gallery 14.5 ft. above that just named, and located on parts of two sides of the sub-station, gives access to lightning arresters and knife switches on the distribution circuits. Beneath the entire main floor there is a basement paved with concrete 1 ft. thick. The surface of this concrete is 7 ft. 10½ in. below the main floor around the outer portion and 11 ft. below in the central portion of the building. In this central portion of the basement a space 37 ft. 8 in. by 65 ft. 2 in. is enclosed for an air pressure chamber by masonry walls each 2 ft. thick. On the main floor over this air chamber are set the sixteen 2,750-kw transformers and the four blower units. The floor space actually occupied by the group of transformers with an aggregate capacity of 44,000 kw is within 38 by 40 ft., and it may be doubted whether an equal capacity of transformers can be found within so small a space elsewhere. Beneath each transformer and each blower an opening in the main floor permits the movement of air out of or into the chamber. The air forced into the chamber by the blowers rises through the transformers and may escape through the windows in the side walls, or the skylight.

The sub-station receives daylight through high windows in each of its four sides, and through windows in the sides of the skylight which extends along the center of the roof between two opposite sides of the building. Light and ventilation for that part of the basement next to the outside walls is secured by small windows along the foundation wall and a little above the ground level. All windows about the sub-station are framed in channel, T or angle iron, and fitted with 3/8-in. wired plate glass. In its central portion the main floor of the sub-station was designed to support a superimposed load of 400 pounds per square foot, and along the sides beneath the galleries the design was for 70 pounds per square foot. Seventy pounds per square foot was the specification for the strength of all gallery floors. For the roof a safe capacity of 125 pounds per square foot was required. Structurally the sub-station is composed almost entirely of brick, tile, steel and stone. The stone foundation extends from 9 ft. 8 in. below to 5 ft. 3 in. above the ground line, and its footing 7.5 ft. wide rests on natural soil. Above this stone foundation the walls are of brick with heavy stone belt courses, plinth course, pier blocks, lintel, moulded course, pilasters and coping. At intervals along their outsides, and at the corners the brick walls are reinforced by heavy piers. Between these piers the regular thickness of the brick wall is 21 in.

All stone and brickwork in the building, save that with pressed brick, was laid with a mortar composed of one part Portland cement and two parts sharp sand. Spaced along the brick walls of the sub-station with their footings in the stone foundation, and also along two sides of its central floor space, are a number of steel columns that support the I-beams for the main floor and the gallery floors, the traveling crane and also the steel roof trusses. The brick walls thus carry only their own weight. Under the central part of the main floor there are independent foundations that carry the heavy machinery there located. As a part of the steel columns is built into the brick walls, the stability of the latter as to any side strains is thereby greatly increased, the steel work being tied together from one side of the station to the other. Steel I-beams carried by the vertical columns and the central foundation walls and piers support the main floor of the sub-station. The first or lower gallery floors are also laid on I-beams secured to the vertical columns. In the second or upper gallery the floor is laid on heavy angle steel shapes that are carried with their supports by the columns in the brick walls. The framework of stairways leading from the basement to main floor, from the main floor to the first gallery, and so on up to the second gallery, and the roof is of iron and steel, and the treads are of slate. A framework for the sides and roof of the skylight is built up of angle steel and I-beams resting on the steel trusses carry the main roof.

The main floor, that of the first gallery and the roof, are all built up of terracotta arches. On the second gallery the floor is laid with slate slabs. On the main and first gallery floors the tile arches are covered with a granolithic mixture of cement, sand and crushed granite 2½ in. thick. Over the terracotta blocks and I-beams of the roof a coating of cement mortar at least ½ in. thick was laid to an even surface. On this surface there was placed a layer of boiling pitch, and then tarred felt roofing with another outside coating of the pitch. After this last was dry, boiling asphalt was spread over the roof to a depth of ¾ in., and in this hot asphalt book tiles 1 in. were laid with ¼-in. joints. The ceiling of the roof was plastered with a mortar composed of one part cement and two of sand, and then with cement and plaster of paris.



Figs. 12 and 13.—Output Curves.

ECONOMIC ASPECTS.

The showing of 46 per cent. of the gross earnings as net income in the Montreal system, as above noted, has been made through good engineering. This will be appreciated from the fact that the regular rate for electric lighting in Montreal is 15 cents per kw-hour, while the rates to very large consumers like the cotton mills and the street railway compare favorably with the cost of steam power. Without neglecting the various other elements that affect the operative efficiency of a great system like that at Montreal, a special effort has there been made to reduce losses in distribution and build up a relatively large day load of motors. As has already been pointed out, the Royal Electric Company was the largest distributor of electrical energy in Montreal prior to the formation of the Montreal Light, Heat & Power Company, of which the former company is now one of the constituent units. In 1896 Mr. P. G. Gossler, at present general superintendent and engineer of the Montreal Company, occupied a like position with the Royal Company, and a paper presented by him at the annual convention of the Canadian Electrical Association, in that year, gives some interesting facts as to the methods followed to reduce distribution losses in the system of this latter company.

Among these facts the results of changes in the number and type of service transformers may be noted. The object in these changes was to displace smaller transformers by a less number of larger ones, and to supply consumers as far as practicable from secondary mains having approximately the lamp voltage. Following out this idea, reconstruction was begun on the alternating lighting service of the Royal Company, which included 1,160 transformers wired up to about 53,000 incandescent lamps. In the course of this reconstruction 473 of the old transformers were removed, 345 being replaced by new transformers, 18 taken down because the service was discontinued, and 110 disconnected because the customers served by them were connected to other old transformers nearby. Meantime 229 new transformers were connected to the lines, and of these 187 replaced old transformers, and 42 were used for new customers. These changes left 916 transformers wired up to 60,000 lamps. With the 1,160 transformers and 53,000 lamps on the lines during the year preceding this reconstruction the smallest load at the station was 380 amp. During ten months after the reconstruction the minimum load on the station with 916 transformers and 60,000 lamps connected to the lines was 245 amp., or 135 amp. less than that with the previous smaller number of lamps and larger number of transformers. This saving of 135 amp. in the minimum load was obviously due to less leakage of current through the new transformers than through the smaller ones that were removed. For the 229 new transformers the leakage current was 19 amp., from which it follows that the leakage of the 473 old transformers that were removed amounted to 135 + 19 = 154 amp. Of the total saving of 135 amp. in leakage current, 36 amp. was due to the removal of the 110 transformers whose lamps were connected to other old transformers through secondary distribution mains. From this it appears that by replacing 345 of the old by 187 new transformers a saving of 99 amp. in leakage current was effected. The entire cost of making the changes in the 187 transformers and the distribution lines, including the cost of the new transformers, amounted to $65 per transformer on an average after the value of the old transformers, as scrap, was deducted. It was computed that the saving in the cost of coal at $2.75 per ton amounted to $25.58 annually for each of the 187 transformers on an average, so that the reduction in the outlay for fuel alone would pay for the change in about 2½ years. It was also computed that when the 1,160 old transformers have all been replaced by 636 new transformers the leakage current would be reduced to less than 75 amp. As the Montreal plant was operated 24 hours per day it was further estimated that the reduction of 135 amp. in the leakage current resulted in a yearly saving of $7,348 for coal at $2.75 per ton. Looking at the 135 amp. as capacity for an increase of load, it was said to correspond with 2,700 lamps of 16 cp in operation, or about 9,000 such lamps connected to the system.

Perhaps the most notable result in the operation of the distribution system at Montreal, as it stands to-day, is the great increase in the connected load of stationary motors, and the relation of this motor load to the maximum load at the station. These results are brought out clearly by the records of kilowatt outputs during a December day of 1900, and an April day of 1901, at the station of the Royal Electric Company. During the 24 hours of the December day the average load at this station was 66 per cent. of the maximum load, and during the 24 hours of the April day the average load was 65 per cent. of the maximum there. These exceptionally high average loads show at once the influence of the relatively great capacity of connected motors, but the mystery is how a day load of motors, however great, can bring the average so far up toward the maximum load. As is well known, a day load of motors operating from 7 A. M. to 6 P. M. laps well over onto the heavy lighting load during the late hours of each afternoon during the winter months, and thus presents a direct addition to the maximum station load. With the great motor load at Montreal it has been necessary to avoid the conjunction of the normal motor and the maximum lighting demands. That this result has been reached at Montreal may be gathered from the fact that the average load at the station of the Royal Electric Company from 7 A.M. to 6 P.M. was not only 85 per cent. of the maximum load during the April day, but was also 85 per cent. of the maximum on the December day, when the annual maximum of the lighting load would naturally be reached. The fact that the regular motor and the maximum lighting loads do not coincide on the Montreal system is made still more evident by the location of the maximum station loads as to time of day in winter and spring. On the April day above mentioned the maximum station load occurred at 5 P.M., and on the December day this maximum came just prior to 4 P.M. Light must be had when wanted in Montreal, as elsewhere, and the maximum station load in December was kept down by cutting off a large part of the motor capacity before the great bulk of the lamps were turned on.

This disconnection of a large part of the motor load at 4 P.M. during the winter months is provided for in the contracts with some of the heaviest power users at Montreal, and the merit of the plan is shown by its success. If large consumers of power are able to purchase it at a very attractive figure prior to 4 P.M. on each day, there seems to be no good reason why they should not do so even though the supply is not available after that hour. The success of power sales on this basis seems to be in the nature of a personal triumph for Mr. P. G. Gossler, who has advocated it for several years.

Electric Traffic in Greater New York.

The Interborough Railway Company has decided in conference with the State Railroad Commission to put on more trains at once, travel having increased rapidly again under the electric régime on the Manhattan Elevated. The company prepared a statement for the Commission showing the number of cars available and the number that can be made ready for use at short notice. According to this the company is embarrassed by the fact that of the 500 subway cars that were to have been available for use on the elevated road by this time less than 200 are ready for use. The statement in part is as follows: "In addition to the delay in getting the cars as anticipated, we have been delayed in receiving the electrical equipment of these cars. Every effort has been made and every argument used that contractors connected with any part of this service should not only push their contracts to completion on time, but anticipate them if possible. A cable or tie has been laid between the Fifty-ninth Street power house and the Manhattan power house, at Seventy-fourth Street, at a cost of $125,000, in order to be ready to make use of any power which may be generated in the Fifty-ninth Street power house on the Manhattan division. The increase in passengers carried in the month of October was 3,000,000 over October, 1902, and the car mileage increase was 1,146,716. For November the increase in passengers was 2,972,000, and the increase in car mileage was 1,052,470."

It was further stated that the company had ample power for present needs, and that the deficiency in cars was being decreased at the rate of three per day.

Over in Brooklyn the Commission has also found problems for consideration and has ordered the Brooklyn Heights Railway Company to secure and operate at once 50 more cars. It is also evident from the report of the Commissioners that the system remains sorely in need of more generator capacity. The maximum number of cars which will be operated during the rush hours the coming winter on the surface lines, including service cars, will be about 1,200. The average number of cars operated during the non-rush hours will be about 545. The report remarks:

"The natural query is if the company can operate 1,200 cars during the rush hours, why can it not operate more than an average of 545 during the non-rush hours?" the report says. Then it answers: "The reason for this large difference in the number of cars operated during different portions of the day is that in order to as nearly as possible accommodate the traffic during the rush hours, the power apparatus is worked to a point far beyond its normal capacity. In the case of electric generating apparatus, this can be done for short consecutive intervals, but during this time of overload the apparatus becomes so warm that if the overload is continued permanent injury will be caused to the machines, and, with the limited amount of generating apparatus which the company has, all the different units must be employed during these hours to furnish even the inadequate facilities which are given at present. After the rush hours the load must be reduced and the machines allowed to regain their normal temperature, and during the non-rush hours some of the units must be shut down each day for repairs, hence the necessity for reducing the number of cars operated during these hours."

A large number of extra cars has already been put into service in New York City, as above stated, and the service is also under increase in Brooklyn. The Sixth Avenue cars on the New York Elevated to relieve pressure are switched back at the Franklin street loop. It is a matter of general comment that electric traction has induced a large amount of new patronage from business men below that point during all hours of the day, on account of the economy of time.

Calculation of the Apparent Inductance in Armature Coils.—V. (*Concluded.*)

By C. C. Hawkins.

II. CALCULATION OF L_s.

10. *Calculation of L_s.*

The apparent inductance of a single section, L_s, at the last moment of short-circuit when the current within it diverges from the straight-line condition must, as Prof. Arnold has pointed out, further take into account the damping action from the adjacent sections which are still undergoing short-circuit at the same moment. And in the due allowance for this lies the difficulty of the required calculation, so that it is hardly possible to do more than lay down the maximum value that L_s is likely to attain. To be on the safe side, therefore, the coil must always be considered in that position relatively to the slots which gives the minimum damping, since when the circuit is opened in this position sparking is most likely to occur. Experiment, indeed, even with closely adjacent coils, hardly shows the amount of damping to be as much as might be expected.

Taking the different classes of winding in the same order as before, (I) with $\frac{N_2}{2p}$ a whole number, two spool sides simultaneously pass out of short-circuit in each interpolar zone, and the mutual inductance from the spool sides, B, B_x, assists the self-inductance of coil $A A'$ (Figs. 2 — 6), since they are all at the same epoch of commutation. Hence,

$$L_s = (L + M) - \Sigma.\left(\frac{M^2}{L}\right) = k_d\,(L + M),$$

where $-\Sigma\left(\frac{M^2}{L}\right)$ represents the damping effect of all the other different sections which are simultaneously short-circuited in the same pair of zones, or this may be taken into account by a certain damping factor, k_d less than unity.

In subdivision (IA) when the slots are also divisible by $2p$,

(1) With *diametric* winding the two spool sides which simultaneously pass out of short-circuit in each zone are then in one and the same slot and one above the other, so that

$$L + M = \left(\frac{\tau}{N^2}\right)^2 \left[l \left(4.19\,\frac{l}{w_s} + 12.57\,\frac{l_3}{w'_3} + 9.2\,\log \frac{\pi\left(r_2 - \frac{w_s}{2}\right) + w_s}{w_s} \right) + l' \left(2.3\,\log \frac{l'}{d_s} - 0.45 \right) \right] \times 10^{-9} \text{ henrys.}$$

where d_s is the diameter of a circle whose periphery is equal to that of the end connection of the entire spool. With a single solid bar per spool side, some allowance must be made by reducing the constant 4.19 for screening within its mass, since all the flux within the slot is not linked with the whole of the bar. The values of

$$9.2\,\log \frac{\pi\left(r_2 - \frac{w_s}{2}\right) + w_s}{w_s}$$

for the surface of the core per cm. length are plotted in the upper curve of Fig. 34.

Whatever the number of spool sides per slot, the spool sides nearest to the trailing edge of the slot must finally come out of short-circuit without any dampers within their own slot, so that for assistance in the suppression of sparking reliance can only be placed on the damping from the simultaneously short-circuited coils in the adjacent slots, so far as they have mutual inductance with the considered section. In other words, though other sections may be more favorably situated, there is in the case of the last section in each slot no damping within the slot itself; k_d is thus not far removed from unity, since damping only arises so far as the surface-of-the-core flux is linked with other sections and in a less degree from the influence of the end connections. To this is partly to be attributed the fact that when there are several sections per slot it is usually the trailing section which first shows traces of sparking. The larger the armature, the greater is the proportion of the flux corresponding to L which is linked with other simultaneously short-circuited spool sides; the damping is also greater with an increase in the number of spool sides per slot, since a large number of spool sides per slot is usually accompanied by an increase in the value of s; hence the value of k_d may be given some such decreasing values as:

0.95 with 2 spool sides per slot.
0.9 " 4 " " " "
0.85 " 6 " " " "
0.8 " 8 " " " "

(2) *Very long chord winding.*—The expression for $L + M$ is the same as above, but the damping factor is slightly increased, since now there is always at least one and there may be more (up to $\frac{k_n}{2} - 1$) dampers within the same slot as the trailing sector when just going out of short-circuit. With four spool sides per slot, and $s = 2$, there is always one damper within each of the two slots; with six spool sides per slot, and $s = 2$, there is one damper in each slot; but when $s > 2$, there are either one or two dampers per slot, according to the degree of the chord winding. Similarly with eight spool sides per slot, and $s \geqq 4$, there are one, two or three dampers according to the degree of the chord winding, and with ten spool sides per slot and $s \geqq 5$ there are one, two, three or four dampers per slot.

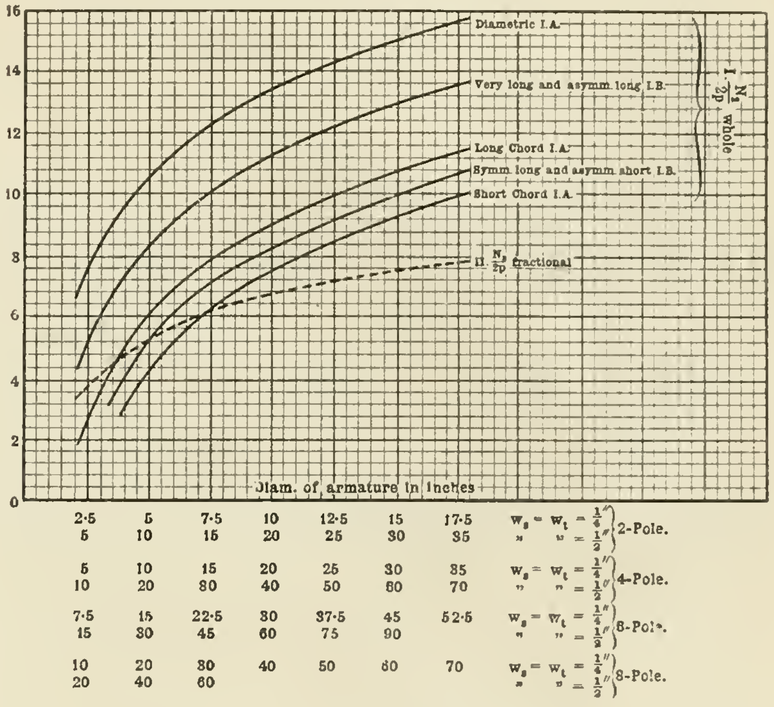


FIG. 34.

(3) *Long chord winding.*—The spool sides, A', B and A, B_x are now no longer within the same slot respectively, but are divided by one tooth, so that the self and mutual inductance is reduced to

$$L + M = \left(\frac{\tau}{N_2}\right)^2 \left[l \left(2.61\,\frac{l}{w_s} + 6.28\,\frac{l_3}{w'_3} + 4.6\,\log \frac{\tau\frac{w_t}{2} + w_s}{w_s} + 9.2\,\log \frac{\pi\left\{r_2 - \left(\frac{w_t}{2} + w_s\right)\right\} + w_t + 2\,w_s}{\pi\frac{w_t}{2} + w_t + 2\,w_s} \right) + l\left(2.3\log\frac{l'}{d_s} - 0.45\right) \right] \times 10^{-9} \text{ henrys}$$

At the same time the damping is reduced, since in one slot there is no damper present; in the other slot, so long as $s \leqq \frac{k_n}{2}$, there are

$s - 1$ damper wires, which reach a constant value of $\frac{kn}{2}$ so soon as $s > \frac{kn}{2}$.

(4) *Short chord winding.*—The two analogous spool sides being separated by two teeth and one slot, there is a still further reduction, and

$$L + M = \left(\frac{\tau}{N_2}\right)^2 \left[l \left(2.61 \frac{l}{w_s} + 6.28 \frac{l_3}{w'_3} + 4.6 \log \frac{\pi w'_t + w'_s}{w'_s} \right.\right.$$

$$\left.+ 9.2 \log \frac{\pi \{ r_2 - (w'_t + 1.5 w'_s) \} + 2 w'_t + 3 w'_s}{\pi w'_t + 2 w'_t + 3 w'_s} \right)$$

$$\left. + l' \left(2.3 \log \frac{l'}{d_s} - 0.45 \right) \right] \times 10^{-9} \text{ henrys}$$

Again, in one slot there is no damper, and in the other so soon as $s > \frac{kn}{2} + 1$, there are one, two, three or more dampers up to a maximum of $\frac{kn}{2}$ when $s > kn$.

In subdivision (*IB*) with number of slots not divisible by $2p$. (1) *very long chord* and (2) *asymmetrical long* yield two spool sides coming out of short-circuit simultaneously in one slot, and two spool sides in the adjacent zone divided by one tooth. Hence, $L + M$ is intermediate between (1) and (3) of subdivision (*IA*); or

$$L + M = \left(\frac{\tau}{N_2}\right)^2 \left[l \left(3.4 \frac{l}{w_s} + 9.4 \frac{l_3}{w'_3} + 4.6 \log \frac{\pi \left(r_2 - \frac{w_s}{2} \right) + w'_s}{w'_s} \right.\right.$$

$$\left. + 2.3 \log \frac{\pi \frac{w'_t}{2} + w'_s}{w'_s} + 4.6 \log \frac{\pi \left\{ r_2 - \left(\frac{w'_t}{2} + w'_s \right) \right\} + w'_t + 2 w'_s}{\pi \frac{w'_t}{2} + w'_t + 2 w'_s} \right)$$

$$\left. + l' \left(2.3 \log \frac{l'}{d_s} - 0.45 \right) \right] \times 10^{-9} \text{ henrys.}$$

In one zone there is no damper within the slot, and in the other there are one or more increasing with the value of the remainder from slots ÷ $2p$.

(3) *Symmetrical long* and (4) *asymmetrical short* yield two spool sides divided by one tooth and two spool sides divided by two teeth and one slot, so that their $L + M$ falls between (3) and (4) of subdivision (*IA*); or

$$L + M = \left(\frac{\tau}{N_2}\right)^2 \left[l \left(2.61 \frac{l}{w'_s} + 6.28 \frac{l_3}{w'_3} + 2.3 \log \frac{\pi \frac{w'_t}{2} + w'_s}{w'_s} \right.\right.$$

$$+ 2.3 \log \frac{\pi w'_t + w'_s}{w'_s} + 4.6 \log \frac{\pi \left\{ r_2 - \left(\frac{w'_t}{2} + w'_s \right) \right\} + w'_t + 2 w'_s}{\pi \frac{w'_t}{2} + w'_t + 2 w'_s}$$

$$\left. + 4.6 \log \frac{\pi \{ r_2 - (w'_t + 1.5 w'_s) \} + 2 w'_t + 3 w'_s}{\pi w'_t + 2 w'_t + 3 w'_s} \right)$$

$$\left. + l' \left(2.3 \log \frac{l'}{d_s} - 0.45 \right) \right] \times 10^{-9} \text{ henrys.}$$

The damping effect from the slots is also further reduced.

(*II*) With $\frac{N_2}{2p}$ fractional.

In this class only one spool side passes out short-circuit at any one moment in each interpolar zone, so that there is no mutual inductance and a single expression suits all cases, viz.:

$$L_s = L - \Sigma \left(\frac{M^2}{L} \right) = k_d L,$$

$$\text{where } L = \left(\frac{\tau}{N_2}\right)^2 \left[l \left(2.61 \frac{l}{w_s} + 6.28 \frac{l_3}{w'_3} + 4.6 \log \frac{\pi \left(r_2 - \frac{w'}{2} \right) + w'_s}{w'} \right) + l' \left(2.3 \log \frac{l'}{d} - 0.45 \right) \right] \times 10^{-9} \text{ henrys,}$$

when there are as many sets of brushes as poles; in the series connected multipolar armature with only two sets of brushes, the above expression must be multiplied by p.

The calculation of the terms which deal with the surface of the core is much abbreviated by the use of the curves of Fig. 34, which give the total value of $b + b' +$, etc., per cm. length of core. Obviously the coefficient for fractional windings is exactly half of that for diametric, and this is true not only for the surface of the core, but also for the slot inductance. There is, however, such an appreciable reduction with short or even long chord windings of class (*I*) with $\frac{N_2}{2p}$ whole, that the only practical conclusion to be drawn is simply as to the inferiority of diametric windings in general, especially when it is remembered that they yield the least amount of damping from the presence of other short-circuited spool sides within the same slots. The more distributed windings may at least be credited with the same amount of damping as is assumed in the table of values of k_d under the first heading, although in practice, in order to be on the safe side, one may be willing to ignore any such action entirely in the calculation of L_s

11. *Practical importance of Ls.*

The importance of the quantity of L_s to the designer turns upon its appearance in the expression $\frac{R_1 T}{L_s}$, where R_1 is the contact resistance of one set of brushes.[¶] That the relation $\frac{R_1 T}{L_s} > 1$ is a necessary condition for sparklessness may now be regarded as generally accepted, and more recently Prof. Arnold has further elaborated (‖) the special case with carbon brushes. With a rapidly-varying current having a given effective current-density $s_{u\,eff}$ the specific contact resistance, R_k for each momentary value of the current density, s_{ux} may, with carbon brushes, be divided into two portions, or $R_k = R_w + \frac{e_u}{s_{ux}}$; the one portion, R_w, remains constant and is independent of the momentary current density, while the other portion varies inversely thereto. The variable part varies in the wrong direction and cancels itself out so that it in no way assists in suppressing sparking. The corrective action of the contact resistance is thus solely dependent upon R_w, and in the calculation of R_1 it is this value, R_w that must be used rather than the entire value, R_k But even the portion R_w varies in the wrong way when the effective current density is altered, being higher when the effective current density is low, and lower when the effective current density is high and the equalizing action of the brush resistance is most urgently needed; in fact, it varies inversely with the effective current density, or $R_w = \frac{P_w}{s_{u\,eff}}$. Thus P_w or the loss of volts over R_w is practically a constant quantity, although varying between the limits of 0.7 to 1.1 volts with different kinds of carbon of varying hardness.

The relation $\frac{R_1 T}{L_s} > 1$ can now be expressed in a form that brings it into line with the previous expressions of paragraph 9. If $f_u =$ the form factor of the curve of the average current density in the brush, the average value for each point along its surface of contact being plotted in relation to a horizontal axis of space, i. e., $f_u = \frac{s_{u\,eff}}{s_u}$, and if F_u is the total area of one set of brushes, $R_1 = \frac{R_w}{F_u}$

[¶] Apart from certain qualifications when the less common forms of armature winding are in question.

[‖] Die Gleichstrommaschine, chap. xix, § 94.

$$= \frac{P_w}{F_u . s_{u\,eff}} = \frac{P_w}{F_u . s_u . f_u} = \frac{P_w}{2\, J . f_u}.$$

Thence by a simple transposition, $\frac{2\, J\, L_s}{T} < \frac{P_w}{f_u}$

$$< \frac{0.7 \text{ to } 1.1}{f_u} \text{ volts.}$$

Yet, while this relation is of primary importance in the mathematical theory of commutation, its practical significance to the designer does not appear to the writer to be so great, owing to the fact that if the $L + \Sigma M$ is not too high for the first condition of paragraph 9, the fulfilment of the second condition is almost invariably obtained without any difficulty, at least with chord as opposed to diametric windings. The final result, therefore, of our examination is to emphasize the necessity for the accurate calculation of $L + \Sigma M$ as *the* important quantity to the designer in the problem of commutation.

Motor Driven Machinery.

By Frank B. Kleinhans.

The subject of motor-driven machinery is brought more or less before every machine builder. If all shops used one standard construction of motors, the problem would be made very much more simple. But we are obliged to equip our machines to accommodate motors of a dozen or more different designs, some being constant-current machines with no variation in the field, and others with a slight variation in the field. Then there are the alternating-current motors which run at a speed that cannot be changed, and motors with a two-to-one variation, a three or four-to-one variation with multivoltage, and finally motors with a variation of seven or eight-to-one, like the Bullock, also a multivoltage motor. The type of motor, therefore, determines the construction which shall be used in applying a motor to the tool. If we were to equip a lathe with a multivoltage motor with the least possible change, we would find that the general run of lathes would require a speed variation of from six to eight-to-one. If the motor which we are to use for the machine had a less range than would be obtained from the cone, an entirely different construction must be schemed out for the motor drive. Here lies the source of all the trouble.

There are cases where the expense of the design, the necessary gearing and changes to accommodate things are such that the motor-driven part of the machine, including the motor, is almost as great as the cost of the machine itself. This the customer is unwilling to pay for. Of course, this is only true of the small-size machines. On account of this enormous expense, which is altogether out of proportion with the price of the machine proper, it is inadvisable to have independent motor-drives on every machine throughout the shop. By the use of a good variable-speed countershaft, we can readily obtain the range of speed which is necessary for the lathes, or any other machine, and we can, therefore, use a standard machine without any alteration whatever. The machines can then be grouped together in sections and driven from a short line shaft by a motor. Such an arrangement would be much more economical than the individual drive for the reason that there are many times when the machine is used for polishing, light drilling, etc., when the power used is a very small percentage of that which would be required to drive the machine with an individual motor.

We would thus have an individual motor running a great part of the time with a very inefficient load, whereas when a group of these machines are all driven from the same motor, there is a tendency to even up things for the reason that the no-load machine and the full-load machine are both on the same motor. On the large-sized machines, however—say those machines which would require 5 hp or upwards to drive them—the mounting of individual motors on the machine is a small item of expense in comparison with the total cost of the machine.

Of all designs for motor drives there is perhaps none that is as difficult in connection with changing speeds as that for the constant-speed motor. We are obliged to have a sufficient number of runs of gearing that the gap from one speed to the other may not be too great. When a great amount of power is transmitted and when gears run at a high rate of speed, it is inadvisable to have several different changes of gearing running all the time. We are thus obliged to slip the gears out of mesh, which requires us to stop the machine and then pull the gears around so as to be able to thread the teeth through each other. This takes time and the operator will frequently run at a slow speed instead of taking the trouble to make the change. A combination of a sliding gear and an eccentric makes this matter very simple.

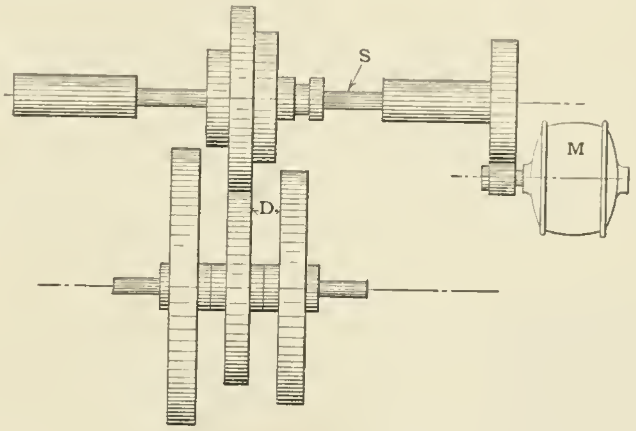


FIG. 1.—DIAGRAM OF GEARING.

Referring to Fig. 1, we have a constant-speed motor, *M*, driving the shaft, *S*, which carries three changes of gearing. In order to shift from one run to the other, the eccentric is first thrown out and then the gears are shifted and the eccentric is thrown in. This can be done by simply slowing down the machine. This construction is very readily applied to a lathe, as the eccentric on the back gear shaft is already a part of the machine. The shifter arm is shown in Fig. 2. The clutch block, *C*, is made of cold-rolled steel and is provided with a spring, *S*, which pushes the block out. As the eccentric is thrown in and out this spring pushes the clutch block out against the clutch spool so as always to be engaged with it.

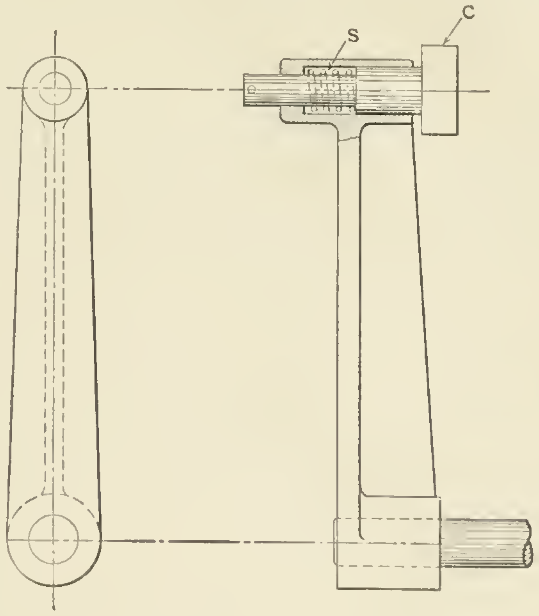


FIG. 2.—SHIFTER ARM.

Another advantage of this double method of shifting the gears is that we only require a little more than once the face of the gears at *D* instead of a little more than twice the face, as would be the case if the eccentric were not used; for we must have one gear disengaged when sliding the gears before the other gear enters. We are thus enabled to get the gearing in a great deal less space, which is a decided advantage in many cases.

The connection for the motor to the machine can be made either through gearing or silent chain. If a silent chain is used, provision should be made for taking up the slack in the chain. This is especially true when the line between the motor center at the gear center is vertical. When the connection is made through gearing direct to the machine, raw hide should be used to deaden the noise.

In Fig. 3 is shown a raw hide pinion on the motor shaft, *S*. These pinions should all be shrouded, and the shrouds should be held together with screws, *A*, with the head on the outside so that when the pinion dries out the slack can be taken up. The pinion should be provided with a key and a headless pointed set screw, *B*, to keep it from shifting on the shaft. We should have one or more pinions, *P*, or keys, to keep the shrouds from twisting around. Many raw hide pinions have failed on account of the shroud slipping around and the pressure coming on one corner of the tooth, thus wearing it away rapidly. The face, *F*, of the gear should be made 50 per cent. wider than would be required for strength, according to the gear formulas, the teeth, of course, remaining the same per inch. Whenever an idler is used in order to get from the motor shaft over to the machine—and this construction must often be resorted to—the idler, as at *I*, Fig. 4, should be made of raw hide, the pinion, *P*, and the gear, *G*, being either made of cast iron or steel, as desired.

When constant speed motors are used to drive a lathe, a thread indicator should be provided to avoid the necessity of reversing the motor. When a multivoltage motor is used, and too much cannot be said in regard to the utility of this style of motor, a spline shaft should be arranged so that the operator can have a comfortable handle always near his work. In using these motors it must be remembered that the multivoltage motor for certain horse-power has a much larger frame and is really a larger motor. This is necessary in order to give us the required power as the speed changes.

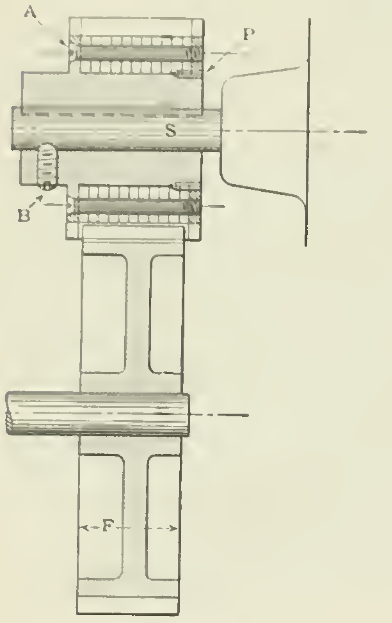


FIG. 3.—CROSS SECTION OF GEAR AND PINION.

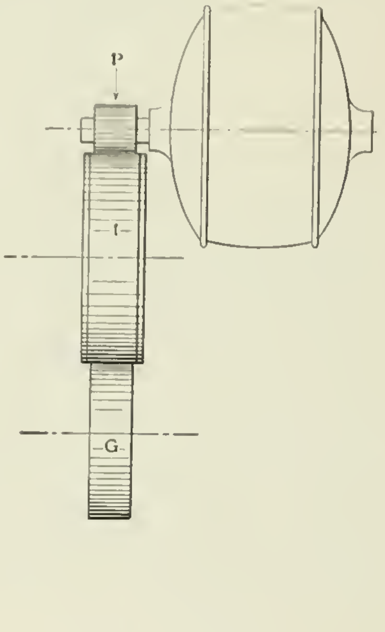


FIG. 4.—IDLER WHEEL.

The Economic Function and Status of the Telephone.

Before the Insurance Society of New York, Mr. C. J. H. Woodbury, M.E., of the engineering department of the American Telephone & Telegraph Company, delivered recently an admirable address on the modern telephone system, characterized not only by popular treatment but by philosophic insight and by great precision of interesting detail. As might be expected, in view of the nature of his audience, Mr. Woodbury enlarged upon the safeguarding features of the system, describing the various fuses and arresters, in principle and operation—protectors so sensitive that they would shut out from the telephone the battery currents used in telegraphy, and keep away heavy currents from delicate wires, some of which are so fine that 3.9 miles would barely weigh a pound.

As to circuits, he pointed to the gain from the use of hard-drawn copper wire, due to Mr. T. B. Doolittle; the substitution of such wire for iron wire having increased the limit of telephonic conversation under equivalent conditions about four times. As to underground circuits, "in the modern cable one mile of underground is the equivalent of 28 miles of overhead copper wire ⅙ in. in diameter, or 12½ miles of overhead copper wire 1/10 of an in. diameter." The use of such circuits between 7 P.M. and 7 A.M., or at night, was slightly over 1 per cent. of the calls in the whole 24 hours. The total amount of telephone line of the Bell system throughout the United States averages 3.29 miles per line to each telephone instrument, and excluding the long distance lines, 55 per cent. of the wire is underground. When one person calls up another by telephone, the average line plant at his disposal is 6.58 miles.

Mr. Woodbury next discussed the switchboard and its evolution up to the present common battery, lamp signal type, and he explained also the features of measured service and toll line operation. As to increase of cost of board with size, so often misunderstood by critics, who think the board and service ought to get cheaper as they get bigger, he noted the increase of cost in bridges with size of span and in pipe organs with size and number of pipes. The mechanical intricacy of the modern switchboard might well be appreciated from the fact that it requires as long to make and install a large switchboard as to build and equip a merchantman, the time being from one to over two years. The cost of an exchange plant may reach $1,200 per linear foot of length for the larger boards, and perhaps half that cost per foot for a switchboard adequate for a city of 50,000 inhabitants. And such boards were only a small part of the cost of a system.

With regard to operation, the result of systematic training in New York City, with the new apparatus, had been to reduce the time of making complete local connections during the past five years 3.9 seconds, a short space of time to any one unless waiting for a gun to go off; but this small amount had, when applied to all the Bell telephone connections in the United States, amounted to 10,098 hours a day, saved to subscribers, or 3.9 years in 8-hour days. The saving of time in disconnection largely owing to use of lights instead of shutters, releases the lines at the end of a talk 3⅔ times as rapidly as before. The Bell network provided for 9,322,951 calls per day, or nearly 2,500 per year per telephone; and as each telephone receives that number, the telephone averages 5,000 uses per year. It was little wonder the line was sometimes "busy," in spite of the resort to duplicate lines and private branch exchanges. In New York City the number of operators in private exchanges was twice that of those in the telephone centrals. The interruptions of service were very slight and chiefly from changes made at night. In New York City the interruption from all causes was 1 h. 21 min. per year, generally without the subscriber's knowledge. Mr. Woodbury disclaimed any ability to determine why people subscribed for a telephone, and indicated the difficulties of predicating the number of telephones on other sociological or economic data. It was true that when roads were bad, toll line telephone traffic was good. A hilly town used far more telephones than one in the plain. A warm climate or hot weather made for telephone use more than did a cool atmosphere; all summing up in the injunction: "Don't travel—talk."

When a person uses the long-distance telephone, a large amount of property is at his exclusive service. In speaking from Boston to Omaha, as one business firm does every morning, the value of apparatus at their disposal at the present price of copper is over $283,000; while the service of nine operators en route is required. The weight of the copper is 1,131,000 pounds, or 565½ tons. There was incidentally the cost of fire protection of all the apparatus, and most modern exchanges had been built specially to afford resistance to fire and fire hazards. The fire losses on these properties had, therefore, been nominal. Those of the New York Telephone Company since its incorporation had been less than 5¼ per cent. of the premiums.

Mr. Woodbury closed by instancing the varied uses to which the telephone service is now put, outside regular exchange work, as in connecting steamships with shore, railroad trains, trolley cars, wrecking cars on steam roads, etc. The cars of the funicular road on Mount Tom, Holyoke, Mass., are equipped with telephones that have sliding contacts on wires at the side of the track, for the motormen. The board of directors of a Chicago corporation with members also in Milwaukee, St. Paul and Detroit has meetings, with these men at their telephones. At presidential conventions the proceedings are telephoned all over the country. Oaths are administered by telephone, and love made the same way. At Muncie, Ind., a young lady dismissed her swain. In response to his plea over the telephone to be allowed to call again, she replied by firing three revolver shots into her own telephone transmitter—which indicated a certain prudence on the part of her interlocutor.

Methods of Signaling and Operating in Telephone Exchanges.—II.

By Kempster B. Miller and Charles S. Winston.

II. CONNECTION BETWEEN TWO SUBSCRIBERS IN DIFFERENT COMMON BATTERY OFFICES.

When a telephone exchange has two or more offices, provision is made so that a subscriber in one office may be connected with a subscriber in any other office. For the purpose of making these connections, trunk lines extending between the offices are provided. The outgoing ends of these trunk lines end in jacks multipled throughout the subscriber's sections of one office, and the incoming ends terminate in plugs and lamps located on the key-board of a particular position or positions at another office. In order to provide means for making connections, both from and to the subscribers of any office each office is provided with both incoming and outgoing trunk lines, the outgoing lines at one office being incoming lines at the other. The trunk lines are therefore used for "oneway" service only. By the arrangement mentioned a calling subscriber desiring a connection with a subscriber in a distant office is always connected with the outgoing end of a trunk line leading to that office, at which the called-for subscriber is then connected with the incoming end of the same trunk line.

Those operators who sit at the regular positions of the board at which the subscribers' lines terminate ("subscribers," or *A* positions) are termed "subscribers'" operators or *A* operators. The incoming trunk lines are terminated in plugs at positions known as "trunk" position or *B* positions, and the operators who handle the incoming ends of these trunk lines are called "trunk" or *B* operators. These operators have, as a rule, no means of listening in on a conversation. Each trunk operator, however, is provided with a telephone set, to which lines from other offices are connected so that the subscriber's operators at these distant offices can, by pressing a key, known as an order wire key, converse with any trunk operator. Each subscriber's operator has at her position a certain number of order wire keys which are connected to lines, used for order purposes only, multipled through all of the regular subscriber's positions. By means of these she may give instructions to the trunk operator as to the connection desired.

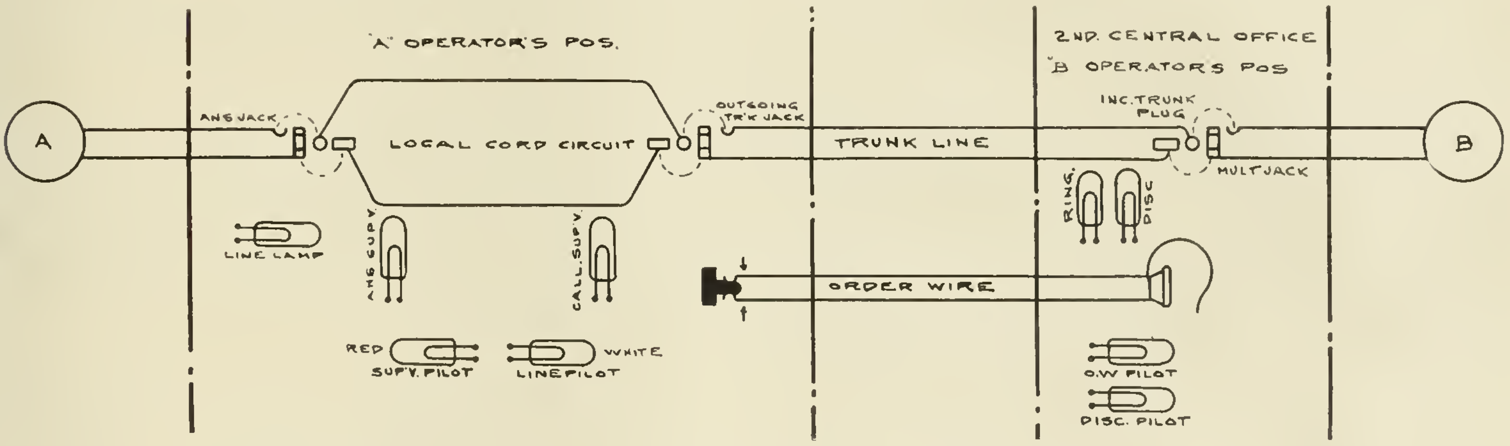


Fig. 3.—Connection Through Two Common Battery Offices.

When a subscriber (subscriber *A*, Fig. 3) whose line terminates at one office desires to converse with a second subscriber (subscriber *B*) who is connected with a second office, he will remove his telephone from its hook, thus lighting the line and pilot lamps at the switchboard of his office in the ordinary manner. The subscriber's operator will answer by inserting the answering plug of one of her pairs of cords into the corresponding jack, and will find out from the calling subscriber the number of the line in the second office, with which he desires to be connected. She will then press a key in an order-wire circuit, which terminates in the telephone set of a trunk operator at the desired office, and tell this operator the number of the line with which one of her subscribers desires to be connected. The trunk operator will then designate to the subscriber's operator, over the order-wire circuit, the trunk line which is to be used in making the connection, and with the plug of this trunk line test the multiple jack of the desired line. If, upon testing, the operator finds that the called-for line is not busy, she will insert the trunk plug into the multiple jack. At the same time the subscriber's operator at the first office will insert the calling plug associated with the answering plug, which is in the answering jack of the calling line, into a multiple jack of the trunk line designated by the trunk operator. The calling supervisory lamp at the subscriber's operator's position will light in the same manner as it does when the calling plug is inserted directly into a subscriber's multiple jack.

As subscriber's bells are always rung by operators at the office in which their lines terminate, the subscriber's operators are instructed not to ring when a connection is made over a trunk line, and the ringing is done by the trunk operator. For this purpose the cord circuits in which the incoming trunk lines terminate are provided with ringing keys of the same type as those used on the calling cords of the subscriber's operators.

Associated with each incoming trunk circuit there are two lamps; one known as the "ringing" lamp, which lights as soon as the trunk plug is inserted into the jack, and remains lighted until the called-for subscriber answers, when it is extinguished and cannot be relighted until the plug is removed from the jack. At the same time that this lamp goes out the calling supervisory lamp of one of the subscriber's operator's cord at the distant office is extinguished. The information is thus conveyed to both operators simultaneously that the called-for subscriber has responded.

The second lamp associated with each incoming trunk circuit, known as the "disconnect" lamp, lights after the conversation has been finished and the connection has been taken down by the subscriber's operator at the originating office. This latter lamp also serves as a guard lamp to prevent mistakes in the selection of trunks by the operators. In the Kellogg system this lamp will light if the trunk operator inserts the trunk plug into a jack of the called subscriber before the subscriber's operator at the originating office inserts a calling plug into the outgoing trunk jack, or, if the subscriber's operator at the originating office inserts the calling plug into the outgoing trunk jack before the incoming trunk plug is inserted into the multiple jack of the called subscriber's line. This feature of the circuit serves as a guard at both offices against misunderstandings on the part of the operators in regard to the trunk line to be used, and therefore against mistakes in establishing connections at either end.

As the trunk operator and subscriber's operator ordinarily establish connection practically simultaneously, the disconnect lamp seldom does more than flash when the connection is put up. If, however, this lamp lights and continues so at the beginning of a connection, it shows that one of the operators has probably used the wrong trunk. Seeing this lamp remain lighted, the trunk operator would obey its signal; that is, pull down the connection. This would leave the calling subscriber without his connection, and the connection would soon be ordered up again by the subscriber's operator.

At the end of conversation the calling subscriber will hang up his receiver and thus light the answering supervisory lamp at the offices at which the call originated, no signal whatever being transmitted to the trunk operator. The called subscriber will hang up his receiver and light the calling supervisory lamp also at the originating office. No act on the part of either subscriber will have any effect upon the lamps at the incoming trunk position. The subscriber's operator, who, as seen from the above, has complete charge of the connection after the called subscriber has answered, will take down the answering plug from the answering jack and the calling plug from the outgoing trunk jack. The latter act will light the disconnect lamp at the incoming trunk position at the distant office, and the trunk operator will remove the trunk plug from the multiple jack.

Thus, it will be seen that there is no instant when either the calling or the called subscriber cannot signal an operator at one of the two offices.

If upon testing with the trunk plug, the trunk operator finds that the called for line is in use, she will insert this plug into a "busy back" jack, one or more of which are located within easy reach of each position. This jack is constantly connected with a source of interrupted e.m f., which will place a "tone" on the line. The placing of the trunk plug into the "busy back" jack will also cause the calling supervisory lamp at the subscriber's position at the distant office to flash at regular intervals. The calling subscriber hearing the tone will (if he understands its significance) hang up his receiver, thus lighting the supervisory lamp of the answering plug used in making the connection, and both lamps being thus lighted, the subscriber's operator will pull down the connection as in the case where two local subscribers were connected. If the subscriber does not understand the tone, the *A* operator seeing the rhythmic flashing of the calling supervisory lamp will listen in on the line and inform the subscriber that the line called for is busy.

If, after having rung the subscriber several times, he does not respond, the trunk operator will withdraw the trunk plug from the line jack and insert it into a "don't answer" jack, which will place a different tone from that given by the "busy back" jack on the line, and this will be interpreted by the subscriber or the *A* operator, or both, as meaning that the subscriber does not respond. This feature is used on the Kellogg systems, and some of those supplied by the Western Electric Company.

The trunk system of the Western Electric Company operates in practically the same manner as the Kellogg system described above, but the guard-lamp feature is not carried out to the same extent. In their system, when an incoming trunk plug is inserted into a multiple jack before the calling plug is inserted into the outgoing trunk jack at the distant office, the disconnect lamp will light, but the act of inserting the calling plug into the outgoing trunk jack at the distant exchange previous to inserting the trunk plug, will have no effect upon the disconnect signal at the trunk position. In all other respects, the methods of signaling are identical.

It is customary to arrange, at each incoming trunk position some means of transferring the incoming order-wire calls, in case a trunk operator leaves her position, either momentarily or for a period of considerable length. The scheme which is used by the Kellogg Company is to wire in the telephone set of each trunk operator a two-way key. If this key, at a trunk position, is thrown in one direction and an operator at a distant office presses an order-wire key and attempts to converse with the trunk operator the order will be received by this operator, and at the same time an order-wire pilot lamp will be lighted at this trunk operator's position. However, if the key is thrown in the opposite direction, the order, and pilot lamp signal will be transferred to some other trunk operator's position. If the key at this second position is thrown in one direction the order and pilot lamp signal will be received at this second position, or if thrown in the other direction, it will be transferred to a third position. In this way it is possible for one trunk operator to do all of the incoming trunk business at night, or whenever the number of incoming trunk calls is small. The order-wire pilot lamp is ordinarily wired in a manner similar to that in which the line and supervisory pilot lamps are wired, so that the night alarm will ring whenever the lamp lights, if the night-bell switch is in the proper position.

The Western Electric Company's scheme of transferring order-wire calls, although similar to that described above, is different in some respects. If the subscriber's operator at one office presses an order-wire key, and upon attempting to converse with a trunk operator at a second office, receives no response, she will press a key, called the ring-down key, at the same time that the order-wire key is depressed. This will send current from generator out over the order-wire circuit and throw a relay (which is mechanically similar to the electrical restoring drop of the Western Electric Company), and light a pilot lamp at the trunk position. This pilot lamp will remain lighted until the operator returns to her position and extinguishes it by pressing a key, which sends battery current through the restoring winding of the relay and brings it back to its normal position. This pilot lamp is connected to the night-bell circuit in the same way that the order wire pilot is connected in the Kellogg system. Incoming trunk calls are transferred from one position to another in the Western Electric system in practically the same manner as in the Kellogg system.

In the operation of systems so far described, the ringing of the called subscriber has always been done manually by the *A* operator when no trunk was used in making the connection, or by the *B* operator where connection was made through a trunk.

In some of the exchanges built by the Western Electric Company, and in some of the foreign work of the Kellogg Switchboard and Supply Company, this necessary act of ringing on the part of the *B* operator is partially or entirely eliminated.

This feature is termed automatic ringing. In the system installed by the Kellogg Company in one of the London, England, offices, and, we believe, also installed in some instances by the Western Electric Company, where there are no party lines the *B* or trunk operator has only to plug into the multiple jack of the called subscriber, which act energizes a relay in the cord circuit, which throws ringing current on to the line. This current continues to flow, ringing the bell of the subscriber until he responds, or until the operator removes the plug from the jack. The response of the subscriber, by closing the metallic circuit of the line, trips the ringing relay, and cuts off the ringing current from the line, and allows the circuit to assume its proper relation for talking. Obviously, this method is not adapted without modification for selective signaling on party lines, for no means would be provided for selecting the proper party on a line. Probably, for this reason mainly the Western Electric Company does not ordinarily have the ringing current automatically thrown on the line, this being accomplished by the operator pressing a button (or when party-line ringing is required one of a series of buttons) associated with each cord circuit, which act sets the ringing relay, which establishes the proper connection between the ringing current and the subscriber's line. This relay is tripped automatically by the response of the subscriber, as in the more completely automatic-ringing system described above.

Automatic ringing apparatus has not, so far as we are aware, been applied to the circuits of the *A* or subscribers' operators in this country. This is perfectly practical when there is no trunking work to be done; that is, when there is but one office in the exchange, but where the necessity for trunking exists the consequent complication of the circuits would probably not be warranted by the gain in operative speed.

III. PRIVATE BRANCH EXCHANGE SERVICE.

By "private branch exchange" is meant an exchange complete in itself, in that it is adapted to bring into communication any two subscribers in a comparatively small community, such as that in a business office or factory; and which also affords communication between these subscribers and those of a larger exchange, such as that of a city. It is a *private* exchange because it is individual to the particular institution which it serves. It is a *branch* exchange because it operates in conjunction with and forms a part of a larger exchange. Hence the term private branch exchange.

In nearly all cases a private branch exchange equipment consists of a switchboard of suitable size from which the lines extend to the various branch exchange subscribers, the operation of the exchange within itself being practically the same as that of any ordinary common battery exchange. Connections between a subscriber in the branch exchange and a subscriber in the city exchange are made in the same general manner as between two subscribers in different offices of a city exchange, being through trunk lines extending between the two switchboards. It is customary, however, in order not to confuse the work of the *A* operators in the city exchange, and on account of economy in trunk lines, to use two-way trunks in connecting a private branch switchboard with the larger central office, instead of using one-way trunks, as has already been described, in connecting two central offices in the same exchange.

In order to avoid confusion between the office or offices of the city exchange and that of a private branch exchange, the former will be designated as main offices; it being understood that a private branch office may be connected by trunk lines with any one (usually one only) of the central offices of a city exchange.

Private branch exchange trunk lines usually terminate in the main office multiple switchboard in the same manner as regular subscribers' lines, the trunk lines being provided with an answering jack and lamp on one section of the switchboard and with a multiple jack on each of the sections. With this arrangement the work of the

A operators at the main office is kept standard, they handling incoming or outgoing calls over these trunk lines in exactly the same manner as over a regular subscriber's line.

The trunk lines may terminate at the private branch switchboard in different ways; perhaps the most common arrangement being to terminate each in a plug and a magneto-drop. In some of the latest Bell systems, however, they each terminate at the private branch end in a lamp and jack.

As in other branches of services, the tendency is to have the subscribers' operators at the multiple boards of the city exchanges perform no more special work than is absolutely necessary. For this reason the termination of the private branch exchange trunk lines on the multiple switchboard in exactly the same manner as ordinary subscribers' lines, and the retaining of the same method of operation for these branch trunks as used in the regular lines, is in accordance with good practice.

The facility with which private branch operators may handle connections is not so important as in the case of the regular subscribers' operators, whose work affects more directly the entire exchange. Moreover, the private branch operator is made to take much of the work of obtaining connections herself which would otherwise fall to the subscribers in the private branch exchange. She may be made to do the waiting necessary for the called subscriber to respond without consuming the time of the private branch subscriber who desires the connection. This applies particularly to outgoing calls from the private branch exchange, but her function is not less important with respect to incoming calls from the main exchange subscribers, for she may properly distribute such calls directly to the departments where they can best be attended to, thus relieving the more prominent members of the firm of many calls which would otherwise come to them. The branch exchange operator may, in fact, perform largely the same duties as are often assigned to an office boy, relieving the subscribers of much of their routine work in obtaining connections, and acting as a go-between between the public and the branch exchange subscribers.

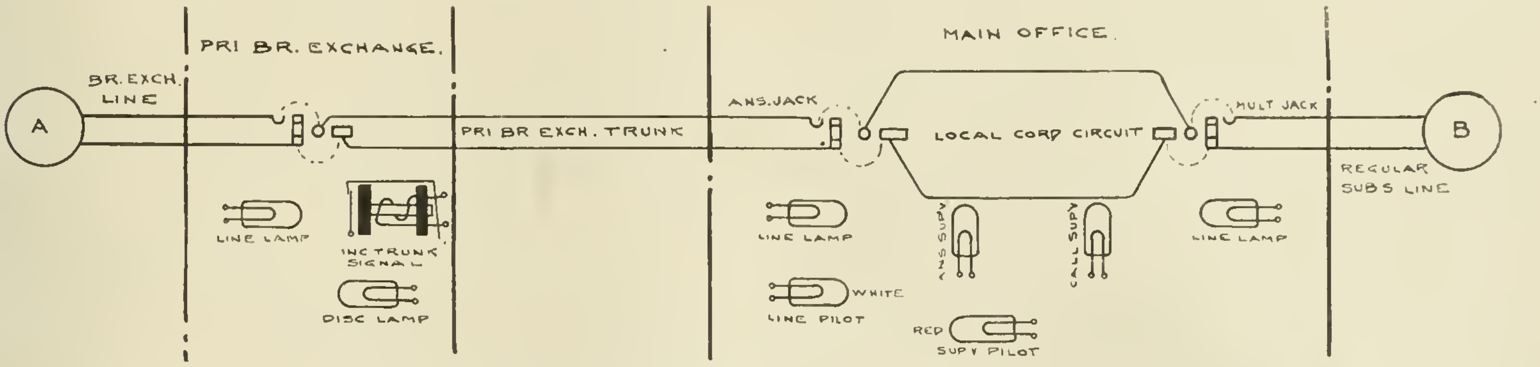


Fig. 4.—Connection Between Private Branch Subscriber and Main Office Subscriber, Using Plug-Ended Trunk.

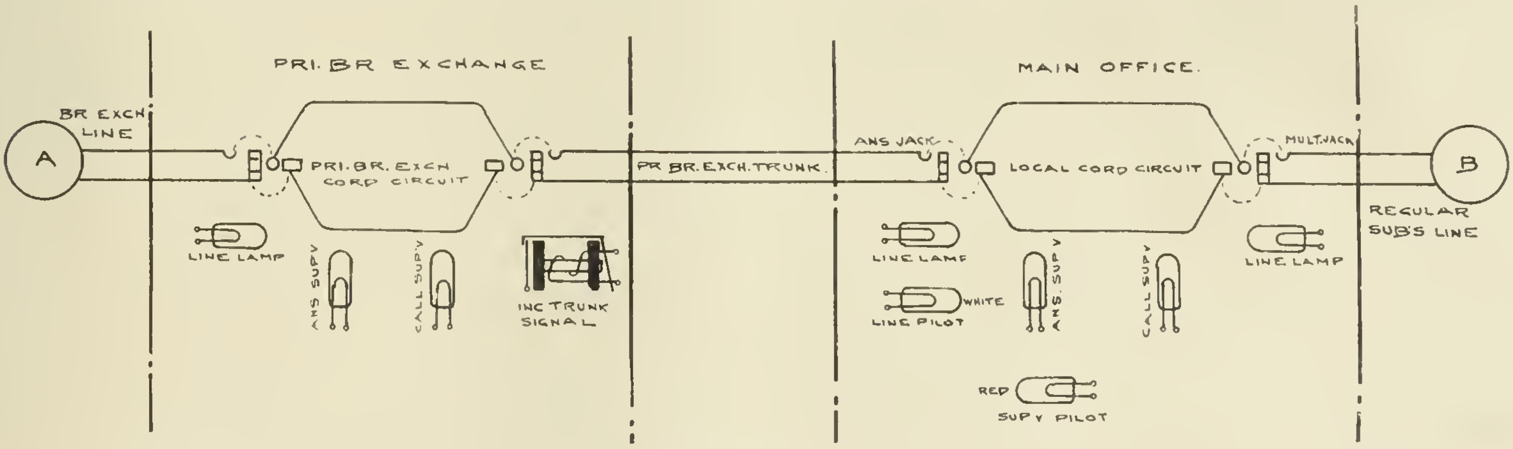


Fig. 5.—Connection Between Private Branch Subscriber and Main Office Subscriber, Using Jack-Ended Trunk.

It may be said in general that the items of first cost and maintenance in private branch exchange working are of more importance than in perhaps almost any other subsidiary branch of telephone work. Private branch exchange switchboards are, on account of the comparatively few lines they contain, and on account of the amount of apparatus they necessarily employ, found to cost more in proportion than any other types of switchboard, and this expense the operating company naturally wishes to keep as low as possible. Furthermore, private branch exchanges are usually required to give service to the busiest subscribers, whose time is valuable, and reliability of service is therefore of the greatest importance. These boards are usually manipulated by operators not in the employ of the telephone company, but of the firm in whose office the exchange is installed. For this reason the operating company cannot be sure of the boards getting the best attention. All of these points tend to make the factor of simplicity in a private branch exchange equipment carry more weight than might otherwise be the case, and for this reason speed in operation is often sacrificed toward this end.

The fact that the private branch exchange operator is usually in the employ of the subscribing company rather than of the operating company is, on the whole, an undesirable feature, from the standpoint of both companies. This fact is, however, generally recognized by the operating company only, with the result that the subscribing companies continue to employ their own operators.

In Fig. 4 is shown a connection between a private branch exchange subscriber and a regular subscriber, the connection being made through a trunk line ending in a plug at the private branch exchange. A similar connection through a trunk ending in a jack at the private branch exchange is shown in Fig. 5. Each of these figures shows the usual signaling devices at both private branch and main offices.

Referring to these figures the method of operation and signaling in private branch exchanges may be described. For a local connection between any two subscribers in the branch exchange the connection is made and supervised by the branch exchange operator in exactly the same manner as between two subscribers whose lines terminate in the same office in a large exchange. If, however, the subscriber in the branch exchange desires a city connection he will raise his receiver from the hook, and the operator will respond by inserting an answering plug into the jack of his line in the usual manner. Instead of telling the operator the connection desired and waiting for it to be established he will usually tell her to obtain a certain party for him and hang up the receiver. If the system is one such as shown in Fig. 4, where the trunk line terminates in a plug on the private branch exchange board, the operator will call central by closing, in some convenient manner, the metallic circuit of the trunk line, thus lighting the lamp belonging to that trunk-line at the main office. She will also bridge her telephone across the trunk circuit by means of a listening key, and await the response of the main office operator. The subscriber's operator at the main board will answer the call in the usual way, and complete the connection with the line of the subscriber called for. After this subscriber responds, which fact the private branch operator ascertains by listening in on the circuit, this operator inserts the plug of the trunk line into the jack of the branch exchange subscriber who originated the call, and by means of a ringing key calls him.

If the private branch exchange employs jack-ended trunks, as in Fig. 5, the operator will answer the calling subscriber with the answering plug, as before, and will, after ascertaining the connection desired, call up the main office by inserting the corresponding plug of the pair into the trunk jack, after which the connection will be completed as just described.

The Central Stations of the United States.

The central station data of the United States, just issued by the United States Census Office, were noted in these pages last week. The bulletin prepared by Mr. W. M. Steuart, the chief statistician, is, indeed, a most interesting and suggestive document, its 51 tables covering every branch of the electric light and power industry. Our previous quotations dealt with the gross figures, the distribution of the stations, and the great gain exhibited by the industry as compared with gas. We may now take up some of the other items brought to account. The first of these deals with the capital account.

Of the 2,040 central electric stations operated under private ownership and controlled by corporations, 747 are operated in connection with gas plants, waterworks, or other industries. In such cases the capital stock and bonds, as a rule, cover the entire interests of the corporation, there being no separate issue for the electric station. This is especially true of a corporation which was originally chartered for the manufacture of gas or the operation of water works, and made no additional issue of stock when the electric station was established. Under these conditions it is impossible to obtain an accurate enumeration of the capital stock or funded debt for electric stations exclusively, and the amounts charged to such stations are estimated. These estimates are based largely upon the income derived from the electric stations as compared with the total income of all interests covered by the capital stock and bonds. The capital stock and bonds reported, therefore, may be accepted as representing the capitalization of the central electric stations. The totals for the United States are summarized in the following table:

CAPITAL STOCK AND FUNDED DEBT—INCORPORATED COMPANIES: 1902.

Total capital stock and funded debt authorized	$743,296,266
Total capital stock and funded debt issued	627,515,875
Capital stock:	
Authorized	435,178,372
Issued	372,951,952
Dividends	6,189,837
Funded debt:	
Authorized	308,117,894
Outstanding	254,563,923
Interest	12,118,740

Capital stock constituted 58.5 per cent. of the total authorized capitalization of the stations operated by incorporated companies, and bonds or funded debt 41.5 per cent. Of the total authorized capital stock $372,951,952, or 85.7 per cent., had been issued and was outstanding at the end of the year covered by the report. Of this amount, $23,871,671, or 6.4 per cent., was preferred stock, and $349,080,281, or 93.6 per cent. common stock. The common stock on which dividends were paid during the year amounted to $126,284,352, or 36.2 per cent. of the total issued. This represents an average rate of 4.4 per cent. on all the common stock which paid dividends. Of the total preferred stock, $12,197,463, or 51.1 per cent. of the amount issued, paid dividends, the average rate being 5.2 per cent. There were, therefore, $222,795,929 of common and $11,674,208 of preferred stock on which no dividends were paid. Only 589 companies reported that dividends were paid on either common or preferred stock. There were 71 companies that reported an issue of preferred stock, and 41 that paid dividends on such stock, while 561 paid dividends on common stock and only 13 paid dividends on both common and preferred stock. Of the 2,049 incorporated companies, 795 paid interest on their bonded indebtedness. The amount of this indebtedness was $250,535,749, and the interest paid was equivalent to an average rate of 4.8 per cent. There were 656 municipal stations that reported an issue of bonds amounting to $11,609,488, and 635 reported that interest amounting to $504,805 was paid on bonds to the value of $11,239,588, or an average of 4.5 per cent. on all bonds paying interest.

The manner in which the expenses are divided up is shown by the following table:

EXPENSES—PRIVATE AND MUNICIPAL STATIONS, AND PERCENTAGE EACH CLASS IS OF TOTAL: 1902.

Items.	Total.	Private stations. Amount	Private stations. Per cent.	Municipal stations. Amount.	Municipal stations. Per cent.
Total	$68,081,375	$62,845,388	92.3	$5,235,987	7.7
Salaries and wages	20,646,692	18,766,970	90.9	1,879,722	9.1
Supplies, materials and fuel	22,915,932	20,493,641	89.4	2,422,291	10.6
Rents, taxes, insurance and miscellaneous	11,895,206	11,456,037	96.3	419,169	3.7
Interest on bonds	12,623,545	12,118,740	96.0	504,805	4.0

The following table gives an idea how the supply expenditures are divided up:

SUPPLIES AND MATERIALS—PRIVATE AND MUNICIPAL STATIONS, AND PERCENTAGE EACH CLASS IS OF TOTAL: 1902.

Items.	Total.	Private stations.	Municipal stations.	Per cent. In private stations	Per cent. In municipal stations.
Total cost	$11,280,423	$10,303,956	$976,467	91.3	8.7
Meters:					
Number	27,632	25,739	1,893	93.1	6.9
Cost	$416,994	$390,569	$26,425	93.7	6.3
Motors:					
Number	602	572	30	95.0	5.0
Cost	$30,099	$29,202	$897	97.0	3.0
Transformers:					
Number	13,288	7,843	5,445	59.0	41.0
Cost	$365,028	$326,407	$38,621	89.4	10.6
Incandescent lamps:					
Number	8,839,905	8,399,571	440,334	95.0	5.0
Cost	$1,507,249	$1,426,224	$81,025	94.6	5.4
Incandescent lamp fittings, sockets, etc., cost	$177,236	$154,517	$22,719	87.2	12.8
Carbons for arc lamps:					
Number	94,686,596	82,156,930	12,529,666	86.8	13.2
Cost	$1,051,386	$900,788	$150,598	85.7	14.3
Globes for arc lamps:					
Number	485,073	428,979	56,094	88.4	11.6
Cost	$170,929	$150,509	$20,420	88.1	11.9
Arc lamp repairs, cost	$244,537	$212,231	$32,306	86.8	13.2
Poles or other supports, cost	$346,587	$319,617	$26,970	92.2	7.8
Wire and cable, cost	$1,152,915	$1,081,380	$71,535	93.8	6.2
Mill supplies (oil, waste, etc.), cost	$712,797	$617,911	$94,886	86.7	13.3
Power purchased, cost	$2,130,759	$2,007,193	$123,566	94.2	5.8
Freight paid, not included in other items	$1,120,363	$939,512	$180,851	83.9	16.1
All other materials, cost	$1,853,544	$1,747,896	$105,648	94.3	5.7

The gross annual income for both private and municipal stations amounted to $85,700,605, and the expenses, including interest on bonds, to $68,081,375. Deducting the expenses from the income leaves an apparent net income of $17,619,230, but this amount should not be accepted as the actual net income because the methods of bookkeeping in use by a number of the central electric stations and the manner of carrying on their business made it impossible to obtain the information necessary to prepare a true income account for the generation and sale of electric current exclusively. For instance, the income from "all other sources" includes amounts derived from wiring houses, sale of lamps, wires and other supplies. In some cases, the stations do considerable mercantile business of this character, but it is impossible to segregate the expenditure so as to show the cost of supplies used, as distinct from those sold. The reports for 380 stations show that free service of some character was furnished to the municipalities in which they are located. This free service consisted of lighting part or all of the public buildings, furnishing a certain number of lamps, or making a discount on the lamps used by the city. Where free service was given, its value was estimated at commercial rates and included in the income. Eighty-nine stations reported that a cash compensation was required for the franchise privilege or that a certain specified amount or percentage of the gross income was required to be paid yearly. In a few cases the stations were required to pay a special tax. All of these amounts have been included in the total expenses shown.

As to the income, incandescent lighting is a much more important source of income than arc lighting for stations operated under private ownership, but for municipal stations these two sources of income are of nearly equal importance. Of the total, $70,138,147, reported as the income from lighting for both private and municipal stations, $50,368,173, or 71.8 per cent., was derived from lighting private dwellings, office buildings, or other business properties, and $19,769,974, or 28.2 per cent., from lighting streets, parks and public buildings. Of the total amount, $25,481,045, reported as income from arc lighting, $8,460,320, or 33.2 per cent., was from lighting commercial or other private properties, and $17,020,725, or 66.8 per cent., from lighting public places; and of the $44,657,102, reported from incandescent lighting, $47,907,853, or 93.8 per cent., was from commercial or other private, and $2,749,249, or 6.2 per cent., was from public lighting.

There are 136 stations that report the purchase of electric current costing $1,300,925; 71, the purchase of water power costing $210,619; 95, the purchase of steam power costing $296,831; and one, the purchase of power generated by gasoline engines costing $240. There are 85 stations which rent the use of water for the operation of water wheels, paying $322,144 for the same, and a number report amounts aggregating $460,011 as paid for water to generate steam.

The totals given in the table below which show the cost of the various kinds of fuel consumed in each class of stations:

COST OF FUEL—PRIVATE AND MUNICIPAL STATIONS, AND PERCENTAGE EACH CLASS IS OF TOTAL: 1902.

Items.	Total.	Private stations. Amount.	Private stations. Per cent.	Municipal stations. Amount.	Municipal stations. Per cent.
Total	$11,635,509	$10,189,685	87.6	$1,445,824	12.4
Coal	9,943,125	8,749,394	88.0	1,193,731	12.0
Crude petroleum	721,838	700,136	97.0	21,702	3.0
Natural gas	254,269	220,460	86.7	33,809	13.3
Artificial gas	28,654	20,135	70.3	8,519	29.7
Other fuel	687,623	499,560	72.7	188,063	27.3

The prominence of crude petroleum will be noted, but its consumption was localized, $515,820 being the value of that used in California and $128,087 the value of that used in Texas.

The pay roll is, of course, a large item. There are 6,996 salaried officials and clerks employed by the central electric stations, receiving $5,663,580 as salaries. Of this number 3,016, or 43.1 per cent., are clerks, who receive $1,716,831, or 30.3 per cent. of the total salaries. The stations operated under private ownership employ 6,046 officials and clerks, or 86.4 per cent. of the total, and those under municipal control, 950, or 13.6 per cent. The salaries paid in the private stations amount to $5,206,199, or 91.9 per cent., and in the municipal stations to $457,381, or 8.1 per cent. of the total. The stations operated under private ownership give employment to 91.3 per cent. of the total number of clerks and pay 96.2 per cent. of the total salaries paid to clerks, as compared with 8.7 and 3.8 per cent., respectively, for municipal stations.

The table below summarizes the totals for the average number and total wages of wage-earners reported for both private and municipal stations and shows the proportion in each class of stations:

AVERAGE NUMBER OF WAGE EARNERS AND TOTAL WAGES—PRIVATE AND MUNICIPAL STATIONS, AND PERCENTAGE EACH CLASS IS OF TOTAL: 1902.

Occupations.	Total.	Private stations.	Municipal stations.	Per cent. In private stations.	Per cent. In municipal stations.
Total:					
Average number	23,330	20,863	2,467	89.4	10.6
Wages	$14,083,112	$13,560,771	$1,422,341	90.5	9.5
Foremen—					
Average number	1,000	943	57	94.3	5.7
Wages	$953,738	$910,072	$42,766	95.5	4.5
Inspectors —					
Average number	571	546	25	95.6	4.4
Wages	$415,904	$397,983	$17,921	95.7	4.3
Engineers—					
Average number	4,587	3,743	844	81.6	18.4
Wages	$3,259,870	$2,721,127	$538,743	83.5	16.5
Firemen —					
Average number	3,456	2,951	505	85.4	14.6
Wages	$1,963,465	$1,717,149	$246,316	87.5	12.5
Dynamos and switchboard men—					
Average number	1,978	1,872	106	94.6	5.4
Wages	$1,351,676	$1,286,065	$65,611	95.1	4.9
Linemen—					
Average number	4,217	3,868	349	91.7	8.3
Wages	$2,710,841	$2,510,269	$200,572	92.6	7.4
Mechanics—					
Average number	1,057	1,009	48	95.5	4.5
Wages	$796,355	$768,694	$27,661	96.5	3.5
Lamp trimmers—					
Average number	2,637	2,318	319	87.9	12.1
Wages	$1,654,462	$1,460,046	$194,416	88.2	11.8
All other employees—					
Average number	3,827	3,613	214	94.4	5.6
Wages	$1.876,801	$1,788,466	$88,335	95.3	4.7

As to the wage earners, it appears that for all classes taken together the prevailing rate of wages is from $1.50 to $2.24 per day, 9,783 wage-earners, or 51.8 per cent. of the total, being paid at this rate. It appears that 13,489 wage-earners, or more than two-thirds of the total number, receive from $1.50 to $2.74 per day. More than one-half of the engineers receive from $1.50 to $2.49 per day, and more than one-half of the firemen receive from $1.50 to $2.24 per day.

Annual Meeting of American Society of Mechanical Engineers.

The annual meeting of the American Society of Mechanical Engineers was held last week at the headquarters in New York City, with an attendance registering in the vicinity of 800. The following were elected officers: President, Ambrose Swasey, of Cleveland. Vice-presidents—O. S. Jacobus, of Hoboken; M. L. Holman, of St. Louis; A. Mattice, of Pittsburg. Treasurer, William H. Wiley; secretary, Frederick R. Hutton, Columbia University. Members of Council—George J. Rockwood, of Worcester; John W. Lieb, of New York, and W. J. Keep, of Detroit. During the week the members of the society were guests of the Edison Company and Interborough Rapid Transit Company in a tour of inspection of the East Side power houses. A meeting was also held at the Stevens Institute of Technology, where Dr. Hans Goldschmidt gave an experimental lecture on "thermit." A crowded reception took place on Thursday night at Sherry's. The annual address of Mr. J. M. Dodge as president was "The Money Value of Technical Training."

Among the papers read at the meeting was one by Mr. Frank B. Perry, of Boston, Mass., entitled, "A Method for Determining Rates and Prices for Electric Power." Mr. Perry criticised the step-rate system, which is illustrated by the example given in the paper, as follows: A uniform rate for use of energy of from 1,800 to not more than 2,160 kw; a smaller rate from 2,160 to 2,520 kw; a still smaller rate from 2,520 to 2,700 kw, and a minimum rate for all in excess of 2,700 kw, all the rates in the illustration given being based on the use of 3,000 hours per annum. The inconsistency of this method is pointed out, one illustration showing that 2,260 kw cost the same as 2,160 kw. With such a method a customer might install a few extra machines that would not only serve to increase his product, but would also be the means of diminishing his bill; as an extreme case, the use of one additional kilowatt would bring about this result.

As a substitute for this method, Mr. Perry recommended that a curve representing rates be plotted, and that a chart containing this curve be embodied in the contract for electric power. The paper gives an algebraic method for determining such a curve, based upon an arithmetical progression, which reduces the cost of unit power as the quantity of power taken increases.

Mr. Benjamin T. Allen, of Harrisburg, Pa., read a paper entitled "The Construction and Efficiency of a Fleming Four-Valve Engine Directly-Connected to a 400-kw Generator." The engine is of the tandem-compound type of a normal capacity of 400 hp at a speed of 150 r.p.m., with 150 pounds pressure on the throttle and 26 in. of vacuum. No steam jackets are used, but a reheating receiver is placed in the steam passage between the two cylinders. Steam is admitted to the high pressure cylinder through triple valves of the Corliss type working in chilled iron bushings, the governing being accomplished by a centrally-balanced inertia shaft or wheel governor. The exhaust valves of both cylinders are of the Corliss type operated by a single eccentric through the medium of a peculiar arrangement of rocker arms and bell cranks. The main feature of the engine is an improved form of cut-off, by means of which a satisfactory amount of acceleration can be given to the valves at the points of admission to the cut-off by means of angular motion only, the gear being unencumbered by elaborate cut-off devices.

Following are the steam consumptions found on test: ½ load, 14.42 pounds of steam per indicated hp per hour, including quantity used in reheating; at 5/8 load, 13.59 pounds of steam; at 7/10 load, 12.33 pounds of steam; at full load, 12.06 pounds of steam; at 10 per cent. overload, 12.73 pounds of steam. Among the conclusions of the paper are that the dash-pots or other accelerated cut-off devices used in Corliss engine practice are unnecessary complications and unwarranted; that the centrally-balanced direct-connecting fly-wheel device serves its purpose to better advantage than an indirect fly-wheel governor; and that there is better warrant for shorter strokes and moderately high speeds than for longer strokes and lower speeds, notwithstanding the element of clearances.

Mr. C. H. Morgan, of Worcester, Mass., in a paper described a gas engine of the "beam" type, which operates on the two-cycle principle, with an explosion at every downward stroke of the piston. Two compressors, one for gas and one for air, furnish the engine with its charges of gas and air, and provide air for scavangering. The exhaust is through ports in the cylinders which are uncovered by the piston at the end of its downward stroke, thus avoiding the use of water cooling exhaust valves and the mechanism required to operate them. The engine can also be operated on the four-cycle system by slight changes. This type of engine allows the cylinder to be placed upright, and the balancing of the pistons and their connecting rods, while the cylinder walls are subjected to much less pressure from the pistons, thus reducing the friction to a minimum. The description given in the paper is very inadequate and is confused with a description of another type of gas engine.

The Efficiency of Modern Telephone Equipment.

Mr. M. A. Edson read a paper with the above title before the December meeting of the Chicago Electrical Association, in which he considered the subject from the technical, engineering and operating standpoint. As to the increase of actual efficiency for purely conversational purposes during the past 20 years, it is stated that the local transmission is only a little better, but the long distance transmission is greatly improved, not so much in any one part, but as a whole, the increase being 50 per cent. in the line and 20 per cent. in the transmitter.

Taking up the subject of transmitters and receivers, it is said that a frequency of 125 to 150 cycles per second should be used, and the most common constant is 750; but when the frequency is raised to 1,200 some phenomena develop in the iron which, if it occurred at a lower frequency, would seriously interfere with transmission efficiency. Fortunately there are only a few singers that can reach a note as high as 1,100, and experiments made at these frequencies (750 to 1,200) are more interesting than useful.

The general tendency of late years is toward transmitters having a low fundamental note, as such transmitters will give greater volume and rate of variation of the primary current per unit of sound energy; lower fundamentals, also, lessen the tendency of the transmitter to amplify certain tones which are near that of the diaphragm. From recent tests it appears that the transmitter changes sound energy into electrical undulations at an efficiency of 50 per cent. in common battery plants and 75 per cent. in local battery. In common battery the efficiency is still further reduced if the loss in the line is considered, which should be the case as it is a part of the primary circuit. These figures are only for the transmitter and do not include the induction coil or other inductive devices.

An uncertain element in the efficiency of the common battery transmitter is the distance from the exchange. It is evident that the greater distance from the exchange means less current, as it is not the modern practice to vary the battery or resistance for different lengths of line. A consequence is that an instrument in the exchange building receives .3 ampere through the transmitter and another through four miles of cable receives one-hundredth .01 ampere, which is about as far as it is safe to go without repeating coils and trunk lines. The average limit is usually set at 350 ohms of line for 24 and 40 volt systems. The line efficiency at two miles from the exchange is 80 and may go as high as 90 for common battery systems, but for local battery the line is used only for the high voltage variable telephone current and is higher. The average value is 95 per cent. for copper metallic circuits aerial and 85 for standard underground cable.

The efficiency of the power plant in exchanges of from 1,000 to 5,000 subscribers is about as follows: Motor-generator combination, 67.5 per cent.; charging mains, 94.3 per cent.; motor-generator and battery leads, 63.5 per cent.; batteries, 72 per cent. The percentage of total energy delivered to switchboards is thus about 52 per cent. The ringing dynamotors have a 24-hour efficiency of 40 per cent. in the general way they are operated with lamps in the ringing circuits.

1—Subscriber takes receiver off hook. 2—Subscriber's individual signal lights up above pilot lamp, involving a double operation as the relay must first make the contact and the heating of the lamp filament a second. 3—Operator inserts answering plug. This also involves three movements from a military point of view, pick up plug, locate jack, insert plug. 4—Operator sets listening key. 5—Operator asks number. 6—Operator gives number. 7—Operator repeats number. 8—Operator picks up plug, locates jack in multiple. 9—Operator tests for busy. 10—Operator inserts plug. 11—Operator rings called subscriber. 12—Operator restores listening key. 13—Operator notes when called subscriber's lamp goes out in cord circuit. 14—Called subscriber answers. 15—Called subscriber hangs up receiver. 16—Connecting cord lamp lights. 17—Calling subscriber hangs up receiver. 18—Operator removes answering plug. 19—Operator removes calling plug.

In the case of a route trunk to a separate exchange, the operations up to and including (7) are identical, and then proceed as follows: 8—Operator selects order wire key. 9—Operator gives order to incoming trunk operator. 10—Incoming trunk operator repeats number. 11—Incoming trunk operator gives trunk number. 12—First operator picks up plug, locates trunk jack and inserts plug. 13—Incoming trunk operator tests line of called subscriber for busy. 14—Incoming trunk operator inserts incoming trunk plug in called subscriber's jack. 15—Incoming trunk operator sets automatic ringing key. 16—Automatic key rings subscriber. 17—Called subscriber takes up receiver and restores key automatically. 18—Calling subscriber hangs up receiver. 19—Supervisory lamp at first operator's position lights up. 20—Called subscriber hangs up receiver. 21—Second supervisory lamp lights up. 22—First operator pulls out plugs. 23—Disconnect lamp on incoming trunk cord lights up. 24—Incoming trunk operator pulls out trunk plug. In all manual boards there is very little variation in this cycle of operations. Visual mechanical signals are used instead of relays, and lamps and different methods of trunk operation are devised without materially increasing the efficiency. The efficiency of operators as a part of the system is one of the most variable quantities with which to deal in the manual system. One operator may work eight hours at an efficiency of 80 per cent. This is based on the principle that the operator has 100 per cent. of work to perform, and 80 per cent. of the work is done correctly and 20 per cent. is unnecessary errors and delay. This seems reasonable when it is considered that 20 per cent. of the calls in a manual central energy office is lost in various ways at the switchboard. In some recent tests on exchanges with a modern equipment, a variation in the work of each operator for the same period of eight hours shows 200 calls per hour and 18 seconds per connection, and another operator at the same time 100 calls on 36 seconds per call.

Farmers Lose to Swindlers.

The "lightning-rod" game in a new guise is being used among farmers of western Lake County, Ill. An agent secures a contract for equipping house and barns with electric lights for $65, as the farmer believes. Another agent comes to "take measurements," as he says, and calls the victim's attention to the fact that the price is $65 for each light. The farmer usually pays from $15 to $50 for a release of the document.

Recent Electrochemical Developments.

FURNACE PROCESSES.

A patent granted on December 1 to Mr. J. C. T. Kessmeier, of Washington, Pa., refers to the casting of glass articles. For this purpose it is necessary to use glass in a state of extreme fluidity and this condition is produced by means of electric heating. The material to be made into glass is first placed in a furnace which is heated from the outside by means of burning fuel. When melted it flows off through an exit tube, through the walls of which pass two carbon electrodes. In its molten condition the glass is an electric conductor and the current passing through it superheats it to a very high degree, say 3500° F., or more. It is then run into the moulds in which it is to be cast. It would be interesting to know whether electrolytic effects are observed when the current passes through the glass, but the patent is silent on this point.

Two patents granted to Dr. F. J. Machalske, of Brooklyn, N. Y., relate to further developments of his process of producing carbon chlorides and silicon, which has already been noticed in these columns. In one patent the inventor brings about a reaction between a chloride of silicon, usually the tetrachloride, and a carbon compound such as carbon disulphide or methane, in the electric furnace. The silicon and carbon interchange and the resulting carbon chloride is driven off and condensed. The second patent relates to the production of silicon chlorides used as starting material in the first process. He heats in the electric furnace a charge of material containing silicon and chlorine—for example, a mixture of silica and an alkali chloride. The different chlorides of silicon may be produced by suitably varying the proportions of the ingredients of the charge. The inventor does not mention carborundum, although he evidently has it in mind.

ELECTROLYTIC PROCESSES.

The Castner process for producing metallic sodium by electrolysis of fused sodium hydroxide is well known and is operated on a commercial scale. A process for producing sodium patented by Mr. T. Ewan, of Glasgow, Scotland, appears to differ only in details from the Castner process. The porous diaphragm for which Castner uses a screen or gauze is made by Ewan of alumina or of sodium aluminate or of mixtures of these substances. In order to evaporate the water, which is said to be formed at the anode, he passes a current of air over or through the electrolyte in the anode compartment. Nothing is said concerning the temperature, which is known to be a deciding factor for the success of the process.

A patent granted to Dr. H. Paweck, of Vienna, refers to a method of electrolytically refining zinc and depositing thick layers of zinc on iron or other metals. The novelty lies in the constitution of the electrolyte, which is a mixture of "zinc salts, conductive salts and boron compounds." Of the latter he prefers borax. One of his processes is as follows: About 17 kg of pure zinc sulphate are dissolved in water and one-half of the solution is introduced into a warm solution of about 9 kg of borax. The precipitate thereby formed is dissolved in concentrated sulphuric acid and stirred until congo paper turns only perceptibly blue when wetted by the solution. The other half of zinc sulphate is then added; 170 liters of water is said to be the most suitable proportion for the given weights of salts.

A patent granted to Mr. H. Blackman, of New York City, refers to mechanical details for the construction of electrodes for electrolytic cells and the method of connecting them with the bus-bars, and one granted to Mr. Frank W. Cann, of Brooklyn, relates to mechanical details of an anode hook for electroplating purposes.

BATTERY INVENTION.

Mr. H. B. Ford, of New York City, patents the construction of a zinc amalgam electrode to be used in secondary batteries. He fills a thin porous wooden cup partly with mercury and places into it a thin copper plate plated with zinc and corrugated in a vertical direction. For the other electrode he uses a copper plate covered with peroxide of manganese. As electrolyte is used dilute sulphuric acid of 25° Baume. "The charging current causes the mercury to act upon the zinc and copper plates in the usual way and also forms by the absorption of hydrogen a mercury sponge containing also some zinc, which expands upwardly until (if the preparations be correct) the porous cup is practically filled. In the discharge of the battery there is double action of the oxygen upon the zinc and upon the absorbed hydrogen, respectively. The action upon the hydrogen is first completed, resulting in the disappearance of the sponge. So long as the latter remains the voltage is about 2.5. Upon its disappearance the e.m.f. drops to about 1.5 volts."

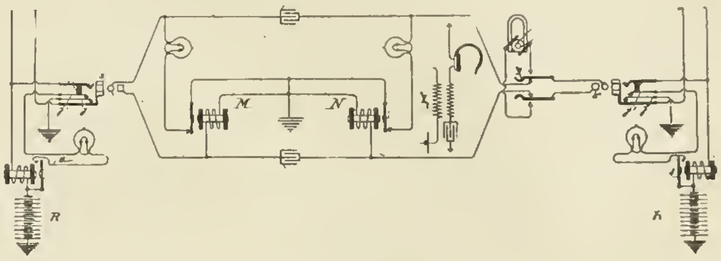
A patent granted to Mr. G. K. Hartung, of New York City, relates to an accumulator plate which consists essentially of a series of porous earthenware cups containing the material to become active, usually an oxide of lead mixed with resilient subdivided inactive material, like finely-divided cork or pure rubber, in order to obviate the difficulty due to the expansion of the active material. Embedded in the active material is a bare conductor. The tubes which form a plate are supported in a frame of insulating strips.

New Telephone Patents.

CENTRAL ENERGY SYSTEM FOR SMALL EXCHANGES.

An extremely simple arrangement of switchboard circuits for central energy working has just been brought out by Mr. W. W. Dean, of Chicago. This new system, which is designed primarily for use in small switchboards, is shown in diagram in the accompanying illustration. At either side of the figure a subscriber's line is shown, while in the middle appears a pair of connecting cords. All relays serve the double purpose of relay and retardation coil, providing not only control of the necessary signals, but also the path of current to supply the subscriber's transmitters.

As may be seen, the grounded battery, *R*, is wired through the line lamp controlling relay, of high inductance, to the subscriber's line wire *a'*, while line *a* in its normal condition connects to ground or to the grounded pole of the battery to a "normal" jack contact *j'*. The illumination of the line lamp in response to the closing of the line circuit by the switch hook is evident, as is also the cutting off of the lamp by the insertion of a plug in the jack in a manner to separate normals *j* and *j'*. The insertion of a plug has another function at the jack, namely, the clearing of the ground normal *j* from sleeve *s*. This transfers the ground return of battery *R* to the cord circuit ground, which can only be reached through the highly inductive relay *M*. This latter relay responding opens the supervisory lamp circuit. The completion of the talking circuits is, of course, through the condensers *l* and *l'*, which serve to separate the circuits of the answering and calling subscribers. As soon as the flow of current to either subscriber ceases following the return of the receiver to the hook, the corresponding relay *M* or *N* de-energized permits the closing of the corresponding supervisory lamp circuit through the jack and plug, and the cord circuit ground. The extinction of this lamp of course occurs with the removal of the plug. A patent for this system has been granted to Mr. Dean and assigned by him to the Kellogg Switchboard and Supply Company.



DEAN TELEPHONE EXCHANGE SYSTEM.

SELF-RESPONDING TELEPHONE.

Messrs. T. D. and C. J. Freese, of Elyria, O., are the joint patentees of a most novel telephonic device, namely, a self-responding telephone. This is a combination of telephone and phonograph apparatus such that one quitting his office may leave word as to his whereabouts or directions as to a message, for the benefit of any chance telephone caller. In case he desires a message to be left for him by the caller, the first or responding phonograph, after delivering its intelligence, stops of itself and sets in motion a receiving phonograph to record the incoming message. It is hard to say offhand as to just what ends such a combination will lead, but if the responding phonograph provokes the same feelings in the calling party as do the phonographs used in some cities to report busy, the message delivered by the receiving phonograph will be apt to be so rich with choice expletives as to be unfit for publication.

A GERMAN IDEA.

The American is supposed to lead the world in labor-saving devices, but a German named Ritter, residing in Stuttgart, has produced a telephone cord circuit with which the manual labor of the operator is reduced to a mere handling of plugs. With this system the insertion of the answering plug connects the operator to the calling party and restores the line drop. The insertion of the calling plug then carries on the operations by disconnecting the operator, ringing up the desired station and cutting the clearing out drop into circuit. After a ring off, the removal of the plug restores the clearing out drop. Now all this would be valuable except that it prohibits the use of all judgment and intelligence by the operator and the use of these by the operator is the chief reason that the manual board holds out successfully against the automatic. A further invention by Mr. Ritter is a toll registering system. As, however, its chief novelty lies in its adaptation to the above mentioned cord system, it does not seem necessary to consider it in detail.

No Municipal Plant for Cleveland, O.

The proposition to bond the city of Cleveland to the extent of $400,000 for the purpose of establishing a municipal electric lighting plant was defeated at the general election on November 3. The vote was 30,501 against the proposition to 24,328 for it. The proposition not only failed to secure the necessary two-thirds of the votes cast upon it, but was lost even by a majority vote, there being 6,173 more votes polled against it than for it. The total vote cast was 67 per cent. of all the voters voting at the general election, which shows that an unusual interest was taken in the matter by the voters generally.

As our readers may remember, the proposition of Mayor Johnson was that this should be a plant not only for the purpose of supplying lights to the streets and public buildings, but it should be a plant to do commercial lighting in competition with the existing companies.

The voters of the city of Cleveland are to be congratulated on the outcome of this proposition, for had they endorsed the measure and entered upon it, it would have been a very costly experiment, for it was well understood that this proposed issue of $400,000 of bonds was to be but the beginning of an expenditure of several millions of dollars, as such an amount would have been necessary to carry out the plans of the politicians who inaugurated the movement.

CURRENT NEWS AND NOTES.

AIDING SCIENTIFIC EDUCATION.—The London *Times* says that a gentleman who wishes to remain anonymous has given, through Prof. Starling, £50,000 to University College, London, to be used for the promotion of higher scientific education and research.

ELECTRIFYING THE ETERNAL CITY.—The Italian Minister of the Interior has approved the project, long mooted, of making Rome a seaport by means of a canal to be twenty kilometers long and to cost sixty million lires. The port is to be formed near the Basilica of St. Paul and will be a thousand meters long and six hundred wide. It will be below the present level of the Tiber, the waters of which will fall six meters, thus providing electric power for light and an electric railway alongside the canal from Rome to the sea. Rome is now receiving electric power from the Falls of Tivoli, twenty miles away, across the Campagna.

DECEMBER A. I. E. E. MEETING.—A regular monthly meeting of the American Institute of Electrical Engineers will be held at the Chapter Room, Carnegie Hall, 154 West Fifty-seventh Street, New York, at 8.15 P.M., Friday, Dec. 18. The following papers will be presented: Automatic Apparatus for Regulating Generator and Feeder Potential, by E. J. Bechtel; Safeguards and Regulations in the Operation of Overhead Distributing Systems, by W. C. L. Eglin; Overhead High-Tension Distributing Systems in Suburban Districts, by George H. Lukes; Gas Engines, by J. R. Bibbins.

BIDS IN ENGLAND.—A cable dispatch from London of December 5 says: "The Corporation of Swansea has accepted a British tender for the extension of the tramway system involving an expense of £103,000, although a German company offered to do the work for £2,000 less. Much attention has been called to this matter, and the question is raised as to whether it is because of Mr. Chamberlain's agitation in favor of preferential treatment of the empire as against foreign countries. Preferences of this kind are becoming far more common than heretofore."

TROLLEY FOR CANADA.—United States Consul Neal McMillan, of Port Sarnia, Ontario, under date of October 7, 1903, says: "This country is not traversed by electric roads (trolleys) to the same extent as is the United States. An excellent opportunity, in my opinion, presents itself for some company to build a road from Port Sarnia to Beaches, on Lake Huron; from Beaches to Petrolia, an inland town of some 10,000 inhabitants; and thence back to Port Sarnia, passing through several villages and the best farming country in Canada. No grading is necessary and there are no streams to bridge. Such a line would be a paying investment."

HOW TO TREAT AUTOMOBILISTS.—In this country, automobilists are lumped together, in a general denunciation, by many communities and journals, and the art has a struggle to secure the support of the leaders of public opinion. In France, it is otherwise. At the automobile show in Paris, President Loubet is presenting a magnificent Sevres vase, to be known as the prize of honor, and called the "Prize of the President of the Republic." At the same time, the Municipal Council of Paris has voted a gold medal, for competitors, to be known as the "Prize of the City of Paris." Let us try to fancy President Roosevelt and the city of New York doing such things.

LETTERS TO THE EDITORS.

The Trolley in New York City.

To the Editors of Electrical World and Engineer:

Sirs:—The writer has read with interest your editorial in the issue of December 5, entitled "Street Railway Conduit Limitations," and noted with some surprise that after your uniformly consistent advocacy of the underground conduit for urban electric street railway work almost from the very beginning of the electric railway industry, you should at length feel under the necessity of favoring an overhead trolley system for the proposed West Street line, in this city, of all others.

Surely, such a confession of weakness and the advocacy of so backward a step as this in electric railway practice at this late day does not speak very well for the resourcefulness and ingenuity of American electric railway engineers, and as one of their number and especially as one of the inventors and pioneer advocates of the underground conduit electric railway system, the writer cannot help but enter his protest against the conclusions reached by you, doubtless somewhat prematurely, as to the impracticability of operating an underground trolley line on such thoroughfares as West Street, where the channel rails, or conductors, are liable to occasional flooding through drainage connections in case of heavy rains or extraordinarily high tides.

In this connection the writer takes the liberty of enclosing you herewith, for publication in your valued journal, a copy of a communication addressed by him on November 28, 1903, upon this subject, to Dock Commissioner Hawkes, of this city, in which a method or methods devised by the writer many years ago in anticipation of the very limitations you speak of, are set forth. These methods, the writer believes, will entirely overcome the objections cited against the underground trolley in the application of the New York City Street Railway Company for overhead trolley privileges along West Street. They will not only permit of the successful operation of an underground conduit on this important thoroughfare, notwithstanding the peculiar adverse conditions complained of, but will, if adopted, bring about certain other improvements in the general electric railway service that have long been needed in this and other cities.

New York City. Elias E. Ries.

[Mr. Ries, in his letter to Mr. Hawkes, proposes the use of his system patented several years ago, and now virtually free to the public, of associating with a conduit system a light battery on each car, to be automatically charged while the car runs over the live conduit sections of the road.—Eds. E. W. & E.]

Automatic Telephone Switchboard.

To the Editors of Electrical World and Engineer:

Sirs:—I have read the description of my automatic telephone switchboard appearing on page 925 of your issue, dated December 5, and am gratified at the kind consideration given my humble efforts.

Regarding the criticism that successive jack plates falling upon each other would be thermally insulated, it is not necessary that this connecting device shall rest directly upon the heated plate; if a series are superposed the rising heated air will produce the disconnection.

As to the criticism that the number of jack plates is liable to run out, one hundred plates can be arranged on a single vertical rod and a series of these rods, each loaded with connectors and arranged like the rods of a squirrel cage, can be rotated into line, one after the other, automatically.

The apparatus is well adapted for use in a large apartment house or in an office building where one circuit is employed between the central telephone station and the apartment building or a suite of offices. The central station operator can place any calling circuit in connection with the called-for exchange circuit, and then, without loss of time, insert one of the perforated cards in an automatic transmitter, and thus complete the connection to the exact individual or sub-station desired; that is, to any occupant of an apartment or to any particular clerk or member of the force in an office. Conversely, the various substations may automatically connect themselves with the telephone central station. The apparatus is, however, susceptible of more extensive use.

New York. W. B. Vansize.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Pulsations of the Direct Current of a Synchronous Converter.—Cramer.—A detailed account of an experimental investigation in which he repeated, under somewhat changed conditions, the experiments of Banti. The latter had supplied a synchronous converter with single-phase alternating current, the direct-current terminals being first connected to a non-inductive resistance and later to a storage battery which thus was charged. In both cases the power in the direct-current circuit measured by means of a wattmeter was found to be smaller than the product of e.m.f. and current determined by hot-wire instruments. In the case of the ohmic resistance this difference amounted to 5 per cent., and in the case of the storage battery to 15 per cent. In the converter used by Banti, the pole shoe and core was divided by a considerable air-gap into two parts, the exciting windings being placed around the two pieces of the pole. This construction aids the pulsation of the field and may, therefore, be expected to increase the above-mentioned difference, since the latter is due to the alternating superposed on the direct current of the converter. The present author, therefore, used a converter with solid poles. In fact, this change improved the conditions, although the effect of the pulsating currents still exists. In this case, when the direct-current energy is absorbed by a non-inductive resistance, the pulsations of the direct current are negligible, but this is no longer the case when a battery is being charged. The direct current shows here pulsations which, at normal load of the converter, caused a difference of 15 per cent. in the readings of polarized and hot wire, or dynamometric measuring instruments. At lighter loads the difference is still greater. The effect of the capacity of the battery is here decisive and causes the current to lead in phase. The frequency of the superposed current is generally a multiple of the frequency of the supply current; in the author's experiments it was double the frequency of the supply current. If the converter is used as a double-current generator, currents taken from the alternating-current side cause again the direct current to become pulsating. All these pulsations depend upon the intensity of the alternating current and its phase difference with the e.m.f. From the experiments it follows that in determining the efficiency of a single-phase converter, hot-wire or dynamometric instruments should not be used, since the efficiency thus obtained is too high. When the author operated the converter by polyphase currents, no pulsations were observed in the direct current. Field, however, has recently found that under certain conditions pulsations may also occur in this case, although they are smaller.—*Elek. Zeit.*, November 19.

Direct-Current Machines.—Fynn.—The first part of an article illustrated by diagrams on the design of direct-current machines, in which the author intends to deal mainly with smaller machines and to discuss the various details of design. He distinguishes four types which he suggests be called the protected, enclosed, gas-tight and open types. The casing of a motor of the "protected type" forms part of the magnetic circuit, and covers, in the poles, the field coils, and the whole of the running portions except the pulley; the end covers, giving free access to the air, allow good ventilation, which may be increased by the use of fans. The casing of the "enclosed type" is exactly similar, but the openings in the end covers are covered with stout copper wire gauze; this allows a certain amount of ventilation, which may be increased by the use of fans. The casing of the "gas-tight type" is again the same, but the end covers being solid, the machine is actually gas-tight. The "open type" is the ordinary dynamo type. The article is to be continued.—Lond. *Elec. Rev.*, November 20.

Diagram of Repulsion Motor.—Blondel.—A brief communication on Osnos' recent paper on the diagram of the repulsion motor. The writer has derived a diagram similar to that of Osnos, but does not agree with him in several points, especially concerning torque and speed. In the diagram (Electrical World and Engineer, November 21, p. 849) the torque is not represented by *J B*, but by the perpendicular distance of *B* from *A D*. The torque becomes zero at point *A* and the corresponding speed has a theoretically infinite value as in a series motor. The short-circuit current does not correspond to the maximum torque.—*Elek. Zeit.*, November 19.

REFERENCE.

Theory of Single-Phase Motor with Unity Power Factor.—Osnos.—A communication referring to two recent articles by Latour and himself on the theory of the compensated series motor. He compares the views, expressed in both articles, and considers that several of Latour's suppositions and results are incorrect.—*Elek. Zeit.*, November 19.

LIGHTS AND LIGHTING.

Carbon Filament Incandescent Lamp.—Strauss.—The first part of an article in which the author describes tests which he has made with modern commercial carbon filament incandescent lamps. In recent years the expense of manufacture has been diminished. The consumption of current per candle has been improved very slightly. The average life has even decreased in spite of the better vacuum which has been obtained since the introduction of the Malignani method of destroying the last traces of oxygen by means of phosphorous vapors. From his tests he concludes that normal incandescent lamps of present make should not be used for more than 300 or 400 hours, as otherwise the candle-power will decrease below 25 or 20 per cent. of the original candle-power. He refers to a relation, given by Weber and stating that the horizontal intensity of the light is equal to the square of the product of current and e.m.f. multiplied by a constant. He gives some figures for this constant, which he found to decrease with increasing life of the lamp. The article is to be concluded.—*Elek. Neu. Anz.*, November 15.

REFERENCE.

Lamp Fixtures.—An illustrated description of suspension fixtures for drop lights.—*Zeit. f. Beleucht.*, November 10.

POWER.

Water Power, Statistics and Cost.—Miller.—An abstract of his presidential address before the Liverpool Engineering Society. France uses water power to the extent of 500,000 hp, the United States 1,500,000, and it is estimated that in Norway 263,000 hp could be supplied by the larger rivers south of Trondhjem without regulation, and by regulation the power could probably be quadrupled. According to Janet, the cost of water power development in France varies from $21.40 per hp to $150 per hp, depending on the head to be dealt with, the lowest expenditure being upon a fall of 140 meters in Haute-Savoie, the horse-power in each case being calculated at the turbine shaft At Geneva, for the first group of turbines erected, of 840 hp, and for the river works then completed, the capital cost amounted to $300 per effective hp. The groups of turbines subsequently erected cost but $95 per hp, and the complete works will cost but $135 per hp. At the chlorate works at Vallorbe the capital expenditure upon the development of 3,000 hp had amounted to but $19.45 per hp. At Niagara the rates charged to ordinary consumers by the Cataract Power Company vary from 2 cents per unit for 1,000 units per month or less to 0.64 cent per unit for 80,000 to 200,000 units per month. The cost of electrical energy for power purposes from water power stations in France and Switzerland varies from 2.1 cent per unit for small powers to 1.26 cents per unit for large powers.—Lond *Elec.*, November 20.

Removing Water from Peat An article on an experimental demonstration given recently in London of a process for removing water from peat by electricity, which was noticed in the Digest last week. This writer is also very sceptical concerning the prospects of this process. Incidentally, it is mentioned that the importance of the problem is indicated by the fact that there are 2,830,000 acres of peat bog in Ireland, of which area the red bog occupies 1,576,000 acres, and has a depth of 25 ft. Lond. *Elec. Rev.*, November 13.

Schwerin.—A paper read before the International Congress for Applied Chemistry on the application of the principle of electric endosmosis to the problem of removing water from peat bog. If a cell is divided by a stationary porous diaphragm into two parts, the phenomenon of endosmosis consists in a bodily transfer of liquid from one side of the diaphragm to the other. When, on the other hand, the diaphragm is movable, the liquid will remain at rest, and the diaphragm will move in a direction opposite to that of the liquid in the former case. Peat bog represents such a porous diaphragm. The author performed the following experiment: A perforated metal basket was suspended and connected as the cathode of an electric circuit. Wet peat bog was placed into the basket and the anode was suspended at the top of the peat. As long as the circuit is not closed, the peat does not lose any of its water, since it is held in its pores by capillary action. But when the current is turned on, the water begins to percolate through the wire basket. Not all the water can be removed by this method, nor are data given concerning the cost of the process, which, however, is based on a correct principle.—*Electrochemical Ind.*, December.

REFERENCES.

Steam Turbine.—An illustrated description of a 1,500-kw vertical shaft Curtis steam turbine, with a description of its main features.—Lond. *Elec*, November 20.

Traction.

Fire-Proof Cars on the Central London Railway.—A description of the make-up of the experimental trains which comprise two motor cars and four trailers, and which have been on trial on the Central London Railway for eighteen months. They have now been adopted as standard, although it is probable that seven-car trains will be run instead of six-car trains, an additional trailer being attached. The most interesting feature of the equipment is the special motorman's compartment, which is a self-contained steel structure placed over the motor trucks to accommodate the electrical equipment. The framework of this compartment is bolted to the framework of the car body, and is fire-proof in every particular. It is essentially a sheet steel structure. A sheet of uralite or asbestos is used to cover the rear partition between the motorman's compartment and the body framing, and the floor of the cab is composed of cast-iron plates, except on the front platform, the plates being hinged to give access to the motors. The master controllers, contactors, reversing switches, resistances and other apparatus are carried on the platform of the motor cars, the contactors being inside the cab and the reversing switch and rheostats arranged below them. The switches and fuses for the main motor circuit, controller circuit, lighting and air compressor circuits are arranged on the slate panel, the motor circuit connections being a bare copper rod, while those of the controller circuits are of asbestos-covered wire.—*St. R'y Jour.*, November 7.

REFERENCES.

High-Tension Direct-current Thury System for Traction.—Soulier.—A full illustrated description of the La Mure electric railway, operated by the Thury system with 2,400 volts between the trolley wires, or 1,200 volts between each trolley wire and the rails, which serve as neutral, as already recently noticed in these pages, and in the Digest.—*L'Industrie Elec.*, November 10.

Dunedin Tramways, New Zealand.—A description of the progress made in the work of installing the electric tramway system at Dunedin, New Zealand. The car house is completed and ten cars have been equipped and are ready for operation. A temporary steam plant has been installed, comprising water tube boilers and three engine-driven generators of 200 kw capacity each. This will be supplanted eventually by a water power plant.—*St. R'y Jour.*, November 7.

Installations, Systems and Appliances.

British Central Station. Pontifex.—An illustrated description of the Isle of Thanet Electric Tramways & Lighting Company's system. The power house contains two 300-kw, 2,500-volt, three-phase generators, two 200-kw, 500-volt, direct-current generators, and one 100-kw synchronous converter with three transformers. The battery consists of two sets of 265 Tudor cells with a capacity of 280 amp.-hours, if discharged to a minimum voltage of 490, with a maximum discharge rate of 72 amp.; the maximum charge rate is 40 amp. The three-phase currents are transmitted to two synchronous converter substations. The traction system comprises at present 10 miles of double track and 1 mile of single track.—Lond. *Elec. Eng.*, November 20.

REFERENCE.

High-Tension Switches.—The first part of an article illustrated by diagrams, in which a summary is given of the various constructions by German manufacturers of high-tension switches. They are mainly based on the principle that in order to avoid sparking at the main contacts, a secondary contact point is provided in shunt with the main contact. Different forms of the well-known horn type of switch are described in which, when one or the other horn is moved, the arc betwoeen is made to move upwards until it breaks. The present installment deals with circuit-breakers actuated by hand. In a continuation of the article automatic circuit-breakers will be described.—*Elek. Anz.*, November 19.

Electro-Physics and Magnetism.

Capacity of a Vacuum Tube in a Magnetic Field.—Lopuchin and Afanasieff.—An account of experiments in which they studied the variation of capacity undergone by a vacuum tube in a magnetic field. They found that there is a close correspondence between luminosity and capacity. They used Borgmann's method for the determination of very small capacities, and compensated the capacity of the vacuum tube by means of two burettes containing mercury. They used a string interrupter which was kept going at a uniform rate by controlling the note emitted by it. The axis of the tube was placed either parallel or perpendicular to the lines of magnetic force. In the first case, the capacity was perceptibly diminished by exciting the magnetic field, whereas in the second case it was strongly increased. The luminosity changes in a corresponding manner. As long as the tube is not luminous the capacity of the tube is constant. The capacity of the electrodes alone is then brought into play. The capacity of the tube is a maximum at a pressure of 1 mm. At about 0.05 mm. it suddenly falls, and the luminosity disappears at the same time. The magnetic effect is strongest at pressures at which the cathode rays begin to appear. At a pressure of 0.07 mm. the magnetic field simply extinguishes the light, if the position of the tube is axial. With an equatorial field, the maximum magnetic effect occurs at a pressure of 5 mm. At very high vacua, when the tube remains quite dark, the magnetic field always increases the capacity of the tube.—From *Phys. Zeit.*, November 1; Lond. *Elec.*, November 20.

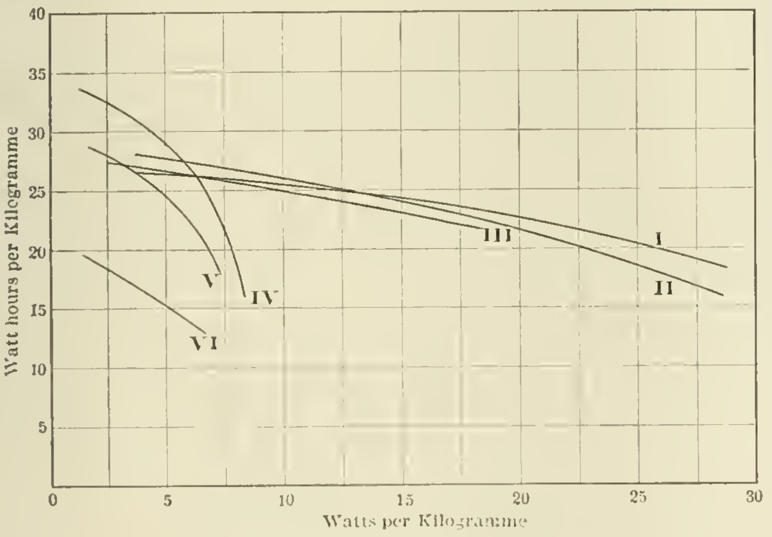
Magnetic Manganese Alloys.—Hensler.—An account of measurements showing that alloys, made from practically non-magnetic metals, may be magnetic. The best results were obtained with a copper alloy containing 26.5 per cent. of manganese and 14.6 per cent. aluminum, i. e., manganese and aluminum in nearly atomic proportions. This alloy showed an induction of several thousand units in fields ranging from 20 to 150 units. A considerable improvement was obtained by keeping it at 110° C. in boiling toluol for two days; the induction was then 4.500 units in a field of 10 units and 5,500 in a field of 150 units. When the percentage of aluminum was reduced to 3.6, the alloy ceased to be magnetic. Similar results, although not so good, were obtained with tin instead of aluminum. Arsenic, antimony, bismuth and boron also yield magnetizable alloys.—From *Verh. Deut. Phys. Ges.*, June 12; Lond. *Elec.*, November 6.

REFERENCE.

Conductivity of Selenium.—VAN AUBEL.—An account of experiments in which he found that besides being subject to variation by light and by Röntgen rays, the conductivity of selenium is also affected by rays emitted by hydrogen peroxide, by essence of turpentine and by certain bodies (like india rubber and camphor) after they have been exposed to the action of ozone.—From *Phys. Zeit.*, November 1; Lond. *Elec.*, November 20.

ELECTRO-CHEMISTRY AND BATTERIES.

Edison Accumulator.—HOSPITALIER.—An account of a series of tests which he has made with the Edison nickel-iron storage battery, simultaneously with other tests made by the Central Laboratory of Electricity in Paris. He made a series of 21 charges and discharges, partly under so severe conditions that a lead cell would have been put out of service, while the Edison cell was not hurt. In the twelfth discharge the cell was discharged nearly short-circuited, but had in the thirteenth discharge, two days later, nearly the same capacity; and the same was the case in the fourteenth discharge, more than three weeks later, the battery having remained at rest in a charged condition during this time. From his tests and those of others he concludes that the Edison battery can be used with charge and discharge rates which would be excessive for the lead cell, while the Edison battery is not hurt, nor does it lose any considerable amount of capacity. From curves, given by the author, it appears that the ampere-hour capacity was about 175, 162, 160, 155 for discharges at 30, 60, 90, 120 amp., respectively. The difference between the mean voltage at the terminals for discharges at 30 and 120 amp. was less than 0.2 volt. The durability of a storage battery is indicated by the total energy given by the battery during its life per kilogram of its weight. The best lead cell, tested in the accumulator tests of the French Automobile Club in 1899 gave 1.5 kw-hour per kg. (Fulmen cell). The tests of the Edison battery have shown that it has a capacity at least twice as great. The disadvantages of the Edison cell are its higher price and the fact that its useful voltage is about 1.1, against 1.9 for the lead cell. This means more cells, more connections, etc. The efficiency of the lead cells in the Automobile Club tests, for the low charge and discharge rates used, was between 70 and 75 per cent. The efficiency of the Edison battery, when charged at 60 amp. and discharged at varying rates, was 50 per cent. The author states, however, that this superiority of the lead cell is only apparent, since a fair comparison would require equal rates of charge and discharge. The adjoining diagram gives some curves which are characteristic for the Edison cell and show its adaptability to automobile purposes, especially the possibility of its use with high discharge rates. The curves give the watt-hours per kilogram as function of the watts per kilogram. IV, V, VI are the curves for lead cells (Contal. Fulmen, Blot-Fulmen, respectively), while I, II, III are curves for the Edison battery, as determined by three different experimenters. The difference in the appearance of the two sets of curves is very pronounced and shows that the Edison battery can be worked at very wide limits of discharge rates, utterly impossible with the lead cell. The volume of the Edison cell per normal watt is smaller than that of the lead cell; the volume per watt-hour, however, is greater. The author concludes that the Edison accumulator represents an important and incontestable advance for electric automobile purposes, and that its advantages assure to it numerous applications.—*L'Industrie Elec.*, November 10.



DISCHARGE CURVES OF EDISON CELLS.

Electrodeposition of Aluminum from Aqueous Solutions.—MCDERMOTT.—A communication in which the author gives a solution for the deposition of aluminum not hitherto used. This is made by dissolving metallic aluminum in a solution of ordinary copper sulphate. A reaction takes place between the aluminum and the monohydrated sulphate, with the result of a precipitation of copper and the formation of a soluble basic aluminalum salt. The solution is ready for use when the precipitation of the copper is complete, the liquid then being clear and the solution tasting strongly of alum. The deposition is of a dull lead color on the surface, but takes the characteristic color of aluminum under the buffer. If the current is too strong or the cathode too small, the deposit will consist of an impalpable lead-colored powder. During the deposition gas is evolved at both plates, from which it must be removed by jarring the plates. On standing unused the solution deposits white aluminum hydroxide and is apparently changed into the normal sulphate, from which as well as from the chloride and acetate, the metal will not deposit except as the hydroxide or as a fine gray powder. An e.m.f. of about two volts is required for the process. A part of the metal may be deposited as a powder and part in the compact form at the same time.—*Am. Elec.*, November.

Copper, Nickel and Zinc from Chloride Solutions.—KOEHLER.—The conclusion of his long and fully-illustrated article on the development of the various electrometallurgical methods for producing copper, nickel and zinc from chloride solutions. This installment deals mainly with the processes of Hoepfner and Browne and with the developments at Hamilton (Frasch process).—*Electrochemical Ind.*, December.

Iron and Steel in the Electric Furnace.—GOLDSCHMIDT.—An illustrated translation of his paper read before the International Congress for Applied Chemistry on electric furnace processes for iron and steel. Very complete information is given on the Stassano process, and some information also on the processes of Keller, Heroult and Kjellin.—Lond. *Elec.*, November 20.

Endosmosis.—BREDIG AND SCHWERIN.—Two papers, read before the International Congress for Applied Chemistry. The paper by Bredig deals with the theory of electric endosmosis and its application to colloidal solutions. The paper by Schwerin deals with the application of endosmosis to removing water from peat bog, an abstract of this paper being found under "Power."—*Electrochemical Ind.*, December.

Theory of Colloidal Solutions.—PERRIN.—An article in which the author puts forward the theory that every colloidal solution is made up of granules, invisible in the microscope, but much more bulky than the molecules, and charged electrically. The author traces the development of these granules from the first conglomeration of atoms.—From *Comptes Rendus*, October 12; Lond. *Elec.*, October 30.

Course in Electrochemistry.—TUCKER.—An illustrated article in which the author gives laboratory notes on exercises in practical electrochemistry, which were prepared for use in the electrical engineering department of Columbia University, to give the students familiarity in the practice of electrochemistry, and particularly in the use of the electric furnace. General instructions are given and partly illustrated by diagrams.—*School of Mines Quart.*, July.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Capacities as Multipliers for Electrostatic Voltmeters.—BENISCHKE.—A communication referring to the recent paper of Marchant & Worrall (Digest, October 24). The principle of using low-reading static voltmeters for high-tension measurements on alternating-current circuits, by connecting two condensers in series across the circuit and connecting the voltmeter in shunt with the larger condenser, has been used for two years by the Allgem. Electr. Ges., of Berlin, which manufactures apparatus for this purpose up to 40,000 volts. With higher voltages, however, not two, but three or four condensers in series, are employed.—Lond. *Elec.*, November 20.

New Books.

A HANDBOOK FOR THE ELECTRICAL LABORATORY AND TESTING ROOM. By J. A. Fleming, D.Sc., F.R.S. Volume II. London: *The Electrician* Printing and Publishing Company, Limited. 622 pages, 188 illustrations. Price, 14 shillings.

This is the second and completing volume of a work, the first volume of which appeared in 1901. It deals with the measurement and tests of electric quantity, energy, capacity, induction, photometry, magnets and iron, dynamos, motors and transformers. These subjects are considered in five chapters.

The book is excellently adapted for text-book service, and for a volume of reference in electrical laboratories. It is also modern and up to date. The descriptions are distinct and the type is clear. The mathematical treatment is also excellent, the author's ability in this direction being well known. The notation and symbols employed appear to be mainly in conformity with the international system, for which much praise is due. Thus, current strengths appear under the symbol I, which is international, although occasionally they appear under A, which is uncanonical.

An unfortunate definition appears in the chapter on magnetic testing. Here the C.G.S. unit of magnetic flux is named a "line," although the nearly universal international usage calls it a "maxwell," following the resolutions of the Paris International Electrical Congress of 1900. Moreover, 10^8 C.G.S. units of magnetic flux are named one "weber," which is an unfortunate name, and an unfortunate magnitude, naturally leading to the use of the earth quadrant as the unit of length in magnetic equations.

There is a good bibliographical list at the end of each chapter. The book deserves to be found in every electrical laboratory, and to be studied by all students of electrical testing.

CALENDAR OF INVENTION AND DISCOVERY. By John Cassan Wait. New York: McGraw Publishing Company. Cloth, illustrated. Price, $1.00; Wall Calendar, price, 60 cents.

This is a remarkable little book, if book it can be called, although that word seems as much a misnomer as calendar. It is in reality an encyclopedic epitome of scientific biography, and the scope and range of it can perhaps be best explained by taking some one individual day or topic. This again is difficult, as, for example, taking the subject of telegraph, we find it referred to under no fewer than 30 different dates. Taking the page devoted to April 27, we find it devoted in part to Prof. Morse, who was born on that day, 1791. There is a brief biographical sketch and the date of his death. There is also a poetical quotation from Lowell on the telegraph, and other pithy little citations of verse. This is a very neat little treatment of the subject. On the same page, however, appears Andronicus, the Grecian architect. This again has a citation from Lowell and a number of references to architectural achievements. There is no particular reason why Andronicus should be assigned to this day, but the material fills out the page interestingly. Five minutes each morning can be spent to advantage running one's eye over such text. Under February 11 we have a neat little biographical sketch of Edison, who was born on that day, 1847, and of William Kelly, the iron and steel inventor, who died February 11, 1888. There are two poetical quotations accompanying these biographies and on the opposite page are two illustrations, one of which shows Edison in his laboratory contrasted with a philosopher in his laboratory of the old school.

As a general thing, the page opposite, or back of the calendar page, is left blank for notes, and the type is printed vertically, up and down, the page in two columns, instead of across, horizontally. The matter thus presented for hundreds of individuals and hundreds of inventors is in remarkably compact shape and evinces an incredible amount of intelligent research and application. Moreover, it is easy to find any particular reference as there are four separate indices; one of illustrations, one of poetical quotations, one of persons, and one of topics or inventions. This little book, therefore, is not only a very excellent thing to have in one's own possession, but a timely and appropriate gift at this season of the year for anyone devoted to scientific or mechanical pursuits. We doubt if Mr. Wait can ever recoup himself for the time and thought expended on it; but it should enjoy a large circulation, either in the book form or in the wall calendar form, the price of which is equally reasonable.

New York Electrical Trades Society Annual Meeting.

The annual meeting of the New York Electrical Trades Society was held at the Arena, New York City, on the evening of December 8, when there was a large attendance. This useful body is continuing to do excellent service in a quiet and unobtrusive manner, and the reports of the secretary and treasurer both showed the Society to be in a flourishing condition, with steady accessions in membership. Mr. Frederick Vose, secretary of the National Credit Association of the industry, was present from Chicago and addressed the meeting in regard to the advantages secured by the Society's work, and the proposed new branches to which effort might be directed. The following directors were then elected for the ensuing year: Messrs. Reed, Bonnis, Schwartz, Gorman, Marshall, Dale, and Gallaher. Owing to the lateness of the hour, the election of officers did not take place, but it is understood the present list will be re-elected. Mr. R. E. Gallaher was again chosen, for the seventh or eighth time, as delegate of the Society to the National Electrical Credit Convention, at which all the cities or centers are represented.

After the regular business an admirable dinner was served by Muschenheim, at which not less than 50 or 60 sat down. The table was dressed with flowers and illuminated prettily with incandescent lamps, and the arrangements reflected great credit on Messrs. Gallaher and Dale, who organized the affair. President H. A. Reed took the chair and after dinner opened with some pertinent remarks. Mr. Wheeler, representing the credit clearing house, of Chicago, presented the plan of a most intresting scheme for imparting information to members regarding credits. He was heard with deep attention. Mr. E. Ward Wilkins, of Philadelphia, made a felicitous and amusing speech, and timely remarks were also made by Messrs. F. Vose, T. C. Martin and R. E. Gallaher. Altogether a most enjoyable and profitable meeting was had, and the first dinner was such a success it is certain the event will become an annual fixture. Secretary Eckert and the other officers received many congratulations.

Telephone Convention Exhibits.

By Special Telegram.

The exhibits at the Independent Telephone Convention in Chicago, December 8, 9 and 10, were under the direction of Mr. C. E. Tripp, of the Auditorium Hotel. The following concerns exhibited apparatus, etc.:

THE AMERICAN STONE CONDUIT COMPANY was represented by G. Painter and W. W. Smythe.

FRANK B. COOK TELEPHONE ACCESSORIES were represented by B. B. Cook, J. Cook, R. Roy Cook, F. A. Parker and C. E. White.

CHICAGO NUT COMPANY was represented by C. F. Hessinger.

KELLOGG SWITCHBOARD & SUPPLY COMPANY was represented by W. W. Dean, chief engineer; A. E. Barker, sales manager; F. J. Dommerque, special representative; P. W. Bossert, St. Louis representative; H. N. Ferris, R. H. Manson, W. J. Gunn, G. L. Ainsworth, W. R. Hines, G. H. Lutz, C. B. Forest, H. E. Krause, R. S. Mueller, A. B. Kratz.

THE AUTOMATIC ELECTRIC COMPANY was represented by H. D. Critchfield, J. F. Crook, H. S. Durant, F. Lucia, H. D. Ogden and W. E. Cook. The exhibit was unusually interesting, as showing the automatic telephone outfit connected with the Chicago automatic exchange, and also part of the 10,000 exchange in operation.

THE VALENTINE CLARK COMPANY was represented by E. L. Clark, F. L. McGillan, and showed photographs of pole yards.

THE MILLER ANCHOR COMPANY was represented by President G. H. Miller and F. B. Miller, vice-president, with a line of Miller anchors for poles and augers.

THE ALLEN HUSSEY COMPANY interior telephone system was represented by President C. J. Huff and Secretary-Treasurer J. F. Boland.

THE NICHOLAS SELECTOR COMPANY, of Rochester, N. Y., represented by C. E. Nicholas, exhibited its party line selective device for rural service.

THE WESTERN TELEPHONE MANUFACTURING COMPANY was represented by Mr. J. E. Keelyn, manager; Mr. W. G. Peacock, engineer; and Mr. E. Schwartz. The company distributed small jacks and cord on pins as souvenirs.

THE INDIANA STEEL & WIRE COMPANY was represented by R. Miller, the secretary and sales agent, and E. F. Kitselman, general manager.

WARNER ELECTRIC COMPANY, Muncie, Ind., was represented by Mr. F. W. Warner, in behalf of his pole changer.

THE CHICAGO TELEPHONE SUPPLY COMPANY, of Elkhart, Ind., was represented by Messrs. G. A. Briggs and B. L. McCoy.

THE GENERAL ENGINEERING COMPANY, E. W. Hammer, president, and H. J. Minhinnick, secretary, showed photographs and plans of plants constructed.

NEW HAVEN NOVELTY COMPANY, H. Grant Thompson, treasurer, and Charles Luke, manager, made an exhibit of its brass splicing sleeves, potheads, etc.

Chicago Writing Machine Company, R. E. Hill, general manager, and F. W. Pardee, corresponding secretary, had an exhibit of the adjustaphone.

Robert Watson, of Menominee, Mich., was represented by M. E. Brown and A. D. Watson, who had a miniature representation of a pole yard.

Monarch Telephone Manufacturing Company was represented by W. H. Trimm, sales manager, and J. C. Hubacher, secretary, as well as C. E. Yaxley, general manager. The exhibit included some interesting special features, such as transmitters working in water. One of the instruments had gone through fire at Webster City, and one through flood at East St. Louis.

National Wire Company, of New Haven, Conn., was represented by Mr. R. B. Abbott, Chicago sales agent, who made demonstrations with the wire meeting Western Union standard requirements.

Crouse-Hinds Company, of Syracuse, N. Y., were represented by Mr. F. F. Skeel, Western manager, who showed a new guy anchor and method of installation.

Moon Manufacturing Company were represented by Mr. H. E. Procunier, manager.

Mr. F. H. Wood showed a line of terminal leads.

Chicago Die and Electrical Company was represented by Mr. M. L. Bowker, with a line of electrical fuses.

Vesta Storage Battery Company was represented by Mr. D. P. Perry, vice-president.

Eureka Electric Company was fitly represented by President I. J. Kusel and Messrs. H. K. Kusel and H. Rosenow.

McRoy Conduits were, as usual, spoken for by E. F. Kirkpatrick.

Elliott Addressing Machine Company was represented by Mr. R. St. John.

Signalphone Company, of Milwaukee, was represented by Superintendent E. E. Salisbury and R. R. Rogers, salesman.

H. B. Camp Company was represented by Mr. J. A. Hammett, sales agent.

Gordon Battery Company, of New York, was represented by Mr. E. M. Deems, Western agent.

Williams-Abbott Electric Company, of Cleveland, was represented by President L. Sands and J. A. Wright.

W. J. Barr Manufacturing Company, of Cleveland, was represented by President W. J. Barr and L. J. Lebornew, in the transmitter arms.

Fulmer, Kuester, Schroeder Company was represented by D. M. Fulmer, J. W. Fulmer and H. C. Miller, who had small cedar poles with cross arms placed in the halls and in the room.

Central Telephone & Electric Company was represented by J. S. Cumming, president; C. H. Wallace, vice-president; W. F. Gradolph, engineer.

W. H. Anderson & Sons were represented by W. R. Anderson and T. H. Tapp.

Stround Telephone Specialty Company was represented by H. D. Stround.

North Electric Company, of Cleveland, had an exhibit, including photographs of work installed. It was represented by C. H. North, president; R. Hendrickson, G. B. Pratt and F. F. Saff.

Standard Underground Cable Company was represented by J. R. Wiley.

Sterling Electric Company, Lafayette, Ind., gave away miniature telephones as souvenirs. It was represented by W. E. Doolittle, president; H. A. Taylor, vice-president and secretary; S. B. Fowler, electrical engineer; H. S. Bullock, superintendent; H. T. Doolittle, purchasing agent; Evan Shelby, sales manager; K. V. Murry, traveling representative; G. W. Metcalfe.

F. Bissell Company, of Toledo, O., was represented by W. S. Bissell, M. S. Walker and E. B. Terry.

Illinois Electric Company was represented by M. McNeill, Jr., and C. J. Litscher, who distributed souvenirs of a healing nature.

Kester Electric Manufacturing Company was represented by A. J. Witherell, president; F. G. Dickerson, manager, and J. E. Goodman.

Nagel Collins Manufacturing Company exhibited a line of enclosed fuses.

Among the companies present not making an exhibit were the Western Lumber & Pole Company, of Denver, B. F. Vreeland, president; the Maltby Lumber Company, handlers of Michigan white cedar poles, etc., represented by E. E. Reynolds; Lindsley Bros.' Company, represented by E. A. Lindsley and J. A. Navarre; Elmore, Fowler, Jacobs Company, J. H. Fowler president, E. Elmore, secretary; National Carbon Company, M. B. Moffett and F. W. Ward; F. B. Badt Company, F. B. Badt and G. M. Willis; Gould Storage Battery Company, E. L. Draffen; C. L. Peirce, Jr.; C. J. Huebel Company, Menominee, Mich., poles; Crawfordsville Wire Nail Company.

English Report on the Edison Storage Battery.

Some months ago we printed an abstract of the report from Mr. W. Hibbert, an English engineer, on the Edison storage battery, and we give below the principal points of a further report made by Mr. Hibbert

The standard automobile cell is of rectangular shape. It stands 13 in. high (over all) and measures 5.1 by 3.5 in. horizontally, the weight being 17.8 pounds. It contains 14 positive and 14 negative plates. Each plate is made of sheet steel, nickel-plated, punched with 18 rectangular holes. In each of these holes is inserted a flat pouch or pocket containing the active material. The walls of these pockets are perforated by exceedingly fine short slots, through which the liquid can penetrate. Thus the current can easily pass to and from the active material contained in the pocket.

Both positive and negative plates are alike, except in respect to the active materials. The pockets on the negative plate contain finely-divided iron, those on the positive contain peroxide of nickel.

The liquid is a 20-per-cent. solution of potash. This suffers no change during the action of the cell, except the loss of a small quantity of water, which is decomposed while the cell is being charged.

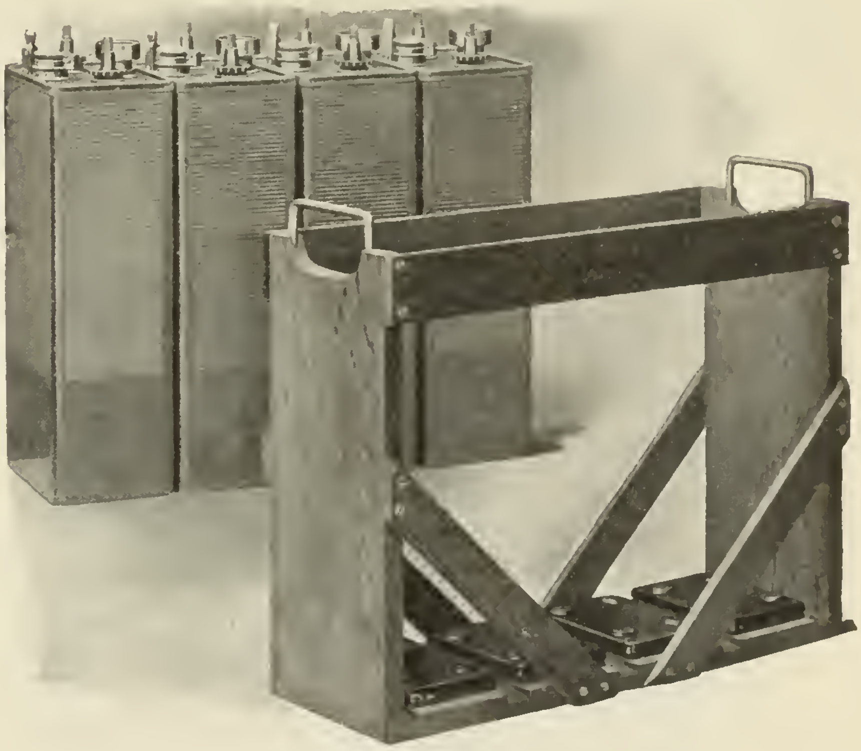


FIG. 1.—FOUR CELLS AND TRAY.

As an immediate consequence, a small quantity of liquid suffices. It is wanted simply to play the part of an electrolytic conductor, and in no way to provide active material in the ordinary sense. The plates may, therefore, be fixed very near each other, for the narrow intervening space allows a perfectly adequate supply of potash solution.

The proximity of the plates does not apparently involve danger of short-circuiting. The plates are thin, but being made of steel, their rigidity is exceptionally good. Mechanical stability is further assured by vulcanized rubber separators, the whole forming a compact mass calculated to resist all the ordinary mechanical shocks it is likely to undergo. Mr. Hibbert says that the only special mechanical difficulty which occurred to him was the chance that the gases evolved during a charge might eject some of the active material from the pockets. He therefore watched the pockets carefully, especially during very heavy charges, but without finding any evidence of loss.

The cell is sealed in its steel case. Two stout connecting pins (from the positive and negative plates, respectively) come through liquid-tight bushes of vulcanized rubber. These pins are made slightly conical, as are also the connectors which fit on them, and the mechanical finish and easy grip of this terminal add to the value of the battery. A further advantage lies in the fact that these connecting pins have a much higher specific conductivity than those of the ordinary type of accumulators.

On the top of the case (Fig. 5) there are also (*a*) a spring stopper, with rubber flange, covering a hole by which the electrolyte is introduced, or distilled water added from time to time; (*b*) a vent hole guarded by a gravity valve. This provides for the escape of the gas evolved during charge. The hole and valve are covered by a gauze nipple, which prevents escape of spray while allowing gas to pass.

The e.m.f. is 1.33 volt, and the internal resistance 0.0013 ohm. The output at 60 amp. is 210 watt hours, or at the rate of 11.8 watt hours per pound of cell. When the cell is examined as to discharging values its excellence becomes most pronounced. At high rates of discharge rising to many times the normal, it suffers no appreciable polarization, and therefore recovers its normal voltage almost instantaneously when the current returns to an ordinary value.

Discharge rate in amperes.	Time of discharge.	Output in ampere hours.	Per cent of the 30 ampere output.
30	5 hrs. 46 min.	173	100
60	2 hrs. 51 min.	171	99
90	1 hr. 51 min.	167	96.5
120	1 hr. 21 min	162	93.6
150	1 hr. 2 min.	154.5	89
200	42 minutes	142	82

The above table exhibits the actual and relative output of the Edison cell at varying discharge rates.

It is stated in the report that while some approach has been made to the above output of 11.8 watt-hours per pound of cell by special lead cells, the design has involved a very early fall of capacity and a rapid deterioration. If the specific output of the Edison cell is compared with that of the better class of lead cells made for traction purposes, it will be found that it is from 25 to 50 per cent. greater. Moreover, the output of the cell does not change during a run on ordinary roads amounting to 1,700 or 1,800 miles, while if the comparison were made after the two types of cells had been run over 1,000 or 1,500 miles, the superiority of the Edison cell would be very pronounced.

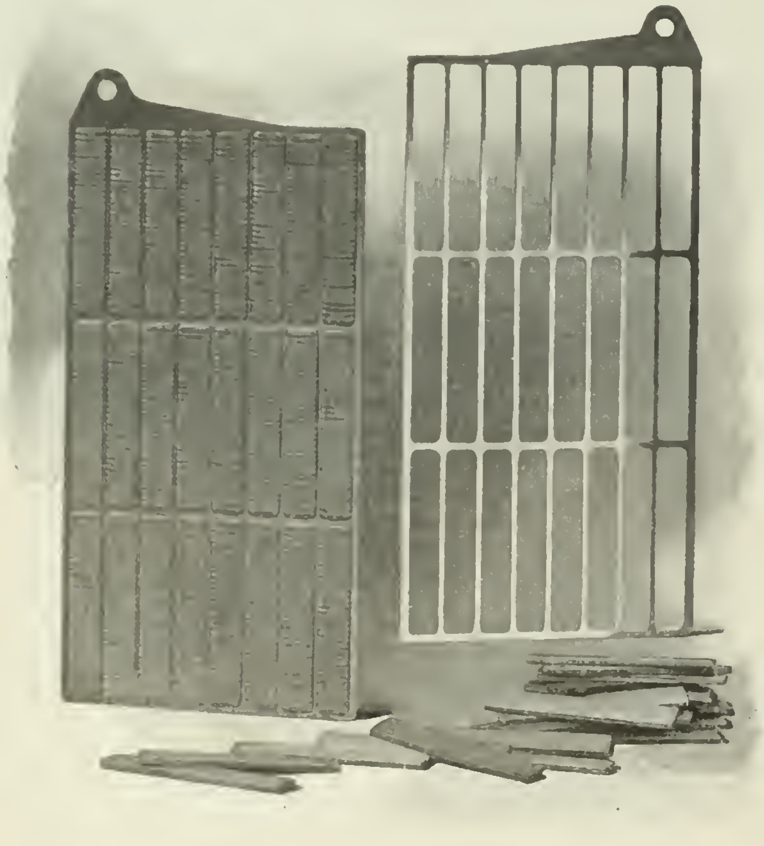


FIG. 2.—FINISHED PLATE, GRID AND POCKETS.

In some tests made by Mr. Hibbert the temperature arose to something like 53° C., partly by reason of high external temperature and partly because of the heavy current passing through the cell. It was found that the cells were not at all the worse for being exposed to such a high temperature. One of the smaller cells was short-circuited for 48 hours and after a subsequent lengthy charge it gave a discharge of somewhat less than normal, and after a second charge it had fully recovered. In order to ascertain the readiness with which the cell recovered from an excessive transient discharge (such as often occurs in traction work), discharges were alternated from 60 to 230 amp., a careful watch kept on the voltmeter to see how the cell responded to the variation in current. Recovery was practically instantaneous, the voltmeter coming back to its upper reading almost immediately.

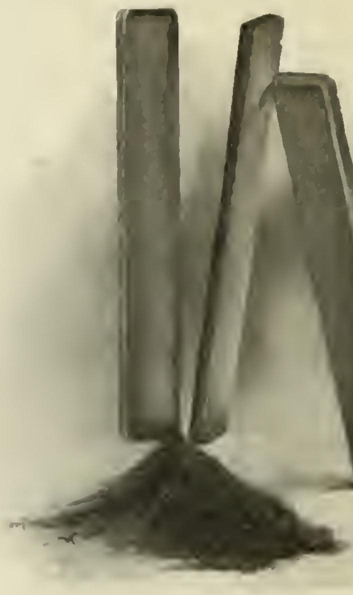


FIG. 3.—TWO PARTS OF POCKET WITH LOOSE ACTIVE MATERIAL, ALSO LOADED POCKET.

Tests were made at high discharge rates as follows: After charging for one hour at 177 amp., the cell in discharging gave 124 amp.-hours, or 70 per cent., of the charge; when charged at the rate of 150 amp. an hour, it gave 107 amp.-hours on discharge, or 71 per cent. of the discharge; and when charged at the rate of 205 amp. for one hour, on discharge it gave 142 amp.-hours, or 70 per cent. of the discharge. Experiments on excessive rates of discharge indicated that when the potential difference reaches the value .9 volt, it falls very rapidly with currents of ordinary value. If the discharge be kept up, the fall is arrested when the voltage reaches the value of about .5 volt, and the current flows steadily for some time at this

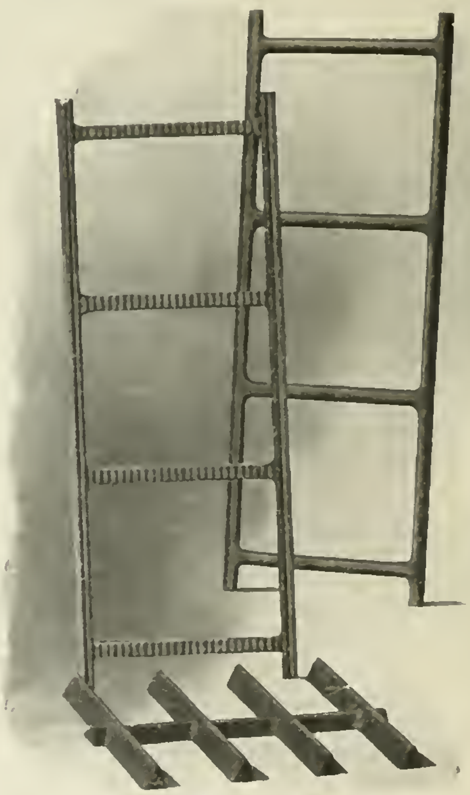


FIG. 4.—HARD RUBBER PLATE-SEPARATORS AND CELL INSULATING PLATE.

lower pressure. So far as Mr. Hibbert has been able to detect, there have been no injurious effects as a result of such low discharges; but here, as in the case of the short-circuited cell, there is need for subsequent excessive charging.

Experiments were made on the Edison cell both in a charged and discharged condition. The cell was discharged at 60 amp. immediately after charging, and gave 170 amp.-hours. It was again discharged with two days intervening between charging and discharging, the result being 150 amp.-hours, or 90 per cent. of the full discharge; part of the 90 per cent. deficiency was attributed to loss of current in the gases filling the pocket at the end of a discharging operation. The cell was again charged and put aside for 26 days when it yielded 124 amp.-hours. As to efficiency, at 30 amp., the watt-hour efficiency is about 66 per cent.; at 60 amp. it is about 60 per cent. and charged at 100 amp. and discharged at 60 the efficiency fell to about 50 per cent. Charged at the higher rate of 177 amp. and discharged at 60 amp., the efficiency was almost exactly 50 per cent.

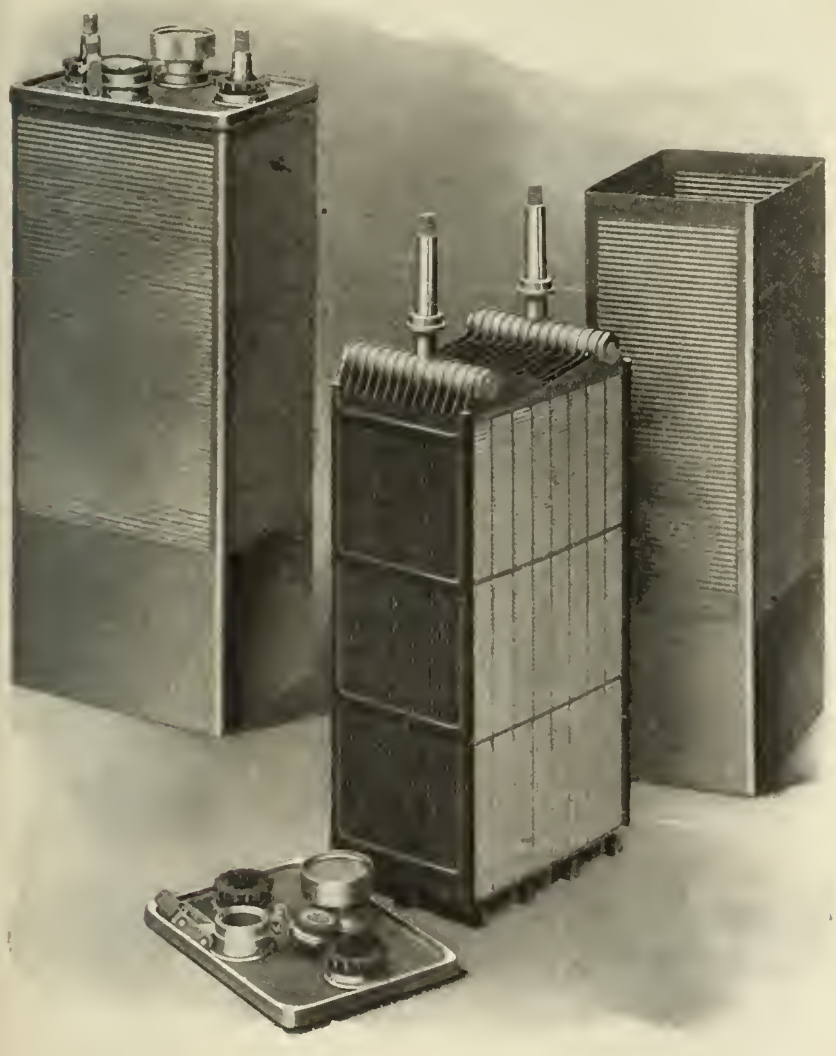


FIG. 5.—COMPLETE CELL, CAN, PLATES ASSEMBLED AND COVER.

The report gives an account of a lengthy trip in an automobile equipped with Edison cells. The total weight of the automobile with two people was 950 pounds and the 38 cells of the battery with their case weighed 700 pounds exactly. When the automobile was turned over to Mr. Hibbert it had already been driven about 400 miles with the battery. The run, which was made partly in France and partly in England, extended from August 29 to September 29, the total distance being 507 miles, and the daily runs varying from 29 to 77½ miles.

Before starting on the journey the battery was discharged and yielded 159 amp.-hours, and observations of the ammeter during the various runs led to the conclusion that about 150 amp.-hours were delivered per charge. In one run, however, under very trying conditions as to weather and road, it was estimated that the output was at least 190 amp.-hours, in this case the latter part of the trip being made with very low battery voltage. The battery was recharged without difficulty the next day and no effect was noticed from the hard usage which it had received. On one of the days the battery ran down until the voltmeter showed .75 volt per cell, and was then charged for one hour at 150 amp.; the subsequent discharges on the road gave 107 amp.-hours, which is 71 per cent. of the charge, the distance run having been 32 miles. Another case of one hour's charge of 186 amp.-hours was followed by a run of 31 miles and a discharge of 134 amp.-hours.

The experiments at one time were interrupted and the automobile put aside for ten days with the battery discharged; at the end of that time it was charged 44 minutes at about 200 amp. and 16 minutes at about 120 amp., making a total of 180 amp.-hours in one hour. The automobile then covered 31 miles, yielding 134 amp.-hours, or giving an efficiency of 72 per cent., the same figure that had been obtained in laboratory tests. During the work on the road, the capacity of the battery did not change. At Paris this was 159 amp.-hours, and at the end of the month the capacity was found to be 158 amp.-hours.

The report gives some instructions as to the care of the Edison battery. The cell should be refilled with water every five or six charges, and more frequent filling will be necessary if there is much overcharging. One important point brought out on the runs above referred to, was the excellence of the cell terminals. From the beginning to the end of the 500 miles of run not a single terminal was touched, and the terminals and connectors were not affected even when carrying a current of 200 amp. As to frothing, in three or four months of continuous working with Edison cells, frothing was only observed in one cell, and that only on two occasions, lasting less than one minute on each occasion. While on the road with the battery one or two cells out of the 38 frothed for a little while after being filled too full, but only for a few minutes. In several cases it has been found that where cells have been "touched up" with a bit of oily waste they froth; and oil and grease should be avoided even in small quantities, since they may easily lead to the formation of soap and speedily cause frothing. All colloidal bodies, including silicates, should be carefully excluded. As to the life of the Edison cell, the fact that in the run made the capacity had not been changed 1 per cent. after 500 miles gives reason for believing that the life of the battery will certainly not be short.

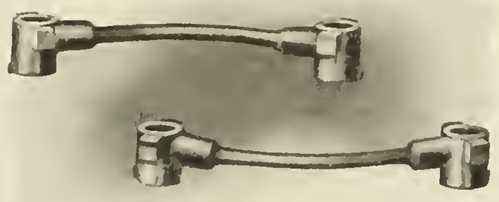


FIG. 6.—CELL CONNECTORS.

A peculiarity of the cells used in the experiments described is that they have an equal number of positive and negative plates, but Mr. Edison has recently altered this by assembling more positives than negatives in the cell. Both Mr. Edison's experiments and those of Mr. Hibbert have shown that the positive plates could not absorb all the oxygen contained in the negatives after discharge.

Long Distance Test of the De Forest Wireless Telegraph System.

On the morning of Saturday, December 5, a test was made between Fort Wright, New London, and Fort Schuyler, N. Y., a distance of about 100 miles, by the De Forest Company on behalf of the government. Three messages of about thirty words apiece were sent by General Greely, of the United States Signal Corps, from Fort Wright to Captain Reber, at Fort Schuyler. The particular interest of the test lies in the fact that certain conditions were imposed which made it very difficult to send a distance of 100 miles; namely, the height of the antennæ at the two stations was limited to 140 ft., and the power at the sending end to 3 kw. With such short antennæ and small power the sending of messages over this distance is an indication of the efficiency of the De Forest system.

The government is erecting two stations in Alaska about 100 miles apart, and General Greely wished to satisfy himself that messages could be transmitted over this distance under the conditions stated. Among those present at Fort Schuyler during the making of the test were General Greely and Captain Wildman, of the Signal Corps, and Dr. Ives and Mr. Athearn, the operator of the De Forest Company. At Fort Schuyler were Captain Reber, of the army, and Messrs. Easton and Hughes, operators of the De Forest Company.

New Integrating Wattmeter for Alternating Current Circuits.

The Westinghouse Electric & Manufacturing Company is now manufacturing an integrating wattmeter, called "Type A," which contains some new features in wattmeter construction, designed to give the greatest degree of accuracy, permanency of calibration and convenience in installation. In general the principles upon which it is constructed are the same as those formerly employed, the changes consisting in the addition of new, and the improvement of old, functions without displacing any of the characteristics which have become well known to the users of Westinghouse wattmeters.

One of the advantages claimed for Westinghouse wattmeters is the small amount of friction in the moving element due to its light weight and careful adjustment. In the new type this friction is still further decreased by the introduction of a highly polished steel ball in the bearing upon which the measuring disc rotates, shown at *C* in Fig. 2. The shaft to which the disc is fastened rests perpendicularly upon the ball, a cupped sapphire jewel with which the shaft is tipped forming the contact with it. A similarly cupped jewel is set into the end of the adjusting screw, which forms the lower half of the bearing, and the ball rests in the hollow between the two cups. The radius of the cups is greater than that of the ball, and the contact surfaces are thus made extremely small.

There are several advantages gained by the use of the new bearing. In the type generally used, containing a steel pivot, which rotates on a jewel, the pivot usually shows wear before the jewel is affected. In the new cup and ball bearing, the wear is distributed over the entire surface of the ball and is inappreciable, the high polish of the latter remaining unimpaired after long usage. There is also a lessened wear upon the jewels, as in this bearing there are two points of contact instead of one, and the wear is equally divided between them. If one of the jewels were destroyed and all of the additional benefit gained by introducing a ball thus nullified, it would still equal in efficiency the old style pivot bearing.

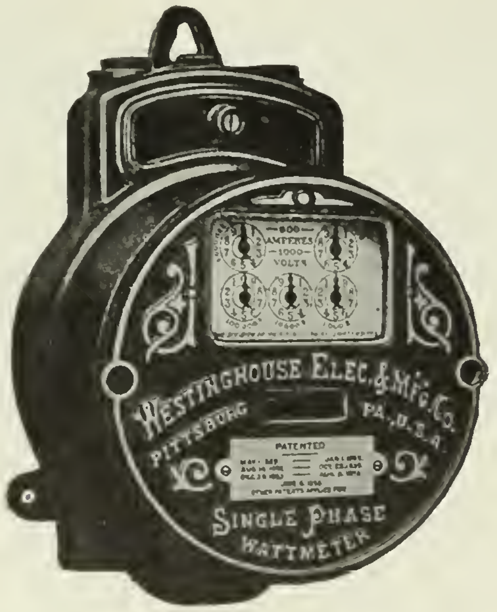


FIG. 1.—INTEGRATING WATTMETER.

An additional advantage is gained by the slight orbital motion of the ball, which gives a rolling instead of a rubbing contact with the jewels, eliminating scratching of the surfaces. Vibration or shock from jarring the wattmeter simply cause the ball to roll in the bearing. The extremely low friction loss permits a delicacy of adjustment and affords a sensibility to small currents otherwise unequaled, and of particular value when installations are running under light loads, a condition existing in the average plant the greater part of the time.

In this type of wattmeter there is a higher ratio of torque to friction and a greater torque per unit of weight in the moving element than in any other. This is gained by securing a high degree of efficiency in the magnets, and by reducing the weight and friction in the moving element as much as possible. To raise the torque by increasing the induction in the magnets is to incur a greater error through variations in frequency, voltage, wave form, power factor, etc. The proportions are, therefore, so arranged as to minimize the effect of such variations. A high torque secured, however, by increasing the weight of the moving parts increases the danger of jewel trouble, a source of much annoyance in wattmeters whose moving elements are heavy. In the new type the rotating disc and shaft weigh only about half an ounce, and the ball bearing still further increases its light running qualities.

If, in the course of long service, the wattmeter slows down on light loads, it can usually be restored to its normal efficiency by cleaning the ball and cup bearing, the wear not being sufficient to injure the polish of the surfaces. If this does not entirely remedy the trouble, the original calibration can be restored by means of a sliding contact, shown at *A*, Fig. 2, so placed on a high-resistance wire that altering its position varies the current in the shunt field and the compensation for friction on light loads. This provides an exceedingly simple and reliable friction compensation and one which can be manipulated by the purchaser.

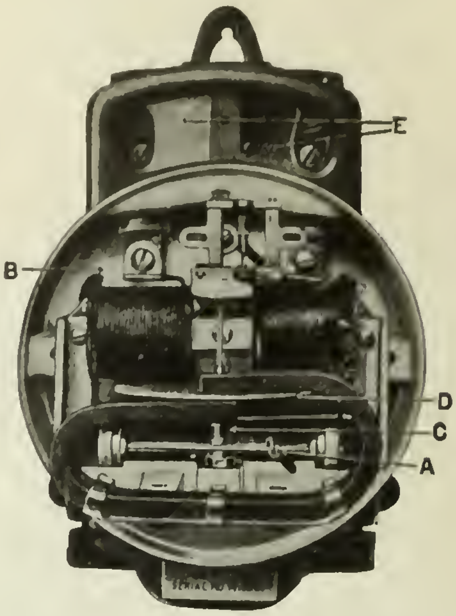


FIG. 2.—INTERIOR VIEW OF WATTMETER.

The wattmeter adjusted for 133-cycle circuits is provided with an open loop, which can be connected and soldered in order to secure a readjustment for 60 cycles. Thus, if at any time an installation using a 133-cycle system is changed to the lower frequency, the wattmeters in use can be readjusted by means of the frequency and compensating adjustments shown in Fig. 2 at *B*, and the purchase of new wattmeters made unnecessary.

The adaptability of the new type is still further demonstrated by the fact that a wattmeter rated for 100 volts can be used without appreciable error upon a 50-volt circuit without any change whatever. This feature is of manifest advantage in providing wattmeters for installations using 50-volt currents, which will later be raised to the higher e.m.f.

The adoption of front connections adds to the ease with which the wattmeter may be installed or removed. The wires pass through the top into a terminal chamber, shown at *E*, Fig. 2, the lid to which is fastened at the front. The cover to the wattmeter is also secured on the front by two screws, which pass through to the back, and can be removed without detaching or disconnecting the wattmeter. The cover is sealed with wax before shipment and the terminal chamber is secured by a lead seal at the time of installation.

The wattmeter combines, in fact, the sturdiness of a field instrument with the delicacy of a piece of laboratory apparatus. It is shipped with all parts in operating position and fully adjusted, and with the case securely sealed in order that the original calibration and adjustment may remain undisturbed. Wattmeters having heavy moving elements, which must be removed from the bearing in shipment in order to protect the jewels, have no such advantage, for after the lineman has made the connections, a meter expert must remove the fastenings from the moving parts and make the adjustments. This makes the installation more expensive, and gives a greater liability of error in adjustment, since a higher accuracy cannot be secured by a man hampered by inconvenient locations, insufficient light and all manner of hard conditions. The expert work on the wattmeter is done at the factory, and any man who can make the connections properly can install it.

The Reid Fuel Gas Battery.

Mr. James H. Reid gave a public demonstration at Newark, N. J., December 2, of a battery which is claimed to solve the problem of electricity direct from fuel. Briefly, the method consists in conducting a fuel gas into a porous receptacle pervious to gas, but impervious to liquid; maintaining a heated liquid electrolyte at the opposite face of said receptacle; supplying oxygen to the heated electrolyte, and providing conductors for the developed electricity from the porous receptacle and from the liquid electrolyte. Minute subdivision and slow oxidation are said to be the conditions upon which the operation of the cell depends.

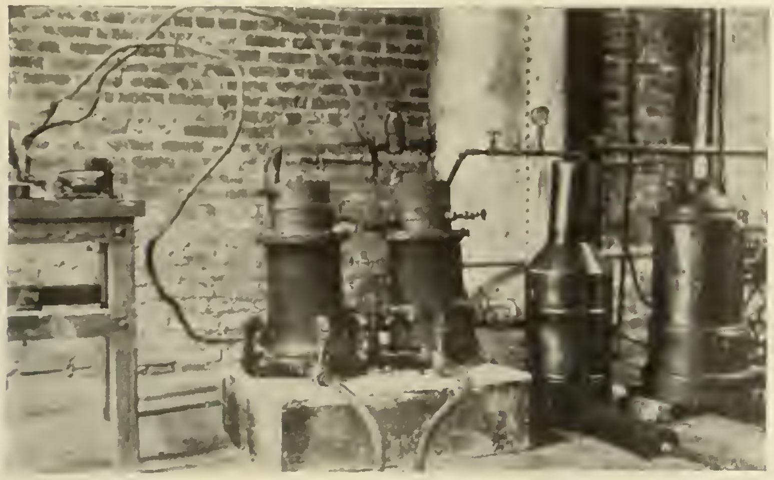
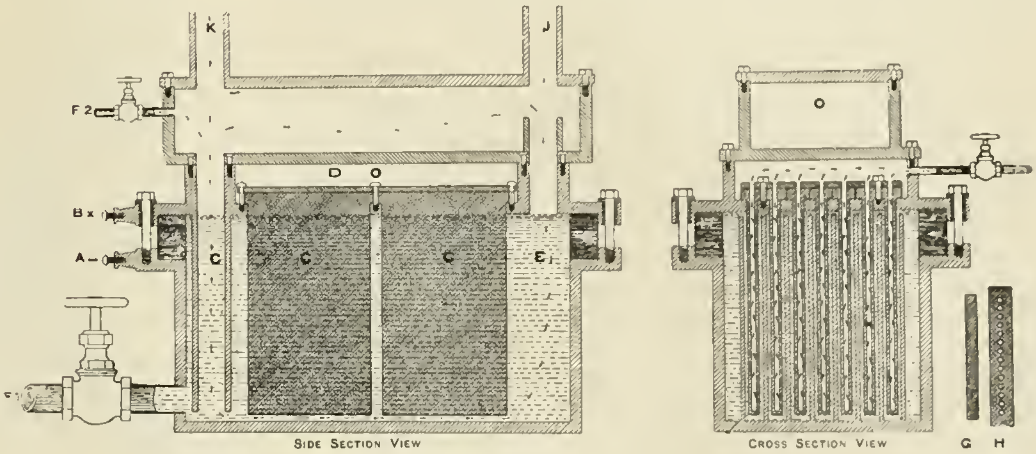


FIG. 1.—FUEL GAS BATTERY.



FIGS. 3 AND 4.—SECTIONAL VIEWS OF GAS BATTERY.

In point of fact, the apparatus appears to be nothing more than a heat battery, the conductor and fluid being maintained below the temperature of rapid oxidation, and unequal with reference to each other. In this case the efficiency would be limited by the second law of thermodynamics, this law applying to all heat transforming devices. In its simplest form and as shown at the demonstration, the cell is illustrated in Fig. 1. The cell (two are shown to the left on the engraving) is a cylindrical iron vessel filled with an electrolyte composed of sodium hydrate, calcium chloride and iron oxide, the electrolyte being maintained at a temperature of 390° F. Penetrating into the electrolyte and insulated from the iron are hollow electrodes made of carbon.

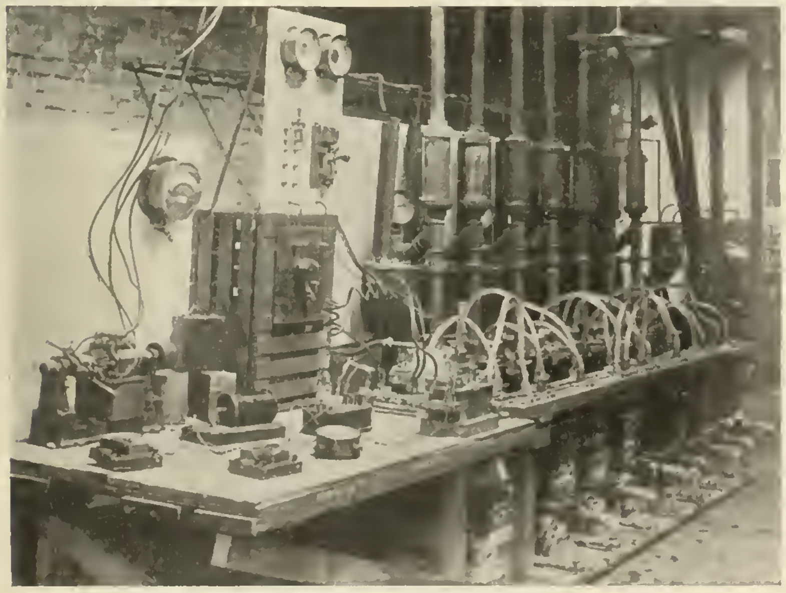


FIG. 2.—VIEW OF 60-HP MACHINE.

The carbons are of positive polarity and the iron pot of negative polarity. Fuel gas is forced into the hollow carbons, and the contention is that it percolates through the porous walls of the carbons, the carbon and hydrogen of the gas uniting with the oxygen in the electrolyte or in the carbon wall, resulting in the production of electricity, which continues so long as the gas is supplied to the carbons and oxygen to the electrolyte.

Any form of fuel rich in hydrocarbons may be used. In Fig. 1 a gas producer is shown to the right, for converting a mixture of street sweepings and culm into gas. At the demonstration, however, illuminating gas mixed with air in the proportion of one part of gas to forty of air was used. The electrolyte was likewise heated by illuminating gas. An e.m.f. equal to .9 volt per cell was developed and maintained fairly constant so long as the gas was passed through under the proper pressure and the electrolyte maintained at a temperature of 390° F. The products escaping at the top of the cell were said to contain water in the form of vapor, carbon dioxide and carbon monoxide; but this was probably inferential since they burned when a lighted taper was applied. The inventor claimed that in a commercial plant these gases would be returned to the combustion chamber so as to recover the heat value of the carbon monoxide. He expected to thus eliminate the necessity of using additional fuel to supply the requisite heat to the electrolyte, this being supplied by the waste gases. The cells recover very rapidly from the effects of short-circuit. One ampere is said to be developed for every five square inches of surface exposed.

Early in the history of Mr. Reid's experiments he built a 60-hp machine which he said performed all the work expected of it, but failed in one particular—the porous carbons disintegrated. Since then carbon from the electric furnace has been used. A view of this outfit is given in Fig. 2. With this outfit the inventor claims to have developed an electrical horse-power for every five feet of gas used, the calorific value of the latter being 650 B.T.U. per cu. ft.

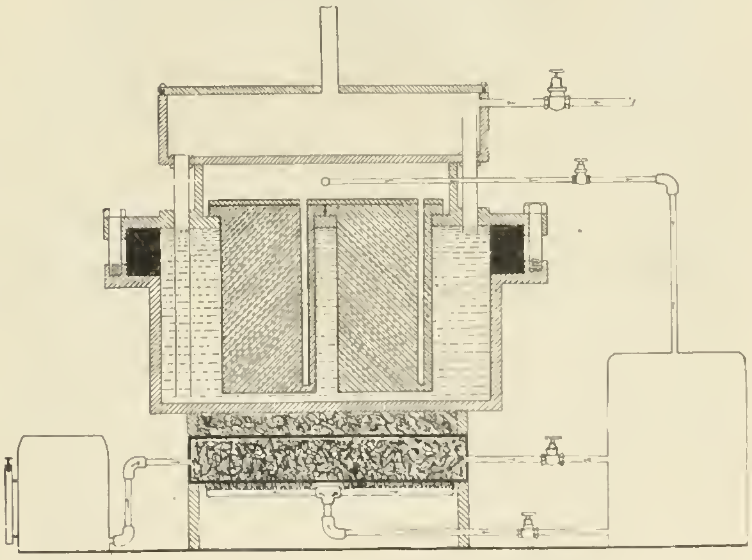


FIG. 5.—SECTIONAL VIEW OF GAS BATTERY.

The average efficiency of electric production by this method is claimed to be 45 per cent., as against 8½ per cent. with the steam engine. The expense of installing a commercial plant will, it is claimed, be about one-fourth of the first cost of present plants. The low voltage of each cell and the impracticability of placing enough of them in series for commercial wants other than for electrolytic purposes, will, of course, render it necessary to use some form of transforming apparatus.

The form which a commercial plant will take is illustrated diagrammatically by Figs. 3, 4 and 5. Fig. 3 represents the containing vessel or shell and is the negative pole; B, the aerating and exhaust part of the apparatus being the positive pole; $C\,C$ are the porous electrodes directly connected to the positive pole, while D is the gas chamber into which gases are forced and allowed to percolate through the porous electrode into chamber E, which is filled to line B, with an electrolyte. This electrolyte is an oxidant. The cock marked F_1 is for convenience in drawing off the electrolyte, and F_2 is a water cock for cleaning out the aerating and expansion chamber. In Fig. 4 F_3 is a cock controlling the flow of gas, G is the bottom view of the electrodes, $C\,C\,h$ is the top view showing gas inlets to electrodes $C\,C$; I shows the iron electrodes connected to A and forming the negative electrode in the electrolyte. The arrow marks in this cut show the flow of gas, and in Fig. 5 of the electrolyte to and from their openings; J represents the exhaust, and K is an intake of free air to maintain the balance of oxygen in the electrolyte.

We are informed that the Dynelectron Company, of 25 Broad Street, New York City, the holding corporation, is building a 100-hp outfit made up of ten cells, which it expects to exhibit publicly some time next month. This is claimed to be a practical and commercial apparatus and will be submitted to a committee of experts. It is stated that it will occupy a space 8 x 8 x 10 ft. long and will include besides the cells a complete gas generating plant. As the e.m.f. will be but 10 volts, a current of 7,460 amperes will be generated.

Brooklyn Ashes to be Electrically Hauled.

Contracts have been entered into for the purpose of carrying the ashes and street sweepings in Brooklyn over the Brooklyn Rapid Transit lines to the lowlands at Coney Island and Jamaica Bay. A unique feature of the work will be that all the handling will be done electrically, none of the material being touched by hand from the time it is shoveled into the carts of the street cleaning department on the streets until it is finally disposed of for filling in waste tracts of land in the outlying districts. By employing the new system the city expects to effect an annual saving of upwards of $80,000.

The American Railways Traffic Company has been incorporated under the laws of the State of New York with a capital of $1,000,000 for the purpose of undertaking the work. The president of the company is H. J. Hemmens, of the law firm of Beardsley & Hemmens, 54 Wall Street, New York. Charles J. Farrell is secretary and treasurer. The company has taken over the contract which H. N. Kennedy, formerly general passenger agent of the Brooklyn Rapid Transit Company, had secured from the city for the removal of ashes, etc.

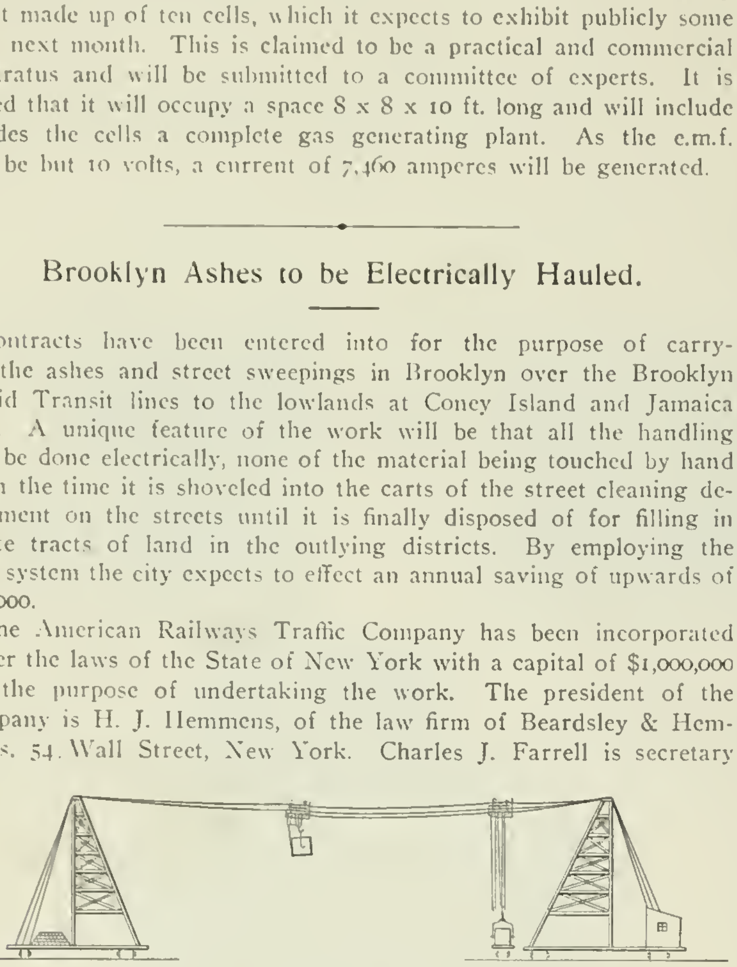


FIG. 1.—ASH-HANDLING APPARATUS.

Thirteen stations will be built on the Brooklyn Rapid Transit surface lines to receive the ashes. They will be located within a radius of about a mile from one another. To each of these stations the city horse carts will carry their collections from their respective districts. The carts will drive into the stations, which will be enclosed as to both roof and sides, to prevent the scattering of the ashes, etc. The material will be automatically shot into large steel bins fitted with light steel covers. These bins will each have a capacity of 10 cubic yards. Each station will have room for about 24 bins. The bins will remain covered except when the wagons are actually dumping into them. When filled they will be raised by an electric crane on to flat cars for conveyance to Coney Island or Jamaica Bay.

The electric crane for each of the stations will be of 10-tons capacity each. The span will be 35 ft. These machines will be built by the Shaw Electric Crane Company, of Muskegon, Mich. The cars will be built by the J. G. Brill Co., of Philadelphia. They will be regulation flat cars. Fifty will be employed in the work. Four bins will be carried on each car. On arrival at the ultimate destination each bin will be picked up by an aerial tramway system and carried along the wires to be dumped wherever desired. The tramways will be built on wheels so as to permit of their removal from place to place. They will be electrically operated. One is to be built by the Lidgerwood Manufacturing Company, New York. The other is to be manufactured by the Carson-Trench Machine Company, of Boston, Mass.

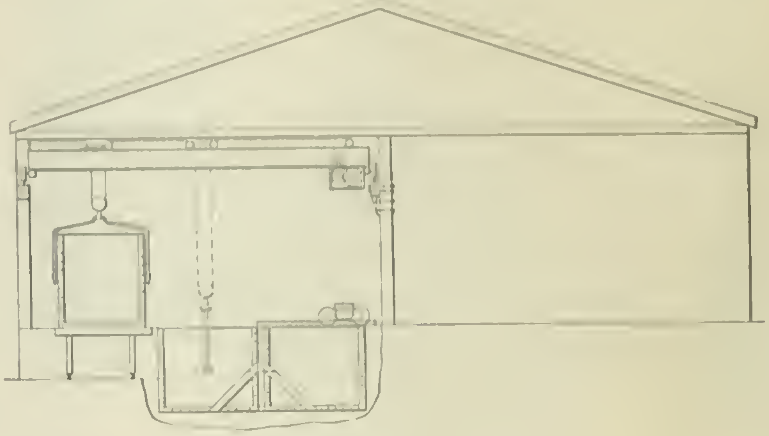


FIG. 2.—PLACING ASH BINS ON CAR.

Work on eight of the receiving stations has already been started. The locations are Ralph Avenue, near Atlantic Avenue; Fourth Avenue and Fourth Street; Third Avenue and Third Street; No. 224 Adams Street; Hopkins Street, between Marcy and Nostrand Avenues; corner of Broadway and Fulton Street; Fulton Street and Tompkins Avenue, and Fourth Avenue and Thirty-eighth Street.

The contract is for a period of five years. About 1,000,000 cubic yards of ashes, etc., are to be handled annually. This means about 500,000 tons. The contract price between the American Railways Traffic Company and the city is 35 cents per cubic yard. The saving to the city by the new system is expected to be nearly 25 per cent. The horse cart haul alone will be reduced 54 per cent. The new system will be in extensive operation by December 28, this year.

Work That Electrical Artisans May Do.

In regard to a trades union dispute over work that "electricians" or electrical workers are allowed to do, without causing a strike, the following is the interesting award of the trade arbitration committee that has considered the subject, in New York City:

"In New York builders shall do the cutting necessary for the installation of electric conduits, of all solid brick work, also of all fire-proofing where three or more conduits run together, and for all panels and cut-out boxes at their own expense.

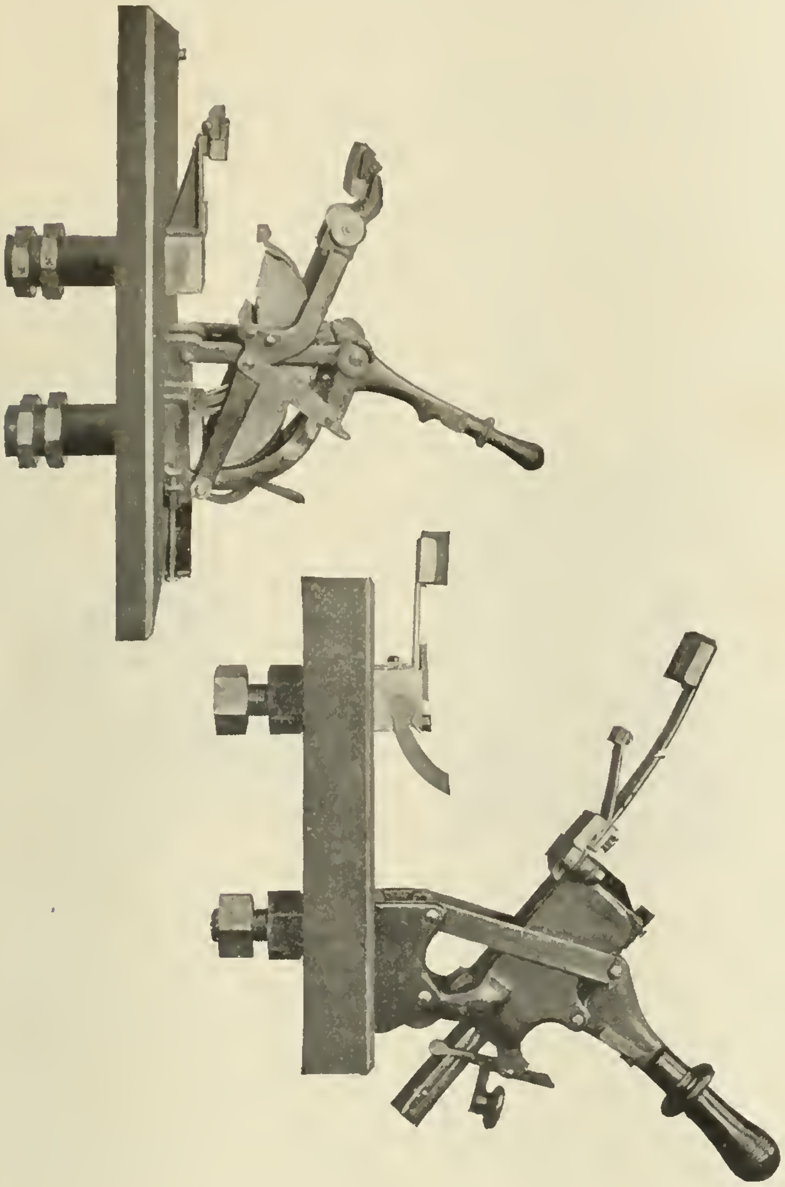
"That electricians shall cut on all fire-proof partitions where less than three conduits run together, and may drill holes through floors or walls, and cut any brick work for slight changes.

"Contracts entered into prior to the date of this award shall be executed as heretofore. That is, if the cutting is in the electricians' contract, he shall employ his own men at his option, to cut. If in the builders' contract, he shall employ the men he now employs; but after the date of this award the cutting of solid brick work, and of all fire-proofing where three or more conduits run together, and all panels and cut-out boxes, shall be eliminated from the electricians' contract.

"Old or Repair Work.—Where cutting or piercing is through or on old walls, the electrician shall cut with whom he may choose. Where cutting is through or on new walls, the builder shall do the cutting necessary for the installation of electric conduits of all solid brick work; also, of all fire-proofing where three or more conduits run together, and of all panel and cut-out boxes, at his own expense, and electricians shall cut the fire-proofing partition where less than three conduits run together, and may drill holes through floors or walls, or cut any brick work for slight changes."

Circuit Breakers.

Some three years ago the General Electric Company placed on the market a line of carbon break circuit breakers. These breakers have given such satisfaction that the company decided to extend and complete the line, and has recently brought out several new forms. This new line of circuit breakers is complete for all current capacities from 1 to 10,000 amperes, and for all voltages up to 650. They embody many new ideas in circuit breaker construction, and are illustrated by the accompanying photographs.



FIGS. 1 AND 2.—CIRCUIT-BREAKERS.

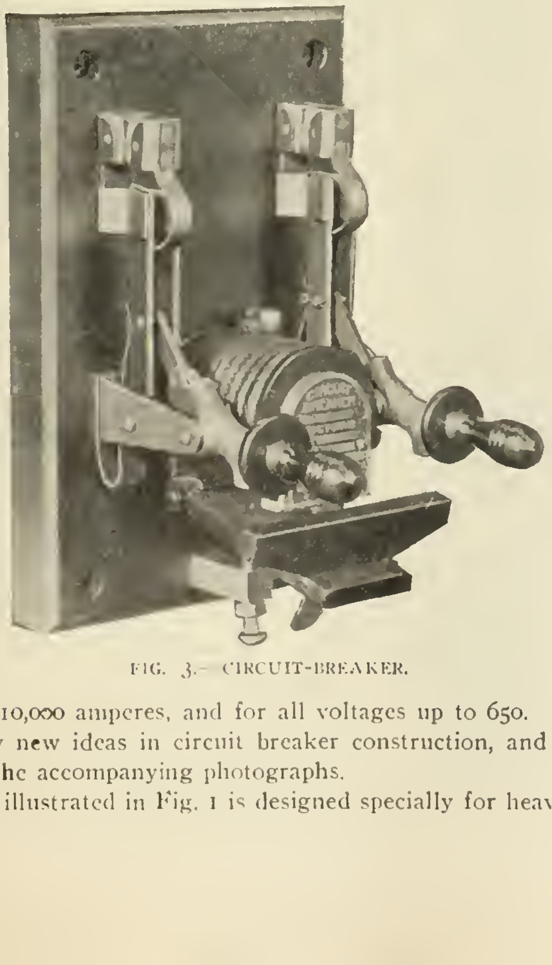


FIG. 3.—CIRCUIT-BREAKER.

The one illustrated in Fig. 1 is designed specially for heavy railway work, and is made in capacities from 800-10,000 amperes, and for voltages up to 650. It has been adopted by the Interborough Rapid Transit Company of New York City, as well as other large companies for use in their power stations. These breakers are very liberally proportioned, both electrically and mechanically, having ample carrying capacity and large contact areas, they are very reliable in operation, and are designed to close with small expenditure of power.

The type illustrated in Fig. 2 is also intended for heavy service, but is of smaller capacity, ranging from 75 to 800 amperes. The type shown in Fig. 3 is compact and simple, yet a very reliable device. It is made in various capacities up to 75 amperes, and for voltages up to 650 volts. Its exceedingly low price permits its use in places where switches and fuses have heretofore been used. This breaker is made in both single and double pole types, and either pole of the latter may be operated independently of the other.

A New Form of Bench Lathe.

The Cataract bench lathe which has recently been placed on the market, combines various features which should commend it to the consideration of the careful purchaser. In its design the question of ultimate worth rather than first cost has been considered paramount. The lathe has a newly designed head, containing unique features and radical departures from old principles. The spindle has been made ample heavy to resist any unusual strain to which the chuck may be subjected, and still retain its exactness and truth. The distribution of weight in the spindle of the new No. 3 head is mechanically perfect. It has no threads upon it, and, therefore, can be hardened and ground true by the inside or hole and can be removed, cleaned and adjusted most easily, an advantage not to be overlooked by the practical mechanic. The outer ends of the spindle and journals are protected by felt washers, held in place by dust caps which screw on the head casting or housing so that they remain in place or may be removed and cleaned with ease. No dirt reaches the spindle journals between the housings, for the reason that the cone comes close at one end and the ball bearings at the other, with the result that the bearings are absolutely protected from dirt. (Fig. 1.)

The journals are made from a hard quality of cast iron lapped and nicely fitted, and the adjustment for wear is sufficient for years of constant use. After a very little use these cast iron bearings become glazed similar to the cylinder of an engine, and being more porous than hardened steel, they present a better surface for retaining oil, thus they never ring or cut like hard steel running against hard steel. They can be replaced quickly if necessary at small expense and still retain perfect alignment.

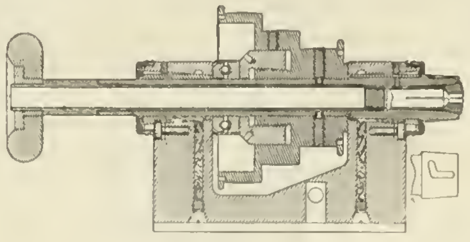


FIG. 1.—BENCH LATHE.

By referring to the illustration, it can be seen that the journals are tapered on the outside, and parallel on the inside, which bears against the spindle, thus allowing the spindle sufficient end shake to wear smooth without affecting the alignment. The adjustment of the journals is accomplished in a most simple and effective manner by a single substantial screw, which holds them in place and also tightens or loosens them. Being accessible by the mere removal of dust caps, there is no reason why the journals in this lathe head should not be as closely fitted at all times as may be desired. The end pressure in the lathe is reduced to a minimum by the ball-bearing end thrust properly arranged, leaving practically the whole traction of the belt for cutting, drilling or facing.

The end shake of the head is provided for between the journal housings or head casting independently of journal adjustment. This is attained within the cone pulley by a threaded nut fitting closely into the cone pulley independent of the thread and secured by set screw. Thus the nut may be turned at will by loosening a set screw and by placing a pin in angular holes, which lead past the outer flange of the cone pulley. One support for the ball bearing is direct with the rear housing, the other one being the large nut within the cone. This gives two flat surfaces, true as a perfectly flat shoulder, the ball bearing being between these and adjusted as closely as the work may require. The resistance offered by this form of journal and ball thrust is the least possible without employing roller bearings which are not suitable for lathe spindles.

The oiling devices for this lathe are features of special value. The holes are one-quarter inch in diameter, and journals are cut out to admit a wick which fills the oil wells, also the recesses at the bottom of journals. The oil is admitted to this wick through oil grooves that are turned into the housings, the oil cups being placed back of the housing out of the way. There being no hole through the boxes, the oil must go through this channel and up through the wick, thus keeping the dirt from the journals and securing the great advantage of having only filtered oil reach the journals. Moreover, the oil wells constantly supply the spindle, and in just sufficient quantity to secure perfect lubrication.

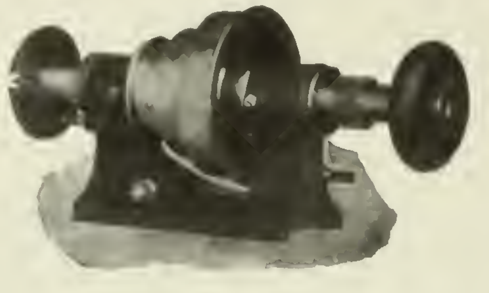


FIG. 2.—BENCH LATHE.

Everything can be thoroughly cleaned without altering an adjustment of the journals or end shake, by taking out the driving screw and drawing the spindle forward, lifting out the cone and ball races, removing the wick and replacing all. This lathe is manufactured by Hardinge Brothers, Chicago, Ill.

Controllers for Cranes and Steel Mill Work.

The application of electric motors to heavy cranes and such work as is done around steel mills requires controllers of a very efficient and durable type. The Case Manufacturing Company, of Columbus, O., has devoted its energies specifically in this direction, and is now introducing the controller herewith illustrated in Figs. 1, 2, 3 and 4.

The design of the controller is a departure in various respects from previous practice in such work, and the contacts are of large area and made of hammered copper and phosphor bronze. The principles involved are similar to those of the old knife switch with a hard copper disc passing between them in a constant shearing motion. This disc is always in contact with at least two of the constant blades, thereby reducing the sparking between steps to almost nil. The first step is provided with a quick-breaking device, which makes it impossible to prolong the arc by shutting the controller off slowly. The reversing circuit is open only after the lines have become dead through the action of the quick-breaking device, as noted above.

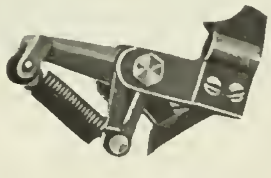


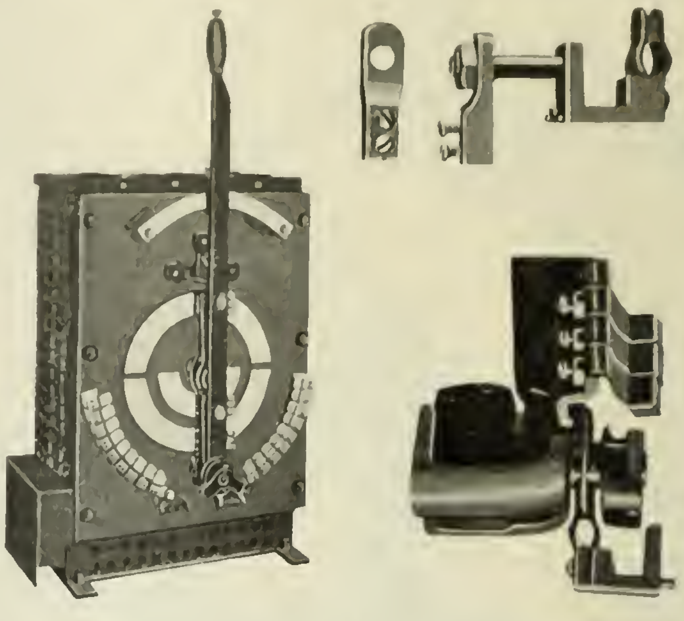
FIG. 1.—DETAIL.

As before stated, the main contacts consist of phosphor bronze knife blade contacts which are very easy to replace, the removal of two machine screws being all that is required to replace each set. They are mounted on a slate slab, and the connection to the resistance is accomplished by means of an ordinary brass terminal.

The roller knife blade is made of a hammered copper disc rotating in a strong magnetic field, the arc on the break being at direct angles to the magnetic lines of force across the air gap of only one-half inch. This construction in connection with the quick breaking device makes it impossible to maintain an arc between the contacts.

The blow-out coils are wound on a form and dipped in an insulating varnish and thoroughly baked, then served with friction tape and painted with an insulating paint. Use has been made freely with mica and asbestos, with a view of reducing the chance of grounds and short circuits to a minimum. The contacts for reversing the motor are of cast brass of large surface, and machined true. The fingers for the reversing contacts are made of hammered copper very large and machined to a true bearing. They are carried on phosphor bronze springs of large sectional area, and in the large sizes the "pig-tail" connector is used to relieve them of the load. They are provided with a practical adjustment of tension which is very easy to operate. They are not called upon to act in the capacity of a switch, as the circuit is always opened before they come off the contacts.

The resistance consists of galvanized iron wire coils on asbestos tubes supported at either end on a porcelain bushing through a cast-iron channel, the ends of the coil being screwed on to a malleable iron terminal. The cross connections are effected by means of copper ribbon "jumpers" placed at the top and bottom of the controller. In order to replace a coil, all that is necessary is to remove two nuts on either end and the coil comes out without disturbing any of the other coils or any connections. This makes replacement readily accomplished. The wiring from the resistance coils to the controller is done with underwriter's wire, and asbestos and mica are used freely.



FIGS. 2, 3 AND 4.—DETAILS OF CONTROLLER.

The terminals are all brought to a slate board at the base of the controller, and all that is necessary to install the controller is to run one wire from each line, two from the fields, and two from the armature circuit to the terminal board; and the apparatus is then ready for operation.

Where specially close regulation is required, such as handling cores, etc., by a crane in foundry work, an auxiliary lever is put on the controller by means of which double the number of variations are secured to control any series motor from 10 per cent of its rated speed to the maximum speed under any load up to its rated capacity.

A New Fuseless Rosette.

FUSELESS ROSETTE.

The rosette herewith illustrated is adapted particularly for concealed work, and is said to be the only fuseless rosette made specially for this class of work. A very neat dome gives ample room for the knot in the cord and completely covers all contact pieces and inside screws. Heavy porcelain walls separate the "leading-in" wires, making short-circuiting impossible, and adapting the rosette for use with 250-volt work. Its extreme neatness and ease of wiring should make it popular with the trade. This rosette is made by the H. T. Paiste Co., of Philadelphia.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was strong on covering of short contracts, due to manipulation and the absence of further liquidation. Pennsylvania Railroad and United States Steel preferred were leaders in the advance, but the standard railroad stocks, the tractions and the industrials all show a material improvement. The firmness of money rates was no obstacle to the advance. General Electric, Brooklyn Rapid Transit and Amalgamated Copper were prominent features. The activity in Brooklyn Rapid Transit is shown in the fact that 277,745 shares changed hands during the week, the range of prices being between 39⅛, the lowest, and 49⅞, the highest, the closing price being 48⅛, thus gaining 8⅝ points net. General Electric made a gain of 5½ points. closing at 160, which is two points below the highest and five above the lowest. Metropolitan Street Railway closed at 120, this being a net gain of 3⅜. Westinghouse common showed unusual activity, 10,670 shares having been sold. The closing price was 148¾, this being an increase of 10¾ points; the preferred stock closed at 195, thus making a net gain of 25 points. Western Union made a gain of 2¼ points, closing at 87⅜. The Boston market was firmer during the week, Massachusetts Electric closing 4¼ points higher, with preferred up 1½ points. The copper stocks were held very steady. Following are the closing New York quotations of December 8:

NEW YORK.

	Dec. 1	Dec. 8		Dec. 1	Dec. 8
American Tel. & Cable	75	78	General Electric	156	163½
American Tel. & Tel	126	127	Hudson River Tel	..	.
American Dist. Tel	25	24	Metropolitan St. Ry	117¾	120½
Brooklyn Rapid Transit	39¾	46⅞	N. E. Elec. Veh. Trns	..	.
Commercial Cable	145	152	N. Y. & N. J. Tel	..	..
Electric Boat	21	20	Marconi Tel	..	..
Electric Boat pfd	45	49½	Western Union Tel	88	87½
Electric Lead Reduction	⅝	⅝	Westinghouse com	140	156½
Electric Vehicle	5½	5¾	Westinghouse pfd	170	185
Electric Vehicle pfd	8	8			

BOSTON.

	Dec. 1	Dec. 8		Dec. 1	Dec. 8
American Tel. & Tel	126	127	Western Tel. & Tel. pfd	80	*82
Cumberland Telephone	*115	*115	Mexican Telephone	1⅛	1¼
Edison Elec. Illum	241½	240	New England Telephone	120	120
General Electric	155	*164	Mass. Elec. Ry	19	20
Western Tel. & Tel	7½	7½	Mass. Elec. Ry. pfd	77	75

PHILADELPHIA.

	Dec. 1	Dec. 8		Dec. 1	Dec. 8
American Railways	40	42	Phila. Traction	95	95½
Elec. Storage Battery	49	53	Phila. Electric	5⅞	6⅛
Elec. Storage Battery pfd	49	53	Phila. Rapid Trans	11½	11
Elec. Co. of America	7⅜	8			

CHICAGO.

	Dec. 1	Dec. 8		Dec. 1	Dec. 8
Central Union Tel	..	..	National Carbon pfd	87	86
Chicago Edison		144½	Metropolitan Elev. com	17	17
Chicago City Ry	165	160	Union Traction	5	5½
Chicago Tel. Co	..	..	Union Traction pfd	28	28
National Carbon	20	25			

*Asked

SAFETY WIRE & CABLE ABSORBED.—Announcement is made that the National Steel & Wire Company has increased its capital stock by $1,500,000 preferred, to $4,000,000, and $1,500,000 common, to $4,000,000, for the purpose of absorbing the Safety Insulated Wire & Cable Company, of Bayonne, N. J. The National Company has been furnishing the Safety Company with a large portion of its wire requirements. There is outstanding $1,250,000 preferred stock and $1,500,000 common stock of the Safety Company, which will be exchanged for National Steel & Wire Company stock, share for share, and, in addition, $250,000 of National Company preferred stock will be sold at par for cash. The working capital of the combined companies will be $1,600,000, equalling 20 per cent. of the entire capital. Earnings of both companies, after charges for depreciation, applicable to dividends on the combined common stock of the two companies, are at the rate of about 10 per cent. The financial plan has been underwritten by interests controlling both companies.

DIVIDENDS.—The board of directors of the Westinghouse Air Brake Company has declared the regular quarterly dividend of 2½ per cent. and an extra dividend of 3½ per cent., payable to stockholders of record January 11, 1904. The board of the Detroit United Railway has declared the regular quarterly dividend of 1 per cent. The regular quarterly dividend of 1½ per cent. on the capital stock of Manhattan Railway Company will be paid January 1. Western Union's executive committee has recommended the declaration of the regular quarterly dividend of 1¼ per cent.

GERMAN ELECTRICAL CONSOLIDATION.—A cable dispatch from Berlin of December 5 says: "It was decided to-day to amalgamate the Allgemeine and Union Elektricitäts Companies, which had already formed a working agreement. The Union Company's 24,000,000 shares will be transformed into 16,000,000 shares of the Allgemeine shares, making the capital of the latter $19,000,000.

CHANGES OF CAPITALIZATION.—The Chase Electric Construction Company, Chicago, has decreased its capital stock from $10,000 to $1,000. The Gregory Electric Company, Chicago, has increased its capital stock from $100,000 to $300,000. The Northwestern Electric Company, Chicago, has increased its capital stock from $5,000 to $25,000..

NEW YORK TROLLEY EARNINGS.—The consolidated statement of the Interurban Street Railway of New York for the September quarter shows $5,570,212 gross and $2,808,612 net. The gross shows a gain of $198,521 over 1902. The surplus is $163,377, showing an increase of $17,007 over 1902.

CHICAGO ELEVATED.—The Lake Street Elevated, Chicago, shows $834,059 gross earnings for 1903, a gain of $40,000 over 1902. The net was $368,568, but after charges, taxes, etc., there was a deficit of $49,170.

PORTO RICO TROLLEYS.—The Vandergrift Construction Company, of San Juan, has closed its doors owing to inability to raise funds to carry on its $3,000,000 trolley construction plan.

Commercial Intelligence.

THE WEEK IN TRADE.—The cold weather and the advent of the holiday season have brought about a more normal tone in public sentiment and a consequent better feeling in retail trade. Some industries are in remarkably good shape with record-breaking shipments for the season, but the advance in raw cotton is a matter of concern to the trade. In the iron and steel trade, shut-downs more than offset resumptions. There is more confidence in the market for the cruder forms of iron and prices are steadier. Winter weather is causing a slowing-down in many lines of building, and lumber; other building material and hardware are rather less active for this season. Lake navigation is practically closed, with a larger movement of grain and coal, but a much smaller ore trade than in 1902. Railway operations are still active with an increase of about 5 per cent. shown in gross receipts over November a year ago. Monthly failure statistics are more favorable in that failures and liabilities are fewer and smaller than in October, though in excess of a year ago. On the whole they seem to indicate less strain in general business than in the month previous. Collections are better in some localities, but in general are somewhat sluggish. Prices of agricultural staples are all stronger. Finished iron and steel products are little changed, and among other metals copper is dull and weak, but in better export demand. Prices for all grades of raw copper have undergone material shrinkage during the past month. The receding tendency was marked throughout almost the entire month of November and nothing occurred to check the gradual decline. In Europe, however, the buying has been on a better scale than in this country and a number of good-sized lots were taken by foreign consumers during the month. As regards domestic demand, there has been a decided lack of animation for some time past, and sagging prices have so far failed to stimulate general buying on a large scale. The foreign visible supply on December 1 was 12,743 long tons, which is the smallest since 1899. During the week just closed there was a further decline in prices in New York, the closing quotations being 12⅛ to 12½c. for Lake, 12 to 12¼c. for electrolytic, 11¾ to 12c. for cathodes and casting stock. Exports of iron and steel are growing. The chief cause of the increase in October exports was the large movement of cotton, now being reduced by high prices; but it is noteworthy that all classes of exports show increases of larger or smaller amounts. The business failures for the week ending December 3, according to *Bradstreet's* compilation, aggregated 239, against 167 the week previous, and 185 the corresponding week last year.

A VIEW OF AMERICAN EXPORTS.—The British *Board of Trade Journal* for December prints a warning to British manufacturers from Seymour Bell, the British commercial agent in the United States, prophesying an extensive invasion of the British markets by American firms in the near future. Mr. Bell writes that the decreasing demand in the United States for many classes of manufactured goods indicates that American firms will soon be looking abroad for markets in which to dispose of their surplus products at almost any price "It will be well, therefore," says Mr. Bell, "to bring before British manufacturers and shippers in an unmistakable manner the progress made in recent years by American exporters in securing a hold on the markets within the British possessions, particularly for certain classes of goods which could be manufactured in the United Kingdom." Mr. Bell asserts that the great extension of their plants by American manufacturers in recent years was necessitated by the home demand, which has already begun to fall off, and hence he forecasts an extensive "dumping" of American goods in British markets He says that while the total of American exports during the past year has decreased 4.6 per cent., American exports to the British possessions have increased 17 per cent., and this, Mr. Bell adds, is a decidedly larger increase than is shown in the statements of exports from the United Kingdom.

AMERICAN BRIDGE COMPANY.—Hereafter the head offices of Post & McCord, composed of officers of the American Bridge Company and the Empire Bridge Company, of New York, who have resigned, will be in the Flatiron Building. The business of Post & McCord and the American Bridge Company will be separate and distinct, it was stated, as they are separate corporations. William H. McCord, former vice-president of the American Bridge Company, is president of the new company. The office of vice-president has been abolished by the American Bridge Company, and its duties, which related to the finances of the company, will be performed after January 1 by other officials, when the headquarters of the corporation are to be removed from Philadelphia to Pittsburg. The office of Erection Superintendent of the American Bridge Company of New York, formerly held by John McCord, will be held by him in the Post & McCord Company.

AUTOMOBILE SUPPLIES IN ST. LOUIS.—The A. L. Dyke Automobile Supply Company, 2108 Olive Street, St. Louis, Mo., has just completed arrangements to expand its business by introducing into the business new capital, and the employment of several salesmen to cover the territory so long flooded with catalogues and other matter. Several well-known residents of the city have become associated with Mr. Dyke. Messrs. F. H. Britton, Roy F. Britton and Charles Peters will become directors of the new company. The capital will be increased from $10,000 (its present authorized capital) to $25,000, fully paid. The company is seeking larger quarters in the business section of the city in order to handle the trade of the coming season. It will start on the road several salesmen experienced in the automobile supply line and its prospects are in every way satisfactory.

AUXILIARY STEAM IN CALIFORNIA.—The California Central Gas & Electric Company are planning the installation of a 500-hp auxiliary steam plant at Petaluma in the near future. This is to provide against the possibility of a break-down in their high-potential transmission line, and with it they intend to supply Santa Rosa, Petaluma, San Rafael and Napa with electric current in case the unexpected happens. This plant will also furnish power for the projected Petaluma and Santa Rosa electric railway in case an accident should happen to their power plant, which is to be located at Sebastopol. At the present time auxiliary steam plants are maintained at the various towns, and this one is planned in order that one plant may supply all the current in case of a break-down and reduce the expense of maintaining four separate plants.

PROJECT TO SUPPLY POWER TO EL ORO MINES.—Mexican advices state that H. H. Filey, resident manager and chief engineer of the Guanajuato Power & Electric Company, which American concern last month completed the construction of its 60,000-volt power transmission line—the second longest in this hemisphere—between the River Douro and the Guanajuato mining district, a distance of some 120 miles, is now at Zitacuaro for the purpose of making an estimate on the cost of power transmission between that point, where there is said to be abundant water power, and El Oro and the country adjacent. Zitacuaro is located about 50 miles from El Oro, the most prominent mining center in the republic.

EQUIPMENT FOR PRESBYTERIAN HOSPITAL.—The Presbyterian Hospital, at Seventieth Street and Lexington Avenue, New York, is to be equipped with a new power plant. The Ball Engine Company, of Erie, Pa., through Woolston & Brew, has secured the contract for the engines. There will be three capable of developing 200 hp each. The generators have been ordered from the Northern Engineering Company, 95 Liberty Street. They will be built by the Commercial Electric Company, of Indianapolis, Ind. There will also be three Commercial motors of 25 hp each, two of 5 hp each and one of 3-hp capacity. These motors will be used for ventilating purposes and for driving laundry machinery.

BRIDGE ILLUMINATION CONTRACT.—The Norden-Bittner Electric Company has the contract for the illumination with electric lights of the new Williamsburg Bridge on the East River, New York City, on December 19. Nearly twenty miles of wire will be used in stringing the lamps, which run toward 20,000 in number The spans, cables, towers, anchorages and approaches will be outlined in white light. In the center of the bridge two immense American flags 100 ft long, one on each side, will be outlined in red, white and blue lamps. At the approaches on each shore the city's coat of arms will be similarly picked out. Lamps of 8 cp will be used

SOME HOLTZER CABOT ORDERS.—The Holtzer Cabot Electric Company, 143 Liberty Street, New York, has just secured a contract for 25 motors from the International Automatic Music Company, 2 West Twenty-ninth Street, New York. The motors will be of special make and of ½-hp capacity each. They will be fitted with an automatic device for use in operating automatic pianos. The Holtzer Cabot Company has also been awarded a contract for the complete Sturtevant blower outfit for one of the United States battleships now under construction in the Brooklyn Navy Yard. There will be 21 motors varying from 2 hp to 5 hp each.

LONG MICHIGAN TROLLEY.—An electric railway to be known as the Detroit, Flint & Saginaw Railway, is proposed. The road will extend from Saginaw to Flint and from Frankenmuth to Vassar, a total of about 45 miles of single-track road. Preliminary surveys will be pushed forward and a report submitted to the company within 60 days by the Arnold Electric Power Station Company, engineers and contractors, of Chicago, Ill., which has been retained as consulting engineers. The specifications to be prepared will cover the buildings and entire power station equipment distributing system, and the sub-stations.

NEW YORK CITY LIGHTING.—The New York City authorities have rejected all lighting bids save one and the companies will also have to sue for the lighting done during this year unless they consent to cut their bills. The allegation is that the price is unduly high. The electric lights are thrown out in their entirety, the rate being $146 per year for each arc light. During the year 1903 the appropriation for lighting the city was $3,306,346.23, while the appropriation for 1904 in the new budget is $3,250,000.

BOILERS FOR NEW YORK CENTRAL.—As already noted, the boiler order for the New York Central equipment has gone to the Babcock & Wilcox Company for the two power houses. The contract includes 48 boilers of 625 hp each, equipped with Babcock & Wilcox superheaters, to give a superheat of 200°. The boiler working pressure is 200 pounds. The Babcock & Wilcox Company has also received a large order for boiler equipments from the New York Edison Company.

WESTINGHOUSE GAS ENGINES are to be adopted in a new central station now under erection at Berlin, Ont. The initial installation will aggregate 460 hp, comprising three 13 x 14, three-cylinder, 125-hp and one 11 x 12, three-cylinder, 85-hp vertical engines. These engines will operate on city illuminating gas of 650 B.T.U. calorific value, and drive direct-current generators for furnishing municipal lighting.

LINCOLN (NEB.) TROLLEY FORECLOSURE.—The Lincoln Traction Company's property, comprising practically the entire street car system of the city, was sold December 1 at auction on foreclosure proceedings to satisfy a tax lien of the city of Lincoln. The property was purchased by Charles A. Freuauff at the price of $1,160,000.

EQUIPMENT FOR MEXICAN QUARRIES.—Considerable electrical equipment will be installed in large marble quarries near Monterey, Mexico. All the drills will be electrically-operated, as well as various other machinery. C. J. Bauderer, of Monterey, is primarily interested in the properties.

ANOTHER MEXICAN HYDRAULIC PROJECT.—Manuel Cuesta Gallardo, of Guadalajara, is interested in a project to construct a large hydraulic plant between the city of La Barca and the Ateguiza hacienda on the Santiago River, State of Jalisco.

BALL ENGINE ORDERS.—The Continental Coal Company, Columbus, Ohio, is installing a 400-hp engine purchased from the Ball Engine Company, Erie, Pa., and has ordered a duplicate engine from the same company. Trinity College, of Durham, N. C., has recently purchased a Ball automatic engine from the Ball Engine Company.

MEXICAN LIGHTING PROJECT.—It is proposed to install lighting plants in a number of towns in the State of Michoacan, Mexico. Jose Maria Barragan, of Jiquilpan, can give further information.

CHICAGO TELEPHONE COMPANY shows a gain in subscribers during November of 1,668. The total of Bell subscribers now connected in that city is 99,570.

KILBOURNE & CLARK CO., of Seattle, Wash., has secured a contract for the erection of a new electric lighting plant at Port Angeles, Wash.

General News.

THE TELEPHONE.

BIRMINGHAM, ALA.—The Farmers' Mutual Telephone Company is the name of a new company just formed here.

ATLANTA, GA.—The Columbus Automatic Telephone Company is installing a large plant in this city and has already expended about $100,000.

PEKIN, ILL.—The Pekin Telephone Company has increased its capital stock from $10,000 to $75,000.

CONCORD, ILL.—The Home Telephone Company has increased its capital stock from $10,000 to $16,000.

ROBERTS, ILL.—The Lyman Telephone Company has been incorporated; capital, $5000. Incorporators: Chris Anderson, F. S. Diller, G. W. Maddin.

MEROM, IND.—The Merom Telephone Company has organized and incorporated with a capital stock of $10,000. George W. Stanley, W. J. Cooper and Winfred Reid are the incorporators.

ALICE, IND.—The exchange of the Knox County Telephone Company maintained here was burned recently. It was temporarily installed in another building. The officials contemplate erecting a new building and installing a new switchboard.

TIPTON, IND.—M. W. Pershing, postmaster, and editor of the *Tipton Times*, has won for himself fame that has spread far and wide. He has a number of farm lines running out into Tipton County. The Indianapolis papers get into Tipton about 6 o'clock. The telephone editor takes these papers, clips the headlines and prepares a careful synopsis of their contents and then at a convenient hour after supper he connects with all his lines and gives a prearranged call that brings every farmer to his telephone. Editor Pershing then proceeds to read to the farmers his summary of the latest news which is followed by weather reports and produce prices. In this way the farmers know the chief happenings of the world almost as soon as the residents of large cities. Mr. Pershing also notifies patrons if any mail or telegrams are in the office addressed to them and often they come immediately for the same.

LOGAN, IA.—The Woodbine Telephone Company has increased its capital stock from $25,000 to $50,000.

COUNCIL BLUFFS, IA.—The American Telegraph & Telephone Company will remove its terminal station from this city to Omaha, Neb.

POCAHONTAS, IA.—The building containing the exchange of the Mutual Telephone Company in this place was destroyed by fire recently.

DES MOINES, IA.—The Lanesboro Mutual Central Telephone Company, with a capital stock of $1200, has been incorporated by the Secretary of State.

BOONE, IA.—The Odgen Telephone Company's system at Odgen has been purchased by the Boone Telephone Company and over 400 subscribers will thus be added to the Boone Company's service.

RIVERTON, IA.—The telephone plant at this place, owned by the Tabor City Telephone Company, has been sold to a recently organized mutual telephone company. The plant consisted of 47 telephones with about 12 miles of pole line. The system will be greatly extended.

BALDWIN, KAN.—The Baldwin Telephone Company has been incorporated with a capital stock of $5000.

FRANKFORT, KY.—The Eminence Home Telephone Company, of Henry County, has been incorporated with a capital stock of $25,000, by William Callahan, W. B. Wilson and I. B. Callahan.

DEXTER, ME.—The Farmers' Telephone line is being built by the farmers of Gilmans Corners and Silver Mills.

POINT LOOKOUT, MD.—The Southern Maryland Development Company has a project to build a telephone line from Point Lookout to Upper Marlboro, where a connection will be made with the Chesapeake & Potomac Company, which has made arrangements to establish an exchange.

HART, MICH.—The stockholders of the Oceana County Bell Telephone Company have accepted the proposition of the Mason County Telephone Company to purchase the latter. The two properties will be merged.

FOLEY, MINN.—The Maple Leaf Telephone Company will establish an exchange here.

MOORHEAD, MINN.—The Red River Telephone Company, of Moorhead, has been incorporated with a capital stock of $50,000, the incorporators being P. H. Lamb, L. H. Baker and Leslie Wetter.

AUSTIN, MINN.—On Dec. 1 the Interstate Telephone & Telegraph Company, of Austin, formally opened its exchange for service. The plant is remarkable in many respects. It is an all cable plant with no cross arms or bare wire, each pole being equipped with a small terminal, so that pairs in the cable are available at every pole. A number of the pairs are in multiplex so they are available at more than one pole, which makes the distribution very flexible. The plant has been examined by leading telephone engineers, who state that it is a distinct advance in telephone construction, and will be very economical to operate. The equipment is of the common battery multiple switchboard type, with selective indicating keys for selective party line work. The plant starts in operation with one telephone for every 12 inhabitants in the city, which, it is said, breaks all former records. The engineering and management have been under the supervision of L. W. Stanton, consulting and constructing telephone engineer, of Cleveland, Ohio.

HANNIBAL, MO.—The electrical workers employed by the Hannibal exchange of the Bell Telephone Company and the Bluff City Telephone Company on Dec. 1 struck for an increase in wages. The Bluff City Company adjusted its differences with its workmen and the latter returned to work at once, but the employes of the Bell Company are still out. An advance of 25 cents a day for those employed by the day and $5 per month for those working by the month is sought. The new scale adopted is as follows; Linemen, $2.75 per day; assistant foreman, $3 per day; city foremen, $3.25 per day; trouble men, $70 per month; switchboard men, $85 per month.

VESTA, NEB.—The Crab Orchard Telephone Company has extended its lines and is putting in telephones to connect Vesta with the Crab Orchard exchange. When finished the exchange will have about 300 country telephones.

FREMONT, NEB.—Because the Fremont Independent Telephone Company has attempted to raise its rates 50 cents per instrument, efforts have been made in the City Council to annul its franchise. The Company was granted a franchise several years ago in which was stipulated that the rating for business houses was not to exceed $2 and residences $1. The company put in a good system costing about $45,000, but found that it could not do business at the stipulated rates. It has been announced that a stock company among the grocers is about to be formed to establish a new line.

CROWN POINT, N. Y.—The Crown Point Telephone Company has been incorporated with a capital stock of $3000. The incorporators are Jas. E. Pond, C. H. Wilson, Crown Point, and F. C. Pond, Schroon Lake, N. Y.

POUGHKEEPSIE, N. Y.—The State Line Telephone Company has increased its capital stock from $1,000,000 to $10,000,000. The Dutchess County Telephone Company is affiliated with the State Line Company and the local system will be extended all over Dutchess County.

PLATTSBURG, N. Y.—The Clinton Telephone Company, an independent concern, has been organized by the election of the following-named officers: J. H. Griswold, president; B. S. Ramsay, vice-president; J. S. G. Edwards, secretary. The company will be ready for business by July 1 next year.

ASHEVILLE, N. C.—The Asheville Telephone & Telegraph Company, representing the merger interests, has been chartered with a capital of $300,000, by C. R. Craig, W. S. Proctor and others.

COLUMBUS, OHIO.—The Middlepoint Home Telephone Company, of Middlepoint, has been incorporated with a capital stock of $60,000.

HASTINGS, OHIO.—The Hastings Telephone Company has been incorporated with a capital stock of $3000. Directors: F. Frank, D. J. McCreedy and others.

URBANA, OHIO.—The Independent Telephone Company will make extensive improvements to its system. A switchboard of larger capacity than the present one will be installed.

SHAWNEE, OKLA.—The Independent Telephone Company has completed a metallic circuit to Denison and Sherman, Tex.

PITTSBURG, PA.—The Lower Luzerne Telephone & Supply Company has increased its capital stock from $7500 to $20,000.

ABERDEEN, S. D.—The Dakota Central Telephone Company has decided to expend about $150,000 in extending its line into South Dakota.

CHATTANOOGA, TENN.—The long distance telephone line which is being constructed from this city to Cincinnati by the American Telephone & Telegraph Company is about completed. When the line is finished it will give direct telephone communication between Chattanooga and Asheville, Lexington and Cincinnati.

BRYAN, TEX.—The Bryan Telephone Company will build a line between this place and the town of Mumford.

SMITHVILLE, TEX.—The Smithville Telephone Company has been organized here with a capital stock of $10,000. H. C. Schumacher is president.

NAPLES, TEX.—A steady growth is reported by the Naples Telephone Company which has 56 subscribers. A Kellogg switchboard of 150 drops is used.

GONZALES, TEX.—A 300-drop American Electric switchboard is operated by the Gonzales Telephone Company which has 250 subscribers and 200 miles of toll line. The rates are $1.50 and $2.50 per month.

DAINGERFIELD, TEX.—The Daingerfield Telephone Company operates an exchange at this place with 80 subscribers, and one at Hughes Spring, Cass County, with 50 subscribers. A 100-drop American Electric switchboard is installed here. Messrs. Truitt & Willis are the proprietors.

LAGRANGE, TEX.—The Fayette County Telephone Company has recently made an arrangement with the Commercial Telephone Company whereby it gets long distance connection to all the principal cities in Texas. At Lagrange a 200-drop American Electric switchboard is used; there are 140 subscribers and 100 miles of toll line. The rates are $2.50 and $1.50 per month.

BROWNWOOD, TEX.—Mr. C. H. Woodward, sole owner of the Telephone Exchange here, contemplates installing 10,000 feet of cable in the Spring and substituting metallic circuit where common return system is now used. He will also rebuild the principal toll lines and double the switchboard capacity. It is Mr. Woodward's intention to organize a company with $50,000 paid-up capital. Kellogg instruments are used and there are now over 300 subscribers, with 150 miles of toll line in the system.

ST. JOHNSBURY, VT.—The Citizens' Telephone & Telegraph Exchange numbers 700 subscribers and reports the addition of 100 of these since June of this year. Couch & Seely apparatus is used. The company is in a very healthy condition.

BARTON'S LANDING, VT.—An addition of 25 miles of toll line is projected by the Vermont People's Telephone Company, which has 700 subscribers. The company is gaining about 150 subscribers a year and the outlook is very good. D. Buchanan is manager.

GREENBACKVILLE, VA.—The Accomac & Northampton Telephone Company, of Greenbackville, has been chartered by J. T. Sharley and others; capital stock $5000.

CHARLOTTE C. H., VA.—One hundred or more miles of line and from 75 to 80 telephones are to be built and installed by the Central Telephone Company which has now 85 subscribers, and 110 miles of toll line.

PORT ANGELES, WASH.—The Angeles Telephone & Telegraph Company, capitalized at $10,000, was started in May of this year, with the stock all paid up in full. Beginning with 95 subscribers, the company now numbers over 200. Stromberg-Carlson apparatus is used, the rates are $2.50 and $1 a month. The outlook for future business is reported good. It is planned to increase the switchboard capacity and to build lines to adjoining towns. The officers of the company are: President and treasurer, Mr. C. L. Farmer; vice-president, Mr. F. A. Jenson, secretary, Mr. C. H. Hirsch.

HUTTONSVILLE, W. VA.—The Beverly & Marlinton Telephone Company uses instruments made by Stromberg-Carlson Telephone Mfg. Company and Eureka Electric Company. The system has recently been extended by the addition of 25 miles. It has 100 subscribers.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has expended over $400,000 during this year for buildings, underground conduits, toll lines, new switchboards, etc., in various parts of the state. Part of the work planned was left undone owing to the scarcity of workmen. This, however, will be completed next Spring. Two new exchanges were built in Milwaukee and two at Eau Claire and Oshkosh. The exchange at Chippewa Falls has been reconstructed and that at Steven's Point will receive new apparatus by January 1.

CITY OF MEXICO, MEX.—The original concession which the Mexican Telephone Company obtained from the Mexican Government for the establishment and operation of its telephone system in this country expired by limitation on Nov. 15. Application has been made by the company for a renewal of its concession and it is stated that the application will be granted.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—The contract for construction work and wiring for electric light plant at the Alabama Girls' Industrial School has been awarded to the Consolidated Electric Company, of Birmingham, for $1750.

ALHAMBRA, CAL.—The Pacific Light & Power Company, Los Angeles, has secured an electric light franchise here.

CORONA, CAL.—The Corona Gas & Electric Company has made a five-year contract with the municipality here for ten arc lamps at the rate of $1000 per year.

LOS ANGELES, CAL.—The Citizens' Co-operative Gas & Electric Company is organizing at San Pedro, with a view to securing lower rates for lighting service.

STOCKTON, CAL., will get its streets lighted next year at a lower rate than any other city in the State. When the bids for the street lighting contract were opened a surprise was sprung. Both companies bid to win and the Stockton Gas & Electric Company captured the contract on the low bid of $3.69 per arc light per month. The bid of the American River Electric Company was $4.40 per light. The present rate which the city is paying the Stockton Gas & Electric Company per light is $6.90. The new rate is just $3.11 lower than the present. As the city is using just 186 arc lights a saving to the city of $578.46 per month or $6,941.50 per year will result. The Stockton Company is to use the Standard's transmitted power for all its work.

PAYETTE, IDA.—Articles of incorporation of the Payette Power Company have been filed at Boise. The capital stock will be $300,000. The power from the plant is to be used for manufacturing purposes and lighting in Payette, Ontario, Weiser and other nearby towns. Power from this plant will also be used in the operation of the proposed electric railway from this city to Emmett and Pearl. The power plant will be erected at a point on the Payette river, about three miles above Payette, where a fall of 35 feet can be utilized.

JERSEYVILLE, ILL.—The Jerseyville electric light plant was inspected recently by a party composed of Owen Ford, B. V. Beckman, J. B. Quigley and G. W. Dudley, of St. Louis, and J. M. Gore and C. D. Cole, of Quincy, Ill., preparatory to its absorption by the Union Light, Water & Traction Company, of Jerseyville, which was incorporated last week with a capital of $50,000. The incorporators were Messrs. Ford and Beckman, of St. Louis, and J. M. Gore, of Quincy, Ill. The Union Light, Water & Traction Company has also purchased the electric plant at Nevada, Mo., for $100,000 and will operate the various plants, making important improvements in the Jerseyville plant as well as increasing its capacity.

CHARLESTON, IND.—This city has voted to build a new electric light plant which will be located on Main Street near the old woolen mill. Address the town board for further particulars.

INDIANAPOLIS, IND.—Israel Hoagland, of this city, has patented an electric plow and is organizing a company to manufacture the machine. It can be applied to any farm implement requiring power for its operation. Mr. C. E. Merrifield is secretary of the company. Mr. Hoagland's address is 447 South East Street.

RICHMOND, IND.—The municipal electric light plant is now in much better condition to meet the competition of the private company than it has been heretofore. This is due to the installation of a new generator. The municipal plant will get the street lighting next year. During the past it relied solely upon commercial business and a few extra lights the city ordered.

DURANT, I. T.—At the election here on Nov. 16 it was voted to issue $89,000 water, light and sewer bonds.

COMANCHE, I. T.—The City Council has granted the Comanche Electric Company a franchise for electric light and telephone systems.

FT. MADISON, IA.—The citizens have voted to grant franchises to F. C. Wood for gas and electric lighting, electric railway and for a public heating system.

HUTCHINSON, KAN.—S. F. Johnson, City Clerk, informs us that private parties propose constructing an electric light plant in Hutchinson.

WINFIELD, KAN.—There may be an election here to vote upon the issuance of $134,000 bonds for water works, electric light plant, etc.

GIRARD, KAN.—Plans and specifications are wanted Dec. 14 for an electric light plant, capacity 50 arc, and 1500 incandescent lights. Address J. B. Grantham, City Clerk.

AUGUSTA, KY.—Bids are wanted Dec. 11 for a franchise for an electric light plant.

EATON RAPIDS, MICH.—The citizens have voted to issue $12,000 electric light bonds.

CAPAC, MICH.—The contract for furnishing a 153-hp. horizontal automatic engine to be direct connected, and a single-phase, 60-cycle, 2300 volt 75 kw generator has been awarded to the Fisher Electric Company, of Toledo, Ohio, for $5913.

WINONA, MISS.—The Winona Water, Sewerage, Ice & Light Company is about to apply for a charter. Incorporators: Claude R. Kedson, Robt. A. Allison, Arthur Flake and others. The capital is $175,000.

McHENRY, MISS.—The McHenry Improvement Company has been incorporated, with a capital of $30,000, to erect a hotel and establish an electric light plant, water works, etc. Incorporators: D. L. O'Neal, G. A. McHenry and others.

VERSAILLES, MO.—At the recent election here the proposition to issue $10,000 electric light bonds was carried.

OMAHA, NEB.—Having its underground conduit system in the down-town district completed and the circuits installed and in operation therein, the Omaha Electric Light & Power Company is taking down its overhead wires and poles in the business portion of the city.

PATERSON, N. J.—The Public Service Corporation has installed a storage battery here which is now in service on the incandescent lighting system. The plant was furnished by the Electric Storage Battery Company, of Philadelphia, and consists of 150 cells.

PHILADELPHIA, N. Y.—Bids will be received Dec. 15 by C. T. Barr, village clerk, for the construction and equipment of an electric lighting plant for both arc and incandescent lights.

BRUSHTON, N. Y.—The Brushton Electric Light Company, of Brushton, has been incorporated, with a capital of $6500. Directors: R. E. Hiffeman, G. Walter Galsey and W. H. McCarthy, of Brasher Falls.

PHOENIX, N. Y.—A certificate of merger of the Phoenix Electric Company with the Seneca River Power Company has been filed with the Secretary of State. Both companies are incorporated to furnish light, heat and power in Baldwinsville, Phoenix and other villages in Onondaga and Oswego counties.

ST. MARYS, OHIO.—The citizens voted Nov. 28 to issue $20,000 bonds for improvements to the water works and electric light plant.

GENEVA, OHIO.—The City Council is considering the proposition of W. C. Reed, of Bluffton, for the installation of an electric light plant.

NEW CASTLE, PA.—Councilman McCaslin is investigating the cost of a municipal electric light plant.

HOOVERSVILLE, PA.—The Town Council is considering the question of constructing an electric light plant. I. M. Hoover is Borough Clerk.

GREENVILLE, S. C.—Lockwood, Green & Company, of Greenville, are preparing plans for the power development of the Southern Water Power Company.

ORANGE, TEX.—S. C. Tremble, of Hillsboro, has acquired a large interest in the Orange Ice, Light & Water Works Company and has assumed the position of general manager of the plant. Extensive improvements to the electric light system will be made.

SPARTANSBURG, S. C.—It is stated that Ladshaw & Ladshaw, of Spartansburg, have completed plans for the power development on Little Tennessee River, and have submitted the same to the syndicate of which J. S. Bailey & Company, of Waycross, Ga., are leaders. It is proposed by the syndicate to transmit this power to Atlanta, Ga., a distance of 120 miles. The plans include two dams, one 127 ft. high, the other 100 ft. high. In one power house 12 generators will be installed of 2000-kw each; the other will have eight generators of 2000-kw each. The cost of material will be for copper wire, $800,000, and poles, $252,000; the entire cost of development will be about $3,325,000.

WHITEWOOD, S. D.—It is stated that the city will purchase a larger engine for the water works, and an electric light system will be run in connection with the water works.

SAN ANTONIO, TEX.—Mayor John P. Campbell has called an election here on Dec. 19 for the purpose of determining whether $200,000 of bonds shall be issued for the purpose of building a municipal electric light and power plant.

SPRINGFIELD, TENN.—The Springfield Electric Light & Water Company has been organized here with Wm. McMurray, A. B. Porter, G. S. Moore and others as directors. The company asks for a 20-year franchise and proposes to sell its plants to the town if it desires to purchase them between the date of erection and July 1, 1905.

RICHMOND, VA.—The Electric Construction Company, of Richmond, has been awarded the contract for erecting a 300-kw electric light plant at the new pump house of the city. The contract calls for nearly $26,000.

SANTA ROSALIA, MEX.—Paul Ginther, of this place, and associates have made the necessary arrangements for the construction of an electric light and power plant here. It is stated that the work of installation will soon be commenced. The same parties will construct a modern water works system here.

CITY OF MEXICO, MEX.—A number of applications are pending in the department of fomente of the Mexican Government for concessions from parties who desire to establish electric power plants in different parts of the country. Among these proposed plants is one to be located on the Tonoco River in the state of Vera Cruz; another to be located at Xompatzal, in the state of Puebla and another on the Tulo River, in the state of Hidalgo.

The Electric Railway.

BIRMINGHAM, ALA.—The last steam dummy disappeared from Birmingham Nov. 23, when the Birmingham Railway, Light & Power Company put into operation its Powderly electric line between here and Bessemer, a distance of 12 miles.

BISBEE, ARIZ.—The City Council of Bisbee has granted a franchise to J. T. Hood, L. C. Shattuck and Neal Rogers for the construction and operation of an electric railway over the principal streets of this place. The same men propose to construct an electric interurban road between Bisbee and Don Luis.

VOLCANO, CAL.—W. H. Boydston and H. C. Shear, of Volcano, are the chief promoters of a proposed 15-mile interurban road to be built north from Volcano. Estimates on material are now being secured.

ATHENS, GA.—It is stated that the electric road from Athens to Carnesville will be built. Athens has subscribed $10,000 as an inducement for the building of the road which will be 32 miles long. W. F. Brown is the chief surveyor.

ATLANTA, GA.—The Atlanta & Marietta Electric Railway, organized to build an extension of the Georgia Railway & Electric Company's lines to Marietta, has made a mortgage to the Guaranty Trust Company, of New York, as trustee, to secure $600,000 of 5 per cent forty-year gold bonds. The bonds ($100,000) are reserved for additions and improvements.

DECATUR, ILL.—The Decatur Railway & Light Company has been incorporated to operate street railways and light, heat and power plants; capital, $1,300,000. Incorporators: W. B. McKinley, Charles Zilley, R. B. Stephens.

TERRE HAUTE, IND.—The Southern Indiana Railway Co. is surveying for a line from Terre Haute to Chicago Heights, distant about 160 miles.

HUNTINGTON, IND.—Business men of this and nearby cities are agitating the building of an electric railway from Huntington to South Bend. Meetings have been held along the line, and the project has received great encouragement.

WAVERLY, IND.—The Indianapolis & Southwestern Traction Company's line, which is projected to run from Indianapolis through Waverly to Martinsville, will be extended to Linton, Washington and Evansville. The company has recently gone through a reorganization.

WABASH, IND.—The Ft. Wayne & Southwestern Traction Company will undertake to do commercial and public lighting in the towns along the road between Wabash and Ft. Wayne. At Roanoke, Andrews and Lagro the merchants are making contracts for electric lights in their stores and houses. The company can supply the current almost 20 hours out of the 24. It will possibly furnish light for street purposes later on.

DUBUQUE, IA.—Articles of incorporation of the Midland Railway Construction Company, of Dubuque, have been filed. The incorporators and board of directors are Peter Kiene, Henry Kiene, Paul Kiene, Stephen B. Howard and Charles L. Niles.

WINFIELD, KAN.—The City Council has granted a thirty-year franchise to L. H. P. Northrup to construct and operate an electric railway system here. According to the terms of the franchise, an interurban line is to be built to Arkansas City.

MONROE, MICH.—The Detroit, Monroe & Toledo Short Line Railway Company has submitted a proposition for the purchase of the Monroe electric light plant. The purchase will depend upon the granting of a lighting franchise by the town.

MINNEAPOLIS, MINN.—It is reported that Philadelphia and Cleveland capital has been interested in an electric railway to be constructed from Minneapolis south by way of Shakopee, Faribault, Mankato and Albert Lea, Minn., from the latter place to Waterloo, Iowa Falls and Mason City, Ia. George F. Getty, of Minneapolis, is believed to have charge of the negotiations at the Minnesota end of the line, and E. M. Mabie, of Iowa, is promoting the Iowa section of the system.

VICKSBURG, MISS.—The Vicksburg Railway, Power & Mfg. Company has in contemplation the construction of a power plant at Waltersville.

ST. LOUIS, MO.—The Wabash railway system is about to instal long distance telephones all along its entire system. The lines will be the exclusive property of the Wabash Company, and will be operated for its use exclusively.

MEXICO, MO.—A meeting was held here recently to consider building an electric railway from Mexico to Memphis, Mo., for both freight and passenger service. The proposed electric line is to be run through five counties. A temporary company was organized, of which S. M. Locke, of Mexico, was made president.

BRIGANTINE BEACH, N. J.—Vice-Chancellor Emery, at Trenton, N. J., has appointed Richard D. A. Parrott, of Atlantic City, receiver for this company, on application of the Continental Trust Company, trustee, preparatory to foreclosing both the first and second mortgages of $50,000 and $25,000 respectively.

SCHENECTADY, N. Y.—The Schenectady Railway Company is to make important additions to its street railway system by extending lines through the newer portions of the city.

ALBANY, N. Y.—A certificate of incorporation has been filed with the Secretary of State for the Traction Development & Securities Company, of New York City, with a capital of $200,000. The directors are S. B. Manning, Henry Oppenheimer and C. C. Marshall, of New York City.

GENEVA, OHIO.—The Cleveland, Geneva & Meadville Electric Railway Company has applied for a franchise in Geneva for its line which will connect Geneva and Meadville, Pa.

TOLEDO, OHIO.—The Toledo Railways & Light Company is to increase the capacity of the power and lighting plant on Water Street. It is contemplated to add considerable new machinery, both for the operation of street cars and for the lighting system. It is understood the work will be started in a short time.

CLEVELAND, OHIO.—The Shaker Heights & Boulevard Railway Company will be incorporated to build a line through the new section of the city known as Shaker Heights and on to Warrensville. It is proposed to have the cars run to the center of the city over the Cedar Avenue line of the Cleveland Electric Railway, under a traffic arrangement with that company.

CINCINNATI, OHIO.—The Chester Park, Morrow & Red Bank Traction Company has been incorporated by C. E. Roth, J. E. McCracken, A. Autenheimer, W. G. Miners and others, of Cincinnati. Capital stock, $10,000. It is the intention to build a belt line connecting several of the suburban towns near Cincinnati, among them Chester Park, Bond Hill, Norwood, Oakley, Madisonville and Red Bank.

BARNESVILLE, OHIO.—The Barnesville & Woodsfield Electric Railway Company has been incorporated, with $25,000 capital stock, by G. E. Hilles, E. T. Petty, J. W. Laughlin, T. J. Buchanan, J. W. Chappell and W. E. Sharps. The company proposes to build a road from Woddsfield to Barnesville by way of Somerton and Miltonsburg. The company also proposes to supply light, heat and power to the towns through which it will operate. A considerable portion of the stock has been subscribed in the towns along the proposed line.

PORTLAND, ORE.—Articles of incorporation have been filed here by the Portland & St. Johns Railroad Company, with Francis I. McKenna, George W. Cone and William Peddicord comprising the board of directors.

NEWPORT, R. I.—The contract for the construction of the Newport & Providence Railway has been awarded, and work is to be begun at once. The company's lines will only extend to Bristol Ferry, where connections are to be made with existing lines. The road will have about 14 miles of new track.

MEMPHIS, TENN.—It is reported here that the contract has been let by the Shelby County Traction Company for the building of the interurban electric line between Memphis and Colliersville, a distance of 25 miles, to the Westinghouse Company.

NASHVILLE, TENN.—The financing of the 32-mile electric road from Nashville to Lewisburg has been completed. The road will cost $1,000,000. It will be known as the Nashville & Lewisburg Interurban Company. Dr. J. R. Shapard is president, and E. R. Richardson, secretary and treasurer.

MEMPHIS, TENN.—St. Louis capitalists have been granted a franchise for a street railway in Memphis. The new concern will be known as the City Street Railway Company. Corwin H. Spencer, vice-president of the World's Fair Association; J. C. McGaunon and L. G. McNair are the backers. The company is given until Jan. 1 to accept the terms and deposit $50,000 as a guarantee.

MEMPHIS, TENN.—The Legislative Council of Memphis has granted a franchise to the City Street Railway Company for the building and operation of an electric railway in this city. St. Louis and Memphis capitalists are interested in the project, Corwin H. Spencer and L. G. McNair, of St. Louis, being the largest stockholders. The present capitalization is $50,000, but is to be increased to $500,000.

SALT LAKE CITY, UTAH.—It is now practically certain that there will be a formal consolidation within a few weeks of the Utah Light & Power Company and the Consolidated Railway Company. The stockholders of the two companies will meet Dec. 15 and 16 to agree upon the terms of the merger. The consolidated company will then issue new bonds, and will provide for an expenditure of from $250,000 to $300,000 annually until numerous contemplated improvements are completed.

CHARLOTTESVILLE, VA.—The entire plant of the Charlottesville City & Suburban Street Railway Company has been sold at public auction for $50,000, the bondholders being the only bidders, including R. H. Wood and others. The deal includes the local lighting system. The sale was made subject to a mortgage of the Piedmont Construction Company and also to cover a lien on new rails.

MORGANTOWN, W. VA.—The Morgantown & Fairmont Traction Company has been reorganized. It is now known as the Morgantown & Pittsburg Railway Company, with a capital stock of $750,000. The incorporators are J. H. McDermott, Davis Elkins, T. R. Dille and C. R. Dille, of Morgan town, and C. W. Swisher, of Fairmont.

MILTON, WIS.—The Rock River Traction Company has been incorporated to build an electric railway from Janesville to Fond du Lac.

APPLETON, WIS.—W. H. Holcomb, of Chicago, is planning to apply to the Council for a franchise to construct an electric railway here. Mr. Holcomb is said to be interested in a project to build a line from Appleton to New London.

FOND DU LAC, WIS.—Charles D. Smith, president of the Rock River Valley Traction Company, says that his company has purchased the Janesville Street Railway Company's system, and will soon take possession of it and put it into condition for effective service. The company intends to build suburban and interurban lines, one of which is to extend from Janesville by way of Milton, Fort Atkinson, Jefferson, and Watertown to Fond du Lac. Mr. Smith has also had a survey made for an electric road from this city to Ripon and Green Lake. Most of the right of way has been purchased.

VICTORIA, B. C.—Messrs. Grant and Lloyd, of Faribault, Minn., have organized a syndicate for the purpose of building an electric railway in British Columbia, to run from Trout Lake up the Duncan River into the rich timber belts, and tap the Lardo Duncan mining region. It is said that M. B. Webber, D. A. Stewart and W. J. Landon, of Winona, Minn., are among those interested in the syndicate.

PORT ARTHUR, ONT.—Canadian and American capitalists are considering the advisability of building an electric railway to connect Fort William, Port Arthur and Duluth. Power for operating the line will be obtained by developing the Kakabeka Falls.

NEW INDUSTRIAL COMPANIES.

THE TACHER MAGNETIC SHIELD COMPANY, of Jersey City, has been incorporated, capital, $500,000. Incorporators Charles N. King, Le Grand Houker and W. Monds Greene.

THE WINN CONKLIN ELECTRICAL COMPANY, of Jersey City, has been incorporated; capital, $4000. Incorporators James L. Larrowe, Hamilton Anderson and De Witt Conkling.

THE W. S. BROWN COMPANY has been incorporated in New York City to deal in electrical supplies. The capital stock is $500 and the directors are W. S. Brown, E. D. Speer and I. L. Brown, of New York.

LEGAL.

NO MORE WESTERN UNION POLE CHOPPING.—The attorneys of the Pennsylvania Railroad Company and the Western Union Telegraph Company have arrived at an understanding whereby there will be no more chopping down of telegraph poles on the railroad company's right of way. The telegraph company has been ordered to remove its lines from the railway west of Pittsburg. The case will probably be taken to the United States Court of Appeals for decision.

TELEPHONE RATES.—In the case of J. F. Manning & Co., against the Chesapeake & Potomac Telephone Company Justice Barnard, at Washington, D. C., has declared that the act of Congress of June, 1898, fixing the telephone rates for the District does not apply to a service that provides extra equipments, such as desk instruments, etc. The decree is in accord with a recent opinion in which the Justice notified the parties concerned that they had the privilege of taking further depositions as to the reasonableness of the rates fixed by Congress.

OBITUARY.

MR. A. J. BALDWIN.—Andrew J. Baldwin, one of the first constructors of telegraph lines in this country, died in Wilkesbarre, Pa., last week, aged 79. He had the distinction of having laid the first long cable in the United States, a short line of six miles between Wood's Hole and Vineyard Haven. A second cable was laid by him between Monomoy and Grand Point, Nantucket, a distance of twenty-five miles. This line was swept away, but not before it had transmitted its first message, the news of the bombardment of Sebastopol, in 1855.

MR. A. A. HONEY.—Albert A. Honey, of Chicago, is dead from a stroke of paralysis in the Chicago Union Hospital. He was a telegraph operator, beginning when twelve years old with the old Illinois Telegraph Company. He was one of the three operators first employed by the Associated Press in Chicago. Later he entered into the employ of the Union Pacific Railroad Company, and afterward superintended the construction of the lines of the Northern Pacific from Bismarck to the Pacific Coast. Mr. Honey settled in Chicago in 1901, and until within the last six months, when illness necessitated his resignation, was president of the Magnetic Equipment Company, which was developing his inventions for increasing adhesive effect in electric traction. He was one of the organizers of the Old Time Telegraphers' Association.

PERSONAL.

MR. FRANK T. CRAVEN has resigned his position with the C. J. Field Conduit Company to represent the American Conduit Company.

MR. JULIAN S. JACKSON, formerly with the Western Electric Company, will hereafter be in charge of the Chicago office of Pass & Seymour, Inc., as sales agent.

MR. CHARLES BRANDEIS, consulting electrical engineer of Montreal, Can., is sailing on Saturday by the Cunarder *Campania* for Europe, on important business.

MR. B. MAGNUS, formerly superintendent of the refinery and silver mill of the Anaconda Company, is now associated with the Buffalo Smelter Works, at Buffalo, N. Y.

MANAGER KUNZ, of the New York offices, 143 Liberty Street, of the Pelton Water Wheel Company, has gone to Mexico with a view to closing some important contracts in that part of the world.

MR. W. C. ANDREWS, who was at one time connected with the editorial staff of this journal has become associated with the Stanley Instrument Company of Great Barrington, Mass., as engineer to the sales department.

MR. CHARLES F. CUTLER has been elected president of the Central New York Telephone & Telegraph Company, and of the Empire State Telephone Company, at a recent meeting in Utica, N. Y., of the directors of the companies.

HOUGH-BEEKMAN.—Mr. David Leavitt Hough, a well-known engineer in this city and one of the trustees of the Engineers' Club, was married last week to Miss Heloise Beekman, daughter of Mrs. W. B. Beekman, of 55 Fifth Avenue. The honeymoon is being spent in the South.

MR. LAMAR LYNDON, E. E., has just delivered a couple of excellent lectures, with experiments, on the storage battery in automobile work before the Automobile Club of America, at the New York club house. The lectures were heard with much pleasure and profit by the members.

MR. CLEVELAND MOFFETT has had an interesting article on radium and the Curies, in *McClure's Magazine*, which somehow manages to get excellent and timely articles all the time on technical and scientific sensations of the hour. Mr. Moffett spent some weeks in Paris with the Curies and their associates getting up his topic.

MR. S. T. DODD, of the Stanley Electric Manufacturing Company, Pittsfield, Mass., will lecture on "The Evolution of the Electric Railway Motor" before the New York Electrical Society, at 8 P. M., December 16. The meeting will be held at the American Institute, 19 West Forty-fourth Street. The lecture will be profusely illustrated by lantern slides.

MR. LEON W. PULLEN, of Philadelphia, is the inventor of a surface contact "push button" electric railway system which was given a trial last week at Atlantic City, N. J., on the Chelsea branch of the Pennsylvania Railroad. The contacts are saucer shaped and are installed in the center of the track, every 16 feet, or about two to an ordinary car length.

MR. A. J. de B. CORRIVEAU, of Montreal, Can., has been visiting New York. In addition to his electric railway interests, Mr. Corriveau has organized the General Automobile Club of Canada, and has now opened the first automobile garage, established in Montreal. It is quite a fine establishment. Mr. Corriveau has also been arranging for important agencies.

REAR ADMIRAL RAE, U. S. N., the new chief of bureau of steam engineering of the Navy, was guest of honor at a reception given at the Engineers' Club, New York City, on Dec. 2. It was remarkably well attended. The presentations were made by President Kafer. A great many electrical men were present, including Messrs. J. W. Lieb, L. A. Ferguson, A. Dow, R. T. Lozier, B. H. Warren, W. F. Zimmerman, T. C. Martin, E. G. Bernard, J. Barre, E. H. Mullin, E. L. Zalinski, G. H. Day, J. W. Reno, W. H. Wiley.

MR. JOHN B. McCLARY has resigned as manaker of the Street Railway Department of the Birmingham Railway, Light & Power Company, of Birmingham, Ala., his resignation to take effect January 1. Mr. McClary has been connected with street railways in Birmingham more than sixteen years, surviving several changes in ownership. Mr. McClary has announced that he will go into business for himself, but has not divulged the line of work. His successor will be Mr. Geo. H. Harris, the present traffic manager of the company.

MR. H. F. J. PORTER, who has been associated with Westinghouse interests since the first of the year and has held the position of assistant manager of the Publishing department with offices in East Pittsburg and New York, has been made second vice-president of the Nernst Lamp Company, of which enterprise Mr. George Westinghouse is president, with the duties of general manager and headquarters at Pittsburg. He assumed charge on Dec. 1. This appointment does not affect Mr. Porter's relations with the publishing department.

U. S. SENATOR CLARK, of Montana, and of the Wayclark Wire Company, is quoted as follows, in an interview about himself and copper: "One billion pounds of copper is taken from the ground annually. Of this 25 per cent. comes from Montana. I am the largest individual owner of copper mines in the world. I produce about 75,000,000 pounds a year. No, I don't think there will be any period in the near future when copper will be scarce, but one can never tell. There is no great amount of copper stored. The consumption each year about equals the production. The world is not getting ahead very much in copper. It is a mineral that cannot be overlooked, and there is more demand for it every day."

MR. LOUIS J. MAGEE, who for some fifteen years past has been prominently identified with electrical engineering and manufacturing in Germany, has returned to this country. He was early connected with the old Thomson-Houston Company and was one of the first representatives abroad of American electrical interests. At the present time he is a director in both the Allgemeine Elektricitats-Gesellschaft and the Union Elektricitats-Gesellschaft, of Berlin, and will now be their agent in the United States. He has opened an office at 25 Broad Street, New York City, and has already renewed with pleasure a great many old acquaintanceships. His health of late years has not been very robust, but the climate here suits him and, to say the least, is more sunny and genial than that of the German capital in the latitude of Labrador. Mr. Magee is quite an acquisition to local electrical circles.

DR. J. A. FLEMING, professor of electrical engineering in University College, London, concludes in *The Popular Science Monthly* for December his important series of articles on "Wireless Telegraphy." He says: "It has been often contended that whilst cables could be cut in time of war no one can cut the ether; but wireless telegraph stations in exposed situations on high promotories, where they are visible for ten to fifteen miles out at sea and undefended by any forts, could easily be destroyed. The great towers which are essential to carry large aerials are a conspicuous object for ten miles out at sea; and a single well-placed shell from a six-inch gun would wreck the place and put the station completely out of use for many months. Hence, if oceanic telegraphy is ever to be conducted in a manner in which the communication will be inviolable or, at any rate, not be capable of interruption by acts of war, the careful selection of sites for stations is a matter of importance."

MR. T. W. VARLEY.—Last Saturday evening, Dec. 5, a surprise dinner was given Mr. Thomas W. Varley at the Cafe Martin, by his old-time friends and associates of the New York Edison Company. The following gentlemen were present: Messrs. T. W. Varley, W. H. Lawrence, A. H. Ackerman, S. C. Harris, W. J. Kelly, C. H. B. Chapin, S. G. Rhodes, W. J. Chisholm, W. M. Wimpie, F. V. Magalhaes, W. T. Russell, Frank W. Wearin, A. C. Rabe, M. P. Ryder, Frank Martin, C. Van Dyck See, R. H. Willmont, Edward Durant, E. B. Powell, G. Moore, W. H. Cordell, W. H. Hill, S. D. Sprong. Mr. Varley resigned as engineer of the testing department for the New York Edison Company to accept a more lucrative position with the Boston office of the Westinghouse Electric & Manufacturing Company. Mr. Varley is a comparatively young man in the profession, and his success is due to ability and continuity of purpose. In this country he introduced a system by means of which the voltage or drop at the extreme end of an electric light circuit can be read from the mains at the power-house. This obviates the necessity of maintaining many extra "pressure wires." The Varley ground detector also locates faults on very high tension circuits while the cable is in service. His latest achievement, the Varley rotating voltmeter, gives a true reading while the meter is near a large generator where magnetic disturbances are liable to be a maximum. Kent's Pocket Book acknowledges assistance received from Mr. Varley in its compilation. Mr. Richard Varley, of Providence, R. I., the designer of improved electro magnets, is his brother.

Trade Notes.

BULLOCK ELECTRIC MFG. COMPANY, of Cincinnati, Ohio, has issued a handsome biographical calendar for December, bearing the portrait of Prof. Louis Agassiz.

BALL & WOOD COMPANY, the engine builders of Elizabeth, N. J., with headquarters in New York have now opened a Chicago office at 1247 Marquette Building, that city.

THE ELECTRIC APPLIANCE COMPANY, Chicago, refers to its Zenith lamps for the Christmas trade and reports that it has a big Chicago stock, so that it can make prompt shipments.

PLUMBAGO CRUCIBLES.—The McCullough-Dalzell Crucible Company, of Pittsburg, Pa., has issued a neat catalogue with handsome cover devoted to its various crucibles and allied apparatus, including fine dust plumbago, etc.

BROWN & SHARPE MFG. COMPANY, of Providence, R. I., has issued a handsome catalogue of its "Mechanical Machinists Tools." The catalogue under this name and numbered 105 is devoted to rules, squares, micrometer calipers, gauges and accurate test tools and is a handsome illustrated pamphlet of over 150 pages.

NORTHERN ENGINEERING WORKS, of Detroit, Mich., have just issued their crane catalogue, No. 18, intended to supplement their general crane catalogue No. 15. It is devoted more specifically to cranes for power plants, pumping stations, etc., and is of interest to engineers who design and construct power plants of all kinds.

KINSMAN ELECTRIC & RAILWAY SUPPLY COMPANY, 91 Liberty St., New York City, is putting a number of excellent specialties on the market. Among these may be mentioned its "Improved Daylight Desk Lamp" and its "Automobile Cable." Mr. Kinsman is not only a man of experience in the art but an inventor of great ability.

WOODWARD GOVERNOR COMPANY, of Rockford, Ill., has issued a descriptive illustrated catalogue devoted to its compensating type of governor for waterwheels, two models of which are intended for electric light, power and railway service. There is also a standard type for mill and factory use. Views of electrical installations are shown.

HYATT FLEXIBLE ROLLER.—The Hyatt Roller Bearing Company, of Harrison, N. J., has issued Bulletin No. 20 on the subject of its bearing as specially adapted to heavy loads at slow speeds, as on cranes, shop trucks, etc. Other bulletins of like nature deal with specific cases in other fields of work. The bulletin is illustrated and is fully descriptive.

TRUMBULL ELECTRIC MFG. COMPANY, of Plainville, Conn., is selling in large quantities its new "Ideal" cord adjuster for incandescent lamps. It consists of a rosette or block with a groove in the base, through which a cord passes with a clip on one end, which can easily be attached to any standard socket and is counterbalanced by a weight. All strain is taken from the lamp cord.

STROMBERG & CARLSON.—The Stromberg & Carlson Telephone Mfg. Company, of Chicago, has just issued in usual handsome form Bulletin No. 8, devoted to its non-multiple central energy switchboards. The boards are most elaborately and instructively described in detail, and all the parts are exhibited in excellent cuts. A feature of the catalogue is the presentation of the boards by diagram with dimensions as well as in half tones. These are great aids to an understanding of the construction and operation of the boards.

THE BISSELL COMPANY, Toledo, Ohio, has added three bulletins to its perpetual catalogue. One is devoted entirely to wires, cables and cordage; another to electroliers and chandeliers, and the third to motor starters and controllers. Each bulletin is very fully illustrated, and covers its specific subject in a very thorough manner. Tables give prices and code words of each article, and information relating to the goods is complete.

AMERICAN CIRCULAR LOOM COMPANY, of Boston, has issued to its friends a very pretty and timely panel picture for Thanksgiving, illustrative of the anniversary in the past and as it is now. The Puritan of olden days shoots his wild turkey—mighty good eating—and in contrast is the fat well-fed bird due to the modern growth of turkey culture and industrial prosperity.

COLUMBUS STORAGE BATTERY COMPANY, of Columbus, Ohio, has just issued an interesting new catalogue which lists its various types of cells and contains in addition a short treatise on the use and care of storage batteries. This is the Company's third catalogue to the electrical trade. The Columbus battery has been installed in a number of electric lighting plants, has been adopted in the telephone field, and is largely used for ignition purposes on stationary and automobile gas engines. The catalogue is illustrated and gives dimensions, capacities and prices.

THE THOMPSON-BONNEY COMPANY, 45 York Street, Brooklyn, has added to its already extensive business a new department for the sale of second-hand electrical machinery. This branch of the business will be in charge of Mr. R. B. Corbett, for many years well and favorably known in this branch of the electrical industry. A full line of electrical machinery of all types, and to suit all conditions, will be carried in stock. The Thompson-Bonney Company still retains the agency for the Fairbanks, Morse machines and is continually enlarging its repair and experimental departments.

"WATER METERS" is the title of a pamphlet just received from the Henry R. Worthington Company, whose new disc meter is described and illustrated with cuts showing the internal construction. The pamphlet also describes the standard duplex piston meter and the Worthington hot-water meter for boiler testing. The latter device has been found of great value in boiler plants for checking up the evaporative values of different kinds of coal, the efficiency of firemen, etc. This pamphlet is an innovation in the way of small leaflets. It is of the standard size for enclosure with letters 3½x6 inches, but instead of being printed upon ordinary coated paper, a high grade of tinted enamel cardboard is used, rendering the pages much more durable to handle. The pamphlet is well worth the asking.

DYNAMO FIELD RHEOSTATS.—The Wirt Electric Company, Philadelphia, Pa., through its sales department, 180 Broadway, New York City, has just issued a series of circulars and price lists of various devices produced by this well-known concern. The list includes dynamo field rheostats, special rheostats, theatre dimmers and battery charging rheostats, all of which apparatus are illustrated by several cuts. The construction of the theatre dimmer is well described. The circulars contain a great deal of crystallized information on the subjects covered. The cover of one of the pamphlets contains an embossed representation of a rheostat hand wheel, in bronze colors, which is very realistic.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 1, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

744,771. VOLTAGE REGULATOR; Alexis Le Blanc, New York, N. Y. App. filed Feb. 18, 1903. A charging switch and voltage regulator especially adapted for charging a storage battery from a small dynamo used on an automobile to supply the ignition spark. An electro-magnet in the main circuit varies the pressure upon the surface of a body of mercury to vary the extent of immersion of a resistance pencil.

745,336. COMMUTATOR BAR; William L. R. Emmet, Schenectady, N. Y. App. filed May 10, 1900. The sides of the bar are roughened to take hold of the insulation and thus solidify the commutator structure.

745,341. SWITCHING APPARATUS FOR TELEPHONIC OR OTHER SWITCHBOARDS; Frederic W. Francis, London, England. App. filed Aug. 12, 1901. Details.

745,342. ANSWERING AND RECORDING TELEPHONE; Theodore D. Freese and Carl J. Freese, Elyria, Ohio. App. filed Nov. 22, 1902. (See page 971.)

745,347. AUTOMATIC CIRCUIT BREAKER; Edward M. Hewlett, Schenectady, N. Y. App. filed April 5, 1900. Comprises fixed terminals, a straight gravitating connector, an automatic release device and an insulated tubular inclosure for the connector, connecting the terminals, forming a closed chamber when the plug is inserted.

745,348. CIRCUIT BREAKER; Edward M. Hewlett and Charles C. Badeau, Schenectady, N. Y. App. filed April 27, 1901. A circuit breaker having a pivoted tripping coil adapted to swing outwardly from the base when the circuit breaker is tripped, and main and shunt contacts on opposite sides of its axis.

745,367. ELECTRODE FOR ELECTRIC TUBE LAMPS; Daniel M. Moore, Newark, N. J. App. filed Feb. 26, 1903. To adapt the lamp for alternating currents the terminal electrodes each consist of an anode and a cathode.

745,370. ELECTRIC CIRCUIT CLOSER AND BREAKER; Thomas E. McQuon, Biggsville, Ill. App. filed Sept. 26, 1902. Details.

745,378. ELECTROLYTIC REFINING OF ZINC; Heinrich Paweck, Vienna, Austria-Hungary. App. filed March 7, 1902. (See page 971.)

745,379. MEANS FOR PROTECTING ELECTRICAL WINDINGS FROM STATIC STRAINS; John Pearson, Somerset, Wis., and Frederick R. McCutcheon, St. Paul, Minn. App. filed June 13, 1902. A subsidiary circuit connected at various points with the main winding contains a conductor adapted to carry abnormal voltages, but non-conductive to normal voltages.

745,382. ELECTRIC RAILWAY; William B. Potter, Schenectady, N. Y. App. filed Aug. 2, 1901. Details of a sectional conductor system.

745,383. SECTIONAL THIRD RAIL SYSTEM; William B. Potter, Schenectady, N. Y. App. filed April 23, 1902. The current for actuating the switches to direct main current into the sections of the third rail, is carried on a light overheal conductor.

745,388. TELEPHONE SYSTEM; Georg Ritter, Stuttgart, Germany. App. filed Aug. 16, 1898. (See page 971.)

745,412. ELECTRODE; Henry Blackman, New York, N. Y. App. filed Dec. 8, 1896. (See page 971.)

745,427. ELECTRIC ARC LAMP; Hubert Emonds, Aix-La-Chapelle, Germany. App. filed May 14, 1903. An electro-magnetically actuated pump removes superfluous oxygen from the arc inclosing chamber.

745,436. ELECTRIC RAILWAY SYSTEM; Frederic W. Hild, Schenectady, N. Y. App. filed April 28, 1900. Switches which control the current to the sectional conductor are arranged in groups and means are provided so that when a switch is closed, its coil is open circuited but the switch remains closed independently of its coil.

745,447. ELECTRIC IGNITER FOR LAMPS; August L. Lind, Stockholm, and Carl H. Carlsson, Liljeholmen, Sweden. App. filed April 18, 1903. Details.

745,461. ALTERNATING CURRENT METER; George Stern and Albert Lotz, Charlottenburg, Germany. App. filed April 30, 1901. A body of good conducting material adjustably mounted in the path of the flux of one of the meter windings and so placed that no turning moment will be produced thereby on the armature, the body being so mounted that it may be moved laterally with reference to the said winding so as to include more or less of the lines of force created by the winding.

745,463. WIRELESS TELEGRAPH RECEIVER; Gustaf T. Seenson, near San Pedro, Cal. App. filed Dec. 23, 1902. The relay is a carbon pencil having a gyratory motion upon a plain surface.

745,479. ANODE-HOOK; Frank W. Cann, Brooklyn, N. Y. App. filed April 9, 1902. (See page 971.)

745,488. MEANS FOR OPERATING ELECTRIC SIGNS; William Goltz, Chicago, Ill. App. filed Dec. 11, 1902. Instead of making and breaking the circuit between the contacts of the switch, a dimming resistance is introduced, thus avoiding sparking.

745,493. PLUG FUSE; John H. Hanson, Chicago, Ill. App. filed July 31, 1903. Details.

745,494. FIXTURE FOR TERMINAL BOXES; Harry A. Hoagland, Chicago, Ill. App. filed June 29, 1903. The chandelier is suspended from a ball joint in the box.

745,502. COMBINED TROLLEY AND AIR BRAKE CONTROLLER; James Kynoch, Toronto, Canada. App. filed April 20, 1903. When the trolley wheel leaves the wire, the air brakes of the car are automatically applied.

745,507. ELECTROTHERMIC VENTILATOR; Frederic De Mare, Brussels, Belgium. App. filed June 16, 1902. The passage through which a fan drives air contains electric heating coils.

745,523. TELEPHONE SYSTEM; Georg Ritter, Stuttgart Germany. App. filed Dec. 24, 1897. (See page 971.)

745,534. ELECTRICAL ELEVATOR; Rudolph C. Smith, Yonkers, N. Y. App. filed June 14, 1901. A multipolar motor and switching mechanism for arranging the field with adjacent or alternate poles and for changing from single parallel two-brush connection to double parallel four-brush connection.

745,579. TELEPHONE EXCHANGE SYSTEM; William W. Dean, Chicago, Ill. App. filed May 9, 1901. (See page 971.)

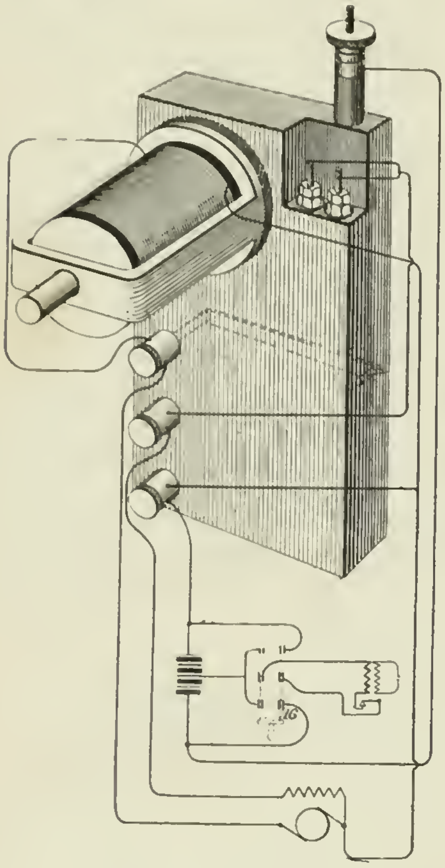
745,588. ELECTROLYTIC APPARATUS; Henry B. Ford, New York, N. Y. App. filed May 11, 1903. (See page 971.)

745,600. ELECTRIC CIGAR LIGHTING DEVICE; John W. Gray, San Francisco, Cal. App. filed April 20, 1903. Details.

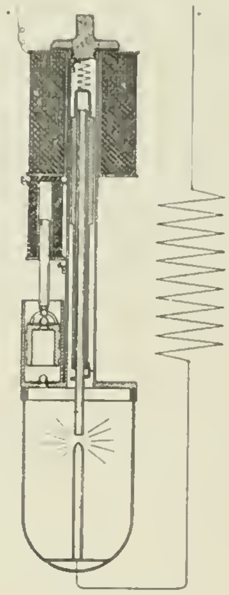
745,604. SECONDARY BATTERY; Gustave K. Hartung, New York, N. Y. App. filed Sept. 16, 1903. (See page 971.)

745,614. TROLLEY; Henry Holland, Detroit, Mich. App. filed Nov. 11, 1902. A spring plate bears directly against the wheel and the harp to carry the current.

745,622. ELECTRIC ARC LAMP; Randolph Hulsart, Brooklyn, N. Y. App. filed March 20, 1903. Details.



744,771.—Voltage Regulator.



745,427.—Electric Arc Lamp.

745,637. PROCESS OF PRODUCING CARBON CHLORIDS AND SILICON; Florentine Joseph Machalske, Brooklyn, N. Y. (See page 971.)

745,682. ELECTRICAL WATER HEATER; Milton H. Shoenberg, San Francisco, Cal. App. filed June 29, 1903. An attachment for water outlets consisting of an outgoing and return passage containing an electric heater whereby the water from the source can be sent through the passages, heated and returned to the regular outlet.

745,683. AIR PUMP GOVERNOR; Samuel B. Stewart, Jr., Schenectady, N. Y. App. filed June 21, 1901. An essential feature consists in storing energy in a freely movable contact while the pressure is fluctuating, which at a determinate position acts to open the circuit with great rapidity, as distinguished from a lock which prevents the movement of the contact until a definite position is reached.

745,687. METHOD OF BALANCING RELAYS; Henry M. Sutton, Walter L. Steele and Michael Coerver, Dallas, Tex. App. filed Aug. 15, 1902. Consists in suspending a polarized armature in the field of mutually repellant magnets, one of which is wound with divisions of the circuit extending in opposite directions around the core.

745,692. TELAUTOGRAPH; George S. Tiffany, Brooklyn, N. Y. App. filed Dec. 20, 1900. The transmitting tracing implement controls the motions of the receiving pen independently of any movement of the transmitting, writing platen.

745,694. FUSE BLOCK; Milton R. Utley and Benjamin J. Clements, Chicago, Ill. App. filed July 11, 1903. A fuse block containing an indicator to show when the fuse is destroyed.

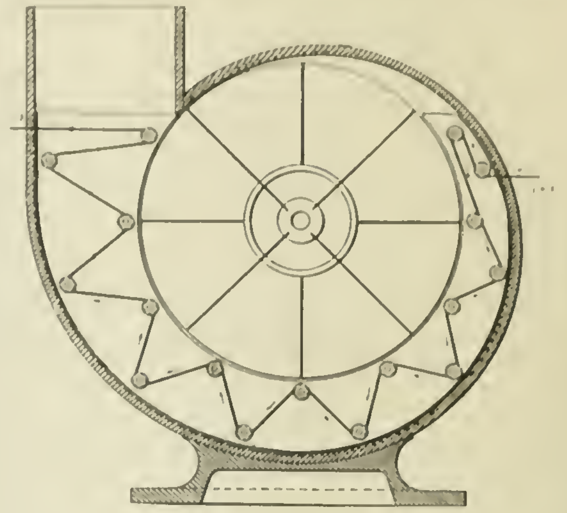
745,715. MEANS FOR MODIFYING HIGH POTENTIAL ELECTRIC CURRENTS FOR LOW POTENTIAL USE; Herbert L. Carpenter, Brooklyn, N. Y. App. filed May 15, 1903. Automatic means for preventing abnormally high potential currents on the main circuit from existing on the secondary or modified circuit.

745,759. RESISTING DEVICE; George Baehr, McKeesport, Pa. App. filed Aug. 6, 1902. A flat resistance strip is wound into a helix with interposed insulating material and its terminals connected with binding posts at the hub and rim, thus forming a resistance unit.

745,760. LEVER CONTROLLER; George Baehr, McKeesport, Pa. App. filed Aug. 6, 1902. A pivoted actuating lever and a pivoted switch blade are connected together by a stud and slot in such a manner as to give quick movement to the switch lever.

745,763. ELECTRICALLY CONTROLLED MOTOR STOPPING APPARATUS; Bertus G. Barlow, Manchester, N. H. App. filed June 16, 1903. An electro-magnetic device for actuating the throttle of an engine in emergencies.

745,772. INDUCTION MOTOR; Donald M. Bliss, Brookline, Mass. App. filed Aug. 17, 1903. The secondary member has two independent systems of inductors, one of high resistance and the other of low resistance, the starting current is introduced into the former and after the machine speeds up the current is directed into the latter, thus making it possible to use a comparatively small starting current.



745,507. Electrothermic Ventilator.

745,778. CONTACT BOX FOR ELECTRIC RAILWAYS; William M. Brown, Johnstown, Pa. App. filed Dec. 6, 1902. The electrodes are in a cup and an arc guard is arranged to prevent the deposit of a conducting coating on the adjoining surfaces.

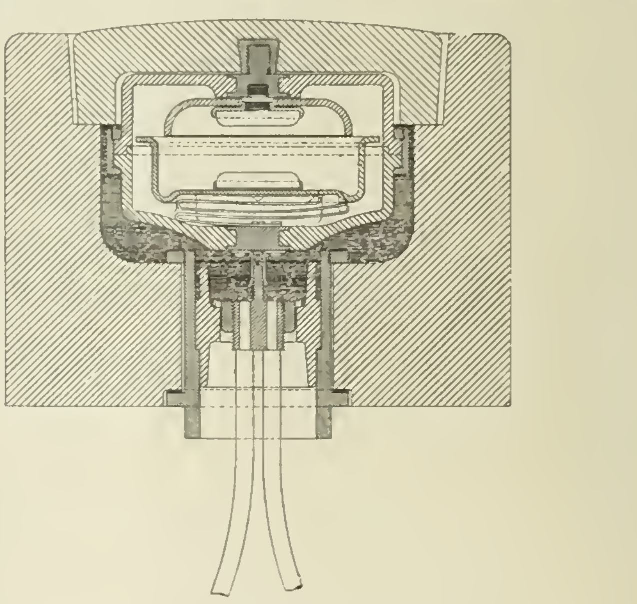
745,830. CAR LIGHTING SYSTEM; Robert F. Hall, Moseley, England. App. filed May 29, 1903. Details.

745,863. METHOD OF MELTING GLASS; Julius T. C. Kessmeier, Washington. App. filed Nov. 14, 1902. (See page 971.)

745,899. AUTOMATIC CUT OUT FOR ELECTRIC LIGHT CIRCUITS; Ralph J. Patterson, Waterville, Me. App. filed April 25, 1902. An abnormal condition on the circuit causes an electro-magnet to successively interrupt the circuit through a quick-action switch, such interruptions serving to indicate the abnormal condition.

745,926. CONTROLLER FOR ALTERNATING CURRENT MOTORS; August Sundh, Yonkers, N. Y. App. filed Aug. 5, 1903. The invention consists in the combination of an alternating current induction motor with a single controlling electro-magnet in shunt circuit therewith and hence energized by the alternating current.

745,929. ELECTRIC DISTRIBUTING SYSTEM; Rene Thury, Geneva, Switzerland. App. filed July 25, 1903. A device for limiting the differences of tension which may arise between the frames of the generators and other apparatus of the distributing system, consisting of two resistances having a neutral point connected to the masses of the apparatus which are to be protected against high static charges, the resistances being connected to the poles of the apparatus to be protected.



745,778.—Contact Box for Electric Railways.

745,958. MANUFACTURE OF SODIUM; Thomas Ewan, Glasgow, Scotland. App. filed April 18, 1903. (See page 971.)

745,966. PROCESS OF PRODUCING SILICON CHLORIDS, HYDROCHLORIC ACID, AND ALKALI HYDROXIDS; Florentine Joseph Machalske, Chicago, Ill. App. filed Oct. 9, 1902. (See page 971.)

745,969. ELECTRIC FUSE HOLDER; James B. McCarthy, Detroit, Mich. App. filed Dec. 3, 1902. Open passages are provided at the heads of the tube to permit the escape of smoke and gases.

THE ELECTRICAL WORLD AND ENGINEER'S

MOONLIGHT TABLES FOR 1904

COMPILED BY H. W. FRUND

These schedules are made up on local mean time. Where standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made.

JANUARY, 1904

Table No. 1. Frund's Moonlight System.

Date	Light.	Date.	Exting.
1	5.15 P.M.	1	12.00 M.
2	5.15 "	2	12.00 "
3	5.15 "	3	12.00 "
4	5.15 "	4	12.00 "
5	5.15 "	5	12.00 "
6	5.15 "	6	12.00 "
7	5.15 "	7	12.00 "
8	5.20 "	9	12.30 A.M.
9	5.20 "	10	1.40 "
10	5.20 "	11	2.40 "
11	5.20 "	12	3.40 "
12	5.20 "	13	4.40 "
13	5.25 "	14	6.20 "
14	5.25 "	15	6.20 "
15	5.25 "	16	6.20 "
16	5.25 "	17	6.20 "
17	5.25 "	18	6.20 "
18	5.30 "	19	6.20 "
19	5.30 "	20	6.15 "
20	5.30 "	21	6.15 "
21	5.30 "	22	6.15 "
22	5.35 "	23	6.15 "
23	5.35 "	24	6.15 "
24	5.35 "	25	6.15 "
25	5.35 "	26	6.15 "
26	5.40 "	26	12.00 M.
27	12.55 A.M.	27	6.10 A.M.
27	5.40 P.M.	27	12.00 M.
28	2.00 A.M.	28	6.10 A.M.
28	5.40 P.M.	28	12.00 M.
29	5.40 "	29	12.00 "
30	5.45 "	30	12.00 "
31	5.45 "	31	12.00 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	4.15 A.M.	1	6.20 A.M.
2	No light.	2	No light.
3	No light.	3	No light.
4	5.15 P.M.	4	7.50 P.M.
5	5.15 "	5	9.05 "
6	5.15 "	6	10.15 "
7	5.15 "	7	11.25 "
8	5.20 "	9	12.30 A.M.
9	5.20 "	10	1.40 "
10	5.20 "	11	2.40 "
11	5.20 "	12	3.40 "
12	5.20 "	13	4.40 "
13	5.25 "	14	6.20 "
14	5.25 "	15	6.20 "
15	5.25 "	16	6.20 "
16	5.25 "	17	6.20 "
17	5.25 "	18	6.20 "
18	5.30 "	19	6.20 "
19	5.30 "	20	6.15 "
20	5.30 "	21	6.15 "
21	5.30 "	22	6.15 "
22	9.00 "	23	6.15 "
23	10.00 "	24	6.15 "
24	10.55 "	25	6.15 "
25	11.55 "	26	6.15 "
26	—	—	—
27	12.55 A.M.	27	6.10 A.M.
28	2.00 "	28	6.10 "
29	3.00 "	29	6.10 "
30	4.00 "	30	6.10 "
31	No light.	31	No light.

FEBRUARY, 1904

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.45 P.M.	1	12.00 M.
2	5.45 "	2	12.00 "
3	5.45 "	3	12.00 "
4	5.50 "	4	12.00 "
5	5.50 "	5	12.00 "
6	5.50 "	6	12.00 "
7	5.50 "	8	1.35 A.M.
8	5.55 "	9	2.35 "
9	5.55 "	10	3.30 "
10	5.55 "	11	4.25 "
11	5.55 "	12	5.10 "
12	6.00 "	13	6.00 "
13	6.00 "	14	6.00 "
14	6.00 "	15	5.55 "
15	6.00 "	16	5.55 "
16	6.05 "	17	5.55 "
17	6.05 "	18	5.55 "
18	6.05 "	19	5.50 "
19	6.05 "	20	5.50 "
20	6.10 "	21	5.50 "
21	6.10 "	22	5.45 "
22	6.10 "	23	5.45 "
23	6.10 "	24	5.45 "
24	6.15 "	24	12.00 M.
25	12.45 A.M.	25	5.45 A.M.
25	6.15 P.M.	25	12.00 M.
26	1.45 A.M.	26	5.40 A.M.
26	6.15 P.M.	26	12.00 M.
27	6.15 "	27	12.00 "
28	6.20 "	28	12.00 "
29	6.20 "	29	12.00 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	No light.	1	No light.
2	5.45 P.M.	2	7.50 P.M.
3	5.45 "	3	9.05 "
4	5.50 "	4	10.15 "
5	5.50 "	5	11.25 "
6	5.50 "	7	12.30 A.M.
7	5.50 "	8	1.35 "
8	5.55 "	9	2.35 "
9	5.55 "	10	3.30 "
10	5.55 "	11	4.25 "
11	5.55 "	12	5.10 "
12	6.00 "	13	6.00 "
13	6.00 "	14	6.00 "
14	6.00 "	15	5.55 "
15	6.00 "	16	5.55 "
16	6.05 "	17	5.55 "
17	6.05 "	18	5.55 "
18	6.05 "	19	5.50 "
19	6.05 "	20	5.50 "
20	6.05 "	21	5.50 "
21	9.45 "	22	5.50 "
22	10.45 "	23	5.45 "
23	11.45 "	24	5.45
24	—	—	—
25	12.45 A.M.	25	5.45 "
26	1.45 "	26	5.40 "
27	2.40 "	27	5.40 "
28	3.30 "	28	5.40 "
29	4.20 "	29	5.35 "

MARCH, 1904

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	6.20 P.M.	1	12.00 M.
2	6.20 "	2	12.00 "
3	6.20 "	3	12.00 "
4	6.25 "	4	12.00 "
5	6.25 "	5	12.00 "
6	6.25 "	7	12.20 A.M.
7	6.25 "	8	1.20 "
8	6.30 "	9	2.20 "
9	6.30 "	10	3.10 "
10	6.30 "	11	3.55 "
11	6.30 "	12	4.35 "
12	6.30 "	13	5.10 "
13	6.30 "	14	5.10 "
14	6.35 "	15	5.15 "
15	6.35 "	16	5.15 "
16	6.35 "	17	5.15 "
17	6.35 "	18	5.10 "
18	6.40 "	19	5.10 "
19	6.40 "	20	5.05 "
20	6.40 "	21	5.05 "
21	6.40 "	22	5.05 "
22	6.40 "	23	5.00 "
23	6.45 "	24	5.00 "
24	6.45 "	25	4.55 "
25	6.45 "	26	4.55 "
26	6.45 "	26	12.00 M.
27	2.10 A.M.	27	4.55 A.M.
27	6.45 P.M.	27	12.00 M.
28	6.50 "	28	12.00 "
29	6.50 "	29	12.00 "
30	6.50 "	30	12.00 "
31	6.50 "	31	12.00 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	No light.	1	No light.
2	6.20 P.M.	2	7.50 P.M.
3	6.20 "	3	9.00 "
4	6.25 "	4	10.10 "
5	6.25 "	5	11.20 "
6	6.25 "	7	12.20 A.M.
7	6.25 "	8	1.20 "
8	6.25 "	9	2.20 "
9	6.30 "	10	3.10 "
10	6.30 "	11	3.55 "
11	6.30 "	12	4.35 "
12	6.30 "	13	5.10 "
13	6.30 "	14	5.10 "
14	6.35 "	15	5.15 "
15	6.35 "	16	5.15 "
16	6.35 "	17	5.15 "
17	6.35 "	18	5.10 "
18	6.40 "	19	5.10 "
19	6.40 "	20	5.05 "
20	6.40 "	21	5.05 "
21	6.40 "	22	5.05 "
22	10.40 "	23	5.00 "
23	11.35 "	24	5.00 "
24	—	—	—
25	12.30 A.M.	25	4.55 "
26	1.20 "	26	4.55 "
27	2.10 "	27	4.55 "
28	2.55 "	28	4.55 "
29	3.35 "	29	4.55 "
30	No light.	30	No light.
31	No light.	31	No light.

APRIL, 1904

Table No. 1. Frund's Moonlight System.

Date	Light.	Date.	Exting.
1	6.50 P.M.	1	12.00 M.
2	6.55 "	2	12.00 "
3	6.55 "	3	12.00 "
4	6.55 "	4	12.00 "
5	6.55 "	6	1.00 A.M.
6	6.55 "	7	1.50 "
7	7.00 "	8	2.30 "
8	7.00 "	9	3.10 "
9	7.00 "	10	3.45 "
10	7.00 "	11	4.20 "
11	7.00 "	12	4.30 "
12	7.05 "	13	4.30 "
13	7.05 "	14	4.25 "
14	7.05 "	15	4.25 "
15	7.05 "	16	4.25 "
16	7.05 "	17	4.25 "
17	7.10 "	18	4.20 "
18	7.10 "	19	4.20 "
19	7.10 "	20	4.20 "
20	7.10 "	21	4.15 "
21	7.10 "	22	4.15 "
22	7.15 "	23	4.15 "
23	7.15 "	23	12.00 M.
24	12.50 A.M.	24	4.15 A.M.
24	7.15 P.M.	24	12.00 M.
25	1.30 A.M.	25	4.10 A.M.
25	7.15 P.M.	25	12.00 M.
26	7.15 "	26	12.00 "
27	7.20 "	27	[illegible] "
28	7.20 "	28	12.00 "
29	7.20 "	29	12.00 "
30	7.20	[illegible]	12.00 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	6.50 P.M.	1	9.00 P.M.
2	6.55 "	2	10.00 "
3	6.55 "	3	11.10 "
4	6.55 "	5	12.10 A.M.
5	6.55 "	6	1.00 "
6	6.55 "	7	1.50 "
7	7.00 "	8	2.30 "
8	7.00 "	9	3.10 "
9	7.00 "	10	3.45 "
10	7.00 "	11	4.20 "
11	7.00 "	12	4.30 "
12	7.05 "	13	4.30 "
13	7.05 "	14	4.25 "
14	7.05 "	15	4.25 "
15	7.05 "	16	4.25 "
16	7.05 "	17	4.25 "
17	7.10 "	18	4.20 "
18	7.10 "	19	4.20 "
19	7.10 "	20	4.20 "
20	10.30 "	21	4.15 "
21	11.20 "	22	4.15 "
22	—	—	—
23	12.10 A.M.	23	4.15 "
24	12.50 "	24	4.15 "
25	1.30 "	25	4.10 "
26	2.10 "	20	4.10 "
27	2.50 "	27	4.10 "
28	No light.	28	No light.
29	No light.	29	No light.
30	7.20 P.M.	30	8.50 P.M.

MAY, 1904

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.20 P.M.	1	12.00 M.
2	7.25 "	2	12.00 "
3	7.25 "	3	12.00 "
4	7.25 "	5	12.30 A.M.
5	7.25 "	6	1.10 "
6	7.25 "	7	1.50 "
7	7.30 "	8	2.20 "
8	7.30 "	9	2.50 "
9	7.30 "	10	3.20 "
10	7.30 "	11	3.50 "
11	7.30 "	12	3.50 "
12	7.35 "	13	3.50 "
13	7.35 "	14	3.50 "
14	7.35 "	15	3.50 "
15	7.35 "	16	3.45 "
16	7.35 "	17	3.45 "
17	7.35 "	18	3.45 "
18	7.40 "	19	3.45 "
19	7.40 "	20	3.45 "
20	7.40 "	21	3.40 "
21	7.40 "	22	3.40 "
22	7.40 "	23	3.40 "
23	7.45 "	24	3.40
24	7.45 "	24	12.00 M.
25	1.20 A.M.	25	3.40 A.M.
25	7.45 P.M.	25	12.00 M.
26	7.45 "	26	12.00 "
27	7.45 "	27	12.00 "
28	7.45 "	28	12.00 "
29	7.45 "	29	12.00 "
30	7.50 "	30	12.00 "
31	7.50 "	31	12.00 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.20 P.M.	1	9.50 P.M.
2	7.25 "	2	10.50 "
3	7.25 "	3	11.40 "
4	7.25 "	5	12.30 A.M.
5	7.25 "	6	1.10 "
6	7.25 "	7	1.50 "
7	7.30 "	8	2.20 "
8	7.30 "	9	2.50 "
9	7.30 "	10	3.20 "
10	7.30 "	11	3.50 "
11	7.30 "	12	3.50 "
12	7.35 "	13	3.50 "
13	7.35 "	14	3.50 "
14	7.35 "	15	3.50 "
15	7.35 "	16	3.45 "
16	7.35 "	17	3.45 "
17	7.35 "	18	3.45 "
18	7.40 "	19	3.45 "
19	7.40 "	20	3.45 "
20	10.50 P.M.	21	3.40 "
21	11.30 "	22	3.40
22	—	—	—
23	12.10 A.M.	23	3.40 A.M.
24	12.50 "	24	3.40 "
25	1.20 "	25	3.40 "
26	2.00 "	26	3.40 "
27	2.40 "	27	3.40
28	No light.	28	No light.
29	No light.	29	No light.
30	7.50 P.M.	30	9.30 P.M.
31	7.50 "	31	10.20 "

JUNE, 1904

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.50 P.M.	1	12.00 M.
2	7.50 "	2	12.00 "
3	7.50 "	4	12.20 A.M.
4	7.50 "	5	12.50 "
5	7.50 "	6	1.20 "
6	7.55 "	7	1.50 "
7	7.55 "	8	2.20 "
8	7.55 "	9	2.50 "
9	7.55 "	10	3.30 "
10	7.55 "	11	3.30 "
11	7.55 "	12	3.30 "
12	7.55 "	13	3.30 "
13	7.55 "	14	3.30 "
14	7.55 "	15	3.30 "
15	7.55 "	16	3.30 "
16	8.00 "	17	3.30 "
17	8.00 "	18	3.30 "
18	8.00 "	19	3.30 "
19	8.00 "	20	3.30 "
20	8.00 "	21	3.30 "
21	8.00 "	22	3.30 "
22	8.00 "	22	12.00 M.
23	12.40 A.M.	23	3.30 A.M.
23	8.00 P.M.	23	12.00 M.
24	8.00 "	24	12.00 "
25	8.00 "	25	12.00 "
26	8.00 "	26	12.00 "
27	8.00 "	27	12.00 "
28	8.00 "	28	12.00 "
29	8.00 "	29	12.00 "
30	8.00 "	30	12.00 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.50 P.M.	1	11.00 P.M.
2	7.50 "	2	11.45 "
3	7.50 "	4	12.20 A.M.
4	7.50 "	5	12.50 "
5	7.50 "	6	1.20 "
6	7.55 "	7	1.50 "
7	7.55 "	8	2.20 "
8	7.55 "	9	2.50 "
9	7.55 "	10	3.30 "
10	7.55 "	11	3.30 "
11	7.55 "	12	3.30 "
12	7.55 "	13	3.30 "
13	7.55 "	14	3.30 "
14	7.55 "	15	3.30 "
15	7.55 "	16	3.30 "
16	7.55 "	17	3.30 "
17	7.55 "	18	3.30 "
18	10.10 "	19	3.30 "
19	10.50 "	20	3.30 "
20	11.25 "	21	3.30 "
21	—	—	—
22	12.05 A.M.	22	3.30 "
23	12.40 "	23	3.30 "
24	1.15 "	24	3.30 "
25	2.00 "	25	3.30 "
26	No light.	26	No light.
27	No light.	27	No light.
28	No light.	28	No light.
29	8.00 P.M.	29	9.40 P.M.
30	8.00 "	30	10.20 "

10	7.00 "	11	4.20 "
11	7.00 "	12	4.30 "
12	7.05 "	13	4.30 "
13	7.05 "	14	4.25 "
14	7.05 "	15	4.25 "
15	7.05 "	16	4.25 "
16	7.05 "	17	4.25 "
17	7.10 "	18	4.20 "
18	7.10 "	19	4.20 "
19	7.10 "	20	4.20 "
20	7.10 "	21	4.15 "
31	7.10 "	22	4.15 "
22	7.15 "	23	4.15 "
23	7.15 "	23	12.00 M.
24	12.50 A.M.	24	4.15 A.M.
24	7.15 P.M.	24	12.00 M.
25	1.30 A.M.	25	4.10 A.M.
25	7.15 P.M.	25	12.00 M.
26	7.15 "	26	12.00 "
27	7.20 "	27	12.00 "
28	7.20 "	28	12.00 "
29	7.20 "	29	12.00 "
30	7.20	30	12.00 "

10	7.00 "	11	4.20 "
11	7.00 "	12	4.30 "
12	7.05 "	13	4.30 "
13	7.05 "	14	4.25 "
14	7.05 "	15	4.25 "
15	7.05 "	16	4.25 "
16	7.05 "	17	4.25 "
17	7.10 "	18	4.20 "
18	7.10 "	19	4.20 "
19	7.10 "	20	4.20 "
20	10.30 "	21	4.15 "
21	11.20 "	22	4.15 "
22	—	—	—
23	12.10 A.M.	23	4.15 "
24	12.50 "	24	4.15 "
25	1.30 "	25	4.10 "
26	2.10 "	20	4.10 "
27	2.50 "	27	4.10 "
28	No light.	28	No light.
29	No light.	29	No light.
30	7.20 P.M.	30	8.50 P.M.

10	7.30 "	11	3.50 "
11	7.30 "	12	3.50 "
12	7.35 "	13	3.50 "
13	7.35 "	14	3.50 "
14	7.35 "	15	3.50 "
15	7.35 "	16	3.45 "
16	7.35 "	17	3.45 "
17	7.35 "	18	3.45 "
18	7.40 "	19	3.45 "
19	7.40 "	20	3.45 "
20	7.40 "	21	3.40 "
21	7.40 "	22	3.40 "
22	7.40 "	23	3.40 "
23	7.45 "	24	3.40 "
24	7.45 "	24	12.00 M.
25	1.20 A.M.	25	3.40 A.M.
25	7.45 P.M.	25	12.00 M.
26	7.45 "	26	12.00 "
27	7.45 "	27	12.00 "
28	7.45 "	28	12.00 "
29	7.45 "	29	12.00 "
30	7.50 "	30	12.00 "
31	7.50 "	31	12.00 "

10	7.30 "	11	3.50 "
11	7.30 "	12	3.50 "
12	7.35 "	13	3.50 "
13	7.35 "	14	3.50 "
14	7.35 "	15	3.50 "
15	7.35 "	16	3.45 "
16	7.35 "	17	3.45 "
17	7.35 "	18	3.45 "
18	7.40 "	19	3.45 "
19	7.40 "	20	3.45 "
20	10.50 P.M.	21	3.40 "
21	11.30 "	22	3.40 "
22	—	—	—
23	12.10 A.M.	23	3.40 A.M.
24	12.50 "	24	3.40 "
25	1.20 "	25	3.40 "
26	2.00 "	26	3.40 "
27	2.40 "	27	3.40 "
28	No light.	28	No light.
29	No light.	29	No light.
30	7.50 P.M.	30	9.30 P.M.
31	7.50 "	31	10.20 "

10	7.55 "	11	3.30 "
11	7.55 "	12	3.30 "
12	7.55 "	13	3.30 "
13	7.55 "	14	3.30 "
14	7.55 "	15	3.30 "
15	7.55 "	16	3.30 "
16	8.00 "	17	3.30 "
17	8.00 "	18	3.30 "
18	8.00 "	19	3.30 "
19	8.00 "	20	3.30 "
20	8.00 "	21	3.30 "
21	8.00 "	22	3.30 "
22	8.00 "	22	12.00 M.
23	12.40 A.M.	23	3.30 A.M.
23	8.00 P.M.	23	12.00 M.
24	8.00 "	24	12.00 "
25	8.00 "	25	12.00 "
26	8.00 "	26	12.00 "
27	8.00 "	27	12.00 "
28	8.00 "	28	12.00 "
29	8.00 "	29	12.00 "
30	8.00 "	30	12.00 "

10	7.55 "	11	3.30 "
11	7.55 "	12	3.30 "
12	7.55 "	13	3.30 "
13	7.55 "	14	3.30 "
14	7.55 "	15	3.30 "
15	7.55 "	16	3.30 "
16	7.55 "	17	3.30 "
17	7.55 "	18	3.30 "
18	10.10 "	19	3.30 "
19	10.50 "	20	3.30 "
20	11.25 "	21	3.30 "
21	—	—	—
22	12.05 A.M.	22	3.30 "
23	12.40 "	23	3.30 "
24	1.15 "	24	3.30 "
25	2.00 "	25	3.30 "
26	No light.	26	No light.
27	No light.	27	No light.
28	No light.	28	No light.
29	8.00 P.M.	29	9.40 P.M.
30	8.00 "	30	10.20 "

JULY, 1904

Table No. 1.
Frund's Moonlight System.

Light.	Date.	Exting.
8.00 P.M.	1	12.00 M.
8.00 "	2	12.00 "
8.00 "	3	12.00 "
8.00 "	5	12.25 A.M.
8.00 "	6	12.55 "
8.00 "	7	1.25 "
8.00 "	8	2.00 "
8.00 "	9	2.35 "
8.00 "	10	3.20 "
8.00 "	11	3.40 "
8.00 "	12	3.40 "
8.00 "	13	3.40 "
8.00 "	14	3.40 "
8.00 "	15	3.40 "
8.00 "	16	3.40 "
8.00 "	17	3.40 "
8.00 "	18	3.40 "
8.00 "	19	3.45 "
7.55 "	20	3.45 "
7.55 "	21	3.45 "
7.55 "	22	3.45 "
7.55 "	22	12.00 M.
12.45 A.M.	23	3.50 A.M.
7.55 P.M.	23	12.00 M.
7.55 "	24	12.00 "
7.55 "	25	12.00 "
7.50 "	26	12.00 "
7.50 "	27	12.00 "
7.50 "	28	12.00 "
7.50 "	29	12.00 "
7.50 "	30	12.00 "
7.45 "	31	12.00 "

Table No. 2.
Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	8.00 P.M.	1	10.50 P.M.
2	8.00 "	2	11.25 "
3	8.00 "	3	11.55 "
4	8.00 "	5	12.25 A.M.
5	8.00 "	6	12.55 "
6	8.00 "	7	1.25 "
7	8.00 "	8	2.00 "
8	8.00 "	9	2.35 "
9	8.00 "	10	3.20 "
10	8.00 "	11	3.40 "
11	8.00 "	12	3.40 "
12	8.00 "	13	3.40 "
13	8.00 "	14	3.40 "
14	8.00 "	15	3.40 "
15	8.00 "	16	3.40 "
16	8.00 "	17	3.40 "
17	8.00 "	18	3.40 "
18	10.00 "	19	3.45 "
19	10.40 "	20	3.45 "
20	11.20 "	21	3.45 "
21	11.55 "	22	3.45 "
22	—	—	—
23	12.45 A.M.	23	3.50 "
24	1.30 "	24	3.50 "
25	2.20 "	25	3.50 "
26	No light.	26	No light.
27	No light.	27	No light.
28	No light.	28	No light.
29	7.50 P.M.	29	9.30 P.M.
30	7.50 "	30	10.00 "
31	7.45 "	31	10.25 "

AUGUST, 1904

Table No. 1.
Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.45 P.M.	1	12.00 M.
2	7.45 "	2	12.00 "
3	7.45 "	3	12.00 "
4	7.45 "	5	12.35 A.M.
5	7.40 "	6	1.10 "
6	7.40 "	7	2.00 "
7	7.40 "	8	2.50 "
8	7.40 "	9	3.50 "
9	7.35 "	10	4.05 "
10	7.35 "	11	4.05 "
11	7.35 "	12	4.05 "
12	7.35 "	13	4.05 "
13	7.30 "	14	4.05 "
14	7.30 "	15	4.10 "
15	7.30 "	16	4.10 "
16	7.30 "	17	4.10 "
17	7.25 "	18	4.10 "
18	7.25 "	19	4.10 "
19	7.25 "	20	4.15 "
20	7.25 "	21	4.15 "
21	7.20 "	21	12.00 M.
22	7.20 "	22	12.00 "
23	7.20 "	23	12.00 "
24	7.15 "	24	12.00 "
25	7.15 "	25	12.00 "
26	7.15 "	26	12.00 "
27	7.10 "	27	12.00 "
28	7.10 "	28	12.00 "
29	7.10 "	29	12.00 "
30	7.10 "	30	12.00 "
31	7.05 "	31	12.00 "

Table No. 2.
Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.45 P.M.	1	10.50 P.M.
2	7.45 "	2	11.25 "
3	7.45 "	3	11.55 "
4	7.45 "	5	12.35 A.M.
5	7.40 "	6	1.10 "
6	7.40 "	7	2.00 "
7	7.40 "	8	2.50 "
8	7.40 "	9	3.50 "
9	7.35 "	10	4.05 "
10	7.35 "	11	4.05 "
11	7.35 "	12	4.05 "
12	7.35 "	13	4.05 "
13	7.30 "	14	4.05 "
14	7.30 "	15	4.10 "
15	7.30 "	16	4.10 "
16	9.20 "	17	4.10 "
17	10.00 "	18	4.10 "
18	10.40 "	19	4.10 "
19	11.30 "	20	4.15 "
20	—	—	—
21	12.20 A.M.	21	4.15 A.M.
22	1.10 "	22	4.15 "
23	2.00 "	23	4.15 "
24	3.00 "	24	4.20 "
25	No light.	25	No light.
26	No light.	26	No light.
27	7.10 P.M.	27	8.30 P.M.
28	7.10 "	28	9.00 "
29	7.10 "	29	9.30 "
30	7.10 "	30	10.00 "
31	7.05 "	31	10.30 "

SEPTEMBER, 1904

Table No. 1.
Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.05 P.M.	1	12.00 M.
2	7.05 "	2	1200 "
3	7.00 "	4	12.40 A.M.
4	7.00 "	5	1.35 "
5	7.00 "	6	2.35 "
6	6.55 "	7	3.40 "
7	6.55 "	8	4.30 "
8	6.55 "	9	4.30 "
9	6.50 "	10	4.35 "
10	6.50 "	11	4.35 "
11	6.50 "	12	4.35 "
12	6.45 "	13	4.35 "
13	6.45 "	14	4.35 "
14	6.45 "	15	4.35 "
15	6.40 "	16	4.40 "
16	6.40 "	17	4.40 "
17	6.40 "	18	4.40 "
18	6.35 "	19	4.40 "
19	6.35 "	19	12.00 M.
20	12.50 A.M.	20	4.40 A.M.
20	6.35 P.M.	20	12.00 M.
21	6.35 "	21	12.00 "
22	6.30 "	22	12.00 "
23	6.30 "	23	12.00 "
24	6.25 "	24	12.00 "
25	6.25 "	25	12.00 "
26	6.25 "	26	12.00 "
27	6.25 "	27	12.00 "
28	6.20 "	28	12.00 "
29	6.20 "	29	12.00 "
30	6.15 "	30	12.00 "

Table No. 2.
Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.05 P.M.	1	11.10 P.M.
2	7.05 "	2	11.50 "
3	7.00 "	4	12.40 A.M.
4	7.00 "	5	1.35 "
5	7.00 "	6	2.35 "
6	6.55 "	7	3.40 "
7	6.55 "	8	4.30 "
8	6.55 "	9	4.30 "
9	6.50 "	10	4.35 "
10	6.50 "	11	4.35 "
11	6.50 "	12	4.35 "
12	6.45 "	13	4.35 "
13	6.45 "	14	4.35 "
14	8.40 "	15	4.35 "
15	9.20 "	16	4.40 "
16	10.15 "	17	4.40. "
17	11.05 "	18	4.40 "
18	12.00 M.	19	4.40 "
19	—	—	—
20	12.50 A.M.	20	4.40 "
21	1.50 "	21	4.45 "
22	2.45 "	22	4.45 "
23	3.40 "	23	4.45 "
24	No light.	24	No light.
25	No light.	25	No light.
26	6.25 P.M.	26	8.00 P.M
27	6.25 "	27	8.35 "
28	6.20 "	28	9.10 "
29	6.20 "	29	9.50 "
30	6.15 "	30	10.30 "

OCTOBER, 1904

Table No. 1.
Frund's Moonlight System.

Light.	Date.	Exting.
6.15 P.M.	1	12.00 M.
6.15 "	3	12.25 A.M.
6.10 "	4	1.25 "
6.10 "	5	2.30 "
6.10 "	6	3.40 "
6.05 "	7	4.50 "
6.05 "	8	5.00 "
6.05 "	9	5.00 "
6.05 "	10	5.00 "
6.00 "	11	5.05 "
6.00 "	12	5.05 "
6.00 "	13	5.05 "
5.55 "	14	5.05 "
5.55 "	15	5.05 "
5.55 "	16	5.10 "
5.50 "	17	5.10 "
5.50 "	18	5.10 "
5.50 "	18	12.00 M.
12.40 A.M.	19	5.10 A.M.
5.50 P.M.	19	12.00 M.
1.30 A.M.	20	5.15 A.M.
5.45 P.M.	20	12.00 M.
5.45 "	21	12.00 "
5.45 "	22	12.00 "
5.40 "	23	12.00 "
5.40 "	24	12.00 "
5.40 "	25	12.00 "
5.40 "	26	12.00 "
5.35 "	27	12.00 "
5.35 "	28	12.00 "
5.35 "	29	12.00 "
5.35 "	30	12.00 "
5.30 "	31	12.00 "

Table No. 2.
Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	6.15 P.M.	1	11.30 P.M.
2	6.15 "	3	12.25 A.M.
3	6.10 "	4	1.25 "
4	6.10 "	5	2.30 "
5	6.10 "	6	3.40 "
6	6.05 "	7	4.50 "
7	6.05 "	8	5.00 "
8	6.05 "	9	5.00 "
9	6.05 "	10	5.00 "
10	6.00 "	11	5.05 "
11	6.00 "	12	5.05 "
12	6.00 "	13	5.05 "
13	5.55 "	14	5.05 "
14	9.00 "	15	5.05 "
15	9.50 "	16	5.10 "
16	10.50 "	17	5.10 "
17	11.40 "	18	5.10 "
18	—	—	—
19	12.40 A.M.	19	5.10 "
20	1.30 "	20	5.15 "
21	2.30 "	21	5.15 "
22	3.20 "	22	5.15 "
23	4.20 "	23	5.15 "
24	No light.	24	No light.
25	No light.	25	No light.
20	5.35 P.M.	26	7.30 P.M.
27	5.35 "	27	8.30 "
28	5.35 "	28	9.20 "
29	5.35 "	29	10.20 "
30	5.35 "	30	11.20 "
31	5.30 "	1	12.20 A.M.

NOVEMBER, 1904

Table No. 1.
Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.30 P.M.	2	1.25 A.M.
2	5.30 "	3	2.35 "
3	5.30 "	4	3.45 "
4	5.25 "	5	5:00 "
5	5.25 "	6	5.30 "
6	5.25 "	7	5.35 "
7	5.25 "	8	5.35 "
8	5.20 "	9	5.35 "
9	5.20 "	10	5.35 "
10	5.20 "	11	5.40 "
11	5.20 "	12	5.40 "
12	5.20 "	13	5.40 "
13	5.20 "	14	5.40 "
14	5.15 "	15	5.40 "
15	5.15 "	16	5.40 "
16	5.15 "	17	5.40 "
17	5.15 "	17	12.00 M.
18	1.15 A.M.	18	5.40 A.M.
18	5.15 P.M.	18	12.00 M.
19	5.15 "	19	12.00 "
20	5.15 "	20	12.00 "
21	5.10 "	21	12.00 "
22	5.10 "	22	12.00 "
23	5.10 "	23	12.00 "
24	5.10 "	24	12.00 "
25	5.10 "	25	12.00 "
26	5.10 "	26	12.00 "
27	5.10 "	27	12.00 "
28	5.10 "	28	12.00 "
29	5.10 "	30	12.20 A.M.
30	5.05 "	1	1.30 "

Table No. 2.
Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.30 P.M.	2	1.25 A.M.
2	5.30 "	3	2.35 "
3	5.30 "	4	3.45 "
4	5.25 "	5	5.00 "
5	5.25 "	6	5.30 "
6	5.25 "	7	5.35 "
7	5.25 "	8	5.35 "
8	5.20 "	9	5.35 "
9	5.20 "	10	5.35 "
10	5.20 "	11	5.40 "
11	7.40 "	12	5.40 "
12	8.30 "	13	5.40 "
13	9.30 "	14	5.40 "
14	10.30 "	15	5.40 "
15	11.20 "	16	5.40 "
16	—	—	—
17	12.20 A.M.	17	5.40 "
18	1.15 "	18	5.40 "
19	2.10 "	19	5.40 "
20	3.10 "	20	5.50 "
21	No-light.	21	No light.
22	No light.	22	No light.
23	No light.	23	No light.
24	5.10 P.M.	24	7.20 P.M.
25	5.10 "	25	8.10 "
26	5.10 "	26	9.10 "
27	5.10 "	27	10.10 "
28	5.10 "	28	11.20 "
29	5.10 "	30	12.20 A.M.
30	5.05 "	1	1.30 "

DECEMBER, 1904

Table No. 1.
Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.05 P.M.	2	2.40 A.M.
2	5.05 "	3	3.50 "
3	5.05 "	4	4.00 "
4	5.05 "	5	6.05 "
5	5.05 "	6	6.05 "
6	5.05 "	7	6.05 "
7	5.05 "	8	6.05 "
8	5.05 "	9	6.10 "
9	5.05 "	10	6.10 "
10	5.05 "	11	6.10 "
11	5.05 "	12	6.10 "
12	5.05 "	13	6.10 "
13	5.05 "	14	6.10 "
14	5.05 "	15	6.15 "
15	5.05 "	16	6.15 "
16	5.05 "	16	12.00 M.
17	12.55 A.M.	17	6.15 A.M.
17	5.05 P.M.	17	12.00 M.
18	1.50 A.M.	18	6.15 A.M.
18	5.05 P.M.	18	12.00 M.
19	5.05 "	19	12.00 "
20	5.05 "	20	12.00 "
21	5.05 "	21	12.00 "
22	5.05 "	22	12.00 "
23	5.05 "	23	12.00 "
24	5.05 "	24	12.00 "
25	5.10 "	25	12.00 "
26	5.10 "	26	12.00 "
27	5.10 "	27	12.00 "
28	5.10 "	29	12.30 A.M.
29	5.10 "	30	1.40 "
30	5.10 "	31	2.50 "
31	5.10 "	1	4.00 "

Table No. 2.
Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.05 P.M.	2	2.40 A.M.
2	5.05 "	3	3.50 "
3	5.05 "	4	5.00 "
4	5.05 "	5	6.05 "
5	5.05 "	6	6.05 "
6	5.05 "	7	6.05 "
7	5.05 "	8	6.05 "
8	5.05 "	9	6.10 "
9	5.05 "	10	6.10 "
10	5.05 "	11	6.10 "
11	8.15 "	12	6.10 "
12	9.10 "	13	6.10 "
13	10.10 "	14	6.10 "
14	11.00 "	15	6.15 "
15	12.00 M.	16	6.15 "
16	—	—	—
17	12.55 A.M.	17	6.15 "
18	1.50 "	18	6.15 "
19	2.50 "	19	6.15 "
20	3.50 "	20	6.15 "
21	4.50 "	21	6.15 "
22	No light.	22	No light.
23	No light.	23	No light.
24	5.05 P.M.	24	8.00 P.M.
25	5.10 "	25	9.00 "
26	5.10 "	26	10.10 "
27	5.10 "		11.20 "
28	5.10 "	29	12.30 A.M.
29	5.10 "	30	1.40 "
30	5.10 "	31	2.50 "
31	5.30 "	1	4.00 "

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THE CENTRAL STATION INDUSTRY.

We complete in this issue our review and summarization of the interesting and valuable figures presented in the bulletin just issued by the United States Census Office on the central electric light and power stations of the United States. In these statistics, collated with great care and thoroughly sifted by the department in Washington, we have a digest of all the important data and features connected with the electric light and power industry, so far as it is carried on by central station companies and municipal plants. These data disclose, on analysis, a great many further facts, themselves of importance and significance. It is remarkable that twenty-five years of the industry should have gone by before such a compilation of statistics became possible, and it was, indeed, high time that the work was done. There have, of course, been many voluntary attempts in this direction of a creditable nature, but it stands to reason that only a collector of such information vested with the authority of the government, could do the work accurately and completely.

The figures will no doubt be studied carefully and closely by our readers, and have already been commented upon in our columns. One of the chief points which emerges is the extraordinary manner in which central station industry has overtaken gas lighting; and the victory of electricity is the more striking when it is borne in mind that the figures included in this bulletin take no account of the work embraced in some 50,000 isolated plants which are believed to constitute a development of electric lighting and power fairly equal to that in the central station field. But taking the central stations alone, it is impressive to note that the gas industry dating back to 1806, has already been passed in investment, income, labor employed, and other respects, by the industry which virtually began only in 1879. Moreover, the competition of electricity has, during these twenty-five years, been of the greatest benefit to the gas industry, and each has reacted and interacted on the other in a very helpful manner. To us one of the most encouraging signs of the times is that in spite of the vast and radical improvements seen in electric lighting, no finality of principle or method or apparatus is in sight, but we have to-day as great promise of advances in economy and efficiency, as well as in general utility and safety, as when Brush and Weston and Edison and Elihu Thomson did their great pioneer work a quarter of a century ago.

CONDUCTIVITY OF MERCURY VAPOR.

Elsewhere we print an article by Mr. Peter Cooper Hewitt giving the result of elaborate experiments on the conductivity of mercury vapor, which forms a notable contribution to scientific literature both in subject and as an example of skillful investigation. The difficulties in the investigation of the electrical conductivity of gases and vapors are very great, owing to the numerous effects that may intervene to vitiate the results. The most prominent of these are the positive and negative electrode effects, which were entirely eliminated in the arrangement employed by Mr. Hewitt in the measurement of the conductivity of the vapor. The results arrived at in the investigation are of increased interest for the reason that any conclusions drawn from them should apply generally to all gases and vapors. The particular deduction by Mr. Hewitt from his work is that in the case of a vapor tube employed as a source of light, there is a point of maximum light efficiency corresponding to a fixed relation between the vapor density and the current. Another point of the highest interest is the observed effect on a vapor column of magnetic force, which increases enormously the resistance at low densities, and also alters the spectrum of the vapor. One curious fact in connection with vapor conduction is that Ohm's law is applicable notwithstanding that for fixed conditions the voltage is constant, the anomaly being due to the fact that the resistance decreases as the current increases, this being directly contrary to the case of electrical conduction in solids. The data presented in the curves accompanying the article will be of the highest interest to physicists; and while the investigation was doubtless undertaken by Mr. Hewitt, particularly in the interest of the mercury vapor lamp, he deserves the highest commendation for having made it so general that the results form a valuable contribution to physics in general. The name of Hewitt has always been connected with disinterested exhibitions of public spirit; and in this article we have but one more evidence of a desire to contribute without reservation to the common store of knowledge useful to the community at large.

THE THIRD RAIL AGITATION.

Frequent accidents of late, in Brooklyn and Chicago, and, even more than that, the indiscriminate agitation of the subject by some of the daily New York newspapers, have aroused in the public mind a feeling of anxiety and uncertainty as to the perils of the third rail on elevated railroad structures. With regard to this subject, some data are given in our columns this week, but the most interesting contribution to the discussion is that by Mr. George Westinghouse, whose vigorous and direct utterances, as usual, immediately command attention. While other electrical engineers and inventors are wrestling with the problem of protecting the third rail or of leaving it so unprotected that if anything happens it is innocuous, Mr. Westinghouse declares boldly his belief that there will be a complete revulsion of feeling in the profession as to the necessity for the third rail, and that the overhead wire will again be recognized not only as a possible way of conveying current to the elevated cars, but the preferable way of doing so. We refer our readers to Mr. Westinghouse's very interesting statement of the case, which loses nothing from his logical and practical analysis of the various questions involved. The overhead wire has, indeed, a great many claims upon public consideration, whether for the elevated system or for such a thoroughfare as West Street, New York, where practically nothing else could operate; and it will be quite interesting to see how the technical developments of the situation support Mr. Westinghouse's views and contentions. We are all hoping that the Manhattan Elevated system may go through this winter without trouble, for a repetition of last winter would break the hearts of most New Yorkers, to say nothing of costing some of them their lives. The Manhattan Elevated management has shown itself so able and far-sighted, as well as liberal, we may trust it to make the *volte face* in regard to the third rail in case it should be demonstrated that the change is necessary.

Incidentally, Mr. Westinghouse makes an important point as to the conditions applying to the underside of the cars. Even if all the cars were all metal, the contiguity to the third rail is not calculated to inspire one with an utter sense of safety. Besides, the manner in which apparatus has of late years been loaded on the underside of the cars and on the trucks, is something extraordinary, with resultant complications of unsystematized wiring. An improvement there seems decidedly possible, and Mr. Westinghouse offers a pertinent suggestion along those lines also. These problems are, indeed, worthy the best engineering thought of the time.

ALTERNATING CURRENT TRACTION.

It is a curious thing that upon the very heels of the great New York Central contracts should come authoritative announcements, both here and abroad, of the development of successful alternating-current motors specially fitted for interurban and other serious service. It would be strange, indeed, if the first great railroad plant should be the last great direct current traction system. We are not disposed to take the perfervid view of some of our foreign contemporaries that both direct-current and polyphase motors are to give way instanter to simple series-wound, single phase motors, but it is undeniable that Lamme in this country and Finzi and the Union Elektricitäts Gesellschaft abroad have produced alternating-current railway motors of very remarkably advanced design. We have long held, against the popular opinion, that the common scheme of distributing power for railway use from rotary converter stations is unwieldly and often uneconomical, and must sooner or later be replaced by an alternating distribution carried at least clear up to the car, but the sudden activity in this line of work is more than we expected at the present moment. It looks now as if the alternating-current contingent proposed to take the aggressive and to force the fighting from now on, and the battle will be most interesting to watch. The new motors are intended not only for the interurban work, where they have been most needed, but for the ordinary work of electric traction, and their competition will thus be doubly formidable. Their practical working properties have yet to be proved on a commercial scale, but the experimental results are certainly highly promising. Sparking and low power factor at starting are the faults most to be feared, yet it is noteworthy that the tests of the Finzi motor show during acceleration an output in volt-amperes not greatly in excess of that demanded by a standard direct-current motor.

GROUPING OF CELLS TO OBTAIN MAXIMUM CURRENT.

On page 955, of our last week's number, we printed an article, by Dr. K. E. Guthe, on the above subject, which introduces several interesting considerations. As pointed out in the article, the solution of the general problem of maximum current from a battery of voltaic cells is by no means recent, but goes back at least as far as 1878. The time-honored rule is that the grouping must be such that the internal resistance of the battery shall be equal to the external resistance. Dr. Guthe shows, however, that this proposition is only true when the cells admit of grouping into a simple or complete series-parallel arrangement, under the definition of the rule. He analyzes some simple cases to show the limits within which the reservation must apply.

If the working e.m.f. of a cell be denoted by e volts, and its working internal resistance of the cell by r ohms, the power which the cell will develop on short-circuit will be e^2/r watts. In most primary voltaic cells this represents a perfectly realizable condition. In secondary cells of the lead type, the condition is not, or should not be, realized. This amount of power is the maximum that a cell can, under any condition, develop, and has been called the "electrical capability" of the cell. The efficiency of the cell under short-circuit, or when developing this electrical capability, is zero. If, on the other hand, the cell be set to work on an extremely large external resistance, its efficiency will be nearly 100 per cent.; but the power developed will be microscopically small. Midway between the preceding two conditions, or when the efficiency is 50 per cent., the cell will develop the maximum external or available power, and the load, if it consists of a simple resistance, will have a resistance equal to r. The power developed by the cell will then be half of its capability, and the externally available power half again of this, or one-quarter of the capability.

The capability of a battery of N similar cells will be N times the capability of one cell. If, therefore, a certain amount of power is required from a battery, say at the terminals of a small motor, the minimum battery, or battery of lowest first cost in cells, that will supply this power, is a battery whose capability is four times the required power. The said battery will deliver this power at 50 per cent. efficiency, whether in simple parallel grouping, or simple series grouping, or in any complete arrangement of parallel series. If the translating device is a resistance, the grouping must be such as admits of a complete series-parallel arrangement having a total internal resistance equal to the said external resistance. If the translating device be a motor, the internal resistance of the minimum battery will be considerably greater than that of the motor, and the grouping of the battery will be determined by the voltage, or winding, of the motor. In all cases, however, the ideal solution calls for 50 per cent. efficiency.

The same rule applies also to dynamos except that no large dynamo can be operated at as low an electrical efficiency as 50 per cent. It was a dim and imperfect recognition of this rule that retarded the development of the dynamo in early days. Investors not only believed correctly that the minimum dynamo that would supply a given power must work at 50 per cent. efficiency, but they, moreover, erroneously believed that the best efficiency of a dynamo was 50 per cent. Under practical conditions, the minimum dynamo that will supply a given power has a capability of from ten to forty times that power, and works at an electrical efficiency of from 90 per cent. to 97½ per cent. In other words, the full-load output of a direct-current dynamo is from 10 per cent. to 2½ per cent. of the capability, according to the size of the machine, and the electrical efficiency is correspondingly 90 per cent. to 97.5 per cent. The minimum dynamo that would yield the power would be theoretically of a capability four times the power, working at an electrical efficiency of 50 per cent., if we could dissipate so much heat in the dynamo, and also be content to operate at so low an efficiency.

The Proposals for Action of the International Electrical Congress of St. Louis.

The American Institute of Electrical Engineers, at its annual convention this year, at Niagara Falls, read and discussed two papers upon subjects which might be brought to the consideration of the Chamber of Government Delegates of the forthcoming International Electrical Congress at St. Louis in September, 1904. One of these papers, by Prof. Carhart, was entitled "The Legalized Standard of Electromotive Force." It sets forth the propositions, first, that the value of the e.m.f. of the Clark cell at 15° C. is nearer to 1.433 than to the official value, 1.434, adopted by the Chicago Congress; and, second, that the cadmium cell is a preferable standard to the Clark cell. The other paper was by Dr. Kennelly and refers to electrical units, electrical nomenclature and to international standardization. These papers have been reprinted, by resolution of the Institute, and distributed among technological institutions, with the object of eliciting the views on these subjects of electricians and electrical engineers all over the civilized world. It is now recognized that an Electrical Congress so far as concerns its official actions, is unlikely to take action upon any matter which may be promulgated there for the first time, or which may only recently have been promulgated. Experience has shown that an International Electrical Congress may take official action on some question of international electrical interest, upon which a consensus of opinion has been reached through the medium of discussion in the transactions of technological societies, or in the technical journals; but it is unreasonable to expect that the seal of international approval shall be set by a congress upon a question that has received no previous general consideration or discussion.

Our esteemed contemporary, the *Elektrotechnische Zeitschrift*, alludes editorially in a recent number to these Institute papers, and opens its correspondence columns to the discussion of the questions considered. The facts are clearly and fairly stated by the editors, who treat the proposals considerately and judicially. There is only one detail in their presentation of the case with which we feel inclined to differ. Whereas they intimate that the units "maxwell" and "gauss," adopted by the Paris Electrical Congress of 1900, have come but little into use in America, we believe that a careful consideration of recent electrotechnical American literature will satisfy the reader that these units have come into fairly extended use on this side of the Atlantic, although it is admitted that they have not come into universal use. The editors of our German contemporary also point out that the question whether a name for an electromagnetic unit will, or will not, come into general use, depends in a great measure whether the unit enters into business dealings. The volt, ampere, ohm and watt come frequently into contracts and into specifications, whereby their general adoption is promoted. The magnetic units and magnitudes are rarely made the subjects of contracts or specifications, and, consequently, they do not spread so rapidly, or come into the same extensiveness of use, as their more commercial brethren. Nevertheless, we consider it as almost axiomatic, that every unit of importance in our fundamental C.G.S. system of units should have a name to recognize it by. An anonymous unit is an anomalous unit. How hopeless it would be to speak of a 50-gramme weight, as a weight of 50 C.G.S. units of mass; or a metric ton as 10^6 C.G.S units of mass. A C.G.S unit of magnetism is as worthy of a name as a gramme. Give a unit no name, and one might as well hang it out of reach for all purposes of practical utility.

Granted that it is desirable to christen and baptize the heathen C.G.S. units, the question of ways and means becomes of imposing dimensions. Only the units of length, area, volume, mass and time in this system have titles. All the rest, with the exception of inductance, energy, magnetic flux, and flux-density, pertain to the ranks of the vulgar and unnamed. To give names of departed eminent electricians to this list is not only to strain the memory, but also to strain the list of the celebrated scientists who have already joined the great majority. The only hope seems to be to adopt a plan similar to that suggested in the A. I. E. E. paper above referred to, and apply a suitable prefix to a practical unit in order to designate the corresponding absolute unit. There is certainly a limit to the practical use of the practical, or volt-ampere-ohm system of units. In this system the unit of length is the earth quadrant, and all quantities involving length, such as gradients, or intensities, must introduce the quadrant, or else involve a numerical factor, in order to maintain the system of equations. Thus the unit of inductance in the practical system—conventionally a length—is inevitably the henry or earth quadrant, as distinguished from the centimeter. Also, in the practical system, the value of magnetic force or gradient of magnetic potential would inevitably entail magnetic potential units per quadrant, as distinguished from gilberts per centimeter. There is an objection to gradients of potential per quadrant in a dynamo of a few meters in size. For this reason, and also because we all learn the science of electromagnetics in the C.G.S. system, it is important to be able to use the C.G.S. system, when desired, by christening all of its principal units.

Work of the Carnegie Institute.

At Washington, on December 8, the second annual meeting of the trustees of Carnegie Institute was held. There were two sessions, with a dinner following. Andrew Carnegie, who set aside the fund for the institution, was present, as also was Alexander Agassiz, of Cambridge, Mass., the president of the National Academy of Sciences. The report submitted on the proceedings of the last year was supplemented by explanatory statements by Dr. Gilman, the president of the institution, and by Dr. Walcott, the secretary. Mr. Carnegie made a brief address, in which he commended the work done and talked generally of the aims of the institution. The report on the year's operations showed sixty-six grants made by the executive committee for scientific research, involving an aggregate of $150,000, and recipients representing every part of the United States and the smaller colleges as well as the large universities, observatories, and laboratories. Twenty-five research assistants were appointed.

The morning session was devoted mostly to a discussion of several large projects. No conclusion was announced. The trustees authorized an aggregate expenditure of $373,000 in grants for scientific researches and $40,000 for publications during the ensuing year. The following officers of the board of trustees were elected: Chairman, Dr. John S. Billings, New York; vice-chairman, Elihu Root, Secretary of War; secretary, Charles D. Walcott, director of the Geological Survey. Vacancies on the board were filled by the election of John Cadwalader, of New York, to succeed Abram S. Hewitt, deceased; Cleveland E. Dodge, New York, to succeed William E. Dodge, deceased, and Judge William Wirthowe, New Orleans, to succeed Justice Edward D. White, resigned. Secretary of State John Hay was chosen as a member of the executive committee in the class of 1905 to succeed Mr. Hewitt, and Dr. S. Weir Mitchell and Carroll D. Wright were re-elected for three years as members of the executive committee.

Protected Third Rails.

A letter that has been sent to the New York State Board of Railroad Commissioners by E. P. Bryan, vice-president of the Interborough Company, on the subject of protection from the third rail, is as follows:

"I will state for your information that our engineering force has been at work for some months to devise some practicable plan for protecting this third rail. Any plan which completely protects the third rail involves a change in the character of a contact shoe used, and I can easily explain to you that it is no trifling matter to do this and not undertake something experimental, and the Manhattan road is the last place in the world to try experiments of this nature.

"Your board is, of course, aware of the fact that the third rail has never been successfully covered anywhere, and is not now either in Chicago, Boston, Paris, or Brooklyn. We have plans that are now being carefully considered, and with which experiments will be made, but it is impossible to do anything toward the protection of this rail during the present winter. I shall be glad at any time to discuss the difficulties connected with this with your commission, and I beg to advise that we have not at present anything with which we are sufficiently satisfied to submit to you.

"We have installed additional telephone stations so that now every station on our line on both sides is being connected independently with the power station and the sub-stations, and we have written Commissioner Sturgis that with proper understanding between the Fire Department and this company we can guarantee that the interval between notice from the Fire Department of their desire to use the structure and the time of shutting off the current will be very brief indeed, which will be much better than any protection to the third rail. Of course, whenever the Fire Department comes upon the structure and places the hose across it immediately stops traffic, and the current should be shut off, and this can be done."

Mr. William Leary, secretary of the New York Fire Department, has sent the following letter to the State Board of Railway Commissioners concerning the protection of firemen from the third rail while working on the elevated railroad structures:

"I am directed by the commissioner to acknowledge receipt of yours of the 10th inst. enclosing copies of letters from the Interborough Rapid Transit Company as to the third rail on the Manhattan structure, and from the Brooklyn Heights Railroad Company as to the third rail on the Brooklyn elevated railroads, and to say that while the commissioner recognizes the advantage of cutting off the current, he feels it his duty to say that this will not meet the requirements for the safety of the Fire Department.

"Any delay in cutting off the current would endanger the lives of the men, who must begin their work upon the elevated structure instantly upon their arrival; otherwise, fires might escape their control. They have, of course, no means of knowing whether the current has been cut off, or whether the rail is dead or alive."

Secretary Leary holds that the Fire Commissioner, unlike Vice President E. P. Bryan, of the Interborough Company, considers this matter to be of intense public interest, and in no sense a private affair.

Mr. Westinghouse on the Third Rail Problem.

A most interesting communication by Mr. George Westinghouse to the New York *Evening Post* deals with the problems of the third rail. We quote it in extenso below:

"Replying to your letter of December 12 concerning the third-rail question, I think the following points will be generally admitted:

"(1) That the operation of the elevated trains by electricity has been an undoubted success, and an enormous advantage to the traveling public, notwithstanding the fact that the continuous third rail has been employed to supply the current.

"(2) That the deaths and injuries to passengers and employees, considering the number of people involved, compare most favorably with any other railway operation in the world.

"(3) That if a third rail charged with an immense power of electricity and located upon the surface near the other rails is to be used for the supply of electricity to the trains, then there will always be a source of danger to those who have occasion to come near such third rail, and in addition there will always be a great source of danger due to the fact that a car may be derailed, or that some iron material may become detached and make a short-circuit between such third rail and the train.

"(4) That the third-rail danger may be lessened by the subdivision of the third rail into sections with provision for the automatic supply of the required amount of current to each section only as required, but that such arrangement will only minimize the third-rail danger.

"(5) That such third-rail danger may be entirely obviated by resorting to the use of overhead conductors, for which the elevated structure is peculiarly suited.

"(6) That there never was a good reason why the overhead wire should not have been used.

"In support of these last two propositions, it may be stated that the third rail is impossible for use on main railways at important junctions and terminals; that the Pennsylvania Railroad does not propose to use the third rail in its underground work between New Jersey and Long Island; that the overhead wire was used at the Zossen experiments in Germany, when a speed of 130 miles per hour was obtained; and, finally, that the New York Railroad Commissioners have recently declared that they would not permit the use of a third rail on interurban lines crossed many times by highways.

"It may seem to be heresy to advocate the use of the overhead wire, but I venture to predict that there will be a complete revulsion of feeling on this point. When I speak of an overhead wire, I do not mean the slight construction which has prevailed, and the breaking down of which has occasioned trouble, but a substantial engineering arrangement so erected that it would, in fact, not be an offence to the eye. It is obvious that the use of an overhead trolley, with the removal of the third rail, would make impossible the present risks of short-circuits between the car or parts of the car and the third rail; but it would leave other questions yet to be settled; namely, first, the proper application of the electric apparatus to those cars, so that in no event could the passengers be frightened by a short-circuit visible to them, and this means that all of the wiring and electrical apparatus would have to be located beneath the bottom of a fire-proof car and with no wires carrying large currents above the floors or near the ends of the cars which might be damaged by accident.

"I am satisfied, from my conferences with railway officials, that they are moving in the right direction and giving this subject the attention it deserves; but it must be borne in mind that it has required experience to demonstrate what is necessary for safety."

Montreal, the Greatest Centre of Transmitted Power.—III.

By Alton D. Adams.

THE Chambly power plant and transmission system, as it now exists and as described below, is the result of reconstructing and doubling the capacity of the old Chambly plant, which operated at 12,000 volts, two-phase currents, generated by the four inductor generators now in the power house. In order to bring it to its present efficient condition it was necessary to reconstruct the old water-wheels, install the new wheels, rewind the Stanley inductor generators for lower voltage, install the new General Electric generators, install step-up and step-down transformers, reconstruct the transmission line and install the 22,500-volt cables included as a part of it, and build the new receiving station in Montreal. That this work was all carried on without depriving the power company of the output of the old plant reflects much credit upon Mr. Gossler and his operating staff.

The reconstruction of the plant, as outlined above, was carried out in accordance with the designs and under the supervision of Mr. Ralph D. Mershon, consulting engineer for the Power Company, with the exception of the receiving station building, in connection with the design of which Mr. Mershon acted in an advisory capacity. The induction motor generator plant in the power house of the Montreal Street Railway Company was also installed under the designs and supervision of Mr. Mershon as consulting engineer for the railway company.

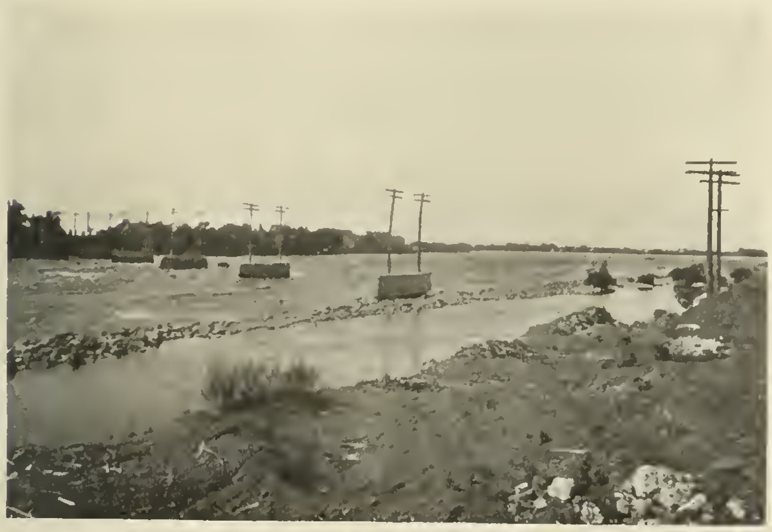


FIG. 1.—TRANSMISSION LINE CROSSING RICHELIEU RIVER.

Energy delivered by the Chambly water power plant at about 25,000 volts is received in the central sub-station, on Queen Street, at 22,000 volts, through underground cables. There are four of these cables, corresponding to the four three-phase circuits that come from the Chambly plant, and each cable contains three stranded copper conductors of 211,600 circ. mils cross section each. Paper saturated with compound is the only insulation in these cables, and outside of the paper is a lead sheath about 5/32 in. thick. The side of each conductor is about 7/16 in. distant from the lead sheath at the nearest point, and the distances between the conductors themselves are about 11/16 in. in each case. The lead sheath of the cables contains about 3 per cent. of tin. Inside of the sheath the diameter of the paper insulation is about 2¾ in., and outside the lead has a diameter of 3 1/16 in.

Each of the four cables is about 3,600 ft. long, and extends from the central sub-station to a terminal house on Mill Street, which lies between the Lachine Canal and the river front not far from the Montreal end of the great Victoria Bridge. For the greater part of their length the cables lie in 4-in. Camp tile ducts, but where they go under the Lachine they lie in 4-in. iron pipes. At the terminal house the cables connect with the bare overhead conductors that run to Chambly by way of the Victoria Bridge.

The terminal house on Mill Street is a one-story structure 21 by 34 ft. outside, and with concrete walls 8 in. thick. An internal wall of concrete divides the interior of this house into two equal parts, and two of the four three-phase circuits enter each half. A wooden cross arm is secured with its center 22 in. from the outside of the wall at each end of the building by iron brackets, and with its top 16 ft. 10 in. above the ground. Each of these cross arms carries six porcelain insulators mounted with their centers 30 in. apart, and to each of these insulators a bare conductor of one of the transmission circuits is attached. Somewhat above these insulators and with their outer ends slanting downward boxwood bushings, each 4 in. x 4 in. x 12 in., pass through the concrete wall, one bushing opposite each insulator.

Each of these bushings carries a glass tube, and through this tube the bare wire from the nearest insulator passes. Inside of the terminal house the bare conductors pass to other porcelain insulators mounted on cross arms, and each conductor is connected to a series of lightning arresters before it joins the cable. Above each cross arm on the outside walls of the terminal house a slanting weather shield is built. By means of the 8-in. concrete wall inside of the terminal house the pair of circuits that enter on one side is protected from damage by any short-circuit that may occur on the pair of circuits at the other side.

After leaving the terminal house the twelve bare conductors that make up the four three-phase circuits pass over a short pole line to the Victoria Bridge. This is one of the few instances if not the only one, where bare conductors carrying current at as much as 22,000 volts are brought on poles within the limits of a great city.

At the bridge the bare conductors are carried on heavy timber fixtures entirely over the top of the trusses. Each of the twelve conductors that make up the four transmission circuits is a solid, medium-drawn copper wire, No. 00 B. & S. gauge. These circuits are carried on two pole lines, there being two circuits per pole. Each three-phase circuit is arranged on two cross arms and on one side of its pole. On the lower of these two arms two wires of the same circuit are spaced 30 in. apart, and the third wire of this circuit is located on the upper cross arm at a distance of 28 in. from each of the other two. The transmission line between the terminal house on Mill Street and the power station at Chambly is 16 miles long. Over the Victoria Bridge one circuit of each pole line is transposed three times, and the other nine times to nullify the effect of the iron. Between the bridge and the power plant each of two circuits is twice transposed; hence this part of two circuits, one of either pole line, is divided into three sections of equal lengths. Each transposition is effected between two poles placed 10 ft. apart, each wire of a circuit being rotated through 120° between these poles. This transposition is carried out to overcome the effects of mutual induction, and as a protection to telephone and telegraph lines. The standard distance of the lowest wires in these circuits above the ground is 32.5 ft., and the regular length of span is 90 ft. Between the angle poles on the line the normal length of span is reduced to 50 or 75 ft., and such poles have double cross arms if the deflection of the conductors is more than 15°. The two pole lines, each carrying two three-phase circuits, are located 50 ft. apart on either side of the right of way.

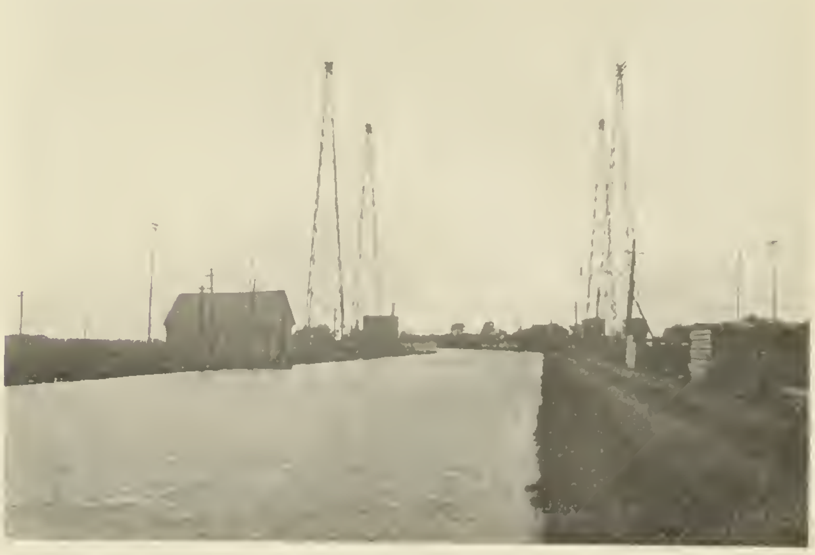


FIG. 2.—CHAMBLY TRANSMISSION LINE TOWERS.

No lightning arresters are connected to these transmission lines save at the terminal house and at the generating station. Along the entire line three grounded wires are strung on each set of poles as a protection against lightning. As may be noted from the above, the upper cross arm on each pole carries only two power wires, one belonging to each transmission circuit. Near each end of the cross arm and 32 in. from the power wire on that side, a barbed wire is mounted on a pony glass insulator. This barbed wire is made up of two No. 12 B. W. G. galvanized iron wires twisted with a four-point barb every 5 in. Another barbed wire is strung on pins in the pole tops. At each pole a ground wire is soldered to each of the barbed wires, and this wire is stapled down the side of the pole and twisted several times about its butt before the pole is set in the ground. Insulators are used to mount the barbed wire, because of the superior mechanical support thus obtained, but with no desire to insulate it in any way. No damage by lightning has ever been done to these transmission lines having the barbed wires, while shorter distribution circuits in the same locality have suffered severely from the frequent thunder storms that occur there. For this reason the grounded barbed wires are thought to afford a high degree of protection.

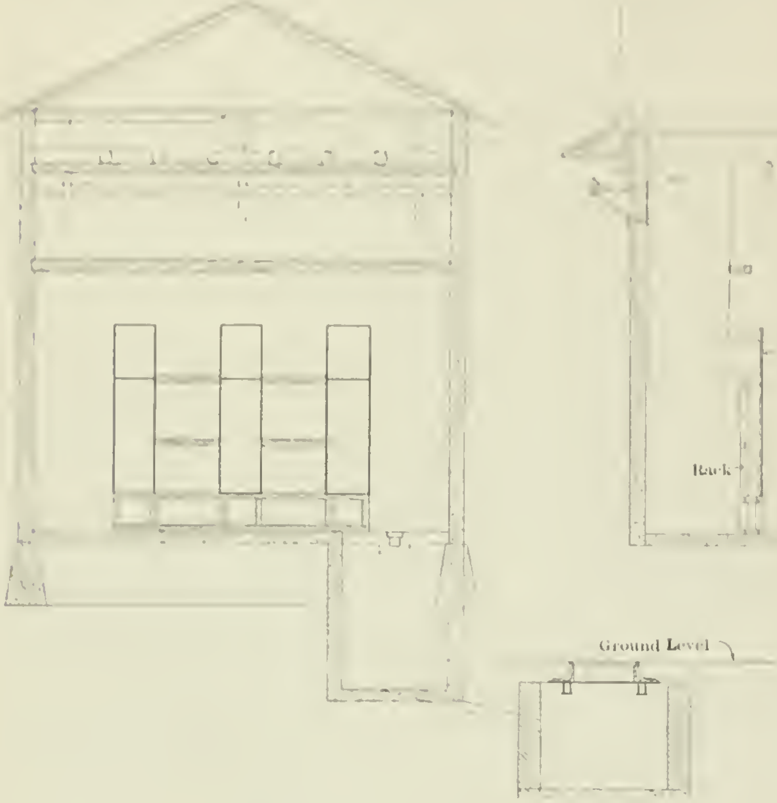


FIG. 3.—TERMINAL HOUSE ON MILL STREET.

On the same poles that carry the transmission circuits two No. 12 hard-drawn copper wires are run for telephone purposes. These telephone wires are attached to the poles by side brackets and pony glass insulators, and spun or barrelled throughout. The telephone wires are 6.25 ft. distant from the nearest wires of the transmission circuits. Stations with jack boxes are located at intervals on the poles for the use of line inspectors, and telephones are connected to the two wires in multiple. For the protection of both users and telephones the latter are provided with film cut-outs. Between the telephone wires and the ground there is an induced pressure of 125 volts. In case either of the telephone wires is broken or they are short-circuited, signals are transmitted according to a prearranged code by means of small incandescent lamps, using a telegraph key, the ground and one of the telephone wires to make a circuit.

All of the insulators that support the bare copper conductors of the four three-phase circuits are of white porcelain and were made by R. Thomas & Sons, East Liverpool, Ohio, under the trade designation of 6-in. Boch T. P. and Mershon type. Porcelain insulators were selected rather than glass because of their greater strength. Each of the 6-in. Boch insulators is 5½ in. in diameter, and when it is mounted on its pin the lower edge of the outside petticoat is 4½ in. above the top of the cross arm. A sleeve from the interior of each insulator follows its pin down for a distance of 2½ in. below the edge of its outside petticoat. Each wire is carried on the top of its insulator and is then 8½ in. above the cross arm.

Conductors nearest to the pole are distant about 10 in. from its side, and neither of the conductors is nearer than 18 in. to the iron braces of the cross arm. From conductors mounted on insulators of the lower cross arm to the lower side of upper cross arm the distance is about 9 in. These insulators were tested at the factory with a pressure of 80,000 volts while immersed in salt water.

Pins for the insulators on which the transmission wires are mounted are made of hickory wood boiled in stearin and the part entering the cross arm has a diameter of 1½ in. Each pin is secured in the arm by a 2½ in. wire nail driven into both. Each cross arm for the three-phase circuits measures 11 ft. by 5 by 4 in., and is made of Georgia pine boiled in liquid asphalt. Gains for the cross arms were cut 1 in. deep in poles, and each cross arm was secured with three ½-in. lag screws. The two cross arms on each pole have their centers 23 in. apart and are braced by four pieces of strap iron each 1¼ by ¼ in. in cross section. One piece of this iron is bolted to both the arms near each end, and the other two pieces pass from the ends of the lower cross arm to a point on the pole 4 ft. 5½ in. beneath its lower side, and are secured at that point by a common screw bolt that passes into the pole.

Corner poles on the transmission line are guyed with steel cable, or braced with wooden struts, or both, and guys where used are attached 18 in. below the lower cross arm. Each of these guys is provided with a strain insulator. Most of the poles used on the transmission lines were round cedar, but a few were steel. Cedar poles of all lengths were required to be of not less than 8 in. diameter at the top, and 18 in. at the butt. The butts of these poles were tarred and the tops were rounded to shed water. Poles were set in earth as follows: Poles 35 to 45 ft. long, set in earth 5 ft.; 50 to 55 ft. long, set in earth 6 ft.; 60 to 80 ft. long, set in earth 7 ft. Where the ground is marshy the butts of poles are set in concrete for greater stiffness.

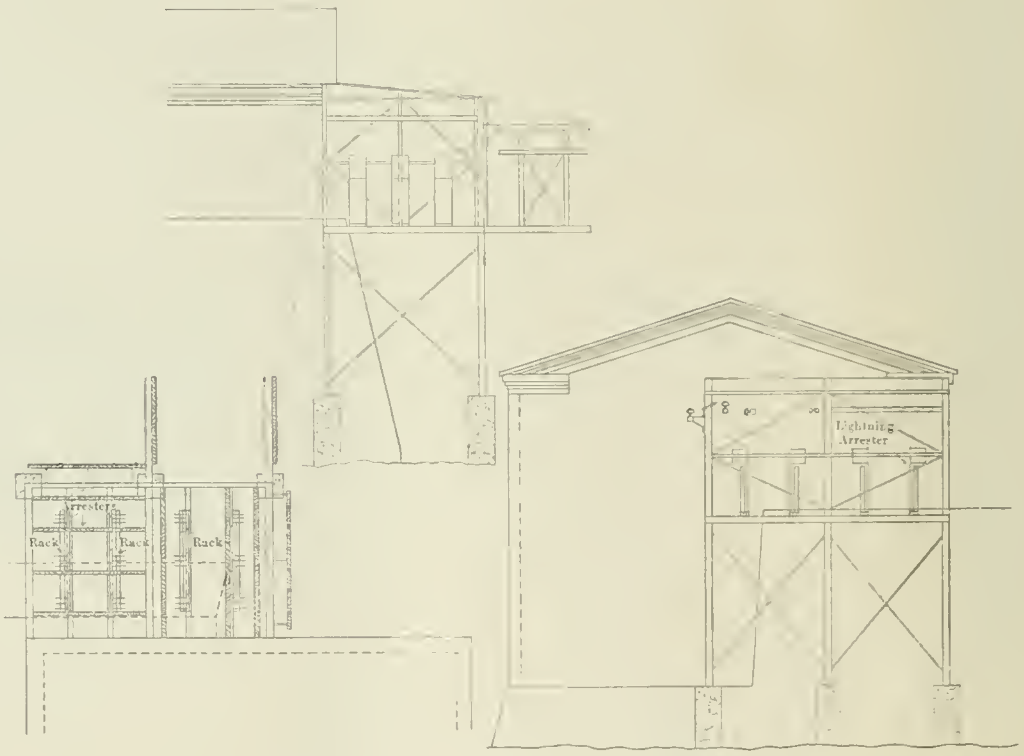


FIG. 4.—TERMINAL HOUSE AT CHAMBLY.

A short distance down stream from the power station at Chambly the two pole lines with their four three-phase circuits cross the Richelieu River. For this crossing six spans were employed, and six concrete piers were erected in the river to support the poles, two poles being set in each pier. Each pole at this crossing is provided with double cross arms, so that each of the twelve 2/0 copper wires has two points of attachment at each pole. The length of each of the spans across the river is about 125 ft. Not far from the river crossing just named the transmission circuits cross the Chambly Canal through which boats pass between Lake Champlain and the St. Lawrence River.

The length of span over this canal is about 132 ft., and with a sag of 5 ft. in the wires that make the span their height above the water in the canal is not less than 131 ft. For the purpose of carrying the circuits over this canal four steel towers were erected, two towers being used for the circuits on each of the two lines of poles. In view of the recent talk about the substitution of steel towers for wooden poles, to carry transmission lines, the details as to the size, weight and cost of the towers in this case may be of especial interest. Each pair of towers was designed to carry twelve No. 2/0 bare copper wires whose diameters had been increased to 1 in. by ice, and to resist all wind pressures without a strain in any member of more than one-fourth of its ultimate strength. The vertical height of each tower is 144 ft. above the foundation. At the top each tower measures 16½ by 16½ in., exclusive of cross pieces that receive the cross arms. Not less than 121,000 pounds of steel was used in the four towers, and their contract price erected on foundations furnished by the purchaser was $5,670, in January, 1902.

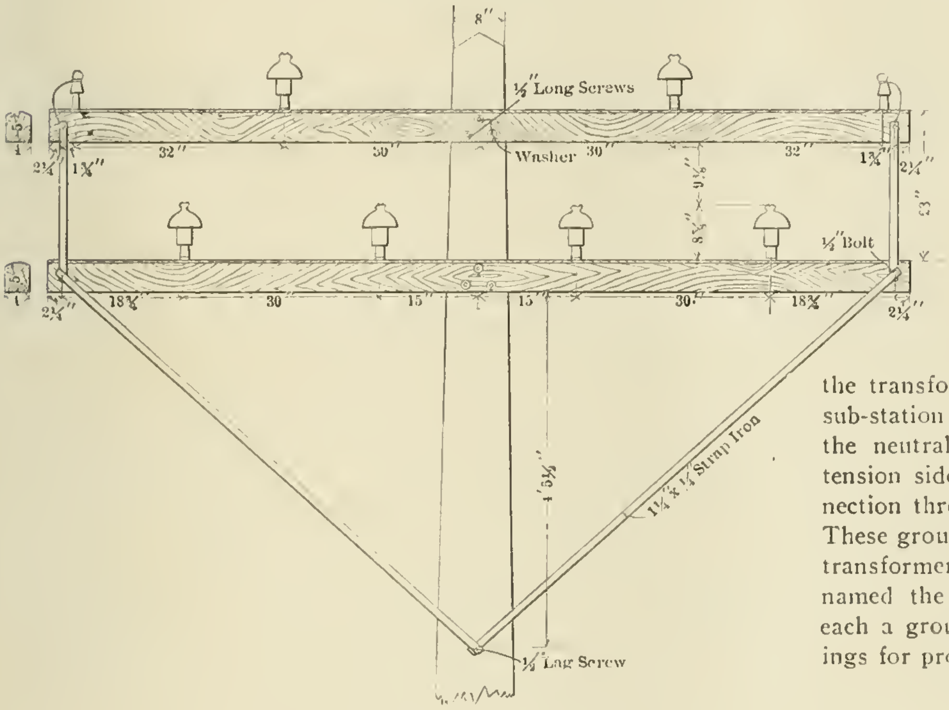


FIG. 5.—POLE WITH CROSS ARMS IN POSITION.

Each tower is provided with a ladder, and supports three sets of cross arms, each set consisting of four cross arms in one horizontal plain. One set of cross arms rests on the top of the tower, the center of the middle set is 30 in. below that of the highest, and the center of the lowest set is 30 in. below that of the second. Two cross arms of each horizontal set are on one side of the tower, and the other two arms of that set are on the other side. Each of the wooden cross arms on the towers is 13 ft. long, and the width across the four arms that make up a set is 4 ft. ½ in. Each set of cross arms provides four insulators for the support of each wire passing over them. Before entering the terminal house at the river end of the power station at Chambly, the four transmission circuits are attached to insulators carried by a heavy timber frame just outside. This frame carries four insulators for each conductor.

The terminal house itself is a one-story structure of steel and concrete, and is separated from the main power house by the end wall. In plan the terminal house is about 18 by 29 ft., and it rests on a steel framework that puts its first floor about 20 ft. above the foundation. The steel I beams on which the terminal house rests extend out about 12 ft. beyond its river side in order to support the timber framework to which the transmission lines are attached.

After leaving an insulator on a cross arm 22 in. from the outside of the concrete wall of the terminal house, each bare conductor passes through a glass tube surrounded by a wooden bushing in that wall. Each of these bushings is of oak 4 in. in diameter, 12 in. long and was boiled in stearin. A little distance inside of this wall each bare 2/0 wire is dead-ended on an insulator like those outside, and an insulated cable is here connected and runs thence to the step-up transformers in the power station. Near the juncture of the bare conductor and the insulated cable a wire is connected that runs to a series of 38 lightning arresters of the brass cylinder and air-gap type, each arrester having six gaps. Between the point where the series of 38 lightning arresters is connected to one of the transmission wires, and the point where this wire is connected to its transformer three inductance coils are inserted in series with each other. Each of these coils is flat, contains 14 turns and is one turn wide.

In each series of lightning arresters the twelve arresters nearest the earth are in shunt with a German silver resistance, and another resistance in series with all of the lightning arresters of each series completes its connection to earth through a copper plate 4 x 6 ft. by ⅛ in. in running water. Knife switches are provided in the 25,000-volt lines at the terminal house, and all of these lines are connected to static ground detectors. From the lightning arresters and knife switches the four three-phase circuits pass directly to the step-up transformers in the main part of the station. These transformers are connected Scott fashion in pairs, each pair receiving two-phase current at 2,200 volts, and delivering three-phase current at 25,000 volts. There are ten of these transformers, each rated at 2,750 kw, so that their combined capacity is 27,500 kw. These transformers are of the air-blast type and Westinghouse make. Both the transformers at Chambly water power plant and at the central sub-station in Montreal are Scott-connected. At the power plant the neutral connection of transformers is grounded on the high-tension side, and at the central sub-station there is a ground connection through a spark-gap to the neutral on the low-tension side. These ground connections are made for the purpose of protecting the transformers from lightning discharges. At the sub-station just named the transformers, which are of Westinghouse make, have each a grounded shield between their primary and secondary windings for protection to the secondary.

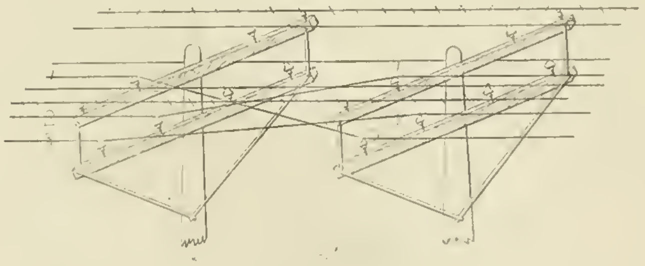


FIG. 6.—TRANSPOSITION POLES.

A Great Electric Thoroughfare.

One of the notable additions to the New York City landscape is the big Williamsburg Bridge, across the East River, which is being opened this week with civic celebration, fireworks and electric light displays. The opening of the bridge will be welcomed by all who have to cross the East River daily, especially during the rush hours, as it will greatly relieve Brooklyn Bridge. The new bridge connects with a large and important manufacturing district, and the arrangements for transportation lines are on a much larger scale than could ever be provided by the old Brooklyn Bridge. It is 118 ft. in width, as compared with 85 ft., the width of the Brooklyn Bridge. It also has two decks instead of one, two foot walks, each 10½ ft. in width, two bicycle paths, each 7 ft. wide, four trolley tracks, two elevated railway tracks and two roadways, each 20 ft. in width. The old bridge has one promenade 15 ft. wide, two roadways, each 18 ft. wide, and each giving half of its space to the trolley tracks, and two elevated railway lines.

The trolley lines on the new bridge will greatly increase present facilities, as there will be four tracks running in a space especially devoted to their use, thus providing facilities for operating 350 cars an hour, and handling 70,000 persons traveling in both directions, as against 40,000 an hour on the Brooklyn Bridge. Trolley cars will also be free from trucks, wagons or carriages, and the elevated railroad will provide for the carrying of at least 29,000 persons in one direction every hour, or 58,000 persons going and coming across the bridge, thus raising the maximum to 128,000 an hour. This

the bridge, thus raising the maximum to 128,000 an hour.

Conductivity of Mercury Vapor.

By Peter Cooper Hewitt.

THE electrical conductivity of gases and vapors and its relation to the conditions under which the electrical current is maintained has occupied my attention for many years. A large number of experimental data accumulated during the progress of my work, which when properly arranged and co-ordinated, furnish a theory of electrical conduction through gases which seems to account satisfactorily for the phenomena observed. It was thought desirable to perform additional experiments for the purpose of obtaining exact quantitative measurements upon some particular gas and for this purpose mercury vapor was selected. The results of these experiments are given in the following brief summary. I was fortunate to secure, during the progress of this work, the assistance of Dr. A. P. Wills, who expects to publish in the near future a detailed account of the methods and apparatus employed in this experimental study.

A gas or vapor forming part of an electric circuit exhibits three distinct sources of electrical reactions, namely, one at the junction of the positive electrode of the conductor with the gas or vapor, one in the gas or vapor uninfluenced by the electrode effects, and one at the junction of the gas or vapor with the negative electrode.

Difficulty was experienced in obtaining electrical measurements upon the conducting gas or vapor independent of these electrode effects; the measuring instruments require the use of terminals or electrodes in contact with the gas or vapor with the electrode resistances accompanying them; difficulty was also met with in obtaining the gas or vapor in a state of purity. The results given in the diagrams are not vitiated by terminal or electrode effects. The measurements were taken in such a way as to be subject to but little variation from the effects of the current during the time of observation.

Fig. 1 is a diagrammatic view of the apparatus. Two upright chambers of insulating material were connected together at the top and bottom, thus forming one continuous air chamber. One chamber contained an electric heating coil, the current supply of which could be regulated externally; a centrifugal fan over this chamber produced a rapid circulation of the air contained by the two chambers for the purpose of bringing the whole to a uniform temperature, which was regulated by the heating coil. In the other chamber was placed the vessel containing the gas or vapor, marked "lamp" with the necessary electric connections. Thermometers were inserted at both ends, as shown, for determining the external temperature. Two platinum-rhodium couples were sealed in the walls of the lamp at a measured distance apart, and extended to the center. The external terminals of the couples were immersed in ice and connected to a

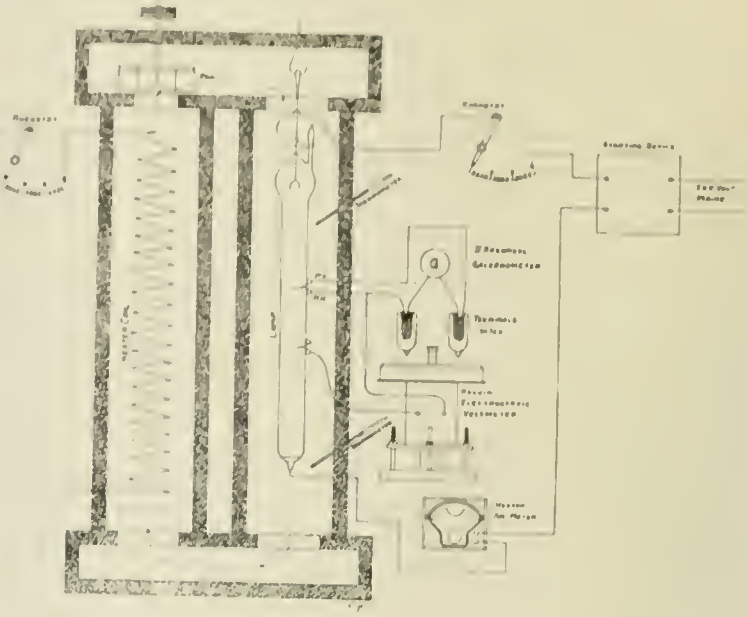
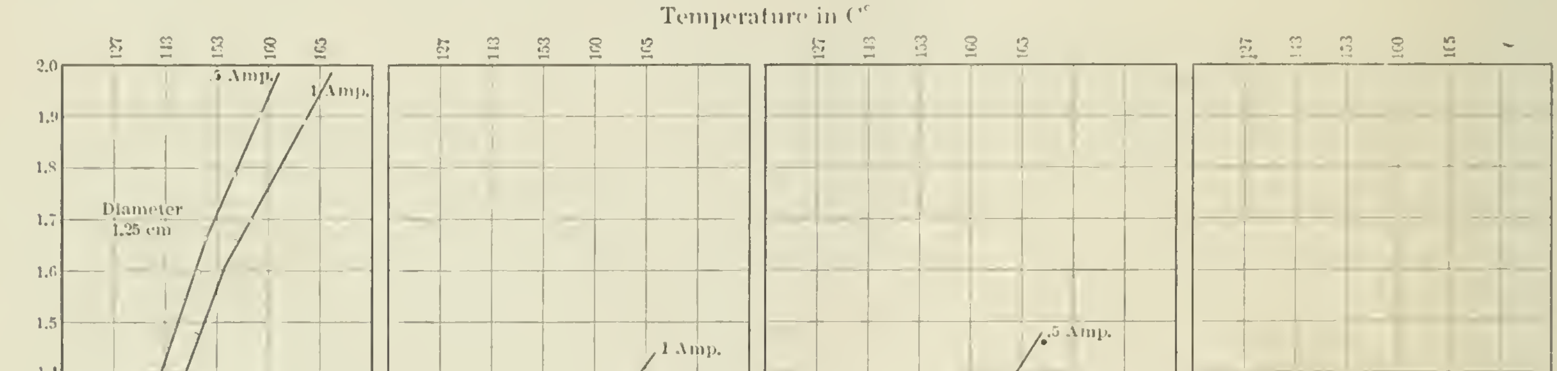
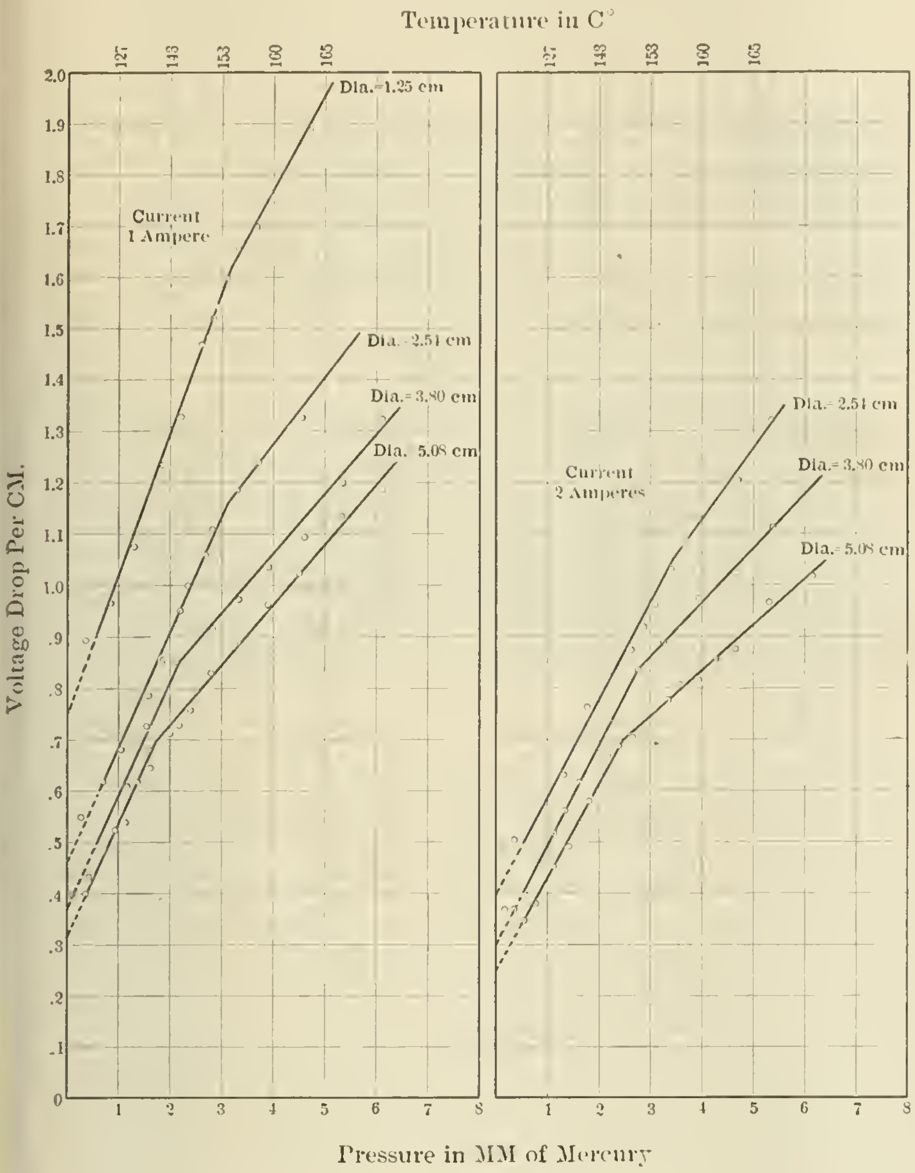


DIAGRAM OF MEASURING APPARATUS.

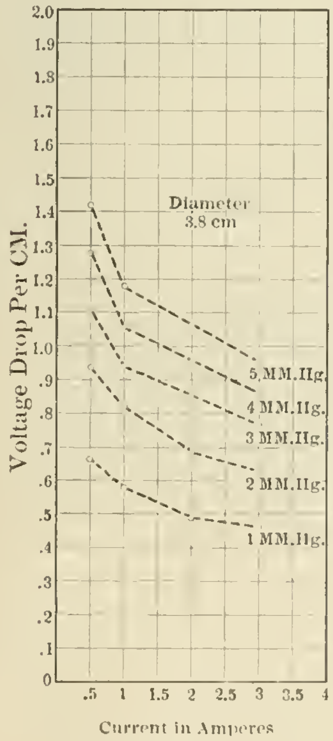


Diagrams Showing the Relation of Drop in Volts per cm. of Length to the Pressure in mm. of Mercury for Different Currents in Lamps of Given Diameter.

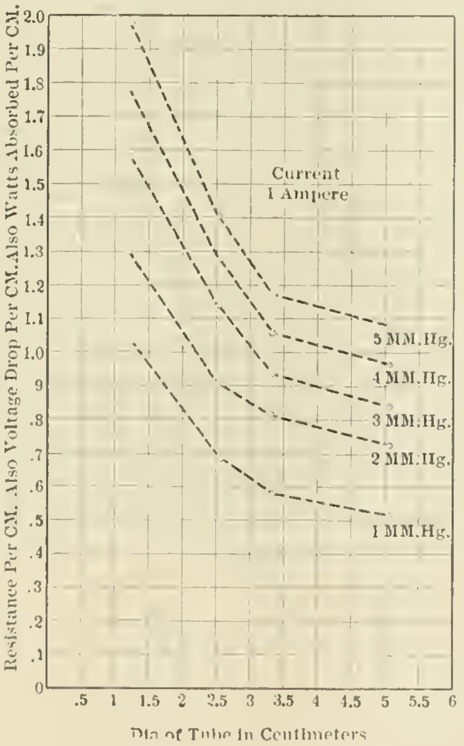
D'Arsonval galvanometer. The internal temperature was measured by means of these couples by observing the deflection of the galvanometer. It was possible to ascertain accurately when the internal and the external temperatures were the same. The drop in volts between the platinum-rhodium points was taken by a Kelvin electrostatic voltmeter; the couples thus served a double purpose. It was possible to obtain voltage measurements at the temperatures desired. When a required temperature was obtained internally and externally, the current was started through the lamp by the starting device, and was controlled by an external resistance and measured by a Weston ammeter. Immediately after starting the current, the reading of the Kelvin voltmeter was taken. There was sufficient time to obtain these readings accurately before the current materially altered the vapor density.



DIAGRAMS SHOWING THE RELATION OF DROP IN VOLTS PER CM. OF LENGTH TO THE PRESSURE IN MM. OF MERCURY FOR LAMPS OF DIFFERENT DIAMETERS AT CONSTANT CURRENT.

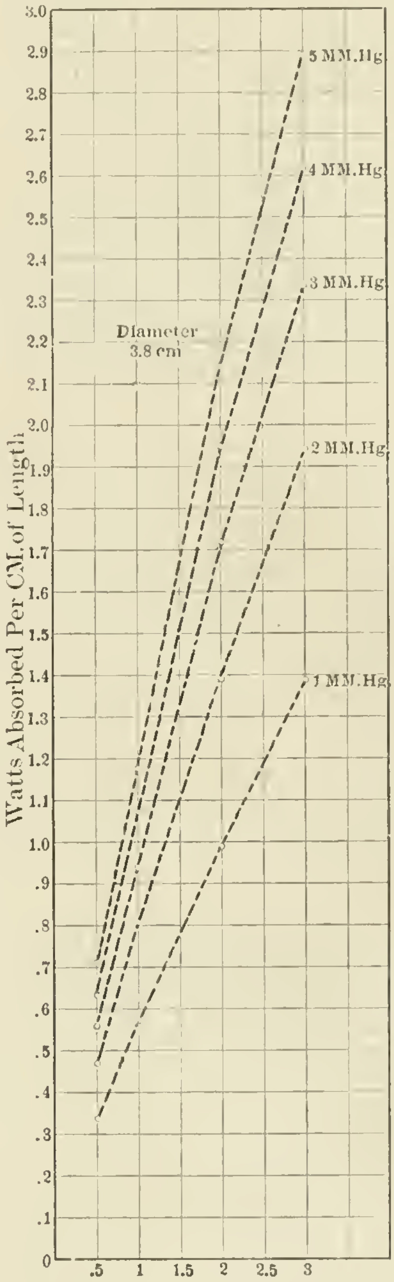


DERIVED CURVES SHOWING THE RELATION BETWEEN VOLTAGE DROP PER CM. TO THE CURRENT IN AMPERES FOR DIFFERENT PRESSURES OF MERCURY VAPOR.

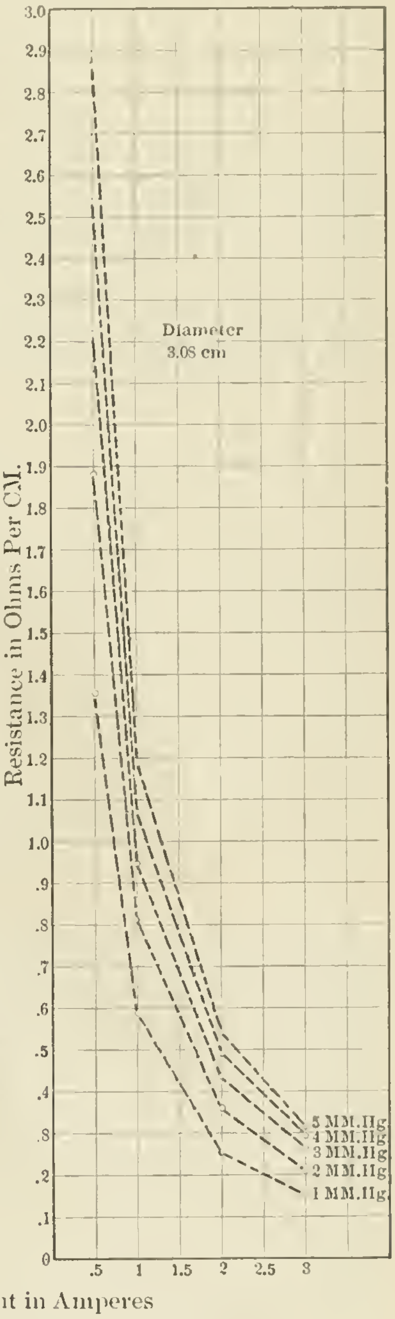


DERIVED CURVES SHOWING THE RELATION OF RESISTANCES PER CM.; VOLTAGE DROP PER CM.; AND WATTS ABSORBED PER CM. TO THE DIAMETER OF TUBE IN CM. FOR DIFFERENT PRESSURES OF MERCURY VAPOR.

The lamps contained some mercury and were exhausted with great care until nothing but mercury and its vapor were present. The size of the tube used for the lamp limited the diameter of the conducting vapor column, and its diameter is the diameter given in the diagram.



DERIVED CURVES SHOWING THE RELATION BETWEEN WATTS ABSORBED PER CM. OF LENGTH TO CURRENT IN AMPERES FOR DIFFERENT PRESSURES OF MERCURY VAPOR.



DERIVED CURVES SHOWING THE RELATION OF CURRENT IN AMPERES TO THE RESISTANCE IN OHMS PER CM. OF LENGTH FOR DIFFERENT PRESSURES OF MERCURY VAPOR.

The relation of the pressure of the saturated vapor to the temperature was deducted from the observations of Ramsay and Young: the density is proportional to the pressure. The walls of the lamp being covered by small globules of mercury and a large amount of mercury being present at the bottom of the lamp, the vapor was considered to be in a state of saturation.

The points on the curves indicate actual readings; the drop in volts and temperature were observed. In most cases the experiments were repeated many times with different lamps, and with the same lamp re-exhausted, in order to be certain that only mercury vapor was present in the lamp, since the presence of a small amount of another gas will cause considerable variation in the measurements. For instance, on admitting a different gas into a lamp containing a pure gas, the effect may be observed by the measuring instruments.

The diagrams show the influence of density, diameter and current on the drop in volts per unit length. From them can be deduced the resistance, as a function of the density current and diameter.

They show that the voltage required to maintain an electric current in a gas or vapor is directly proportional to the density, and that it decreases as the diameter of the lamp increases. The resistance decreases with increase of current. From the diagrams, relations among the diameter, density and current may be established.

The current assumes a definite cross section for a given density and current when not restricted by the lamp; this cross-section increases with increase of current and decreases with increase of density. The angles in the curves shown may be due to these effects, but this point needs further investigation.

The light efficiency of mercury vapor varies with the density; there is a density of maximum light efficiency. On passing a current at a very low density practically no light is visible and the drop in volts for the same current is less than at greater densities. At densities greater than a certain limit the light efficiency decreases. If another gas is present with mercury vapor, the current is usually selective and gives the spectrum of mercury vapor, but the resistance is materially altered. The effect of magnetic force transversely applied at low densities is very marked, and is that of increasing the resistance in an extraordinary degree, while at higher densities it increases the resistance but little. Magnetic force alters the spectrum particularly at low densities.

The experimental curves speak for themselves; the conclusions which may be drawn with respect to the relation of the conductivity of mercury vapor to the physical conditions under which the electrical current through the vapor is maintained appear to be, broadly speaking, generally true for all gases and vapors. It is not necessary to enumerate here all these conclusions, for they are sufficiently evident on the face of the curves. Some curves are given which have been deduced from the curves obtained by direct experiment. They are marked in the diagrams as "derived" curves. There is one conclusion, however, which from a purely technical point of view deserves special attention. It is this:

When a given vessel containing mercury vapor is to be employed as a source of light, that is, as an electric lamp, the highest light efficiency will be obtained when the vapor density and the current employed have a definite and fixed relation.

German Gas Engine Power Stations.

By Frank C. Perkins.

A LARGE number of electric power plants have recently been designed and constructed in Germany, in which gas engines of various sizes have been utilized exclusively for driving the electrical generators. The types of engines used in these installations may be divided into four classes. First, those having single cylinders of the single-acting type working on the Otto cycle, a plant of this character being noted in the accompanying illustration, Fig. 3. Second, those employing cylinders on opposite sides of the fly-wheel and electrical generator, as shown in the accompanying diagrams and Figs. 1 and 2, and in Fig. 4. Third, central stations utilizing twin gas engines of the single-acting type, consisting essentially of two single-cylinder Otto cycle gas engines, one being directly-connected to the armature shaft on either side of the electrical generators, as seen in Fig. 5. Fourth, double-acting engines are employed in the various ways above mentioned and also with two cylinders connected in tandem.

The double-acting Deutz engine noted in Fig. 6 was constructed for driving a direct-current electrical generator at the plant of the Actien-Gesellschaft-Lauchhammer, and has a capacity of 300 hp. The gas engines and direct-current generators installed at the Elektricitätswerk at Münster, i. W., Germany, as illustrated in Fig. 5, include four units each having a capacity of 200 hp. The engines were constructed at Köln-Deutz by the Gasmotoren Fabrik Deutz. This engine room is one of the most handsomely decorated of any in Germany. The switchboard gallery is located directly over the main entrance and is very artistic in appearance. The electrical equipment, including the direct-current dynamos, which are of the fly-wheel type, as well as the switchboard apparatus, were installed by the Elektricitäts-Actien-Gesellschaft, formerly W. Lahmeyer & Co., of Frankfort-on-the-Main, Germany. These generators each have a capacity of 100 kw and operate at a speed of 170 r.p.m. They each generate a current of 320 amp. at 500 volts.

At the Hoerder Bergwerks und Hutten Verein in Germany, the electric power station, as shown in Fig. 4, is operated by two gas engines, each having a capacity of 1,000 hp. These engines are operated by waste blast furnace gases and drives a large three-phase generator at the speed of 135 r.p.m. Each engine weighs about 176 tons.

In these engines, which were also constructed by the Gasmotoren Fabrik Deutz, the fly-wheel effect is produced by the revolving field of the alternator. The dynamos have each a capacity of 810 kw and supply a polyphase current of 270 amp., the potential being 3,000 volts. The generators were constructed by the Elektricitäts Actien Gesellschaft, formerly Schuckert & Co., of Nüremberg, Germany, and the power developed by the waste blast furnace gases is utilized for operating electric motors about the works as well as for supplying current for both arc and incandescent lamps about the great plant.

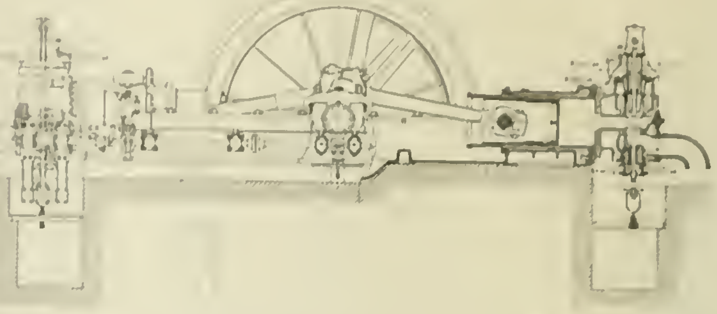


FIG. 1.—ELEVATION OF 500-HP DOUBLE-CYLINDER DEUTZ GAS ENGINE.

The Hoerder Bergwerks und Hütten Verein was changed to a limited liability company in 1852 with a capital of six million marks. The works consist of the blast furnace plants in Hoerde and Dortmund, the Hermann's mills, foundries and smelting works in Hoerde, and the collieries at Hoerde, including the Pit Scheswig, near Brackel, and Pit Holstein, near Asseln.

The Hoerde Verein was a pioneer in the utilization of waste gases by internal combustion motors. The first successful trial was undertaken in 1895, but the first large engine which was set at work continuously after long difficulties was in 1898. At present the electric power station is fitted with three Oechelhaus gas engines of 600 hp each, and two of 1,000 hp-capacity each, constructed by the Gasmotoren Fabrik in Deutz, as mentioned above. This plant gives excellent satisfaction and the electrical energy is used for various purposes at the Hermann Works and in the collieries.

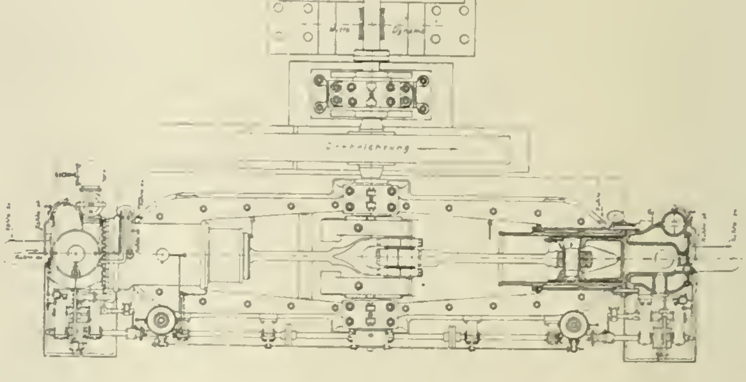


FIG. 2.—PLAN OF 500-HP DOUBLE-CYLINDER DEUTZ GAS ENGINE.

The electric power station at Friedenshütte, near Morganroth, is equipped with high-power gas engines of the Otto cycle type, using waste blast furnace gases for fuel from the works of Oberschles Eisenbahn Bedarfs Actien-Gesellschaft. There are four units in this plant with a total capacity of 1,000 hp. Two of the engines operated at a speed of 150 r.p.m. and have a capacity of 200 hp each, while the remaining two units are somewhat larger, developing 300 hp each, with a normal speed of 167 r.p.m. The fly-wheels of the smaller engines weigh 9 tons each and measure 10 ft. in diameter, while the larger fly-wheels weigh 20 tons each and have a diameter of 15 ft.

The electrical generators are of the multipolar direct-connected three-phase type, constructed at Nüremberg, Germany, by the Elektricitäts Actien Gesellschaft, formerly Schuckert & Co. Two of the alternators are 132-kw machines each, supplying a current of 600 amp. at 2 × 110 volts on the three-wire system. The remaining alternators each have a capacity of 250 kw and generate a current of 500 amp. at a pressure of 500 volts. This plant is illustrated in Fig. 3, and Figs. 1 and 2 are drawings of a 500-hp, double-cylinder Deutz gas engine, direct-connected to an electrical generator.

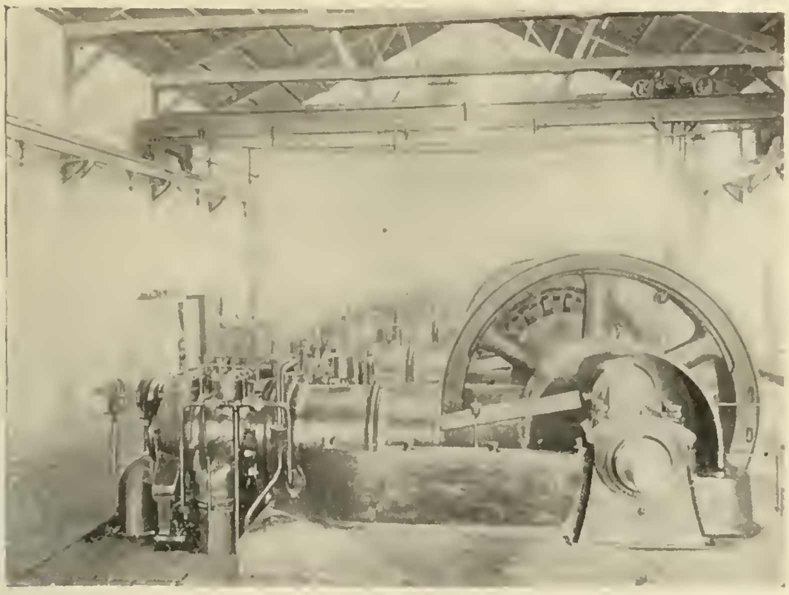


FIG. 3.—POWER STATION AT FRIEDENSHUETTE.

This type of engine has a very heavy fly-wheel to aid in the regulation, as the two impulses are delivered in one revolution and no impulses are given in the next revolution. The two cylinders are controlled independently and there are, therefore, a large number of air, gas, exhaust and water-cooling pipes, which are, however, compactly arranged and are not at all cumbersome.

With the single-acting Deutz gas engine the gas valve and the inlet valve are combined with a piston valve mounted on the same spindle, the air being admitted into the same casing. As the valve spindle is pressed down by the gear mechanism, the inlet is opened first and the air valve and the gas valve follow a moment later, opening inward or downward. A powerful spring supplies the necessary pressure to close the parts upward. The spindle of the valve is attached to one end of the valve lever and the other end to a rod driven from the valve shaft, a roller supporting the valve lever.

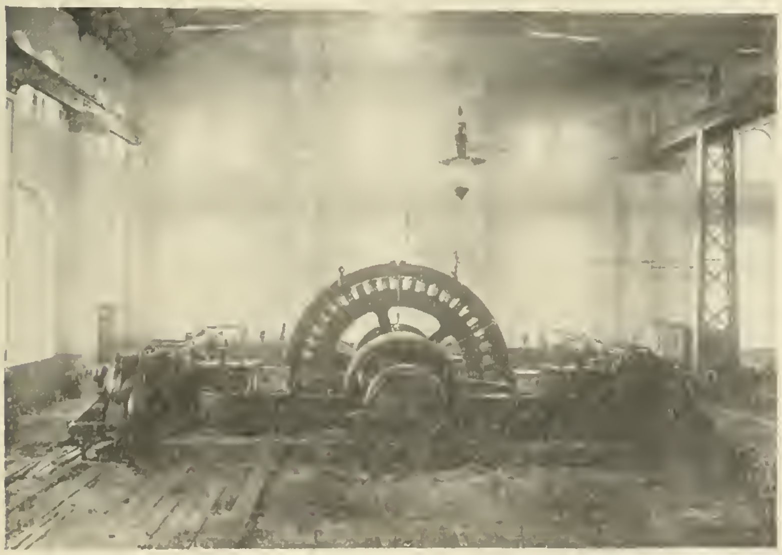


FIG. 4.—POWER PLANT AT HOERDER, GERMANY.

The valve lever presses against the roller when the driving rod is lifted, the inlet valve is forced downward and the valve is then closed as the driving rod descends. This valve closes toward the end of the suction stroke and opens at the beginning of the stroke.

It will be observed from the drawings, Figs. 1 and 2, that the two cylinders, one on each side of the central shaft, are duplicates, the valve mechanism being also the same. When the position of the roller is changed by the governor the valve is opened more or less, but for the same length of time. By throttling the gas and air mixture the proper regulation is obtained. This is accomplished by changing the sizes of the openings for the air and gas at the same time, the mixture remaining practically the same, but a larger or a smaller amount of the mixture entering the cylinder, according to the position of the governor. The compression is also changed by this regulation, but it is stated that the engines work exceedingly well under light loads.

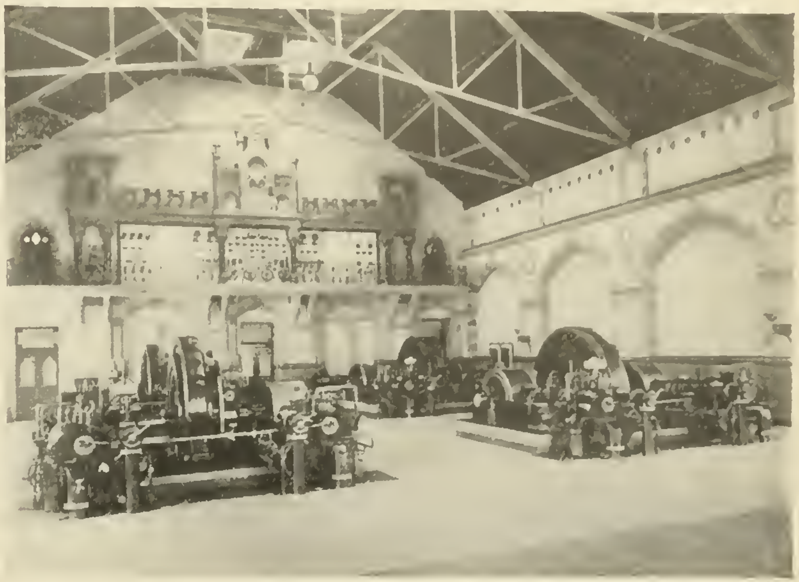


FIG. 5.—INTERIOR VIEW OF MÜNSTER STATION.

Double-acting gas engines of large sizes are now being constructed by a number of prominent engineering firms abroad, such as the Koerting and Cockerill, the former being a double-acting, two-cycle engine and the latter being of the double-acting four-cycle type. A Deutz double-acting four-cycle engine has recently been designed, having at each end of the cylinder an inlet valve combined on one spindle with a gas and air valve, while the exhaust valve is placed very low. It is said to work very regularly and economically and is much smaller than the single-acting engines of the same capacity. The double-acting, four-cycle engines are, however, larger than the double-acting, two-cycle types of the same capacity.

High-power gas engines have proven of great service in making use of waste blast furnace gas, which is capable of supplying 1,000 hp, it is claimed, for every 100 tons of pig iron produced. Gas engines are now in operation driving electrical and generators as well as blowing engines, with capacities ranging up to 1,000 hp for single-cylinder engines and from 1,200 to 2,000 hp with double tandem cylinders, while double-acting engines have been designed of 5,000 hp for driving electrical generators, two 2,500-hp engines being directly-connected to the same alternating-current machine.

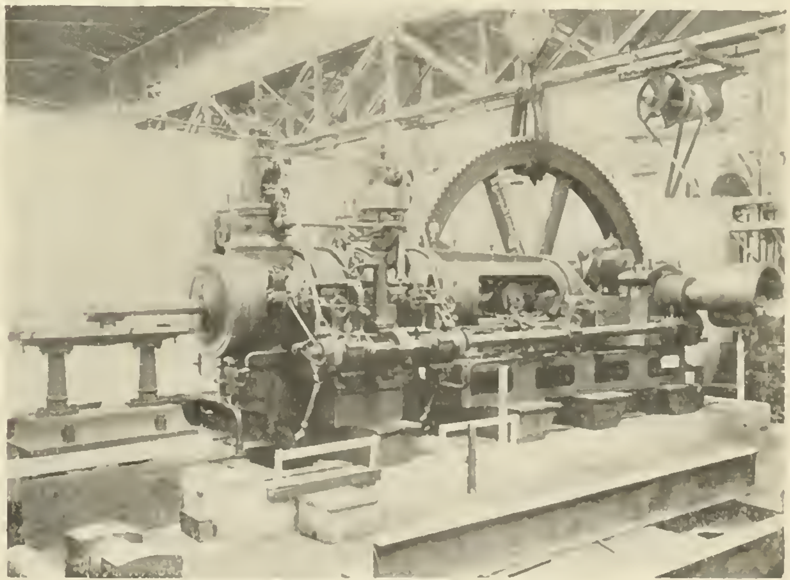


FIG. 6.—300-HP DOUBLE-ACTING DEUTZ GAS ENGINE AT LAUCHHAMMER.

There is every reason to believe that during the next decade thousands of horse-power will be generated by waste blast furnace gases in the power houses of iron and steel plants in this country, as is now being done in the largest power plants abroad.

Physical Equipment of American Central Stations.

IN continuance of our digest and analysis of the statistics of central stations in the United States, as reported by the Census Office, we will now take up the data of physical equipment of the 3,620 plants reported upon. It appears that more than one-half of the private stations and three-fourths of those operated under municipal control have a dynamo capacity of less than 200 hp. The dynamo capacity of 80.3 per cent. of all central electric stations is less than 500 hp, and 83.8 per cent. of the stations operated under private ownership have a dynamo capacity of less than 500 hp each, as compared with 95.2 per cent. of the stations operated under municipal control. Of the total number of private stations, 7.1 per cent. have a dynamo capacity of between 500 and 1,000 hp, while 3.1 per cent. of the municipal stations are included in this group. The dynamos of only 1.7 per cent. of the municipal stations have a horse-power capacity exceeding 1,000, while the horse-power capacity of 0.1 per cent. of the private stations exceeds this quantity.

In 3,301 stations, the dynamos are operated by the use of steam or steam and water power. In a number of cases the steam power is merely auxiliary to the water power, being used only when the water power is not available. There are 319 stations in which the machines are operated by the use of water power exclusively. These stations have 649 water wheels with a stated capacity of 222,585 hp and a dynamo capacity of 172,101 hp, the kilowatt-hour output of current for the year being 250,105,461.

The total horse-power capacity of the steam engines and water wheels reported by the central electric stations, as used for the operation of dynamos to generate electric current is 1,772,813. Of this amount 1,379,941 hp, or 77.8 per cent., is the indicated capacity of steam engines and 392,872 hp, or 22.2 per cent., the stated capacity of water wheels. The indicated capacity of steam engines and water wheels in the stations operated under private ownership is 1,614,577 hp, or 91.1 per cent. of the total, and of those in stations operated under municipal control, 158,236 hp, or 8.9 per cent. The varying capacities of the steam engines is shown from the accompanying table:

STEAM ENGINES: PRIVATE AND MUNICIPAL STATIONS, AND PERCENTAGE EACH CLASS IS OF THE TOTAL: 1902.

Class of engine.	Total.	Private stations.	Municipal stations.	Per cent. In private stations.	Per cent. In municipal stations.
Total:					
Number	5,930	4,870	1,060	82.1	17.9
Horse power	1,379,941	1,232,923	147,018	89.3	10.7
500 horse power and under—					
Number	5,450	4,407	1,043	80.9	19.1
Horse power ...	848,836	715,418	133,418	84.3	15.7
Over 500 and under 1,000 horse power					
Number	279	266	13	95.3	4.7
Horse power ...	194,070	184,670	9,400	95.2	4.8
1,000 horse power and over—					
Number	201	197	4	98.0	2.0
Horse power ...	337,035	332,835	4,200	98.8	1.2

In general it appears from this table that private stations employ steam engines with a greater horse-power capacity than do municipal stations, practically all of the latter containing engines with a capacity of not over 500 hp. In addition to the engines shown there are reported for the private and municipal stations, 165 gas engines having a capacity of 12,181 hp, and 365 auxiliary steam engines having a capacity of 14,454 hp.

For all classes of stations 1,390 water wheels are reported in operation. Of this number, 113, all but 1 of which are operated under private ownership, possess a stated capacity of 1,000 hp and over. As in the case of steam engines, the smaller size of water wheels predominates, and wheels having each a stated capacity of 500 hp and under form 85.4 per cent. of the total number installed. Their horse-power, however, forms only 39.7 per cent. of the total horse-power. Only 8.1 per cent. of the water wheels have a stated capacity of 1,000 hp and over, but their total stated horse-power forms 47.2 per cent. of the total for all classes of water wheels.

We come now to the dynamos in central stations, 12,484 being reported of an indicated capacity of 1,624,980 hp. The accompanying table shows their character.

DYNAMOS: PRIVATE AND MUNICIPAL STATIONS, AND PERCENTAGE EACH CLASS IS OF TOTAL: 1902.

Variety of dynamo	Total.	Private stations.	Municipal stations.	Per cent. In private stations.	Per cent. In municipal stations.
Total:					
Number	12,484	10,662	1,822	85.4	14.6
Horse power	1,624,980	1,472,996	151,984	90.6	9.4
Direct current, constant voltage—					
Number	3,823	3,405	418	89.1	10.9
Horse power	442,446	418,913	23,533	94.7	5.3
Direct current, constant amperage—					
Number ...	3,539	2,957	582	83.6	16.4
Horse power ..	195,531	157,768	37,763	80.7	19.3
Alternating and polyphase current—					
Number	5,122	4,300	822	84.0	16.0
Horse power ...	987,003	896,315	90,688	90.8	9.2

The private stations contain 85.4 per cent. of all dynamos, and their horse-power forms 90.6 per cent. of the total horse-power of dynamos of every description. The showing of alternating and polyphase apparatus may be regarded as remarkable.

In addition to the equipment shown in the foregoing table, there are employed in the central stations 193 boosters, with a capacity of 17,911 hp, and 132 rotaries, with a capacity of 63,817 hp. As to sub-station apparatus, the number and horse-power of storage battery cells, transformers, rotary converters and miscellaneous equipment in sub-stations were required to be reported separately. The totals are summarized in the following table:

SUB-STATION EQUIPMENT—PRIVATE AND MUNICIPAL STATIONS: 1902.

Kind of equipment.	Total. Number.	Total. Horse power.	Private Stations. Number.	Private Stations. Horse power.	Municipal Stations. Number.	Municipal Stations. Horse power.
Storage battery cells ..	8,388	25,284	8,388	25,284	..	....
Transformers	2,525	420,667	2,490	419,368	35	1,299
Rotary converters	163	85,556	162	85,546	1	10
Miscellaneous	140	21,443	135	21,269	5	174

In addition to the 8,388 storage battery cells in sub-stations, with a capacity of 25,284 hp, there are 6,881 cells, with a capacity of 16,355 hp, reported for the main power plants, making the number of cells for all classes of storage batteries 15,269, with a capacity of 41,639 hp. It will, of course, be understood that the capacity of the storage batteries cannot be taken in definite horse-power, that depending so much on the rate of discharge; but the figures here given are such as are justified by the reports from the central stations as to battery output of current, although it was not found feasible to reduce this to horse-power-hours, the rate of discharge varying somewhat indefinitely.

In addition to the 2,525 transformers in sub-stations, with an indicated capacity of 420,667 hp, there are 207,151 on consumers' circuits, with a total capacity of 922,774 hp, making an aggregate of 209,676 transformers, with a capacity of 1,343,441 hp. The miscellaneous equipment consists largely of motor-generator sets and boosters.

Some difficulty was naturally experienced in getting at the output, especially with plants carrying chiefly an arc light load, or unchecked by consumption meters. There were reported, however, 582,689 consumers' meters, of which 98.7 per cent. were electro-mechanical, the others being chemical. Each station was required to report its kilowatt-hour average per day and the total for the year, and also the horse-power of the current average per day and the total for the year. In the majority of the stations no record is kept of the output of current, and the amounts reported are largely estimates based on the voltage and amperage of the machines with reference to the hours of operation. The average kilowatt-hour output of current per day for all stations is 6,814,074, and the total for the year 2,453,502,652. The horse-power-hours of current, average per day, is 9,097,796, and the total for the year 3,270,162,309. The stations operated under private ownership report 92 per cent., and those under municipal control only 8 per cent. of the total kilowatt and horse-power-hours of current. The total dynamo capacity of central stations is 1,624,980 horse-power, or, roughly, about 1,200,000 kw. As the average kilowatt-hour output of current per day is shown to be 6,814,074, it appears from this that the electric light stations are on a basis of average daily operation for six hours, or, approximately, 25 per cent. of their possible capacity of production of current. As the gross earnings from operation are shown to be slightly over $84,000,000, and the total production of current for the year to be 2,453,502,652 kilowatt-hours, it appears that the earnings per kilowatt-hour are not quite 4 cents. On the other hand, it is not to be understood that the central stations are able to sell all the current that they produce, as the inevitable losses between the switchboard and the consumers' lamps and motors reduce the apparent earning capacity very seriously. But even if only half the current reported as produced were consumed and paid for and the other half were lost, the yield per kilowatt-hour would appear to be not in excess of from 7½ to 8 cents.

What becomes of the current used and sold is an important consideration, and a large amount of data is given bearing upon this point. As to the arc light service, the following table is of interest:

ARC LAMPS—PRIVATE AND MUNICIPAL STATIONS, AND PERCENTAGE EACH CLASS IS OF TOTAL: 1902.

Kind of lamp and character of service.	Total.	Private Stations. Number.	Private Stations. Per cent.	Municipal Stations. Number.	Municipal Stations. Per cent.
Aggregate	385,698	334,903	86.8	50,795	13.2
Commercial or other private, total	173,973	168,180	96.7	5,793	3.3
Open	42,988	41,622	96.8	1,366	3.2
Inclosed	130,985	126,558	96.6	4,427	3.4
Direct current	104,176	101,849	97.8	2,327	2.2
Open	38,120	36,856	96.7	1,264	3.3
Inclosed	66,056	64,993	98.4	1,063	1.6
Alternating current	67,538	64,085	94.9	3,453	5.1
Open	3,733	3,631	97.3	102	2.7
Inclosed	63,805	60,454	94.7	3,351	5.3
All other	2,259	2,246	99.4	13	0.6
Open	1,135	1,135	100.0	......	....
Inclosed	1,124	1,111	98.8	13	1.2
Public, total	211,725	166,723	78.7	45,002	21.3
Open	138,684	108,082	77.9	30,602	22.1
Inclosed	73,041	58,641	80.3	14,400	19.7
Direct current	154,749	119,520	77.2	35,229	22.8
Open	125,298	96,659	77.1	28,639	22.9
Inclosed	29,451	22,861	77.6	6,590	22.4
Alternating current	48,063	38,316	79.7	9,747	20.3
Open	4,630	2,681	57.9	1,949	42.1
Inclosed	43,433	35,635	82.0	7,798	18.0
All other	8,913	8,887	99.7	26	0.3
Open	8,756	8,742	99.8	14	0.2
Inclosed	157	145	92.4	12	7.6

In addition to the 385,698 arc lamps shown for central electric stations, the street railways operating electric light stations report 33,863 arc lamps, making the total in the United States 419,561. This does not include, of course, a large number operated in isolated plants of all kinds, as previously pointed out. The total annual income derived from arc lighting of every description, with the exception of isolated electric plants, is $27,408,708, giving an average of $65.33 per lamp, regardless of the daily hours of burning.

Of the total number of lamps reported for central electric stations, 334,903, or 86.8 per cent., are in use by stations operated under private ownership and 50,795, or 13.2 per cent., by stations under municipal control; 173,973, or 45.1 per cent., are engaged in commercial or other private lighting, and 211,725, or 54.9 per cent., in lighting streets, parks and public buildings; 181,672, or 47.1 per cent., are of the open variety, and 204,026, or 52.9 per cent., are of the enclosed. There are 258,925 lamps, or 67.1 per cent. of the total, operated by the application of direct current, and 115,601, or 30 per cent., by alternating current.

With regard to the lamps classified as "all other" this should be understood as referring to lamps which are not, strictly speaking, in the arc lighting category on private or public circuits. There are, throughout the country, a great many focusing and small projector lamps which are not known as arc lights, although the current is made to produce light by passing between two carbon points. These lamps are used in theatres, for stage projection purposes, in photographic studios, engraving shops, and daily newspaper offices for the quick production of photographs, engravings, etc. To add such arc lamps to the class devoted strictly to purposes of lighting buildings and streets would be misleading, and, therefore, the attempt has been made to segregate them as far as possible, although it will be understood, of course, that these are operated on the ordinary central station circuit.

Of the 334,903 arc lamps reported by stations operated under private ownership, 168,180, or 50.2 per cent., are used in commercial or other private lighting, furnishing an income of $8,220,154, or $48.88 per lamp; and 166,723, or 49.8 per cent., are used in public lighting, furnishing an income of $13,871,646, or $83.20 per lamp. Of the 50,795 lamps reported by municipal stations, 5,793, or 11.4 per cent., are used in private lighting, furnishing an income of $240,166, or $41.46 per lamp; and 45,002, or 88.6 per cent., are used in public lighting, with an estimated income of $3,149,079, or $69.98 per lamp. The income of municipal stations from public lighting is estimated for each station at the commercial rates prevailing in the community. The number of lamps, however, is not the number actually performing service at any one time, but only the number in position to render service, and, therefore, to earn an income. Including the lamps operated from stations controlled by electric railway companies, there are 195,122 of the open variety and 224,439 of the enclosed.

The general introduction of meters and the application of meter rates to the sale of electric current have made it unnecessary, and even impossible, to keep a record of the number of incandescent lamps in service, and in the majority of cases the numbers reported are estimates; but, while the totals are not the result of an actual count, they may be accepted as a close approximation of the actual number of lamps wired and ready for use at the end of the year covered by this report. The table herewith summarizes the totals for the United States and shows the proportion in private and municipal stations.

INCANDESCENT LAMPS—PRIVATE AND MUNICIPAL STATIONS, AND PERCENTAGE EACH CLASS IS OF TOTAL: 1902.

Kind of lamp and character of service.	Total.	Private Stations. Number.	Private Stations. Per cent.	Municipal Stations. Number.	Municipal Stations. Per cent.
Aggregate	18,194,044	16,616,593	91.3	1,577,451	8.7
Commercial or other private,				STAOIN SHRDLUUL	
total	17,738,384	16,243,853	91.6	1,494,531	8.4
16-candle power	15,261,067	13,890,281	91.0	1,370,786	9.0
32-candle power	514,679	484,246	94.1	30,433	5.9
All other candle-power	1,962,638	1,869,326	95.2	93,312	4.8
Public, total	455,660	372,740	81.8	82,920	18.2
16-candle power	296,776	235,842	79.5	60,934	20.5
32-candle power	59,988	47,063	78.5	12,925	21.5
All other candle power	98,896	89,835	90.8	9,061	9.2

There are 16,616,593 incandescent lamps of all varieties reported for stations operated under private ownership. Of this number, 16,243,853, or 97.8 per cent., are used for commercial or other private lighting, and 372,740, or 2.2 per cent., for public lighting. Of the 1,577,451 lamps reported for municipal stations, 1,494,531, or 94.7 per cent., are used for commercial or other private lighting, and 82,920, or 5.3 per cent., for lighting streets, parks and other public places.

The total number of "all other candle-power" incandescent lamps, 2,061,534 is composed of small lamps of from 4 to 8 cp., used for advertising and decorative purposes, and of a comparatively small number of lamps of high candle-power, such as 50 candle-power. It is estimated that the equivalent in 16-cp lamps would be about half the number, or 1,030,767. Doubling the number of 32-cp lamps in order to reduce them to a 16-cp basis and including the incandescent lamps reported by electric railway companies, we have an aggregate equivalent of 19,171,544 as the number of 16-cp incandescent lamps wired and ready for use in the United States so far as central stations are concerned. The annual income from these lamps is reported as $48,222,108, or $2.52 per lamp. Reducing to a 16-cp basis the incandescent lamps reported for central electric stations, we have an equivalent of 17,737,944 lamps, of which 16,168,321, or 91.2 per cent., are operated by private stations, and 1,569,623, or 8.8 per cent., by municipal stations. Of the total number of lamps for both classes of stations, 17,271,744, or 97.4 per cent., are used in commercial or other private lighting, and 466,200, or 2.6 per cent., in public lighting.

The following statement shows the number of arc and incandescent lamps reported by private and municipal stations as used for commercial or other private and public service, and also the total annual income from each variety of lamp, with the average income per lamp:

NUMBER OF LAMPS IN SERVICE, TOTAL INCOME, AND AVERAGE INCOME PER LAMP.

Items.	Arc Lamps. Commercial or other private service.	Arc Lamps. Public service.	Incandescent Lamps. Commercial or other private service.	Incandescent Lamps. Public service.
Private stations:				
Number of lamps	168,180	166,723	16,243,853	372,740
Total income	$8,220,154	$13,871,646	$39,039,557	$2,257,927
Average income per lamp	$18.88	$83.20	$2.40	$6.06
Municipal stations:				
Number of lamps	5,793	45,002	1,494,531	82,920
Total income	$240,166	$3,149,079	$2,868,296	[1]$491,322
Average income per lamp	$41.46	$69.98	$1.92	$5.93

[1] Estimated value if paid for at prevailing rates.

There are 99,102 stationary power motors of all kinds, with a capacity of 619,283 hp, reported as being in operation by private stations, and 1,962, with a capacity of 5,403 hp, in operation by municipal stations, making an aggregate of 101,064 stationary motors, with a capacity of 624,686 hp. No inclusion is made, however, of fan motors, nor of the 2,370 railway motor cars served.

As to the circuits employed in the industry, the following figures are reported:

MILES OF ELECTRIC LINE CONSTRUCTION—PRIVATE AND MUNICIPAL STATIONS AND PERCENTAGE EACH CLASS IS OF TOTAL: 1902.

Items.	Total.	Private stations.	Municipal stations.	Per cent In private stations.	Per cent In municipal stations.
Total:					
Mains	107,263.63	93,352.95	13,910.68	87.0	13.0
Feeders	17,880.51	16,452.28	1,428.23	92.0	8.0
Underground—					
Mains	5,847.71	5,408.55	439.16	92.5	7.5
Feeders	2,276.55	2,262.02	14.53	99.4	0.6
Overhead[1]—					
Mains	101,383.76	87,913.13	13,470.63	86.7	13.3
Feeders	15,592.59	14,181.75	1,410.84	91.0	9.0
Submarine—					
Mains	32.16	31.27	0.89	97.2	2.8
Feeders	11.37	8.51	2.86	74.8	25.2

[1] Includes 79.50 miles of mains and 120.25 miles of feeders for electric railway service owned by lighting company.

There are 125,144.14 miles of main and feeder wires reported for both private and municipal stations. Of this total, 109,805.23 miles, or 87.7 per cent., are reported by private stations and 15,338.91 miles, or 12.3 per cent., by municipal stations. The mains and feeders for underground circuits measure 8,124.26 miles, or 6.5 per cent. of the total, and the overhead circuits 116,976.35 miles, or 93.5 per cent. Comparatively few stations have a record of the actual length of the wires strung and ready for service, but the amounts reported are careful estimates prepared by, or under the direction of, the management of each station. In several instances it has been found that electric light stations supply current to electric railway companies, and that, in the majority of such cases, the railway companies own the main and feeder wires over which this current is supplied. There are, however, 199.75 miles of mains and feeders for electric railway service owned by the central stations. These quantities are included in the statistics presented.

Paris Underground Roads.

According to recent dispatches, the city of Paris is to have another electric railway. The Council of State has approved the building of an underground railway from the Porte de Versailles to the Porte de Saint Ouen. Parliament has not yet given its final authorization, but should it be favorable the work of construction will be commenced in January or February next. Work in connection with the new line, No. 3, between Courcelles and Menilmontant is almost completed and the official inauguration will take place at the beginning of next year.

The Winter-Eichberg Single-Phase Railway System.

An English patent has been granted to Messrs. Winter and Eichberg, which discloses some of the features of the motor which is the basis of the single phase electric railway system that has given such excellent results in trials made in Germany. We give below an account of such features of the motor as are disclosed in the patent, prefaced by some further matter relating to the system as a whole. The system of Messrs. Winter and Eichberg, which was taken up by the Union Electricitats Gesellschaft, has been experimentally operated over two lines. One of these was a short section of track at the works of the company, the car being equipped with two 40-hp motors and a controller not differing greatly from that used with direct current. Single-phase current was supplied at 40 cycles per second, and the car was braked by short-circuiting the motors. This car is the first of twenty ordered by the National Railways Company, of Brussels, for the equipment of one of its lines.

The other line on which the system has been tried is two and a half miles long, between Johannesthal and Spindlersfeld, and a part of the Prussian State Railways. On this line a car has been in regular service since last August. The car weighs 52 tons, of which total the electrical equipment comprises 6 tons. There are two motors mounted on the same truck, each of 120 hp, and the car has a controller at each end. The car has a small transformer which supplies current to drive the braking air pump, for the controllers and for the lighting service. The line voltage is 6,000, with a frequency of 25 cycles. The characteristic curves of the motors, which are connected in parallel, are given in Fig. 5. Two bows are used to collect the current from a single overhead trolley wire, and the rails are used for the return circuit. Figs. 2 and 3 give exterior views of the motors, and Fig. 4 of the manner of supporting the trolley wire. The trolley wire proper is hung from one or more bearer wires, this method eliminating the catenary curvature of the former and enabling it to be kept at practically the same height everywhere above the track. As will be seen, the bearer wire is supported from a rod which is borne by two insulators carried by two horns or brackets. Another advantage of this arrangement is that in case of a break in the wire the ends cannot hang down sufficiently low to endanger life.

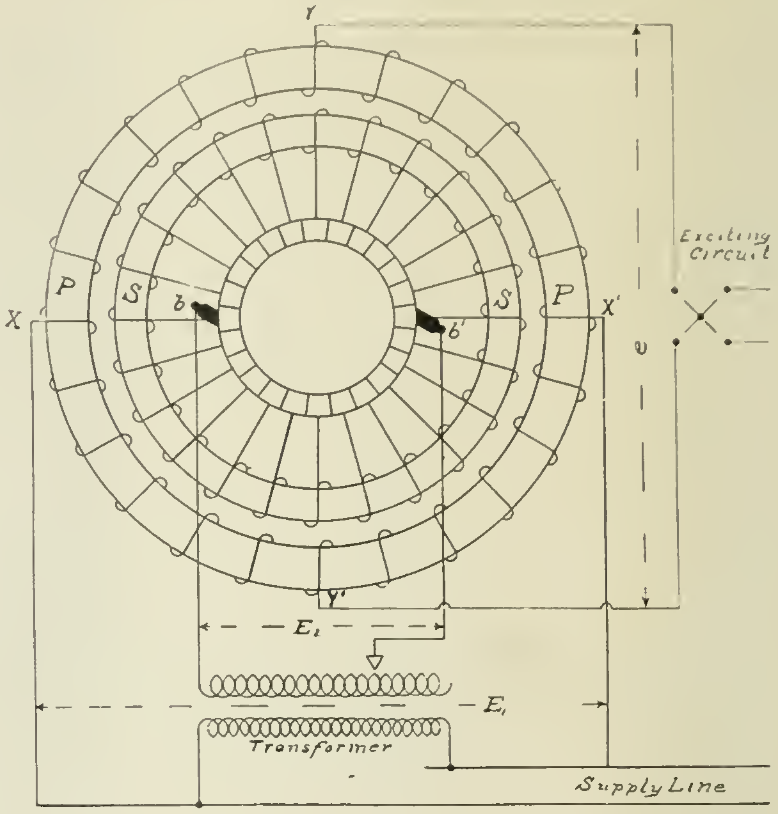


FIG. 1.—DIAGRAM OF MOTOR WINDINGS.

The Winter-Eichberg motor, in common with all recent variable-speed alternating-current motors, is of the commutator type. Fig. 1 will serve to represent diagrammatically its connecting circuits for the purpose of giving an account of the theory of its operation, as disclosed in the English patent. As shown in Fig. 1, the motor possesses two windings, *P* and *S*, the primary and the secondary.

The secondary winding is joined to a commutator and is supplied with current at low e.m.f. by means of brushes connected to the low-potential side of a variable-ratio transformer. The brushes are placed in line with the points *x x'*, at which the high-potential current is supplied directly to the primary winding. The primary is tapped at its center at two points, *y y'*, where current for magnetization is introduced. The working current flows in the secondary by way of the brushes and in the primary by way of the points *x x'*; while only magnetizing current enters the winding at points *y y'*.

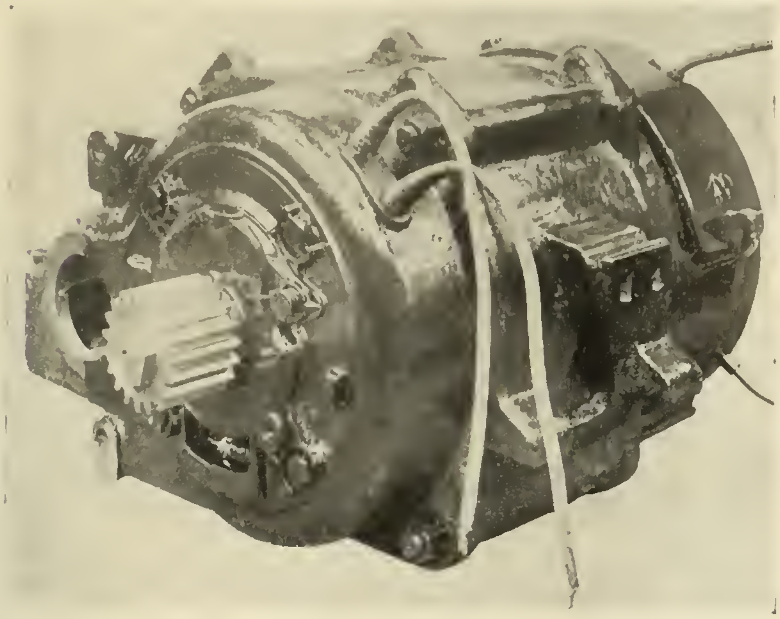


FIG. 2.—VIEW OF MOTOR.

It will be appreciated that, since points *y y'* are symmetrically located with reference to the points *x x'* of the primary winding, when current of any value or relative phase position is led into the windings by way of the points *x x'*, no difference of potential will be caused thereby to exist between *y* and *y'*; or, with reference to any current introduced by way of *x x'*, the points *y y'* are equipotential. A similar course of reasoning will show that the points *x x'* are equipotential with reference to any current entering the winding by way of *y y'*. This means that current introduced by way of *y y'* flows independently of any current entering from *x x'*, and conversely, so that, with the exception of the heating effect produced, each current acts as though a separate winding were provided for its use alone.

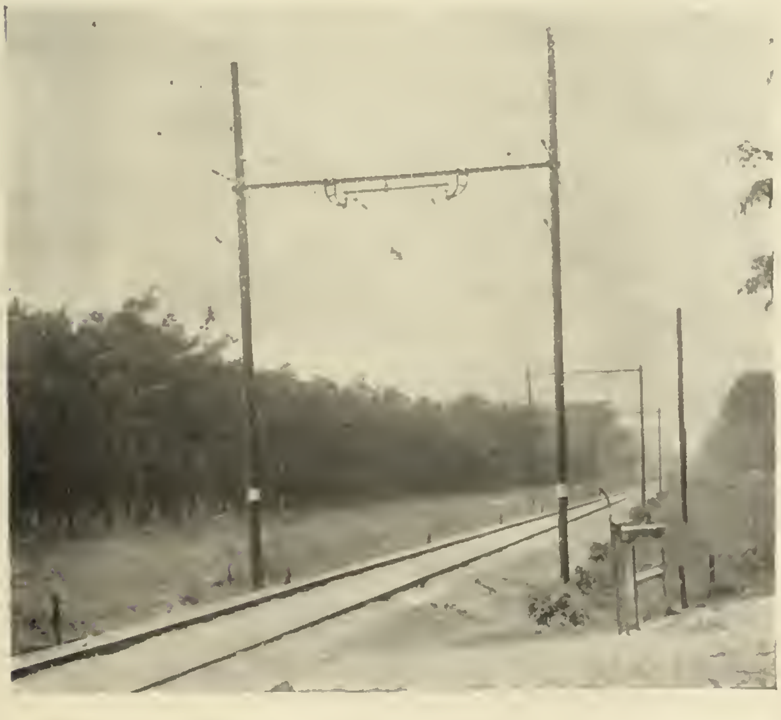


FIG. 4.—OVERHEAD CONSTRUCTION.

The magnetism due to the current through *y y'* will have its axis in the line connecting *y* and *y'*. Current which enters the secondary by way of the brushes, *b b'*, will be in the proper mechanical position to produce a torque due to the presence of the magnetism on the line *y y'*. It is this torque which gives motion to the rotor. The torque, whose value depends upon the product of the field strength along the line *y y'*, and the current in the secondary, can be varied by altering either of these quantities. As shown in the diagram, there is provided a variable-ratio transformer by means of which may be changed at will the e.m.f. impressed upon the secondary.

Current which flows in the secondary has no effect in altering the value of the magnetism along the line, *y y'*, but it is in position to affect directly the magnetism along the line *x x'*. Since the primary e.m.f. applied at the points *x x'* and which is kept at a constant value, demands a certain definite amount of magnetism to produce by its rate of change a corresponding counter e.m.f. in the primary windings, current in the secodary coil is directly opposed in magnetomotive force by current in the primary; that is to say, independently of the motion of the rotor the current in the conductors thereon acts as though it flowed in the secondary coils of a stationary transformer. The value of this secondary current depends inversely upon the impedance of the secondary circuit and directly upon the difference between the secondary impressed e.m.f. of the secondary. When the secondary is stationary, the internal generated e.m.f. is that due to the rate of change of the magnetism along the line *x x'*, and if the secondary impressed e.m.f. is equal to the primary e.m.f., divided by the ratio of transformation of the stationary transformer, no working current will flow in the secondary windings. A greater value of secondary impressed e.m.f. will cause to flow a current which will produce a torque tending to give motion to the rotor.

When the rotor is in motion, its conductors cut the magnetic lines

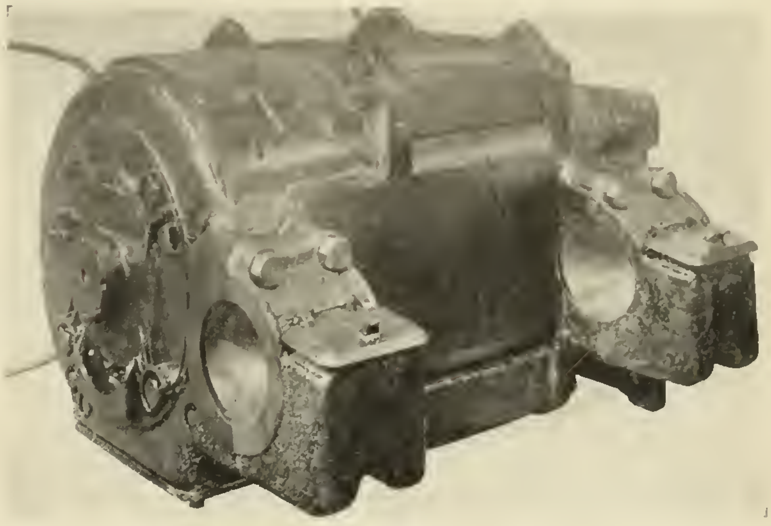


FIG. 3.—VIEW OF MOTOR.

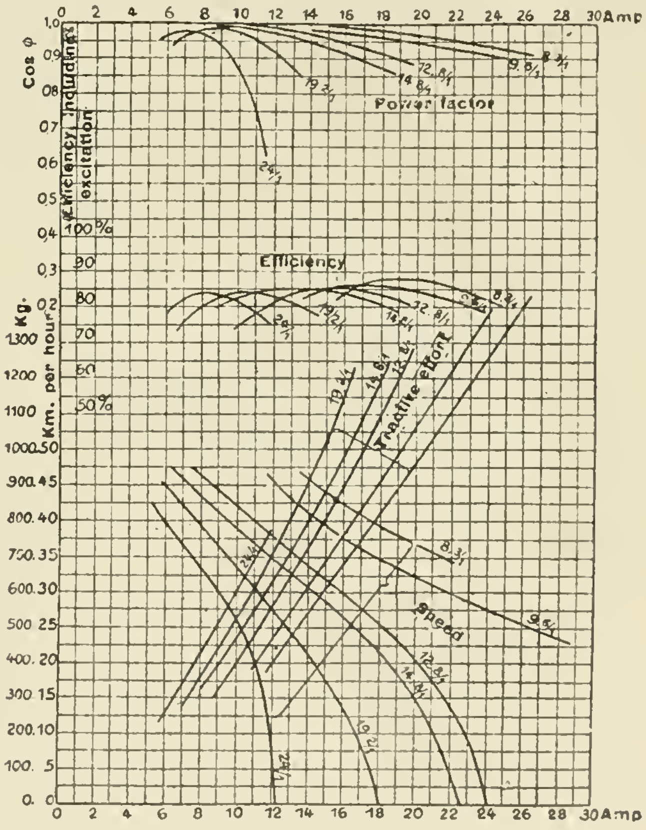


FIG. 5.—CHARACTERISTIC CURVES.

along $r\,r'$, and there is generated an e.m.f. which appears as a maximum at a position upon the commutator in quadrature to the field; that is, at the brushes $b\,b$, and it is in a direction to decrease the effective e.m.f. of the secondary. Thus, with increase of speed, the secondary current is decreased and the torque is reduced thereby. Additional torque can, however, be obtained at increased speed by augmenting the impressed secondary e.m.f.

If the speed of the rotor is such as to generate in the conductors due to cutting the field along $x\,x'$, an e.m.f. greater than the difference between the e.m.f. due to the alternating field along $x\,x'$ and the impressed secondary e.m.f., then the current in the secondary will flow in a direction to produce a retarding torque and the motor will thus act as a brake and will also restore energy to the supply system.

In practical operation, the line voltage of suitable value for transmission is impressed directly upon the primary windings, while a low e.m.f. suitable for commutator operation is derived by transformation for the secondary circuit.

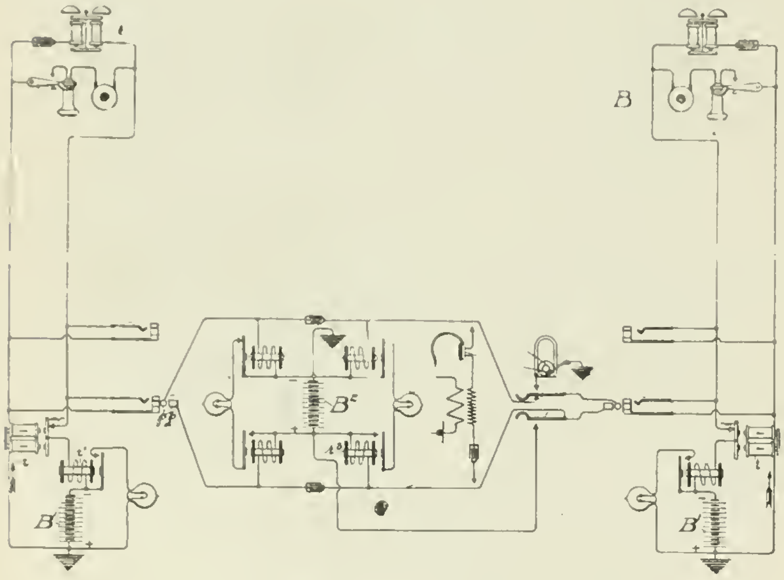
Messrs. Winter and Eichberg, in their patent, have devised numerous connections of circuits for the application of the principles enumerated above. The illustration given is intended merely to cover the essential features of the new motors without introducing undue complications.

New Telephone Patents.

IMPROVEMENT IN TWO-WIRE COMMON BATTERY SWITCHBOARD.

The practicability of a two-wire common battery switchboard once having been demonstrated, many different schemes for arranging the circuits were almost at once forthcoming, and even yet every few weeks a patent appears for some new idea along this line. The latest is that of Mr. W. W. Dean, of Chicago, embodied in a patent recently granted. This new idea consists in the use of a polarized cut-off relay in such a manner that all relay contacts are removed from the talking circuit. The advantage of this is at once evident.

The operation of the system is best explained by referring to a diagram of connections such as shown in the accompanying figure, in which are represented two subscribers' lines and one pair of connecting cords. As will be seen, the cut-off relay, *r*, is legged to ground from the thimble side of the two point jack, and it is so polarized as not to respond to the line signal current from battery *B'*, which will, of course, pass in the direction of the arrow from positive out through the line to negative. When, however, the cord-circuit battery of reversed polarity is tapped on by the insertion of a plug in the jack, the cut-off relay current at once reverses in direction. The relay, properly polarized, at once responds to cut off the signal circuit at its single contact. Mr. Dean has assigned his patent to the Kellogg Company.



DEAN TELEPHONE SYSTEM.

AN ODD PARTY LINE SYSTEM.

An odd scheme for a selective party line system is described by Amos Gagnan, of Stafford Springs, Conn., in a patent just granted to him. At each station he proposes to use two adjustable bell-controlling relays, so wired in the bell circuit that one must fail and the other operate in order that the bell may ring. At each station, also, is a hand generator and an adjustable rheostat, the joints of the latter being numbered to correspond to the various stations. Now the current which the generator will send through resistance number one should pull up one relay of station one, and fail to pull up any other relay on the line. Bell one alone will then respond. Again, the current through point two of the rheostat is to affect one relay of station two, and both relays of station one, but is to fail to actuate any other relays. Of course, according to the premises, bell number two alone will ring. Such a scheme would probably work if a power ringing generator were provided. With a hand generator it seems entirely out of the question to suppose that all users will drive the generators within the required speed regulation.

A NEW HOOK SWITCH.

The Stromberg-Carlson Company has obtained by assignment the patent for a well-designed hook switch, the work of Nels August Engstrom, of Chicago. The base of the hook bar is so shaped that a bell crank lever is formed, the prongs being at the extremity of one of the arms, and an insulating roller stud being carried at the extremity of the second arm. This stud serves as the wedge of a switch consisting of spring members assembled exactly after the manner usual for switchboard keys. The result is a substantial though positive switch.

TELEPHONE BRACKET.

A fourth patent of the issue under consideration concerns a folding telephone stand set desk bracket, designed upon the principle of the "lazy tongs." Intermeshing gear sectors provided upon the base and end members of the tongs restrain the axis in a horizontal position when the base plate is properly mounted upon the side of a desk. The patent brings out no particular merit in this bracket over its predecessors.

Recent Electrochemical Developments.

Only three patents were granted on December 8th relating to matters electrochemical. Mr. Sakizo Yai, of Tokio, Japan, patents a modification of the Leclanche cell, consisting of an outside zinc cylinder and a graphite rod in the center. The space between the graphite rod and the zinc cylinder is divided into two parts by means of a porous cylinder, preferably formed of blotting paper. The space between the zinc cylinder and the porous cup is filled with zinc oxide, and the space between the carbon rod and the porous cylinder is filled with a mixture of manganese oxide and graphite powder. A solution of caustic potash is then poured into the cell. When it is charged by means of the electric current the manganese oxide is converted into a higher oxide, while the zinc oxide is reduced. During discharge the chemical action is the reverse.

Mr. M. R. Hutchison, of Norwood, N. J., patents a device for the sealing and venting of batteries, whereby gases have a free escape, while the liquid solution is effectively sealed in, and whereby it is easy to replenish the liquid solution that may have been evaporated.

A patent granted to Mr. H. Garret, of Dallas, Texas, relates to an automatic circuit-breaker for storage batteries, which breaks the circuit whenever the voltage of the charging current drops below a certain value, and automatically closes the circuit again when the voltage of the power lines resumes the proper figure. Such a device is of importance, since if in case of an accident in the power house or on the line the voltage of the charging current should drop too low, the battery would discharge into the mains if the circuit was not broken.

Ohio Engineering Society.

The Ohio Society of Mechanical, Electrical and Steam Engineering held its seventh annual meeting at Canton, Ohio, recently. Mr. R. H. Probert, of Akron, was elected president; Henry Jackson, of Steubenville, vice-president, and O. C. Pillichody, of Steubenville, treasurer. It was decided to hold meetings semi-annually hereafter, instead of three times a year. Each annual meeting will be held at Canton, as required by the constitution. The next meeting will occur in Columbus. Among the papers read was one by P. F. Moock, of Canton, on "Some Power Plant Economics." Other papers of an engineering character were also read.

Engineering Features of the St. Louis World's Fair—A General Review.

So many reports are now finding their way into print regarding the various electrical and mechanical engineering features of interest at the Louisiana Purchase Exposition that a brief general summary of some of these principal features as definitely arranged for up to date may be of value. Some of these principal features already noted in these pages can be enumerated as follows:

1. The service power plant in the Machinery Building, consisting of four 2,000-kw units, with boilers in the Steam and Fuels Building.
2. The exhibit power plant in the Machinery Building, consisting of various prime-movers, such as steam engines, gas engines and steam turbines, all connected to dynamos furnishing current for exposition uses, and also including the boiler and gas plant located in the adjoining Steam and Fuels Building.
3. Illumination of grounds and buildings.
4. Cascade pumping plant, which produces an artificial waterfall of considerable size forming the center of the Exposition picture.
5. Steam and electric railway exhibits, including locomotive testing plant and facilities for electric railway motor tests, both of which features it is hoped will contribute substantially to the fund of engineering knowledge before the Exposition season closes.
6. The exhibits in Electricity Building.

GENERAL POWER SUPPLY.

The power supply to an exposition of this size calls for the utilization of all the exhibit power apparatus possible. The illumination of such immense buildings and areas as this exposition has, together with the large number of electric motors to be used, calls for great outlay in electric generating machinery. Practically all the engines and dynamos in Machinery Building will be operating exhibits and contribute to the general power supply. The necessity for this fits in very well with the prevailing idea of the Exposition management, as announced at the outset, which is, to make this an operating exposition showing machinery and processes of manufacture in operation.

SERVICE AND EXHIBITION POWER PLANTS.

The Exposition management, in enumerating the sources of energy that will be available for exposition purposes, is in the habit of considering that it has three such sources, although two of them are closely allied. The service power plant in the Machinery Building will have a nominal capacity of 8,000 kw in 25 cycle, 6,600-volt current. The Exposition will purchase from the Union Electric Light & Power Company about 7,500 kw of the same kind of current. Besides this there will be available miscellaneous exhibit engine and generating apparatus to the amount of about 20,000 kw, though the steam and gas supply will probably not permit this full capacity to be utilized at one time.

The main service power plant in Machinery Hall, with boilers in the Steam and Fuels Building, is now being installed, the contract for this entire plant having been given to the Westinghouse companies. This plant will have four 2,000-kw generators, direct-connected to vertical Corliss engines, supplied from 16 B. & W. boilers in the Steam and Fuels Building. The contract includes switchboard and, indeed, the complete plant, with the exception of the buildings in which the machinery is placed. The plans for this plant will be taken up in detail in a later issue. The output of this plant being of the same voltage and frequency as the outside supply, these two sources of energy are interchangeable with each other and if thought best can be operated in parallel with each other.

The exhibit power plant in Machinery Building will, of course, have an immense variety of apparatus which it is not necessary to catalogue in a general article of this kind, but some of the features which will certainly attract the engineer will be the steam turbines of the Parsons, Rateau, De Laval and Curtis types, and several large gas engines. The largest steam engine unit will be a duplicate of the 5,000-kw units in the Interborough station in New York, and the largest turbine, a Curtis of 4,000 kw. All engine and turbine units will be direct-connected to dynamos, the belt having at last disappeared in exposition power plant work in this country.

The Steam and Fuels Building is the name that has very properly been chosen for the building 100 ft. west of the Machinery Building, where the steam boilers and gas plants will all be located. It seems that the gas engine is to take a prominent part in this exposition. The steam boiler capacity will be 23,000 hp, according to the usual boiler rating. A dozen foreign and American boiler makers will be represented by their products in this building. The boilers will be principally of the water tube type.

As to fuel, oil was, of course, given much consideration at first, but was abandoned because of the uncertainties of delivery of the necessary 1,400 to 1,600 barrels per day and the high price as compared with coal. By the use of mechanical stokers and by making some of the fine coal into briquettes, it is hoped to make combustion sufficiently smokeless to be inoffensive. Briquettes can be made from the tar by products of gas manufacture. The gas made by the gas plants can either be used directly in gas engines or used under boilers instead of coal.

ILLUMINATION.

The illumination of buildings and grounds of modern expositions, and especially of those in America, has become such a prominent part of the show and the standard set by the Pan-American in this respect was so high that the Louisiana Purchase Exposition will have difficulty in providing anything which is a radical advance in general lighting effects. The areas and buildings are so much larger than were those at the Pan-American, however, that even an equally good illumination would not fail to have its effect on the popular eye.

The incandescent lamp has wisely been chosen for the outside night decoration and illumination, and the majority of lamps will be of 8 cp. The effectiveness of the Omaha and Pan-American illuminations, which were the first to use the incandescent exclusively, left the St. Louis Exposition engineers but little choice in the matter. The buildings will be outlined with incandescents and the main areas and lagoons illuminated by the same means. The main areas of the Exposition cover about 500 acres and consist of a number of courts radiating from a common center known as the Cascades. The view toward the Cascades from all these courts has the Cascades and high ground for a background, which makes a very impressive setting, as can be seen even at this incomplete stage of the work. The Cascades give opportunity for many beautiful illuminated water effects, by the use of projector lamps throwing different colored rays on the water. It is expected to make use of the Cooper Hewitt lamp in securing some of these effects, because of the peculiar quality of the illumination it can give the water. The arc lamp will be used for the interior illumination of buildings. An order for 300,000 incandescent lamps was placed with the General Electric Company last week.

CASCADE PUMPING.

The Cascade pumping plant, which is to produce continuously a gigantic artificial waterfall, is to have a capacity of raising 90,000 gallons of water per minute a height of 154 ft. It will be located beneath one of the Cascades on the hillside and will probably be the largest pumping plant of the kind ever built. It will have 2,000-hp Westinghouse induction motors direct-connected to Worthington centrifugal pumps, running 165 r.p.m. These will be the largest induction motors ever built and probably the largest centrifugal pumps. It is figured that this pumping plant will circulate the water in the lagoons once every 4½ hours, which certainly ought to prevent it from becoming stagnant or foul with refuse matter thrown into it. To prevent having too strong a suction at any one point, the suction pipe is carried 1,500 ft. down the main lagoon, with screened openings along its length for taking in water at various points, and keeping the velocity low at any one point. A 90-in. suction pipe is required. The water is to be filtered before the lagoons are filled with it and the pumping plant simply draws from and discharges into the lagoons, acting as an aerating and circulating plant, as well as producing a necessary adjunct to the main vistas of the Exposition.

RAILWAY EXHIBITS AND TESTS.

Besides the stationary exhibits of cars, trucks and locomotives in the Transportation Building, a $100,000 locomotive testing plant is being installed by the Pennsylvania Railroad Company in Transportation Building. Applications have already been made to have tested more locomotives than can be tested during the Exposition season, and probably the testing will have to be continued after the season is over, or possibly the testing plant made permanent.

For electric railway tests, one track 3,000 ft. long and one 1,400 ft. long parallel with the intramural railway back of the Transportation Building are available. The short track can be used for imitating the conditions of city surface lines, and the longer stretch for testing higher speed motors. Two types of single-phase railway motors have been promised for test, which is a point of considerable practical interest just now.

Although not in the Electricity Building, these tests and exhibits of electric railway apparatus come under the department of electricity. The exhibits in Electricity Building are not sufficiently decided upon to permit of detailed mention. Owing to the pressure of the prime-movers in the Machinery Building, all the operating generating machinery will be found there.

Owing to the size of the grounds, transformer sub-stations (and rotary converters, if necessary), will be put in the various buildings, and high-tension transmission lines will supply these sub-stations.

The electrical and mechanical department of the department of works, which department is responsible for the lighting and power of the Exposition, has been under the charge of Henry Rustin, as chief, who occupied similar positions at Omaha and at the Pan-American. Mr. Rustin having been obliged to leave his post on account of his health, Edward B. Ellicott has assumed the duties of acting chief during Mr. Rustin's absence.

The exhibits in Machinery Building are under the charge of Thomas M. Moore, chief of the department of machinery, and electrical exhibits are under Prof. W. E. Goldsborough, chief of the department of electricity.

New Year World Time Signals.

The United States Naval Observatory at Washington, D. C., has announced the details of its scheme to send telegraphic time signals throughout the world to mark the beginning of the new year. The signals were sent out last year for each of the four great standard time belts of the United States. This year it is proposed not only to secure a wide distribution of these new year signals throughout North and South America, by the co-operation of the telegraph and cable companies, but also to send one or more of the four series of signals around the world and back to the room in the Naval Observatory where they started. The signals will begin at 11.55 P.M. and end at midnight, Eastern time. The same series will be sent out an hour later, ending at midnight, central standard time; again an hour later, ending at 2 A.M., for midnight of mountain standard time, and again an hour after that, ending at 3 A.M., for midnight of Pacific Coast standard time. During each of these four five-minute intervals the transmitting clock will send an electric impulse practically every second.

On the world circuit signals will go by land lines to Cape Canso, N. S., thence by cable to the Azores, Lisbon, Gibraltar, Malta, Alexandria and Port Said; by land to Suez, by cable to Aden and Bombay, by land to Madras, by cable to Penang, Singapore, Saigon, Hong Kong, Manila, Guam, Midway, Honolulu and San Francisco, and by land back to Washington. It is proposed to receive both the outgoing and incoming signals on the same chronograph at the Naval Observatory, and thus preserve a permanent graphic record of both on a single sheet of paper. It is suggested that, besides demonstrating the possibilities of practical astronomy and telegraphy, working together through international co-operation, benefits will result from the general attention that it will direct to the advantages of the use of accurate standard time throughout the world.

Peat Coal by Electrical Process.

Note is made in the United States Consular Reports of peat coal making by electricity in England, where at the works of Messrs. Johnson & Phillips, at Charlton, in Kent, there has been exhibited during the past month an electrical process for converting ordinary peat into firm, smokeless steam coal at a cost which promises to bring the product far within the industrial price limit of steam fuel in Great Britain and Continental Europe.

The peat is cut and excavated by machinery, loaded into dumping cars, which convey it from the bog to the plant, where it is packed into rotary iron cylinders of a peculiar construction. The cylinders being rotated at high velocity, the centrifugal pressure, aided by an interior beating device, expels all but a small remnant of the 80 per cent. of water which the material originally contained. Electrodes connected by conductors with a dynamo are then inserted in the cylinders in such a manner that the mass of centrifugally-dried peat becomes the medium through which is completed the circuit between the electrodes. The resistance offered by the peat, like the filament of an incandescent lamp, generates heat which carbonizes the material, producing a mass of disintegrated black globules, which retain all the valuable elements of the original material. This part of the process, which depends largely upon the conductivity of the peat, may be promoted by moistening the mass with certain cheap liquid chemicals, the use of which is covered by the patent.

From the cylinders the carbonized material passes to machines, which knead it into a putty-like mass, which is then pressed into briquettes or left to dry and harden in masses, which are broken into lumps, screened and graded like ordinary coal. Among the special advantages claimed for this method is the fact that the electrical current converts but does not destroy any of the valuable elements of the peat, whereas coking by fire heat expels a large percentage of these elements in the form of gases, which, being either wasted or burned as fuel beneath the retorts, are lost from the composition of the ultimate product.

Briquettes produced by this method can be compactly stowed on shipboard or elsewhere; they are practically smokeless, leave no clinkers whatever, and, according to English press reports, have the high thermal value of 9,000 British units. The cost of a plant capable of treating 100 tons of peat per day is stated to be £4,000 ($19,466). The actual cost of producing one ton of peat fuel by this process is stated to be 5s. ($1.21), equal for all steam-generating purposes to a ton of South Wales steam coal, which costs at the mouth of the mine 8s. 4d. ($2.02). These are given as the economic results in a location where the electric current used by the process is generated by steam. In districts where generators can be driven within a working radius of peat bogs by water power, the cost of production would be proportionately reduced. The method is now to be tried in Ireland.

Mr. Westinghouse on the Steam Turbine.

Confirming what has already been forecast in these pages, Mr. George Westinghouse made, last week, the important announcement that for the Westinghouse Machine Company, of Pittsburg, he has acquired from Mr. C. A. Parsons the full rights to manufacture in the United States and Canada the well-known Parsons steam turbines for all purposes, including marine propulsion, and that a special department will be organized at the works for the introduction of this remarkable engine, in order to more effectively promote its use upon all classes of vessels, including warships of every type. This new department will work in close touch with all the steamship builders in the country.

Mr. Westinghouse, when interviewed, said: "The steam turbine is not a new and comparatively untried invention, as many laymen seem to think. There are half a million horse-power of Parsons steam turbines in daily operation in different parts of the world; eighty-four thousand horse-power of these are in steam vessels. In the United States alone there are 60,000 horse-power of the stationary type used in connection with electric light and power in continual operation, and 150,000 horse-power more are already contracted for and now under construction at Pittsburg, where units as large as 8,000 horse-power are being built. The impression in the public mind that the steam turbine is a new thing, is probably due to the fact that attention is frequently called to new makes of turbines. The fact is, these new types have not demonstrated any superiority over the Parsons, which is the only turbine of world-wide repute and operation, and is the only one which will give, or is at present capable of giving, highly economical results. Other turbines have made claims to economy, but they justify these claims only when they borrow the Parsons idea, which is fundamental. I have made a broad investigation of this question, with the result that the Parsons turbine is the one with which I have concluded to ally my interests. We shall build up a great marine turbine industry in the United States. The importance of the marine turbine has not been overestimated, and it is long past the stage of experiment. For passenger ships, freight ships, yachts and for battleships, not less than for torpedo boats, the turbine is unquestionably the best engine. For pleasure craft the turbine surpasses all other forms of engine, because of its absolute freedom from vibration. Its compactness recommends it for all classes of vessels. In torpedo boats the saving of room is needed to accommodate other machinery. In naval cruisers and battleships, the engines lie so much closer to the ship's keel as to make them far less likely to be injured by the enemy's shots. We need not call the turbine the engine of the future, it is decidedly the engine of the present."

Convention of the Interstate Independent Telephone Association.

In our issue of last week a telegraphic report was given of the opening sessions of the Convention of the Interstate Independent Telephone Association, including an account of the extensive exhibits of manufacturers. Below we present a fuller account of the proceedings up to the time of adjournment.

In welcoming the convention as the representative of Mayor Harrison, Mr. David R. Levy said that the Association stood for the independent element in business, and it is this element which in these days is unfortunately kept in the background. Vast aggregations of capital are controlling almost every line of business and the small man is either pressed into a corner or put out of business. He therefore wished to compliment the Association, representing as it does nine great commonwealths, on the great strides it has made independent of such aggregations of capital, and in fact against one of the largest capitalized institutions in the country. The independent spirit which it represents is one that Chicago fosters. The Association has grown from two or three men fighting a gigantic monopoly to where it is recognized in the commercial world. He wished it every success and prosperity, and in behalf of the Mayor of the city of Chicago he offered the freedom of the city.

In his presidential address Mr. Hull said that it is unfortunately true that taken as a whole independent telephone companies have, in a great degree, lived each for itself. Feeling strongly intrenched in its own locality, the disposition has been to get all that could be gotten and to keep it. This disposition upon the part of some of the large operating companies has driven from the ranks many who would have preferred to remain independent operators. President Hull urged that the matter of a press committee be taken up and he pointed out the desirability of informing the people in all quarters of the country of the merits of the fight the independents are making. It is difficult to win against public sentiment and it is the duty of the Association to create and foster an aggressive sentiment in favor of the independent movement, both on the score of public good and as an avenue for sound financial investment.

Secretary Coleman, in addition to the statistics contained in our telegraphic report, said that 175 cities having a population of over 20,000 now have independent exchanges in operation, and that the earnings of the independent companies in this country are best illustrated by the statements of 20 large companies during a period of four to five years, which show net earnings of from 8 to 16 per cent. The statistics which he gave as to the number of subscribers did not include many rural companies' lines and small systems aggregating at least 500,000 telephones actually in use. To illustrate the effect of the independent movement he said that eight years ago there were only between five and six thousand telephones of every sort in the State of Indiana, while there are now 80,000 independents and 22,000 Bell telephones in that State.

He referred to the methods adopted by the Bell Company in fighting the independent movement. At first its practice was to buy up independent telephone exchanges, but these came so thick and fast that this finally proved an impossibility. The next plan was to wait until a cluster of towns in one particular section of the country was built up and one became necessarily the center of the cluster, when this latter would be purchased, thus seriously affecting the surrounding exchanges. At present the plan is to persuade small exchanges to connect with Bell toll lines, with the result that when it is attempted to start an independent toll line they find that the independent exchanges in the territory are bound by toll line contracts with the Bell interests. Mr. Coleman said that the latest scheme of the Bell Company is to get control of the outside manufacturing telephone interests. He referred to the Kellogg Company and said that the air is full of current reports that other manufacturing establishments are in one way or another connected with the Bell Telephone Company.

He strongly urged that the Interstate Independent Telephone Association, which at present has representation from only nine States, be extended to cover the entire United States. He suggested that the headquarters of the Association should be the general headquarters of the independent telephone movement in the country, with a power delegated to it under the executive board to exercise general supervision and watch over the operating companies of the country; and that a general information bureau should be established by which should be disseminated information of every sort calculated to build up the independent telephone business of the country, and to counteract influences working against it. He considered absolutely imperative the necessity for adopting co-operative plans, alliances and legitimate combinations to combat an organized competitive foe, and to protect their own interests and those of others against alleged independent operating companies and alleged manufacturing companies that have dealt or would deal with the enemy.

The report of Secretary Coleman was referred, for thorough investigation of its recommendations, to outline action and to report to the convention at the earliest hour possible, to a committee consisting of the president and a member from each State represented in the Association.

A motion for the appointment of a committee to call upon the Illinois Telephone & Telegraph Company for the purpose of obtaining terms and conditions for connecting the toll lines of the territory of the Interstate Association with the exchange now being installed in Chicago, led to considerable discussion, in which the extreme desirability of an arrangement which would enable their companies to connect with Chicago was dwelt upon. A motion for the appointment of such a committee was unanimously carried. Subsequently a motion was passed asking that a committee be appointed to wait upon the Illinois Telephone & Telegraph Company and ask President Wheeler to come before the convention at one of its sessions and favor it with a detailed statement as to his plans with respect to the independent telephone interests. At the session of the following day the committee reported that President Wheeler had informed them that his company is at present operating a switchboard in Chicago with about 4,000 subscribers and that within the next 30 days they expect to have 10,000 of the business men of Chicago connected up. They had been so very busy that thus far no attention had been given to the long-distance feature. They wanted it distinctly understood, however, that they were independent in the telephone field, perhaps more so than any of the independent telephone companies, and that early in the spring they proposed to take up the question of making long-distance connections. The committee was assured that as soon as it was practicable to do so, they would make long-distance connection with any company proposing it having metallic lines and that could furnish good service. He said it would be as advantageous for his company to have the suggested long-distance connections as it would be to the independent companies.

At the opening of the session on Wednesday, the Hon. Theodore Gary, of Macon, Mo., delivered upon request an address giving his views concerning freight rate classification and the treatment by railroads of small exchanges along their lines. Among the points mentioned was that freight rates for dry batteries are based on the same classification as for the old wet battery, and that it costs about 4 cents apiece to get them to the western part of Missouri from Cleveland. He considered that something should be done toward getting a proper classification on dry batteries. Another injustice is in the matter of returning reels. Some of the railroads classify reels higher than the original shipments, and in no case is there any reduction given as is the custom in most other cases. A very great injustice is the demands made by railroads on smaller exchanges for free service, and if they do not agree the telephones are ordered out. As subscribers need this service the telephone companies are generally compelled to accede.

Mr. Holdole, of Iowa, said that the independent companies are paying four or five times the freight rate on telephone instruments that is paid on sewing machines. The discussion brought out that wherever they could do so, the railroad and express companies insist upon having free service.

The committee appointed to consider the recommendations of Secretary Coleman recommended the appointment of a committee to prepare a suitable constitution and by-laws for the Association; that the Association be incorporated; that it shall be an organization covering the present States in the Association, together with such other States or Territories as it may be deemed expedient to admit; that the membership fee for any operating exchange company, toll line company, individual or corporation, be fixed at $5 per year with an additional tax, if necessary, based upon the number of toll line miles or the number of telephones in an exchange; that uniform contracts for toll line connections and as far as possible uniform rates in exchanges be based on telephones in operation.

One of the enlivening features of the convention was a discussion concerning the presence at the meeting of men having connection of one kind or another with Bell interests. Several were denounced by name, and of these two took the floor to defend themselves.

In the absence of Mr. W. C. Polk, a paper contributed by him entitled, "Standardization of Construction," was read by Secretary Coleman. Mr. Polk is very skeptical as to the possibility of any considerable opportunity for standardization. Commencing with conduits, he stated that there are the single-duct, multiple-duct, clay conduit, iron pipe, cement lined pipe, cement conduit, paper conduit, creosote wood, etc., all of various sizes and shapes, laid in a variety of ways. The manufacturers claim each to be the best, cheapest, most durable, and he who would decide which shall be the standard and how it shall be laid will have a difficult problem. The same is true with respect to a decision concerning poles, as to whether they shall be of chestnut or white, red, Northern or Western cedar, cypress or tamarack, and whether they shall be 4 in. in diameter at the top or 5, 6, 7, 8 or 9 in., or even greater, or whether the heights shall be 20 ft. or 60 ft. Mr. Polk also mentioned wire and cable as other material which it would be very difficult to standardize, and he said that one could go through the entire list of construction material such as cross arms, cable boxes, terminals, protectors, hardware, etc., and meet with the same situation. In view of these facts it is certain that it would not be safe or wise to decide, at the present time at least, what shall constitue standard construction.

He does not believe that it is either possible or practical to have a standard of construction in the independent telephone field, owing to there being such a large number of separate and distinct organizations, each with its individual and personal ideas which each insists upon following regardless of results; and also owing to the large number of manufacturers and supply houses from whom it is possible to purchase material and equipment precludes the possibility of early standardization. All of these manufacturers produce certain articles which are good and which any operating company could wisely purchase. Moreover, owing to the recent development of the business, independent telephony is at present in an evolutionary stage, and progress in improvements should not be retarded for the sake of keeping up to a standard. Notwithstanding the fact that the Bell company purchases its equipment and supplies practically from one and the same source, it has been unable so far to reach a satisfactory standardization of its equipment or methods of construction; and the fact of its failure to standardize equipment and establish uniformity of methods of construction indicates that there are very formidable barriers to overcome.

Mr. Polk considered, however, that although it may not be possible to bring about an absolutely uniformity, it would be well to begin to formulate plans to attain as much uniformity as possible. He suggested a national board composed of experienced and practical telephone engineers and construction superintendents made up from representatives from all parts of the country, familiar with all the conditions and operating features in the various localities. This board could have a standing committee to which financial men and investors could apply for advice. The operating owners and managers in the various sections could be kept advised by this committee, upon which they could feel at liberty at any time to call. All important matters, however, should be referred to the general board, and especially all new propositions or large ones calling for new and large investments. In this way the new investor or new operator would have a source to which he could turn at any time for advice, which would be conscientiously and intelligently furnished. Membership in this national organization should be very carefully chosen. Only persons of certain minimum number of years of actual experience and practice in construction and maintenance of telephone properties should be chosen, as the membership should consist largely of practical engineers and superintendents of construction and not of owners and investors. The expense of the maintenance of such an organization should not be great, and it could be maintained by the various telephone associations.

In the discussion on the papers by Prof. Kelsey[1] and Mr. Polk, in answer to an inquiry, the former said that No. 6 copper wire ought to carry 1,000 miles, and that No. 10 copper wire would work 500 miles, but not so satisfactorily as No. 8. No. 10 would be suitable for four or five hundred miles if the instruments and circuit are clear. Mr. Meyer said that to some extent standardization is practicable, particularly with respect to toll lines in relation to the size of copper, the spacings of the wires, etc. Mr. Thompson said that in Ohio there are just about as many different kinds of telephone instruments as there are telephone companies, and that the quality is probably a good deal worse than that number. This is the result of two things: First, the want of business capacity on the number of persons who did the buying, and second, the want of information, which should be furnished by such organizations as the Association to the public press and through other means of disseminating information. He believed that standardization of apparatus is possible because energetic business men and telephone associations are beginning to realize that they cannot run the telephone without a standardized equipment. He referred to the analogy of the present telephone situation with that of the electric lighting situation many years ago, when it was found that while a plant was paying perhaps 25 per cent. profit, it was constantly installing in new machinery and apparatus, and the stockholders got nothing, the reason being that the people who invested had not required a standardized equipment. He considered it would be a wise plan to disseminate information that people would know they could get a certain character of equipment and that equipment would enable them to connect with others who have perhaps a different equipment, but of the standard type, and this could be done without adopting the standard of any particular manufacturer. Secretary Coleman gave some illustrations of the evils of lack of standardization and insisted that something must be done along the lines of standardization. He made a motion that the matter be referred to a committee and a plan worked out so that standard apparatus can be used, which motion was seconded and unanimously carried.

Mr. H. D. Critchfield appeared before the convention at the request of Mr. Wheeler, president of the Illinois Telephone & Telegraph Company. Referring to the tunnel built by his company, he said that it was claimed that it is a freight proposition, but the truth is that it is not only a freight proposition, but is a telephone proposition, and a proposition which can be used for anything for which the street of the city could be legitimately used for the purpose of public utility. It is the purpose of the company to give toll connections when it can connect with the right sort of apparatus, and any company having a good exchange operating under proper conditions will stand on the same footing exactly as the company's own exchange. The company, however, will not give a toll connection until good toll service can be given, and it will not offer a toll line service until it can give such a service as will be satisfactory to users. The matter will be taken up in the spring of constructing some toll lines radiating from Chicago, not with a view to undertaking to handle the toll business of Illinois, Wisconsin or Indiana, but of making connections with the toll lines in those States to handle the business by trunk lines in a way that will afford the best possible service. The company will not compete in the territory for local business, but to bring that business into Chicago. This will not be taken up by the Illinois Telephone Company, but by another company not yet announced. In reply to a question, he said he considered it reasonable to suppose that a good entrance can be made into Chicago by next fall. In reply to another question, he said that the Illinois company had no affiliation with the Bell Company of any kind and that it will not sell a telephone or switchboard to any man who is using Bell apparatus; the company has had opportunities to do so and has refused.

At the morning session of Thursday, December 10, the Committee on Temporary Constitution submitted a draft of constitution, which was adopted after some amendments.

Mr. O. Rex, of North Manchester, Ind., read a paper entitled "Competition Between Independent Companies and Farmers' Mutuals," which led to considerable discussion. He deprecated the practice of manufacturers working up farmers' companies, and suggested that independent exchanges should take the lead, advising the farmers as to construction and equipment in order that no difficulty will be encountered with exchange connections.

The subject of competition from farmers' mutual telephone companies was discussed at considerable length and various means were proposed whereby harm from farmers' companies might be warded off. Complaint was made that notwithstanding the resolution adopted by the Association last year condemning manufacturers for working up farmers' companies, certain manufacturing concerns were still promoting these competing farmers' companies where independent companies already exist. The subject of exchange of business having been broached, Judge Taylor, of Indiana, mentioned a case where a judge had ruled that if a telephone company makes arrangements for an exchange business with one company it must exchange with any other company that makes the demand. The case is now on appeal. Mr. Zimmerman stated that in Kansas it had been considered that telephone companies had the right of public domain, but a recent decision by a Supreme Court judge was to the effect that the telephone companies have no right on the public highways except such as are gained from the farmers along whose lands their lines run. Mr. Rogers, of Indiana, argued in favor of the principle that the occupation of highways shall be decided by the voice of the people. Mr. Thompson said that in Ohio the right of eminent domain had been adjudged to telephone companies, but the companies must settle with persons who have land abutting upon the highway. Mr. Barnhart, of Indiana, said that his State Legislature had recently passed a bill in the interest of the independent telephone movement, whereby telephone lines could be constructed in towns and cities without the consent of the abutting property owner, but consent must first be obtained of the commissioners of public highways and of the town council; the consent of the owners of property is not, however, required.

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[1] See Electrical World and Engineer, Dec. 12, page 950.

Mr. Henry A. Barnhart, of Indiana, read a paper entitled, "Where Should the Line of Demarcation be Drawn Between Independent Operating and Manufacturing Companies and the Bell?" He considered that the independents should stand aloof from any compromise whatever with the Bell Company, but he counseled the evasion of fight unless absolutely necessary in self-defense or in clearing away for the forward march. As to manufacturing, if there is Bell capital in any so-called independent factories the Association should know it and protect its membership and independent telephone interests from this imposition so they might not contribute strength to a competitor. A condition of great concern for the independent telephone movement is long-distance connections. For instance, a half million independent telephones are in operation within a radius of 200 miles from Chicago, all serving territory within the immediate commercial environment of Chicago, but not a single one of them can get a connection with this most important business center. The influence which keeps the independents out of Chicago is costing its business millions of dollars in cases of rental and trade losses every year, and this all goes to Bell telephone profits. The same is true, moreover, of other cities. Following the paper of Mr. Barnhart, Mr. Prewitt presented a paper entitled, "What Should be the Voting Representation in the Conventions of the Interstate Independent Telephone Association?" He advised that the country should be divided into telephone districts and the organization in each of a district association, in which every independent telephone company should have a right to become a member. He recommended that each company send one representative, who, on all questions, should have a single vote; but on certain questions he should have a vote in proportion to the size of the company he represents. The members of the district associations should delegate to their association the power to control the sale of voting stock and to make contracts with all telephone companies not members of the association, and settle all questions arising between members of the district association, and such other powers as may be expedient. Every district association would become a member of the Interstate Association, which on certain predetermined questions would have a single vote, while on other questions he would have a vote commensurate with the size of the companies in the district association of which he is a delegate. Every district association delegate to the Interstate Association would have the power to revoke or annul the sale of any stock by one of its members or any contract it may make for any of its members with a company other than the district association, together with the power to settle all questions that may arise between district associations, or a member of one association with a member of another association and other powers that may be deemed expedient. He considered that his proposition embodied the great American idea—management of the owners by the owners for the owners.

Mr. J. S. Bailey, of Ohio, then addressed the convention and gave a review of the present situation of the Independent Telephone Association, with particular reference to large installations recently completed or now underway. He considered that by the time the convention meets next year the independent systems will have long-distance service for a greater distance than the Bell Company. The various independent long-distance companies already represent each one of them millions of dollars—some of them two or three millions—and the large companies which will come will represent probably forty or fifty million dollars. No small interest should be afraid of the effect of consolidation of long-distance systems when it comes, and all should welcome it as the one thing which adds more to the value financially and to the service of the independent telephone interests in the United States than any other one thing.

A resolution introduced by Mr. Brooks, of Minnesota, referring to Postmaster-General Payne, led to an animated discussion. The resolution was to the effect that the president should appoint a committee of three to investigate the action of the Postmaster-General relative to his ordering independent telephones out of post-offices. Mr. Brooks said that his resolution was suggested by the action of the Postmaster-General in ordering out an independent system in the post-office at St. Paul and ordering the Bell system to be used. Mr. Presson, of Iowa City, Iowa, said he was heartily in favor of the Association taking up the matter of the resolution with Washington, as it is very plain that Postmaster-General Payne is biased in favor of the Bell system. Mr. Rogers, of Iowa, also supported Mr. Brooks and made some severe reflections on the action of Postmaster-General Payne. Mr. R. C. Hall, of Pittsburg, said he considered that the matter should be brought to the attention of the President, and he thought it might result in the removal of Postmaster-General Payne. An amendment to the resolution that the report of the committee be sent direct to President Roosevelt was adopted. Another resolution was adopted directing that each member of the Association should write to the Congressman of his district and call his attention to the matter that had just been discussed, and that copies of the resolution be printed so that the members might have it to forward to the Congressmen.

Mr. W. H. McDonough, of New York, then read a paper on the telephone periodical press. He showed what service the journal which he edited had been to the independent interests through showing up the methods of the Bell Company. At the conclusion of Mr. McDonough's paper, Mr. Rogers, of Iowa, complained that it contained an attack upon him and said that he had laid a trap for the gentleman and had been informed that he would be attacked at this meeting for that reason.

Electrical Production in Germany.

Mr. Simon W. Hanauer, Deputy United States Consul at Frankfort, sends the following with regard to electrical production in Germany: "An essay on the electrotechnical industry of Germany, written by Dr. Brüner, the syndic of the Association for Fostering the Interests of German Electrotechnics, gives the following data: 'Germany's output of the electrotechnical products during the year 1898 aggregated 228,670,000 marks ($54,423,460) in value, of which 57,000,000 marks ($13,566,000) was for foreign orders. The value of the exports of electrotechnical products rose to nearly 100,000,000 marks ($23,800,000) in 1902, although the total production decreased considerably in that year. The total amount of capital invested in German electrotechnical works and enterprises in 1900 amounted to 2,500,000,000 marks ($595,000,000). The greater part of this colossal sum has since been wiped out by the terrible depreciation of the share capital. Many of the enterprises inaugurated and conducted for their own account by the electric manufacturing companies proved unprofitable and had to be given up, nearly all the capital invested becoming a dead loss. Among these ventures electric railroads in mountain districts and tramways and lighting plants in the smaller towns form a large proportion of the losses.'

"Dr. Brüner discusses at length the errors committed by the electrotechnical companies and urges them to center their energy upon obtaining orders abroad.

"The *Electrotechnical Journal* says that the increase of electric roads in Germany during 1902 was about 300 km. (186 miles), with an additional 400 km. (248 miles), in course of construction. The number of motor cars is estimated at 12,500, against 7,300 in 1901."

British in Thibet.

A British expedition has, after a long march, invaded the ancient and mysterious land of Thibet, but has not found the Central Asians particularly polite or cordial, although the desire is to promote trade relations with them. The Thibetans strongly objected to the telegraph line which the expedition laid as it advanced, and it is believed that they made an attempt to destroy it.

Ohio Independent Telephone Traffic Association.

A meeting of the directors of the Independent Telephone Traffic Company, of Cleveland, was held in Columbus recently for the purpose of discussing, besides other matters, the advisability of moving the headquarters of the company from Cleveland to Columbus. The Traffic Company was formed about a year ago for the purpose of bringing about a number of improvements in the management of independent telephone exchanges in Ohio. Thus far its efforts have been confined chiefly to buying supplies of all kinds and distributing them to the 70 or more companies who are members of the association. It was finally decided to allow the headquarters to remain in Cleveland for the present at least. A meeting will be held in Cincinnati the second week in February for the purpose of organizing a broader association somewhat on the order of the now defunct Ohio Independent Telephone Association. The independent interests of Ohio are much interested in the movement to establish an independent company in Cincinnati, and the meeting held in Cincinnati will also be for the purpose of helping along that movement. It will be the aim to bring all the independent companies in the State into the association.

The Year's Patent Record.

The Secretary of the Interior, Mr. Hitchcock, in his annual report just published, says:

"The record of the Patent Office shows that there were 49,199 applications for letters patent, 801 applications for designs, 156 applications for reissues, 1,767 caveats, 2,530 applications for trade marks, 1,208 applications for labels, and 362 applications for prints. There were 29,892 patents granted, including reissues and designs, and 2,194 trade marks, 910 labels and 233 prints were registered. Twenty-three thousand three hundred and ninety patents expired. The number of allowed applications which were by operation of law forfeited for non-payment of the final fees was 4,760. The total receipts were $1,591,251.04, the expenditures being $1,423,094.40. The commissioner shows that the business is growing, there being an increase of about 32 per cent.

Attention is called to the amendment of March 3, 1903, to Sections 4887, 4892, 4896 and 4902 of the Revised Statutes. This gives effect to the International Convention for the Protection of Industrial Property, and extends the period within which an application for a patent could be filed in this country, after an application abroad, from seven to ten months; requires the authority of foreign officers administering oaths to applicants for patents to be proved by a certificate of a diplomatic or consular officer of the United States; permits a foreign administrator of a deceased foreign inventor to file an application in this country, upon the authority of such foreign administrator being proved by a certificate of a diplomatic or consular officer of the United States, and prevents foreigners, as well as citizens of this country from filing caveats.

CURRENT NEWS AND NOTES.

CHEAPER RADIUM.—Professor Himstedt, of Freiburg University, Germany, states that he has made the interesting discovery that all the products of water and petroleum sources yield a heavy specific gas closely resembling and probably identical with the emanation of radium, whence he concludes that a very large number of bodies possess the quality of emitting a kind of Becquerel rays.

MUNICIPAL SHORTAGE IN CHICAGO.—An apparent shortage of $5,000,000 in the Special Assessment Bureau of the municipal government is reported by Haskins & Sells, expert accountants, engaged to audit the books. With the statement are charges of misappropriation of funds and of criminal management during the last thirty-two years. It is alleged that much of this reported shortage, which should have gone to taxpayers of Chicago in rebates for improvements, has been illegally transferred during former years to the credit of other municipal governmental departments which had exhausted their appropriations and wanted to make a good showing. It is also stated that a sum in the millions has been stolen.

N. E. L. A. REPORT ON STEAM TURBINES.—The National Electric Light Association's committee for investigating steam turbines, of which Mr. William C. L. Eglin, of Philadelphia, is chairman, has already accumulated a large amount of very valuable data on steam turbines, and will publish in its report a full description of the turbines manufactured in this country, and also expressions of opinion from some of the leading European engineers concerning the use of the steam turbine and the field it occupies in Europe. This report will be quite voluminous, and will undoubtedly give more interesting information than has yet been published. It is the expectation of the committee that this report will be in the form of a bound volume prepared for distribution to members at the twenty-seventh convention, to be held in Boston in May.

TELEPHONE PHONOGRAPH.—A cable dispatch from London of December 14 says: "The *Daily Mail* announces that it has conducted reasonably successful experiments with a recording telephone, called the electrograph, which is the invention of E. G. Craven, an English engineer, who was once an assistant of Thomas A. Edison, at Menlo Park, N. J. The mechanism combines a telephone and phonograph. Messages spoken into the telephone transmitter were sent over a dozen miles between London and Twickenham, where they were received by the phonograph, without audible sound, by direct electrical effect on a vibrating diaphragm. When the phonograph was disconnected from the telephone wire and reversed the messages were reproduced audibly and distinctly. Mr. Craven declares that his invention will be the greatest addition to the conveniences of business since the invention of the telephone a generation ago, as the electrograph leaves a permanent record of conversations." This was all done successfully years ago by Mr. W. J. Hammer, between New York and Philadelphia. He was awarded a medal for it by the Franklin Institute. Let us have something really new

SECRETARY SHAW AND THE METRIC SYSTEM.—In his annual report the Secretary of the Treasury very strongly urges the adoption of the metric system. The report states that during the year the attention of the department has been forcibly called to the growing need for international uniformity in so fundamental a necessity to trade as weights and measures. The Customs Congress of American Republics, held at New York, strongly urged the adoption of the metric system to simplify the transaction of government business in connection with international trade. Moreover, the National Board of Trade of the United States, the Board of Trade of Canada and the Congress of Chambers of Commerce of the British Empire have recently urged by strong resolutions the adoption of the metric system. In conclusion Secretary Shaw says that the experience of forty countries of the world has proved beyond question that the international metric system is unsurpassed for practical convenience, possessing as it does a terminology concise, definite and free from ambiguity, affording a maximum facility in the countless transactions and computations of science, manufacture and commerce.

REPORTING ACCIDENT BY WIRELESS TELEGRAPH.—The steamship *Kroonland,* of the Red Star Line, from Antwerp, December 5, for New York, which sent a wireless telegraph message saying that her steam tiller was broken and that she was returning to Queenstown, steering with her engines, arrived there at 8.30 A.M. on the 9th. She was attended by a tug, which had been sent in response to her wireless message. The saloon passengers, on landing, were enthusiastic over the utility of the Marconi wireless telegraph system, by means of which news of the accident was received. The break-down of the steering apparatus occurred when the *Kroonland* was 130 miles west of Fastnet. Captain Doxrud immediately sent a wireless message to Crookhaven for the agents of the line in Antwerp, describing the damage and informing them that the steamer must abandon her voyage. A reply was received within an hour and a half, whereupon Captain Doxrud complied with the instructions sent him to return to Queenstown. Meanwhile, three-fourths of the saloon passengers and a number of those in the second cabin sent wireless messages to friends in various parts of Great Britain and Europe, and many of them received replies before Fastnet was sighted from the steamer. Some of the wireless messages were cabled to the United States. In some cases the senders asked friends for money, and the replies authorized the purser to advance funds to them, which was done before land was sighted.

RADIUM AND CANCER.—The London papers are discussing radium cures of cancer. Eleven cases are under treatment at the Cancer Hospital, but the medical authorities are very cautious and slow about announcing cures or changes, except in surface cancers.

FIRST ELECTRIC SLEEPING CAR.—A special telegram from Wilmington, Del., states that the Harlan & Hollingsworth Company has completed the electric sleeping car, Theodor, and has shipped it to Indianapolis. The car was built for the Holland Car Company, of Indianapolis, and is the first electric sleeping car constructed.

ROYAL ELECTRIC LIGHT BATHS.—King Edward is reported from London to be taking electric light baths. "These are installed at Windsor Castle and at Buckingham Palace. One has a projector of 2,500 cp for use in local affections of the body. Inside the other bath, in which a sitting posture is adopted, there are fifty-two incandescent lamps, which radiate any colored light desired."

A NEW INCANDESCENT LAMP.—A new type of incandescent lamp filament has recently been perfected by Dr. Just, of Vienna, the essential feature of which is the use of bornitrate $B(NO)_3$ as material for the filament. The lamp gives a light similar to that of the ordinary filament, and tests have shown an average life of 300-400 hours. It is stated that the cost of manufacture is not greater than that of the ordinary lamps. Up to the present only lamps of 50 and 100 volts and 35 cp have been produced. The most important feature of the lamp is its high efficiency, it being stated that the lamp operates satisfactorily at 1.9 watts per candle-power.

LIGHTING WESTMINSTER ABBEY.—A cable dispatch from London of December 12 says: "Westminster Abbey is to undergo something tantamount to a revolution. The historic Pyx Chapel, the massive door of which is a familiar feature in what are popularly known as the dark cloisters, is about to be lighted by electricity and thrown open for inspection. Public entrance to the chapel was no easy matter, for no fewer than seven keys were necessary before the two oaken doors would swing open. It was in this chapel, one of whose doors was upholstered in human skin, that in days gone by were stored government standards and assays of gold. Among the other contents of the place are a curious stone altar and some ancient chests, in which State documents, exchequer tally sticks and other things were deposited."

RADIUM TEAS FASHIONABLE.—In London radium afternoon teas and parties are quite the fashionable thing, and the Crookes spinthariscope has gained popularity as a Christmas present. The supply ran short, however, perhaps fortunately, because there have been several cases where the spinthariscope has been the cause of certain troubles to which inexpert handling of radium frequently gives rise. The announcement made of the lethal effects upon rabbits obtained by Dr. Heinicke, of Leipsic, by exposing them to the action of Röntgen and radium rays, gave warning that those desirous of treatment by new methods should be careful in their choice of practitioners, and their handling of scientific apparatus. He showed that systematic exposure to X-rays, already known to be harmful to the skin, is also very damaging to the internal organs, especially the spleen and brain, resulting in death after emaciation, fear, languor and prostration.

TELEGRAPHY IN HONDURAS.—An official report from the Republic of Honduras says with regard to means of communication: "Telegraph lines have been hung in every department (province) and all the principal towns are connected with each other and the capital telegraphically. The system is under government control, and during part of the day the wires are open only to official messages. There are 180 offices and over 600 persons are employed in this branch of the service. The system comprehends about 3,250 miles of lines. The revenue of the telegraph office amounted in 1901-2 to 54,455.40 pesos. Government messages are carried without charge. Cable messages produced a revenue of 24,837 pesos from a transmission of 10,951 words. Telephone service is established in Tegucigalpa, but will require considerable attention to produce efficacy. Eight new offices were opened during the year, but the system in general has not been improved or extended. Telegram blanks of the value of 15, 30, 45, 60, etc., centavos are sold in all the stores, and upon them may be written five words for each 15 centavos of value. These telegrams may then be placed in any telegraph office for transmittal without further charge."

ELECTRIC LIGHTING IN CLEVELAND.—The Cleveland authorities seem to be possessed with the Socialistic idea. Just recently the voters of that city decided positively against the proposition to establish a municipal electric lighting plant. Thus defeated, other means of working injustice upon existing private companies are to be tried, it seems. The city solicitor of Cleveland is preparing an ordinance fixing the price of electricity for illuminating purposes in the city. The city officials claim that the new municipal code for Ohio cities authorizes municipalities to fix the price of electricity distributed by companies holding franchises on streets. It is probable that the ordinance will fix the price of city arc lamps at $70 per year, instead of $75 as paid under the present contract with the Cleveland Electric Illuminating Company, and the price of current for private consumers will be reduced from 12 cents, the present scale, to 7 cents per kw-hour. The attempt to enforce such an ordinance will probably result in law suits.

NOBEL PRIZES.—The Norwegian Parliament has awarded the annual Nobel Peace Prize of $39,150 to William R. Cremer, M.P., publisher of *The Arbitrator,* of London, for his work on behalf of international arbitration. The prize for physics is divided between Henri Becquerel and M. and Mme. Curie. The chemical prize goes to the Swedish Prof. Arrhenius, the medical prize to Dr. Finsen, of Denmark, and the prize for literature to Björnstjerne Björnson, the Norwegian poet and dramatist. These prizes amount to about $40,000 each. The formal distribution of the prizes took place last week in the presence of the King and several members of the royal family. His Majesty presented the prizes, each of which was accompanied by a diploma and a gold medal, to Henry Becquerel, Prof. Arrhenius, and M. Björnson. Dr. Finsen and M. and Mme. Curie were absent, but were represented by the Danish and French Ministers.

STEAM TURBINE TESTS.—The opinion of members of both the Senate and House Naval Affairs Committees is believed to be favorable to an appropriation of $25,000 for experiments by the Navy Department with steam turbine engines. This appropriation has been asked for by Rear Admiral C. W. Rae, chief of the Bureau of Steam Engineering, who believes that at least two small ships of the navy should be fitted with this type of propulsive machinery for experimental purposes. Rear Admiral Melville, retired, who was Rear Admiral Rae's predecessor, made a recommendation to this effect. A board, of which Commander John R. Edwards and Alfred B. Canaga were members, filed recently a report of an inspection they made of the turbine yacht *Revolution,* equipped with the Curtis turbine. They found this yacht very fast, especially for short distances. They made careful observation of her general features and of the engine installation. While the performance of the craft was creditable for her class, they reported that there was no means of telling how expensive her engine might be in steam consumption or how effective it might be. The board favors the installation of steam turbine machinery in some type of naval vessel. The Bureau of Steam Engineering and the Bureau of Construction and Repair are and have been for several months, conferring as to the best methods of installation of machinery and the best type of hull for a turbine-propelled scout ship or cruiser, should one be authorized. England is already equipping some ships in her navy with the turbine.

LETTER TO THE EDITORS.

Heating Handles of Automobiles and Cars.

To the Editors of Electrical World and Engineer:

Sirs:—I was much gratified to observe in your issue of December 5 a short description of an electrically-heated handle, a patent for which was recently granted to me. I am pleased to know that the invention has attracted your attention. You have evidently experienced the great discomfort that, heretofore, has been inevitable from cold hands while operating automobiles in winter weather.

If I remember correctly, you say in the last line of your paragraph, "A small supply of current suffices to keep the fingers comfortably warm." I think you will be surprised when I tell you the results of a test I made recently in very cold weather with one of my handles attached to the steering lever of an electric automobile. The temperature during the test was considerably below freezing and a high wind was blowing—a combination guaranteed to numb the fingers and hands of the most hardy motorist in a very short time. After numerous experiments, I found that a consumption of energy at the rate of 9 watts would keep the handle as warm as I could desire it even on such a cold day. This is practically a negligible quantity of energy to consume, especially when one considers the very great comfort that such a small amount of energy affords.

As you know, one seldom wishes to operate a machine for five hours at a stretch. Assuming such a contingency, however, the amount of energy that would be required to keep the hands perfectly warm, even in extremely cold weather would only be 45 watt hours. Allowing for such losses as occur in charging storage batteries, the actual expense for five hours of solid comfort, charging for current at the rate of 10 cents a kilowatt hour, would amount to the huge sum of .64 of a cent. Of course, the handle can be used to great advantage on the handles of trolley cars, bicycles, steering wheels of yachts, ships, etc., as well as on the steering wheels and controlling levers of automobiles.

New York City. R. A. Fliess.

DIGEST

OF

CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Single-Phase Traction Motor.—Szasz.—An article in which he refers to an opinion recently expressed by Niethammer that in view of the success of the Winter-Eichberg single-phase motor, the competition will be in future no longer between direct current and three-phase current, but rather between direct current and single-phase for traction purposes. The present author thinks that this opinion is not justified by the information published on the Winter and Eichberg motor, and he compares their single-phase motor with the three-phase motor, to show that the latter is superior in efficiency. He first analyzes some curves showing the behavior of the single-phase motor (these being the same curves printed in another connection elsewhere in this issue). These curves show that when the power varies (either on account of variation of speed or of torque), there is a certain transformation ratio for the regulation transformer for which the efficiency and the power factor are a maximum. When the torque changes, the speed also changes when the same transformation ratio is maintained, but by varying the ratio of transformation it is possible to maintain the speed more or less constant. For a constant ratio of transformation the behavior of the Winter-Eichberg single-phase motor is somewhat similar to that of a direct-current series motor as far as the variation of torque and speed are concerned. But on account of the very rapid slope of the efficiency curve from its maximum point, the motor must be operated at a certain ratio of transformation within relatively small limits in order to insure good efficiency. If a road should have many and rapidly-changing grades it will be necessary to regulate the ratio of transformation continually with great care. This is not required for direct-current nor for three-phase current traction. The single-phase motor is peculiar in so far as for the different ratios of transformation the maximum efficiency is obtained at nearly the same speed. From the diagrams the author finds that this speed is 32, 32, 32, 31.5, 36, 38 km. for six different ratios of transformation varying between 24 to 1 and 8.3 to 1. The corresponding values of the torque are 450, 570, 725, 825, 830 and 890 kg., respectively. The most economical speed is, therefore, nearly constant, though increasing somewhat for the greater values of torque. Any deviation from the most economical speed produces a decrease of efficiency. According to the ratio of transformation, differences from the most economical speed up to about ± 20 per cent. can be obtained if one does not care to decrease the efficiency by 5 per cent. In this respect the Winter-Eichberg single-phase motor is different from the direct-current series motor. First, the efficiency of the latter is good for all speeds, and, secondly, the tendency toward maintaining uniform power with varying torque is lacking in the single-phase motor. In fact, the latter has the reverse tendency, since wherever torque and speed change together, they increase simultaneously. The author then compares the economy of a pair of two single-phase motors with that of a pair of equivalent three-phase motors. For the single-phase motor he assumes a continuous adjustment of the ratio of transformation. The comparison is also made for half the normal speed, which corresponds to the tandem connection of the three-phase motors. From his curves it appears that at the most economical speed the single-phase motor operates with a higher power factor, but a smaller efficiency than the three-phase motor. For half speed both power factor and efficiency are better for the three-phase motor. For the consumption of current the product of efficiency and power factor is of decisive importance, and this product throughout is better for the three-phase than for the single-phase motor, and the difference is even greater in the case of half speed. The efficiency of the Winter-Eichberg system is in the most favorable cases about 83 to 87 per cent., while it is 93.5 per cent. for the three-phase motor, and this value is maintained over a wide range. The losses in the motor have, therefore, in the single-phase motor, about double the value of the losses in the three-phase motor; the single-phase motor, therefore, must have considerably larger dimensions in order to give off the developed heat. The author concludes that these conditions render the value of the regulation of the Winter-Eichberg single-phase system without resistances quite doubtful. As far as can be judged from the published diagrams of the motor, the starting is less economical and the energy losses in motor and transformer are greater than with the three-phase system.—*Zeit. f. Elek.*, November 22.

Testing of Generators by Air Calorimetry.—Teelfall.—A long, illustrated paper read before the (British) Institution of Electrical Engineers on a method of determining the efficiency of generators in cases in which the ordinary methods are unsuitable. He encloses the generator in a non-conducting casing and pumps air through the system at a measured rate. The arrangements are so made that no heat is lost by radiation. If, then, means are available for the rapid and accurate measurement of the current of air, it is only necessary to ascertain the temperature of the air on entering and leaving the system in order to find the heat developed in the generator. The efficiency is then given by the ratio of the electrical energy developed by the generator divided by the sum of the same electrical energy plus the heat developed in the same time. The main difficulty is in measuring the air current, and the devices for this purpose are described at great length. The author points out that his method shares with the well-known Hopkinson test the advantage that the power lost is the direct subject of measurement, and a considerable error may be made in this estimation without proportionately effecting the result for the efficiency, as long as machines of high efficiency are in question. For instance, if a 100-kw machine under full load is being investigated and the measured loss is 10 kw, then the resulting efficiency is 100 ÷ 110 = 90.91 per cent. If there should be an error in the determination of the loss amounting to 10 per cent., so that instead of 10 kw it is really only 9 kw, the efficiency of the generator would be really 100 ÷ 109 = 91.74 per cent., and the error of the estimate would be 91.74 — 90.91 = 0.83. Hence, an error of 10 per cent. in the measurement of the loss corresponds to an error of less than 1 per cent. in the efficiency figure.—Lond. *Elec.*, November 27.

REFERENCES.

Single-Phase Motor.—A reprint with illustrations of a British patent applied for by Winter and Eichberg on October 24, 1902, the complete specification being accepted exactly twelve months later. An abstract of the patent will be found on another page of this issue. —Lond. *Elec.*, November 27.

Single-Phase Motors with Commutator.—Blondel.—The first part of what appears to be a serial on this subject. He first describes the various single-phase motors devised before 1900 and then gives a mathematical theory of the series motor. The article is profusely illustrated by diagrams and is mainly mathematical.—*L'Eclairage Elec.*, November 28.

Induction Motor Diagram.—Thomallen.—An article in which the author says that while the Heyland diagram of the induction motor is simple, that of Ossanna is more exact, but the calculations based upon it are much longer. The author describes a graphical method which he believes to be suitable for application to small motors. The article consists mainly of diagrams and formulas.—*Elek. Zeit.*, November 26.

Lights and Lighting.

Stage Lighting.—An illustrated description of the lighting installation of the new Gaiety Theatre in London. Current is obtained from three distinct sources, two of which are interchangeable. The total number of lamps in the building is 4,703, exclusive of arcs, for which 240 amp. are required. The stage switchboard is provided on its extreme right hand with four main switches fitted with carbon breaks. They control, respectively, the auditorium lights, and white, red and blue lamps on the stage. At the top of the board are three pilot lamps, which indicate whether switches on smaller boards situated in other parts of the building, are open or closed. All lights on the stage, as well as the majority of those in the auditorium, are controlled by the stage board. Only one of the two wires is taken through the stage board, the return being connected through fuses to a separate distribution board. Hence, it is impossible to get a short circuit on the board itself, as it only controls one pole. In connection with stage lighting, it is frequently necessary to put out every light with the exception of a few in the float or a particular batten. This constituted a difficulty hitherto and has usually been effected by switching off individual circuits separately. In the Gaiety Theatre this difficulty has been overcome in the following manner: In series with each circuit switch is a two-way switch, one pole of which is connected to the ordinary bus-bar controlled by the main switch, the other pole being connected to a bus-bar attached to the live side of the main switch. Hence, it is possible to make any circuit fitted with this device independent of the main switch. The whole board controls 3,000 lamps and has a capacity of 1,000 amp. As regulating devices, 24 liquid resistances and 33 wire resistances, the latter wound on asbestos-covered iron frames, are used. One of the wire rheostats is shown in Fig. 1, from which it will be seen that connections are taken from the winding at various positions and attached to contacts at the top. These contacts when built up form a solid bar of alternate slices of copper and insulation, which presents the appearance of a developed commutator. Along the bar runs a rubbing "jockey," which is worked to and fro by the regulator lever and a counter-weight. A device is provided to prevent damage to the last contact by sparking. Before the jockey gets to the end of the bar it causes the circuit to be broken through a tiny spring switch with carbon contacts. This switch closes again automatically when the jockey is drawn back by the counter-weight.—Lond. *Elec.*, October 30.

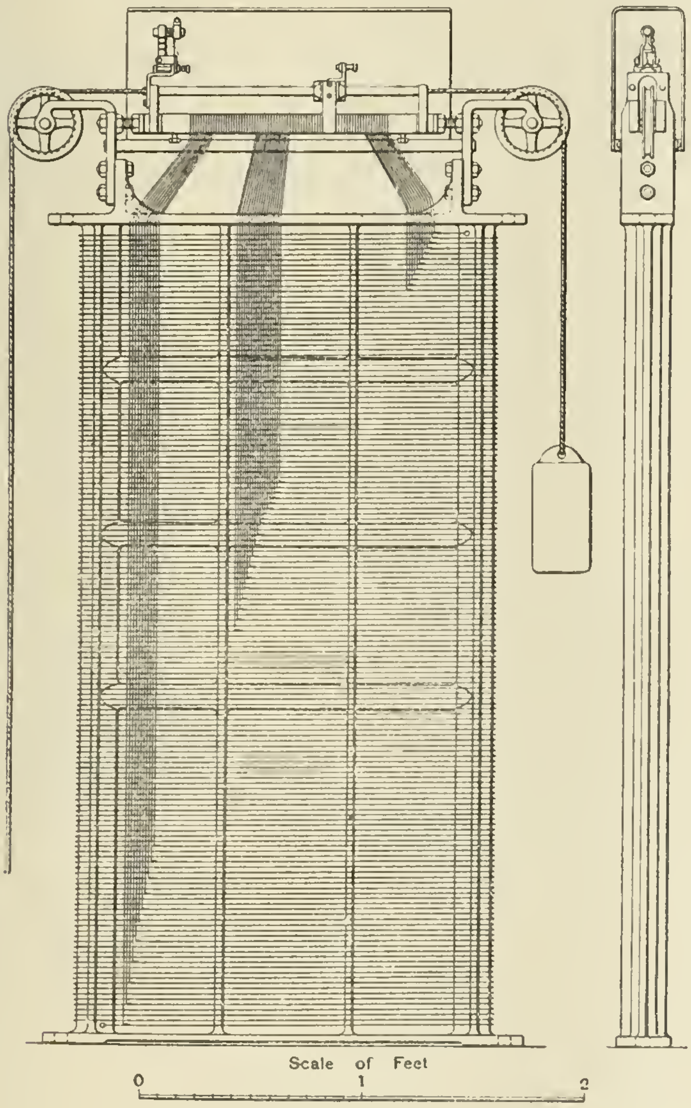


FIG. 1.

Power.

Motors for Power Presses.—Fladd.—An article in which the author gives a long list of commercial power presses, together with the horse-power of electric motor required to drive it. Concerning the connection of motor and press, he is inclined to slightly favor the belt drive, as it gives a little elasticity between the motor and the press, when a quick, heavy load is suddenly thrown upon it, as in the case of press punching and stamping. The large coining presses used by the United States Mint in Philadelphia for striking up silver dollars exert a pressure of 160 tons and run at a speed of 80 per minute, with a 7½-hp motor. The smaller size press for coining the quarter dollar pieces, which runs at a speed of 100 per minute and gives a pressure of 60 tons, is driven by a 3-hp motor; a double-feed roll blanking press at a speed of 90 per minute requires a 3-hp motor; a double-cut-off shear, 3 hp; the 10 x 9-in. rolling mills are driven by a 50-hp motor and the coin upsetting machine by a 3-hp motor. This mint machinery is of special design. Some factory managers think it better economy to run their power presses in groups, driving from one motor a main line.—*Iron Age*, November 26.

Traction.

Repair Shop.—A fully-illustrated description of the repair shops of the St. Louis Transit Company. By means of an electric hoist a car can be raised and the truck run out; twenty-four tracks are equipped with hoists of this kind. All new cars are built with motors which open from above, so that examination from the pit is not required. An electric transfer table is used which takes its power from an overhead wire. Some of the special machines used in the winding department are illustrated, and also the apparatus for testing the insulation of armatures by means of transformers. The operator holds in his hand a small piece of light sheet iron, which will vibrate in case there is a short-circuit.—*St. R'y Jour.*, November 14.

Paris.—Guery.—The first part of a profusely-illustrated article on the electric installation of the road Les Invalides à Versailles. He first gives the history of the electric installation of this line on which the third rail is used with 500 volts direct current. For transmission, three-phase currents at 5,000 volts are used and converter substations are installed along the line. The equipment of the main power house is described in detail. It contains nine generators each of 800 kw and four direct-current exciters.—*L'Eclairage Elec.*, November 28.

Single-Phase Traction.—See the abstract and reference under "Dynamos, etc."

Installations, Systems and Appliances.

Electric Installations in an Asylum.—An illustrated description of the Portrane Asylum, which is the largest private lighting and power installation in Ireland. Power is generated by three 80-kw, 250-volt dynamos. There is provided a storage battery sufficient to provide current for 1,000 lamps of 8 cp for three hours. A motor-driven booster serves to charge the battery. Numerous motors are distributed over the buildings. There is also a telephone system and a fire alarm system installed.—Lond. *Elec.*, October 30.

Wires, Wiring and Conduits.

Wiring.—Rawlings.—An abstract of a paper read before the London Contractors' Association, in which the author proposes a model specification for electric wiring and fittings. His object is to arrive at a standard specification carrying with it general conditions to be known as the National Electric Contractors' Association conditions of contract, in order to avoid a repetition of words in drawing up a specification. This model specification is printed in full. It relates to the various forms of wiring in use, but does not include concentric.—Lond. *Elec.*, November 6.

ELECTRO-PHYSICS AND MAGNETISM.

Positive Ions.—TOWNSEND.—An account of a theory of the genesis of ions by positive ions, and its application to experiments with air and hydrogen. The theory is founded on the determination of the conductivity produced between parallel plate electrodes when ultraviolet light falls on the negative plate. The potential required to produce a continuous discharge may be found by his theory on the assumption that all the ionization is produced by the collisions of positive and negative ions with neutral molecules in a uniform field of force. There is a very good agreement between the potentials thus calculated and the sparking potentials determined experimentally. It requires much larger forces to develop new ions by the motion of positive ions in air than in hydrogen.—From *Phil. Mag.*, November; in Lond. *Elec.*, November 13.

Spinthariscopic Phenomena.—BECQUEREL.—An account of an investigation in which he studied the phenomenon observed by Crookes in order to determine to what kind of radium rays it is due, and what physical process the scintillations represent. For the screens he used the hexagonal zinc blende or diamond dust. In a strong magnetic field the rays producing the scintillations were not deflected. This confirms Crookes' supposition that the rays producing the sparks consist of positive electrons. As regards the nature of the scintillations, they are in general the more pronounced and vivid the smaller the crystals are which compose the screens. The sparks are most likely due to cleavages taking place in the crystal, and not to the mere impact of the positive ions. There exists here an analogy with the scintillations observed on breaking a piece of sugar.—From *Comptes Rendus*, October 27.

Charge by Ion Absorption.—SIMPSON.—The permanent negative charge on the earth's surface is due, according to Elster and Geitel, to a charging of the surface through absorption of ions from the surrounding atmosphere. The present author points out that this theory rests upon an experiment by Zeleny, which had a different result when repeated by Villari. The present author has made a series of experiments to find the conditions under which a conductor can become charged, and to what extent in consequence of ionic absorption. Zeleny's results are best accounted for by ascribing a higher rate of diffusion to the negative ions.—From *Phil. Mag.*, November; Lond. *Elec.*, November 13.

Influence of Electrodes on Colloidal Solutions.—HARDY.—A description of an effect of radium rays in producing a colloidal substance. Specially purified globulin from blood was dissolved first in a trace of acetic acid and secondly in a trace of sodium hydrate. In acid the globulin moves in an electric field from the anode to the cathode, while in alkali it moves from the cathode to the anode. In the former case the globulin particles are, therefore, assumed to carry a positive charge and in the latter case a negative charge. These two solutions were exposed to the radiations from radium bromide, and it was found that the electronegative solution of globulin was turned into an opaque jelly in three minutes, while the electropositive solution became more mobile and less opalescent.—From *Proc. Camb. Phil. Soc.*, October 21; in Lond. *Elec.*, November 13.

Magnetic Storm.—A full account of the effects observed in Europe during the recent magnetic storm, together with an editorial discussion of the subject. The connection between sun spots, magnetic storms and intense earth currents is now practically beyond dispute, since they are always observed simultaneously, but the first cause of these phenomena is still to be sought. At present the hypothesis of Fitz Gerald and Lodge seems to be the most easily acceptable. The magnetic storms are considered to be due to the actual projection from the sun of minute particles in enormous number flying past the earth at great speed. The fact now accepted that radioactive elements emit charged particles at excessively high velocities, makes it easy to reconcile these views with the present position of physical theory. Moreover, as Arrhenius has pointed out, the aurora borealis which usually accompanies the phenomena of sun spots and magnetic storms may be explained under the same hypothesis, for the flying electrons would be deflected in the earth's magnetic field and carried towards the poles. During the recent magnetic storm the short telegraph lines were more effected than the long ones. While traffic on the long cables of the cable companies was only affected to a slight degree, inland telegraphic communication in England and France was completely disorganized. The reason is twofold. First, the majority of the submarine cable companies use the syphon recorder, while on land lines and on the shorter cables the Morse system, working through relay is employed. Secondly, the interpolation of condensers between the cables and instruments shuts off the steady part of the current. As a result the British post office lines were troubled with 60 milliamp., which held over their relays and rendered signalling impossible, while the syphon recorders at the ends of the cables at Porthcurnow were recording perfectly legible messages just as usual, the only effect noticeable on the records being a displacement of the zero. Few measurements were made of the intensity of the earth currents. An actual electrometer test on a new section of Atlantic cable about 1,900 miles in length, showed a maximum measured potential difference between the conductor and sheathing of 31 volts, while the range of variation of pressure was something like 60 volts. In other cases voltages of over 300 have been observed during magnetic storms.—Lond. *Elec.*, November 6.

REFERENCES.

Water Radioactivity.—ADAMS.—An account of an investigation of the nature of the radioactive gas found in Cambridge tap water by J. J. Thomson. It possesses properties remarkably similar to the emanation of radium. The value obtained for the rate of decay is in sufficiently good agreement with that of radium emanation to make it very probable that the radioactivity of the gas is actually due to radium emanation. Contrary to the opinion of Rutherford, he succeeded in showing conclusively that a small amount of radium emanation can be absorbed by water.—From *Phil. Mag.*, November; Lond. *Elec.*, November 13.

Magnetism of Basalt.—ALLAN.—An abstract of a (London) Physical Society paper on the magnetism of basalt and the magnetic behavior of basaltic bars when heated in air. The results are given of an experimental investigation in which bars were cut from English and German basalt and were tested by means of a magneto metric method to determine their magnetic properties at temperatures from 15 to 800° C.—Lond. *Elec.*, November 6.

ELECTRO-CHEMISTRY AND BATTERIES.

Sodium.—LETHEULE.—An illustrated article on the sodium industry in France. The electrolytic process of Becker is first described, the electrolyte being a mixture of caustic soda and carbonate of sodium. A special device is used for collecting the deposited sodium at the top. The construction is described in detail and illustrated. In the second part of the article the electric process of Becker for the manufacture of chromium, manganese and sodium is discussed. By heating in an electric distillation furnace, sodium chromate and carbon, one obtains sodium which distills off and is collected in a condenser, and chromium of excellent quality which is tapped from the furnace. By treating mixtures of salts, or mixtures of salts and oxides, it is possible to produce alloys. By heating, for instance, sodium chromate and sodium aluminate with a sufficient quantity of reducing agent, an alloy of chromium and aluminum is obtained which remains in the furnace, while sodium distills off. Sodium has recently been applied to the refining of iron and other metals.—*Electrochemical Ind.*, December.

REFERENCES.

Electric Steel Furnace.—PERKINS.—A description of the Kjellin electric furnace at Gysinge, Sweden, for the manufacture of steel. The furnace is based on the induction principle, as has already been noted in the Digest. The present article gives detail drawings of the design of the furnace and data on the cost of operation.—*Electrochemical Ind.*, December.

International Congress for Applied Chemistry.—DANNEEL AND CLEMENT.—A very full account of the proceedings of the electrochemical section of the Berlin Congress for Applied Chemistry with concise abstracts of all the papers read.—*Electrochemical Ind.*, September, October, November, December.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electrical Units at the St. Louis Congress.—An editorial discussing the programme of the International Electrical Congress to be held next year in St. Louis. It is said that while the Paris congress, in 1900, adopted the names of maxwell and gauss for units, yet in the technical literature of Europe they are not yet used at all, and in the American technical journals only to a comparatively small extent. The reason is thought to be that the business man does not need names for the magnetic units, while he needs them for the electrical units when he orders a machine or charges for current, etc. Nevertheless, technical men should appreciate these names for the magnetic units on account of their brevity, since it is much easier to write 6,000 gausses than 6,000 C.G.S. lines of force per square centimeter. For this reason the suggestion to adopt in St. Louis the names of gilbert and oersted for the units of magnetomotive force and reluctance, will probably not find any opposition, especially since the proposition is made from the United States, and the two names to be honored are English and Danish scientists. It might, perhaps, be different with the two propositions made by the American Institute of Electrical Engineers and embodied in the two Institute papers of Carhart and Kennelly concerning the legalized standard of e.m.f. and the introduction of ames for c.g.s. (abvolt, abstatvolt, etc.). The editor urges that these propositions should be thoroughly discussed in advance of the congress, and opens the correspondence columns of his journal to such discussions.—*Elek. Zeit.*, November 26.

Electric Pyrometer.—An illustrated description of a pyrometer made by a British firm. It consists of a coil of platinum wire wound upon a cylinder of refractory material and usually fixed at the end of a long closed iron tube, where it is protracted by a platinum shield for measuring the resistances of the coil in order to ascertain the temperature. Two different arrangements are used. One comprises a differential galvanometer and a set of resistance coils and gives readings in ohms, and the temperatures corresponding thereto are ascertained by means of special tables. The second arrangement, which is shown in Fig. 2, is a combination of a simple d'Arsonval galvanometer and a Wheatstone bridge with a circular resistance and sliding contact, and it gives readings directly in thermometric degrees. It is claimed that both types give very accurate readings. Their principal field of application lies with iron, steel and similar processes, the temperature of which has to be constantly watched and regulated. In the instrument of the first type described above a change of the resistance from 10 ohms to 44.9 ohms corresponds to a rise in temperature from 58° F. to 2204° F.—Lond. *Elec.*, November 6.

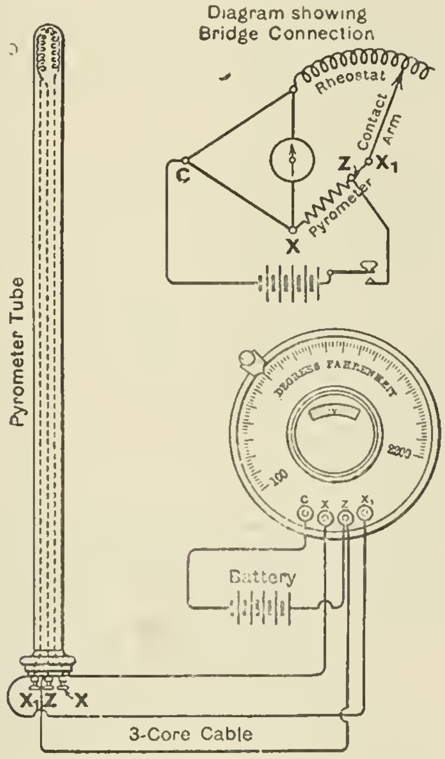


FIG. 2.—ELECTRIC PYROMETER.

Compensation Apparatus.—FRANKE.—An illustrated description of forms of compensation apparatus which enable one to measure e.m.f's with great ease within a very wide range, and which are intended to be used not only in the laboratory, but for tests of switchboard instruments, etc. The apparatus in its simplest form is shown in Fig. 3. The resistance wire, *A B*, over a scale with 100 divisions, is connected in series with the rheostat, *C D* (the resistance of which is 14 times that of *A B*), and an adjustable resistance, *R*, and a single storage cell, *H*, with an e.m.f. of about 2 volts. A standard cell, *N*, with a galvanometer in series, is connected by means of the sliding contacts, K_1, and K_2, to two points of the two resistance, *A B* and *C D*. These two points are so chosen that their numerical values correspond to the e.m.f. of the standard cell; for instance, 1.0192 volt for the Weston cell. If, now, the regulating resistance, *R*, is adjusted until the galvanometer shows that no current flows through the standard cell circuit, then the voltage drop produced by the accumulator current corresponds exactly to the numerical values on the scale. If, therefore, the e.m.f. *S* to be measured is substituted for the standard cell, *N*, and the sliding contacts, K_1 and K_2, are adjusted so that no current flows through the standard cell circuit, the figures on the scale for K_1 and K_2 give the e.m.f. *S* directly in volts. In this form the apparatus is, therefore, suitable for measuring any e.m.f. between 0.1 and 1.5 volts. In order to apply the instrument to the measurement of higher and lower e.m.f's, the author uses the following devices which are not new in principle, but are said to have not been used before in connection with compensation apparatus. For the measurement of e.m.f's between 0.1 and 0.001 volt, the author provides suitable additional resistances which are in a fixed relation to the total resistance, *W*, namely, shunt resistances equal to 1/9 *W* or 1/99 *W*, and series resistances 9/10 *W*, or 99/100 *W*, as shown in Fig. 4. The effect of these resistances is a reduction of the current in the compensator, so that the total voltage drop is now only one-tenth or one-hundredth of the original value. The figures read from the scale are, therefore, now to be divided by 10 or 100 in order to find the e.m.f. *S* directly in volts. For measuring an e.m.f. *h* greater than 1.5 volt, the arrangement of Fig. 5 is used. Four resistances of 100, 900, 9,000 and 90,000 ohms (together 100,000 ohms), are connected in series with *h*. By inserting a plug, it is easy to either connect the terminals *n* to 100, 1,000 or 10,000 ohms; i. e., to 1/1000, 1/100 or 1/10 of the total resistance, 100,000 ohms. The voltage, *n*, can thus be made to be between 0.1 and 1.5 volt and the compensation apparatus gives the e.m.f. *h* directly in volts, if the reading of the scale is multiplied by 1,000 or 100 or 10. Several constructions of the apparatus based on these principles are described.—*Elek. Zeit.*, November 26.

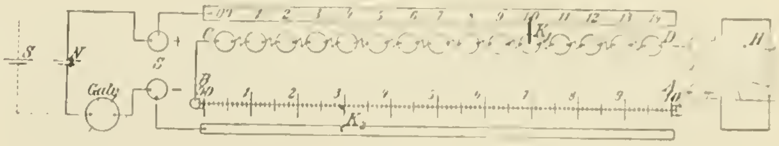


FIG. 3.

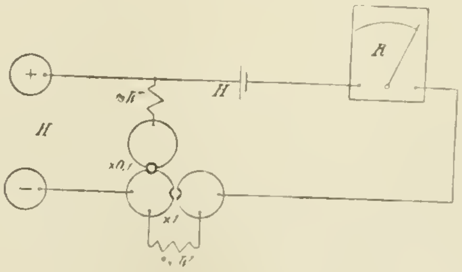


FIG. 4.

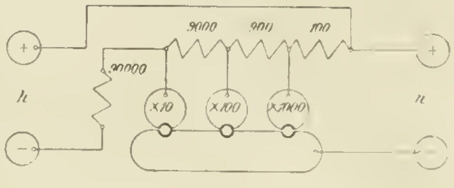


FIG. 5.

Measuring the Frequency of Very Rapidly Alternating Currents.—SALOMONSON.—In a paper on the variation of pitch of the "whistling arc," caused by the variation of the primary current, he had given some results of measurements by Peukert's method of the frequency of the so-called "Duddell currents," a frequency of 268,000 periods per second being observed. Duddell had recently remarked that a measurement with Peukert's method, giving a frequency of the order of 100,000 periods per second ought to be distrusted. The author now gives his reasons why he believes this method to be generally correct, although somewhat inexact at high frequencies. He has now devised the following method for measuring such high frequencies with greater accuracy. The arc lamp is shunted by a condenser and a self-induction which is the primary of a transformer, the secondary being in series with an adjustable condenser and a hot wire galvanometer. If periodic currents are generated in the first circuit by establishing a singing arc, an impressed e.m.f. will be set up in the secondary circuit and will generate a current of the same frequency as that of the original primary current. This current will be a maximum when the natural frequency of the secondary circuit corresponds with the frequency of the impressed e.m.f. The capacity of the condenser in the secondary circuit is varied until the ammeter shows a maximum current and thus indicates the condition of resonance, the adjustment being very easy. The frequency may then be calculated from the known self inductance and capacity in the secondary circuit. To confirm his results the author measured the frequency by photographing the singing arc with the aid of a revolving mirror. From his experiments he concludes that a current in the primary circuit closely approximates a simple periodic current without harmonics of any appreciable intensity. He observed sinusoidal currents with a frequency of more than 400,000 periods per second.—Lond. *Elec.*, November 13.

REFERENCES.

Magnetometer.—CHREE.—An abstract of a (London) Physical Society paper. He had previously found theoretically that the bending of the deflection bar of an ordinary magnetometer, under the combined weight of the bar and its load, must increase the distance between the deflecting and deflected magnets, during determination of the horizontal force, to an extent which is not negligible. He has now confirmed this conclusion by direct observations made at the National Physical Laboratory on a number of magnetometer bars, including specimens from the leading makers. Various attempts have been made to get rid of the bending effect, but the author believes that if this effect can be measured accurately it is of minor importance.—Lond. *Elec.*, November 6.

Calometric Method for Testing Electrical Generators.—See the abstract under "Dynamos, etc."

MISCELLANEOUS.

Presidential Address.—GRAY.—A full reprint of his presidential address delivered before the (British) Institution of Electrical Engineers. In the introduction he distinguishes between an institution as a body for dealing with technical interests and an association as a corporation whose functions are related to everything affecting general interests. He hopes that the (British) Institution of Electrical Engineers will for some time yet continue to take an interest in things general as well as technical, although in future it will fall back into its proper function as an institution. He then discusses at some length the influences of legislation on electrical enterprises in Great Britain and gives a summary of the present conditions of electrical engineering. Exclusive of traction motors, in March, 1903, lamps and motors equivalent to over 14,000,000 lamps of 8 cp were connected in Great Britain to the mains of public electricity supply undertakings, London being represented to the extent of about 5,000,000. About 300 towns had an electricity supply, this number including, with two exceptions, all the towns whose population exceeds 100,000. Exclusive of power companies, the public supply stations had motors amounting to 55,000 hp connected to their mains. Municipal undertakings own generating plant of a rated capacity of 320,000 kw, and private undertakings are represented by 160,000. In London the companies are proprietors of about 100,000 kw, whereas the public bodies are responsible for about 28,000. The pre-eminence of the companies in London is due to the fact that they acted as pioneers and were first in the field. The average rated capacity of a British station is 1,400 kw. Present tendencies in Great Britain are decidedly in favor of the direct-current system with three-wire distribution. The author then gives a summary of recent progress in electric lighting, power generation and transmission, traction, telegraphy, and electrochemistry. He speaks of America as the electrochemical headquarters of the world.—Lond. *Elec.*, November 13.

REFERENCE.

Slide Rule.—BARTH.—A fully-illustrated paper on slide rules for the machine shop as a part of the Taylor system of management.—*Eng. News*, December 10.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wave Detector for Wireless Telegraphy.—SCHLOEMILCH.—An illustrated description of a new wave detector, the principle of which is based on the fact that when an ordinary polarized cell (platinum or gold electrodes in dilute acid) is connected to an e.m.f. slightly greater than the e.m.f. of decomposition, so that a continuous current flows through the cell with a slight development of gas at the electrodes, an ammeter in the circuit shows an increase of the current when electric waves reach the cell. This effect is very pronounced if the electrode which is anode (at which oxygen is developed) is made very small. The author uses a wire of 0.001 mm. diameter and 0.01 mm. length. The arrangement of the apparatus is shown in the adjoining diagram, in which *L* is the vertical wire provided with some inductance windings, *C* is a variable capacity, in shunt with the polarization cell, *F*, which acts as wave detector; *T* is a telephone and *W* a sliding contact which enables one to adjust the e.m.f. impressed on the ends of the polarization cell. The action of the polarization cell is not yet explained, and it is still an open question whether the cell represents an ohmic resistance or a capacity, although the former seems more probable.—*Elek. Zeit.*, November 19.

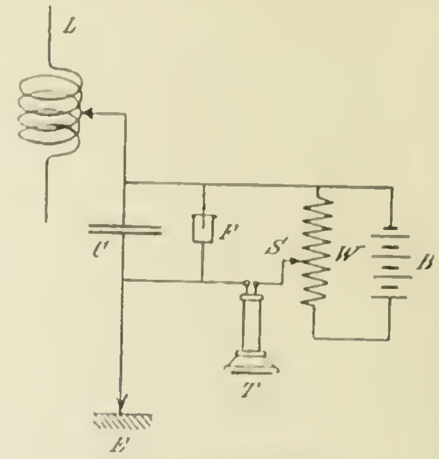


FIG. 6.—WAVE DETECTOR.

Wireless Telegraphy.—The first part of a long abstract of the official report of the preliminary International Wireless Telegraph Conference, held in Berlin in August. There is also an editorial on this subject, pointing out that under the present state of the law in Great Britain the government has no right to interfere with any wireless telegraph company unless the company is sending commercial messages between two stations, both within the boundaries of the kingdom. This condition caused the position of reserve taken up by the British delegates to the conference. They could only point out that the British Government has no power to impose the regulations and restrictions agreed upon by the other nations (with the exception of Italy). It is said that the British Government cannot be justly accused of want of consideration to the claims of Marconi and his associates, and that it might now fairly turn its attention to the question of widening the field of wireless telegraphy by a judicious use of a beneficent state control.—Lond. *Elec.*, November 20.

New Books.

LA TELEGRAPHIE SANS FIL. By E. Guarini. Bruxelles: Ramlot Freres et Soeurs. 64 pages, 88 illustrations. Price, 2.50 francs.

This little volume is one of a series of little works intended to form a library of industrial science. The text is a reproduction of a number of articles contributed to periodicals by M. Guarini, several of which appeared originally in these columns, and treats principally of Marconi's achievements and the author's experiments in wireless telegraphy. The book opens with a highly complimentary appreciation of Marconi, and the various chapters relate to the origin and the principal developments of the Marconi system, including his experiments at Spezzia in 1897; between England and France in 1899; between Poole and St. Catherines in 1900, and his trials between Corsica and France in 1901, and those across the Atlantic in 1901 and 1903. A discourse on the propagation of electric waves and the commercial value of the Marconi system form the concluding chapters. It is a very complete account of Marconi's work and from its favorable tone one might easily make a guess that Guarini had sold his patents to the Marconi interests.

TOOLS AND MACHINES. By Charles Barnard. New York: Silver, Burdett & Company. 164 pages, illustrated. Price, 60 cents.

Mr. Barnard has written a readable book in conversational tone throughout so as to hold easily the attention of the reader. He deals with the ordinary tools of the household, pointing out the functions of each, giving hints as to the kinds of tool to be used for different sorts of work, tracing the growth of the finished product from prehistoric times and then dilating upon the extension of the ordinary tool as seen in power machines. This is particularly shown in his chapter on hammers, where he shows that the original hammer was undoubtedly made of stone, and gives an interesting talk on the manner in which the hammer proper was first attached to a handle and then goes on through the various uses to which the hammer is put until he speaks of the power hammer. Other chapters on cutting and boring tools, abraders, etc., follow in natural sequence.

In addition to the 158 pages that the book contains there are added six pages of index, in which over 400 references are made to tools and appliances mentioned throughout the book. It is a useful book in the home where there is a growing boy with a mechanical turn of mind.

Automatic Track Switch for Street Railways.

A new electromagnetic track switch has been recently placed on the market by the American Automatic Switch Company, of New York, the advantages of which lie in its durability, simplicity, certainty of operation and safety from lightning. It is illustrated herewith in Figs. 1, 2 and 3. The principal operating parts consist of but one magnet and one steel cam plate for the reverse motion. The magnet is immersed in a special oil in a sealed case, giving it absolute protection from moisture. The switch may be adapted to take operating current either through rail or overhead wire.

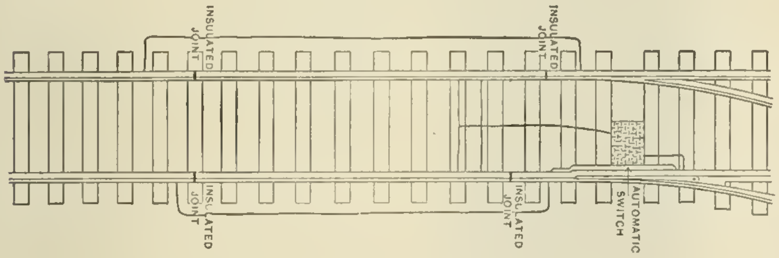


FIG. 1.—AUTOMATIC TRACK SWITCH.

The motorman on a road thus equipped leaves the controller at one or two points while passing over the breaker or insulated rail. If the switch is right the car passes over the breaker or insulated rail with the power off. This method is very simple and prevents the motorman from becoming careless, but it is unnecessary for the motorman to memorize switches in order to operate them. The switch mechanism is made of the finest tool steel. There are no wearing surface or pivoted points, nor is there any chance for short-circuits. As the operating mechanism is enclosed in a strong sealed box placed under ground, no dirt, water, salt or ice can come in contact with the magnet or the working parts. The cam plate produces a semi-lock, but does not prevent the turning of the switch with the switch iron. The switch is easily accessible for inspection. It is also stated that switch tongue splitting and car derailments are impossible. There are no boxes on poles, as the breaker may be placed near the switch. The breaker is arranged to spring on the trolley wire without cutting it.

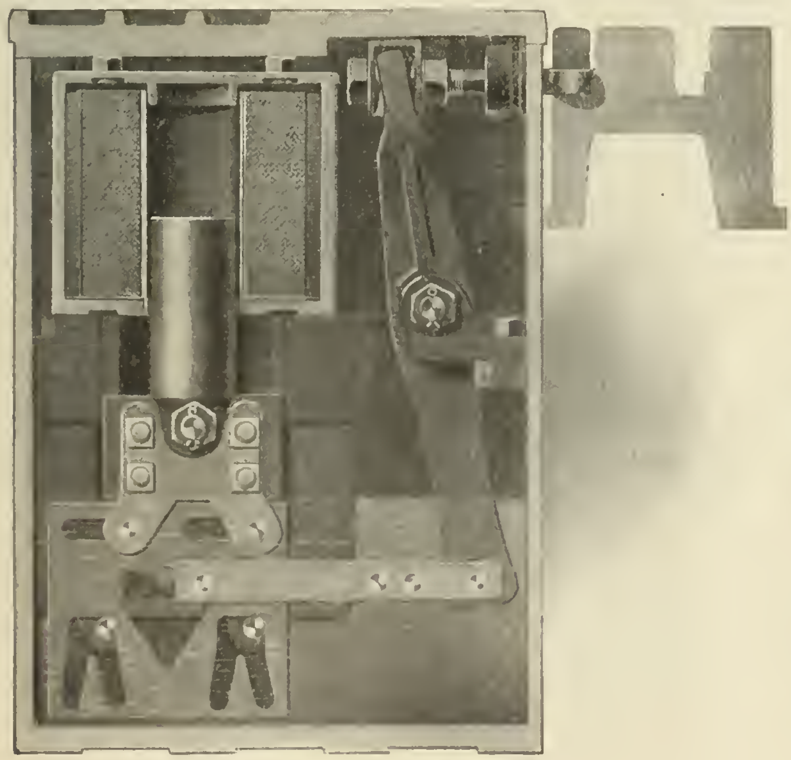


FIG. 2.—SWITCH MECHANISM.

One of these switches has been in practical operation for the last nine months at One Hundred and Forty-ninth Street and Eighth Avenue, New York, and has given excellent satisfaction. The company also has orders for installing these switches in Brooklyn, on the system of the Public Service Corporation of New Jersey, and at Albany, Utica, Trenton, Cleveland and other cities. Mr. Aldred K. Warren, the consulting engineer of the Automatic Switch Company, which has developed this system, was formerly assistant engineer of the equipment of line of the Brooklyn Rapid Transit Company and for the last year and a half has been one of the electrical engineers of the Interborough Rapid Transit Railway Company.

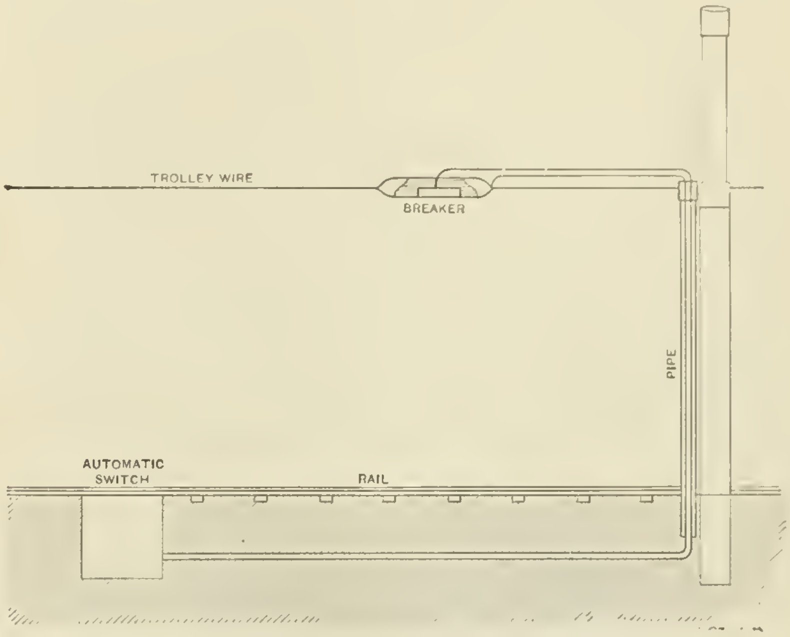
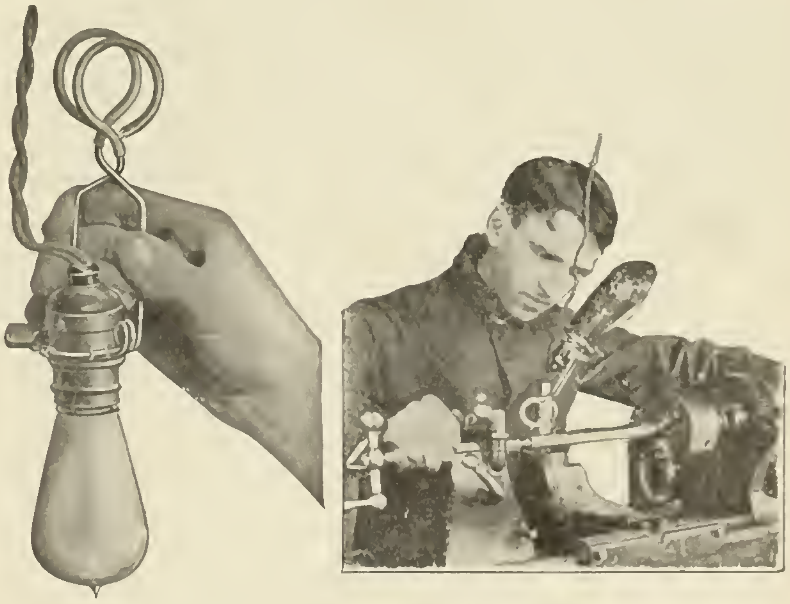


FIG. 3.—OVERHEAD CONNECTIONS.

◆

Adjuster for Incandescent Lamps.

A simple and novel form of adjuster for incandescent lamps called the "Electrogrip" has been placed on the market by the Applied Device Company, of 56 Harrison Avenue, Springfield, Mass. It is clearly illustrated in the two cuts herewith, Figs. 1 and 2. By pressing the arms or jaws of the device toward the central axis, as shown in Fig. 1, the jaws open, and then attachment can be made to the desired object, the springs at once tightening the grip as they revert to normal. In Fig. 2 the appliance is shown fixed on a machine tool, enabling the workman to throw the light just where he wants it without any further bother as to the adjustment of the lamp. It is an "approved" device.

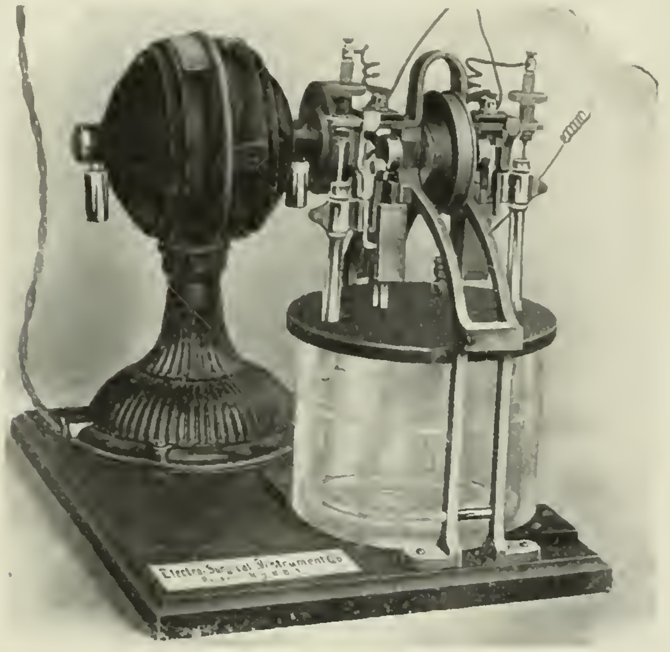


FIGS. 1 AND 2.—LAMP ADJUSTER.

Current Interrupter.

Mr. F. A. Houghton, of Rochester, N. Y., has assigned to the Electro Surgical Instrument Company, Rochester, N. Y., a patent recently granted to him on a current interrupter, which is a combination of the electrolytic and mechanical break, and is claimed to reduce the amount of current flowing to the minimum. For very heavy work, in connection with Rontgen ray coils, the current is only from ¼ of an ampere to 4 or 5 amperes, whereas it is claimed that types of interrupters, such as the Wehnelt, etc., use a current of from 5 to 18 amperes with no better results, and constantly endangering the vital parts of the coil and tubes. This type of interrupter is double in all its working parts, and is motor-driven. There is an alternate action, the positive fork wire marked (+) entering at binding posts (1) and (2) respectively, one acting while the other is cut off by the glass sliding over the wire in the liquid; then in one revolution of the shaft the other wire is exposed to the liquid.

The interrupter will work very slowly, thereby giving momentary surges of current through Röntgen-ray tubes, coming slowly to a maximum, then slowly receding to the minimum; if the current were left at the maximum it would fuse the anode, but moving slowly, the platinum anode has time to cool somewhat between the surges. For radiographic work extremely clear negatives have been made of the hand with but five of these surges; more surges, of course, would be necessary for the denser parts of the body. Slower interruptions can be obtained by detaching one of the points of the forked wire, thereby making the interrupter single-acting. However, the very rapid interruptions possible with the double action make an almost constant spark or flow of current through tubes.



CURRENT INTERRUPTER.

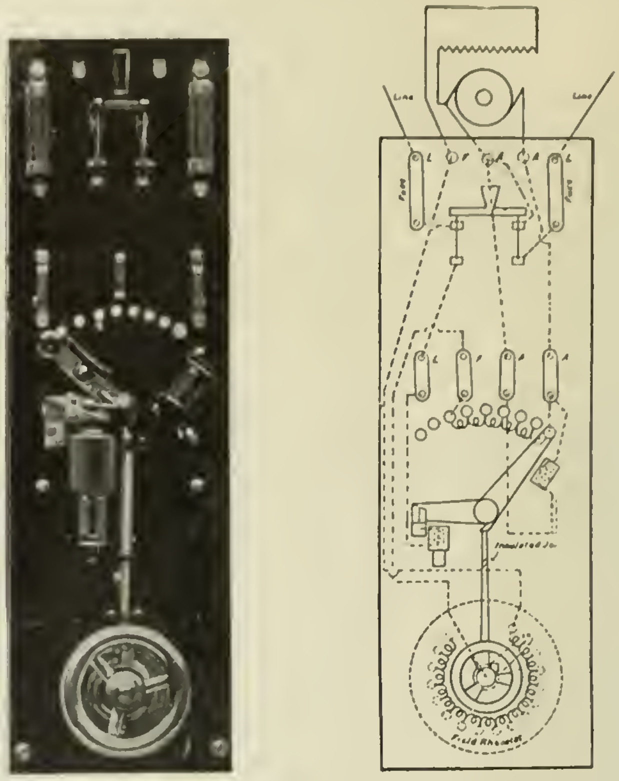
This interrupter can be used with any coils with which interrupters are now used, including tubes with thin platinum anodes designed for static machines.

It is stated that the interrupter works equally well on a ¼-in. or a 52-in. spark coil. In use with a 12-in. coil a good, heavy discharge can be obtained with from one to two amperes to the limit of the coil. It also makes a very efficient substitute for the rotary converter used in transforming direct current into a suitable current for cautery work; and it provides a convenient means of regulating current strength, thereby taking the place of a rheostat and rotary converter for this work. One of its applications owing to the small amount of current consumed from the supply source is in connection with coils for electrotherapeutic work, such as with vacuum electrodes, ozone tubes, brushes, ultra-violet apparatus, high tension coils, etc.; in fact, owing to the small amount of current and very great amount of voltage, the current is so similar to that generated by static apparatus that, it is claimed, any form of treatment possible with the static machine is possible with this interrupter in connection with any coil. Owing to the absolute mechanical make and break in connection with the electrolytic break, in coils of ¼ to 1-in. spark there is barely enough current passing to move the needle of an ordinary Weston ammeter graduated from 0 to 1 ampere. This interrupter, when used with a very slow motion, gives a great momentary surge of the induced current, then recedes to an absolute break, thus making it applicable to wireless telegraph apparatus.

Electric Motor Starters and Controlling Panels.

The accompanying illustrations show several types of panels and controlling devices recently placed upon the market by the Ward Leonard Electric Company, of Bronxville, N. Y. Some of the important features cited below and shown in the illustrations were developed to meet the demands of variable speed motor control.

Fig. 1 shows a panel built for the United States Government, having a number of important features. It is self contained and complete. The no-voltage release magnet is connected across the armature terminals and is independent of the amperes in the field circuit. This prevents the flying back of the starting arm when the field is weakened. The overload device is a positive protection against overload at all times and consists of an independent interlocking circuit-breaker. This prevents the blowing of fuses during the period of starting. Fig. 2 shows the diagram of connections of the panel.



FIGS. 1 AND 2.—CONTROLLING PANEL AND DIAGRAM OF SAME.

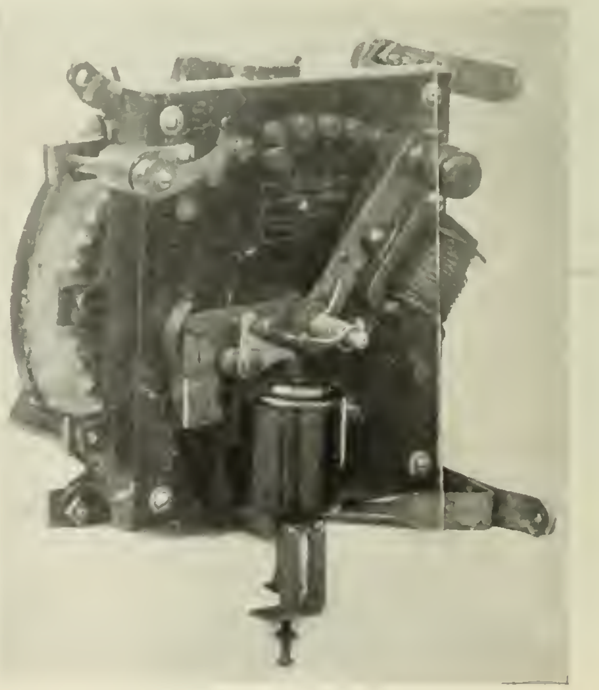


FIG. 3.—CONTROLLING OUTFIT WITHOUT SWITCH AND FUSES.

Other features are that the field rheostat is so interlocked with the starter that the motor cannot be started under conditions of weak field. This prevents the possibility of overloading the motor armature, due to starting the motor under load with a weakened field; the field rheostat has any number of steps desired from 30 to 150 or more, giving even control of the amperes in the field or the speed of the motor; the panel is water-proof, fulfilling the United States Government specifications, the most accurate and strict of those covering motor starters.

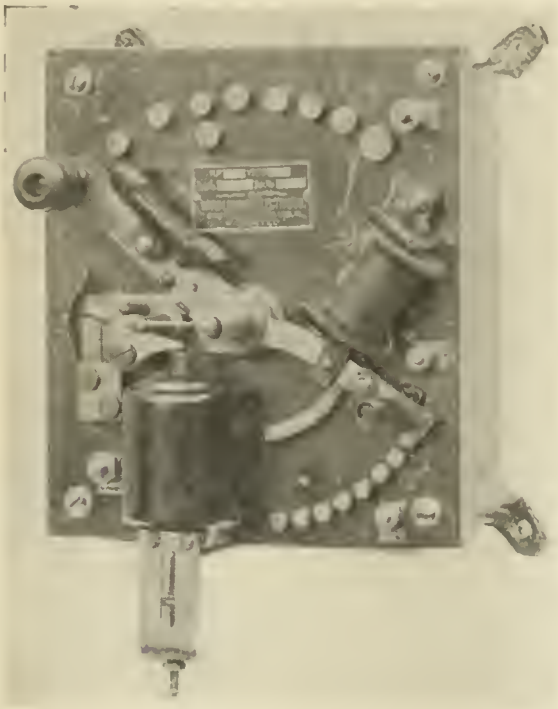


FIG. 4.—COMBINED STARTER AND FIELD REGULATOR.

Fig. 3 shows another type of controlling outfit without the switch and fuses, but having all the other advantages cited above, arranged to meet the desired requirements as to location, space, etc. Fig. 4 shows the starter and field regulator all on one box. This box has the interlocking features, but has not more than 10 points of field control.

* * *

The Evolution of the General Electric Transformer.

The General Electric Company has issued an interesting pamphlet entitled, "Fifteen Years Experience in Transformer Design," in which, after sketching the pioneer work of Faraday, Ruhmkorff and Varley and Ferranti, the story of the evolution of the present General Electric types is taken up.

The Thomson-Houston Company, predecessor of the General Electric Company, commenced the manufacture of transformers in 1888-89 with two types, both employing the shell type of core. Notwithstanding the fact that these transformers represented the highest development in transformer construction of that period, the year 1889 witnessed the introduction of a new type, which embodied improvements in insulation and a marked reduction in core losses. In 1890, with the experience gained from nearly thirty thousand transformers installed, a new design was produced. This embraced a much larger range of sizes than had hitherto been provided, and employed more modern methods of utilizing insulating material while giving again a marked reduction in the iron losses as shown on page 17. The shell type of core was still employed. Over fifty-three thousand transformers of this design were installed within the six years following, the average size increasing during that period from 1.14 kw to 3.2 kw.

The earlier transformer systems were all operated at high frequency, and with the subsequent growth of low frequency plants came a demand for suitable transformers. Many sizes of the new transformers were operated at 60 cycles, but with objectionably high core losses, and in 1894 a transformer was specially designed for 60-cycle service.

The Thomson-Houston Company, under the inspiration of Prof. Elihu Thomson, was among the first in the commercial use of oil-cooled transformers. The use of oil in transformers not only increased the value of the insulation and prolonged its life, but also provided a means whereby the heat generated within the core and windings would be conveyed to the surrounding case and readily dissipated into the air. To employ the advantages thus afforded, the Thomson-Houston Company's transformers were as early as 1889 provided with oil-tight cases. With its later types the use of oil was again strongly recommended, and as the possibility of carrying a greater load with a given heating, and the lessened risk of damage from lightning became recognized, the use of oil gradually increased, and to-day it is the standard practice in the United States.

In 1895 the engineers of the General Electric Company made a thorough investigation of the relative merits of various forms of cores and methods of winding and insulating. In this investigation the designers had before them the consideration of lessened risk from accident as well as the greatest economy of construction and the proportioning of losses to give the highest economy of operation. It was found that the long-neglected type of core first used by Ruhmkorff, combined with concentric cylindrical primary and secondary windings, gave a combination which was most excellent for transformers of small and moderate capacity. This form was particularly advantageous in that the insulation between the high and low potential windings could consist of an approximately cylindrical tube of simple construction. The result of these investigations is the present General Electric transformer type.

Mica, the best and most durable insulating material, cannot, unfortunately, be bent around sharp corners without injury, and cannot, therefore, be made to protect the sides, edges and corners of the several flat coils in a shell type transformer. In the cylindrical insulations of the core type design, however, it is employed under the best conditions. Many accidents have happened with small, shell type transformers, due to the primary current passing from the core to the secondary. Owing to the many complicated surfaces to insulate in a shell transformer, the designer is tempted to reduce the insulation below the safety point in the small sizes where the insulation at best must occupy a large percentage of the total available winding space. Since the primary coils of the core type transformer are not adjacent to the core, this danger is avoided.

Low reactance is essential to good regulation. As a result of the favorable form of winding space in the core type transformer, the required low reactance is obtained, it is claimed, without the numerous subdivisions of primary and secondary coils required in all but the smallest sizes of shell type transformers.

Comparing the core type and the shell type designs of a given size, it is stated that the former has a much lower voltage per turn of wire and a far greater number of turns in series. Consequently each layer of wire may be of considerably greater length without increasing the voltage between layers over that found in the corresponding transformer of the shell type. An additional safety factor was introduced in the new transformer by dividing the primary into four distinct coils, each occupying somewhat less than one-half the available winding length. After carefully scrutinizing all cases of transformer trouble the General Electric Company's engineers concluded that break-downs within the windings of oil-immersed transformers were generally due to moisture absorbed by the fibrous insulations before being immersed in oil. In some cases water had become mixed with the oil and was absorbed by the windings. To overcome this difficulty there was developed a system of treatment by which the coils, first dried in a vacuum, are thoroughly impregnated with a specially prepared waterproofing compound which, liquified by high temperature, is forced under heavy pressure into every interstice of the windings. This process, it is stated, was first put into permanent commercial use by the General Electric Company, and was applied to the new type in 1898.

When a transformer feeds a three-wire service, each portion of the secondary winding must be in intimate relation with the entire active primary; otherwise unbalanced voltages will be found when operating unbalanced loads. This feature was fully investigated with special reference to core type transformers, and all such transformers designed for three-wire secondary service have been provided with a "balanced" form of winding which gives perfect distribution under all conditions of load.

The universal application of series multiple, primary connection boards on all sizes of lighting transformers was introduced by the General Electric Company in 1897.

The many improvements first offered to the public in the new type of transformer were not limited to the core and windings; a new type of box was adopted from which the lead wires pass vertically downward from overhanging lead pockets. The value of this improvement is well demonstrated by the fact that this construction has become standard.

Simultaneously with the developments which led to the introduction of the latest type, the subject of transformer iron was investigated, with regard to the effects of variations in chemical analysis, treatment during manufacture, and special processes of supplementary treatment. The object sought was not only an improvement in the initial quality of the iron but particularly a freedom from that "fatigue" or ageing, the serious nature of which was even then recognized.* These investigations and the special processes developed from them have resulted in materially lower specific losses, a remarkable constancy, and a degree of uniformity in commercial production hitherto unknown. In addition to numerous factory tests, over five hundred transformers have been recalled from actual service, and the core losses before and after service compared. The average result shows a negligibly small percentage of "aging" or increase in core loss while in service.

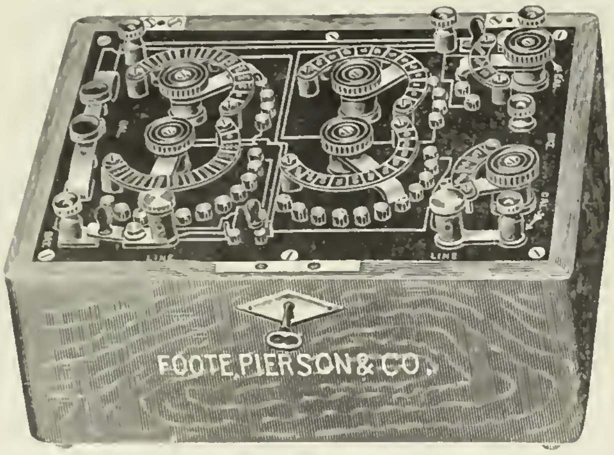
Type	600 Watt	2500 Watt	7500 Watt	30 Kw.
B (1889)	140 Watts	290 Watts		
E (1889)	117 Watts	173 Watts		
F (1890)	47 Watts	104 Watts	250 Watts	
G (1894)	38 Watts	76 Watts	156 Watts	
H (1896)	25 Watts	48 Watts	116 Watts	370 Watts
H (1903)	23 Watts	45 Watts	96 Watts	230 Watts

The above table shows the improvement in the core losses of transformers. All the figures are based for comparison on 60-cycle measurements.

New Switch Pattern Set.

The new pattern switch set lately designed by Foote, Pierson & Co., 82-84 Fulton Street, New York City, has four groups of coils consisting of 10 units, 10 tens, 10 hundreds and 10 thousands, and with bridge arms of 10, 100 and 1,000 ohms each.

The resistance is varied by means of special phosphor bronze switches moving over platinum-faced contact studs. The switches consist of several leaves of metal so arranged that each leaf comes in contact successively and with sufficient pressure to insure absolute contact. The platinum studs present at all times a bright surface, which does away with the necessity of cleaning. The resistances are arranged on the decade plan, and the numbers on the plates, as shown in the illustration, give the reading direct of the number of coils in circuit. These plates are finished with a black metallic surface and filled in with white letters.



SWITCH SET.

Keys for galvanometer and battery are arranged in circuit, and have an adjustable pressure screw which allows for the adjustment of the tension of the springs, also forming a guide for the keys, which keeps them from sliding off the platinum-faced studs. Each key has in circuit a small single point switch which throws in or out either of the keys.

A special switch and binding post are arranged with ground connection, so that either the Murray or Varley loop tests can be made. Binding posts for galvanometer, battery and line are placed in the most convenient places for use. The brass work, switches, etc., are mounted on highly polished hard rubber plate, and the different circuits are outlined in white on the plate, giving the operator the advantage of easily tracing out the different connections.

The set is contained in a highly polished mahogany box, and throughout shows excellent material and workmanship.

New Submarine Cable Plant.

The John A. Roebling's Sons Company has just completed a new building which will enable it to increase largely its product of insulated wires and cables of all kinds, and will provide room for introducing on an adequate scale the manufacture of submarine cables. It has made submarine cables for many years, but this part of its business seems to demand greater facilities, and to provide for this one of the largest and most complete plants in this country will be installed. The new buildings are located so that shipments may be made by either water or rail, and they will soon be in a position to solicit the largest contracts in this line.

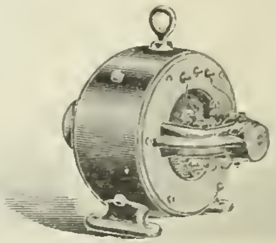
Both rubber and gutta percha core is used and the company's present large rubber plant will take care of those orders calling for rubber-insulated cables. Formerly it has imported gutta percha core, but it is its intention in the new plant to provide a complete factory for manufacturing this core under the direction of a most competent and experienced manager, who has had a long and successful experience abroad in this kind of work. It is its intention to so equip the new factory that submarine cables of any kind of core, with any description of armor, may not only be made, and to provide the necessary apparatus and equipment to lay any of the cables it manufactures.

The Roebling Company will be in a distinct position not only in the variety of insulations it can furnish, but also from the fact that it will be prepared to take contracts to turn over to the purchaser, the submarine cable laid and ready for use. It will also have the advantage of manufacturing all the constituent parts of a cable, viz.: copper wire, insulated core and armor wire. This should not only reduce the cost, but it should insure to the purchaser the very best materials, all manufactured under one supervision, and for which one company will be responsible.

The Roebling Company has always undertaken contracts boldly and successfully, and there is no reasonable doubt that its new factory will soon be engaged on heavy government contracts for this class of materials.

Small Multipolar Motors.

Among its latest types of motors brought out by the Fidelity Electric Company, of Lancaster, Pa., is that shown in the cut, built from ⅙ to 10 hp, which recommends itself on account of its adaptability for back gearing, or for inverting for ceiling suspension. The motors are all multipolar and of moderate speed. The body castings are of cast steel, of the highest permeability, the body being cast in one piece. The field coils are form wound, dipped in a special insulating compound and wrapped with varnished linen, before being taped. The armature is barrel wound, and of the ventilated type, air ducts being provided from the interior of the core to the exterior. The commutators are constructed of drop forged bars, and the washers and core of carbon steel to withstand the strain of drawing up in course of construction. The brush holders are so constructed that the amount of tension of the spring can be either increased or reduced by moving the end of the spring in the notches provided on the back of the holder. The sliding bases in the larger sizes are parallel machined sliding bars, and in the smaller, the now almost universally used platform base.



MOTOR.

The Fidelity Electric Company, Incorporated, of Lancaster, Pa., was formerly the Geo. C. Towle Manufacturing Company, which has lately been reorganized with $50,000 capital. They began as manufacturers, in 1896, of fan motors exclusively, then added a line of small power motors and generators, which they have gradually increased in capacity. They have lately added a special type of horizontal boring mill, weighing about three tons, which reduces the amount of machine work several hours on each machine, allowing the motor bodies to be faced and bored in one operation. The total floor space of their buildings is 12,000 square feet. The officers of the new company are: C. F. Stauffer, president; B. G. Stauffer, treasurer and general manager; M. S. Graver, secretary.

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* See General Electric Company's publications, "Aging of Transformer Iron," and "Sheet Steel for Transformers."

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The prices of stocks reacted after an advance led by the Steel and traction group. There was a tendency on the part of bearish interests to circulate unfavorable rumors about various properties, particularly United States Steel and Brooklyn Rapid Transit, which latter, together with the other tractions, were features, despite their later tendency to sell off. Standard railroad stocks were held fairly well, and were less active. On Thursday Brooklyn Rapid Transit advanced to 53⅝, and other members of the traction group made corresponding gains. At the close Brooklyn Rapid Transit had receded to 48⅛, the total number of shares sold being 497,700. The lowest point reached was 46¾. Metropolitan Street Railway, on sales of 36,600, made a net gain of 1¼ points, closing at 121¼, the highest and lowest quotations being 124¾ and 120¼, respectively. General Electric made a gain of 5 points, closing at 165, after having touched 160¼. The sales of this stock aggregated 5,600 shares. Westinghouse common fluctuated between 149 and 160, closing at 152, this being a net gain of 3¼ points, 15,700 shares having been sold in the course of the week. Western Union closed at 87—a net loss of ⅜ point; American Telegraph and Cable closed at 81, this being a gain of 3½ points. Following are the closing quotations of December 15:

NEW YORK

	Dec. 8	Dec. 15		Dec. 8	Dec 1
American Tel. & Cable......	78	80	General Electric.	163½	164
American Tel. & Tel........	127	125	Hudson River Tel...........	..	.
American Dist. Tel	24	23	Metropolitan St. Ry.........	120½	121¼
Brooklyn Rapid Transit ..	46⅞	49⅝	N. E. Elec. Veh. Trns....... .	..	..
Commercial Cable.	152	..	N. Y. & N. J. Tel...	..	..
Electric Boat	20	*23	Marconi Tel	.	..
Electric Boat pfd..	49½	48	Western Union Tel...... ...	87½	..
Electric Lead Reduction.. .	⅝	⅝	Westinghouse com....	156½	155½
Electric Vehicle	5¾	5¾	Westinghouse pfd..........	185	185
Electric Vehicle pfd.	8	8			

BOSTON.

	Dec. 8	Dec. 15		Dec. 8	Dec. 15
American Tel. & Tel	127	125¾	Western Tel. & Tel. pfd....	*82	79½
Cumberland Telephone....	*115	*115	Mexican Telephone	1¼	1⅛
Edison Elec. Illum..........	24	231	New England Telephone. .	120	122
General Electric............	* 6	163	Mass. Elec. Ry..	20	18½
Western Tel. & Tel	7⅛	7½	Mass. Elec Ry. pfd.... . .	75	76

PHILADELPHIA.

	Dec. 8	Dec. 15		Dec. 8	Dec. 1
American Railways.........	42	42½	Phila. Traction..	95⅛	..
Elec. Storage Battery	53	53	Phila. Electric	6⅛	6⅛
Elec. Storage Battery pfd.	53	53	Phila. Rapid Trans.........	11	10½
Elec. Co. of America.	8	8			

CHICAGO.

	Dec. 8	Dec. 15		Dec. 8	Dec. 15
Central Union Tel.	..	..	National Carbon pfd........	86	90
Chicago Edison..........	141½	·	Metropolitan Elev. com.....	17	16
Chicago City Ry....	160	159¾	Union Traction	5½	6
Chicago Tel. Co	..		Union Traction pfd...	28	25
National Carbon	25	20			

*Asked

"SOO" SALE.—All the assets of the Consolidated Lake Superior Company, capitalized at $122,000,000, and owned largely in Philadelphia and Canada, were sold by auction this week by Adrian H. Muller & Son, auctioneers, to Speyer & Co., who were represented by E. C. Henderson, for $4,500,000. Notice was served on the auctioneer by Receiver J. G. Carruth of an action which has been begun in the Supreme Court of New York to set aside the agreement between the officers of the company and Speyer & Co., which, if successful, would render the sale nugatory and void. A protest was read from Francis C. Davison, who says he owns 100 common and 50 shares of the preferred stock of the company. He claimed the sale would not be legal because the agreement between Speyer & Co. and the officers of the company was made without the authority of the stockholders. Notices of liens on various properties were filed by the Stanley Electric Manufacturing Company, Frawley Bros., Colgan & Whelan and others.

BELL TELEPHONE DIVIDENDS.—Advices from Boston say: "There is no question but that there has been selling of American Telephone stock by prominent trustee interests who fear that the 'extra' dividends are not of long duration. The selling movement in American Telephone became more pronounced when the Bell Telephone Company, of Philadelphia, in which the American Company owns 80 per cent. of the $12,000,000 stock, reduced its dividend from 8 to 6 per cent., for this action was considered by the street an advance notice of a coming change in American Telephone & Telegraph Company's dividend policy. It can be officially stated, however, that earnings of the American Telephone & Telegraph Company are considerably in excess of last year, the business never in a more prosperous condition, and that fears of reduced dividends on American Telephone stock have no present basis in fact. No change is in sight for the next four dividends at least."

DIVIDENDS.—The directors of United Traction & Electric Company, of New Jersey, have declared the regular quarterly dividend of 1¼ per cent. on the capital stock, payable January 2. The directors of General Electric have declared the regular quarterly dividend of $2 on the common stock. The United Gas Improvement Company's directors have declared the regular quarterly dividend of 2 per cent. ($1) on the capital stock, payable January 15. A dividend of 1¼ per cent. has been declared on Rochester Railway preferred, payable January 2. The directors of the Otis Elevator Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable January 15. The Bell Telephone Company, of Philadelphia, directors have declared the usual quarterly dividend of 1½ per cent., payable January 25.

DENIAL OF DEAL.—Referring to an article in a daily paper about the merger of the General Electric Company and the Westinghouse Electric & Manufacturing Company, Mr. George Westinghouse authorizes the following statement: "There is no foundation whatever for the suggestion that the control of the Westinghouse & Manufacturing has passed into unfriendly hands. On the contrary, my friends, who are in accord with me, and I own a good deal more than a majority of the shares of the Westinghouse Electric & Manufacturing Company, and I may add that there is no record of any indications of dissension on the part of any shareholder."

WESTERN UNION EARNINGS.—The Western Union Telegraph Company issues its statement, partly estimated, for the last three and six months of the year, showing for the half year net revenues of $4,497,196, as compared with $4,364,504 last year. The actual returns for the September 30, 1903, quarter were: Net revenue, $2,347,196; bonds, interest, $286,300; balance, $2,060,896; dividends, $1,217,017; surplus, $843,879; previous surplus, $13,019,724; total surplus, $13,863,603. The regular quarterly dividend of 1¼ per cent. is payable January 15.

BOSTON ELEVATED ANNUAL.—The annual financial statement of the Boston Elevated Railway Company shows an increase in every item, with the single exception of a decrease of $1,100 in rental paid for the use of the subway. Net earnings were $3,699,654, being $241,195 greater than last year. The aggregate number of round trips was 5,029,453, and 233,563,578 passengers paid fares, an increase of 11,078,767 passengers over the previous year. The general balance sheet showed total assets of $20,358,058, and a surplus of $2,327,687.

TELEPHONE COMPANIES DISSOLVED.—The Bell Telephone Company, the New England Telephone Company and the National Bell Telephone Company, on their own petition, were dissolved as Massachusetts corporations, in Boston, on December 8, by Judge Hammond, of the Supreme Court. The ground of the petition was that they are not now engaged in business, having been superseded by a corporation or corporations organized under the laws of another State.

PHILADELPHIA ELECTRIC COMPANY.—The Philadelphia Electric Company, which was chartered a year ago in Pennsylvania, has filed notice of an increase of capital stock from $100,000 to $2,500,000. The company will be controlled by the Philadelphia Electric Company, a New Jersey corporation, which controls the electric lighting in Philadelphia. The new company will operate all the subsidiary plants of the old company, and its entire stock issue will be owned by the New Jersey corporation.

BOSTON EDISON STOCK.—At a directors' meeting of the Eastern Illuminating Company, of Boston, the directors recommended stockholders to authorize an issue of 95,000 shares of new stock to be subscribed for early next year. This new stock is to partly capitalize recent purchases of suburban properties.

PEEKSKILL (N. Y.) EARNINGS.—The earnings of the Peekskill Lighting & Railroad Company for the September quarter show gross $19,789 and net $9,950, an increase of $1,011 over 1902. The surplus is $8,412, an increase of $1,868 over 1902.

ELECTRIC LIGHT MERGER.—An agreement merging the Plainfield Gas & Electric Company and the Somerset Lighting Company has been filed at Trenton, N. J.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade conditions in general are favorable, and a satisfactory and seasonable business is the rule. This applies particularly to retail trade. In the wholesale lines the usual season's quiet is noted, and there is some slackening in industry. A favorable condition is the easing of money, which is returning from the country more freely, although there is yet room for improvement in collections. Railway earnings are very satisfactory, and will show a gain of fully 5 per cent over last November. The November export trade will, it is said, come close to the best previous records. Seasonable conditions, stock taking or readjustments to lessened demand are all assignable reasons for the quieting down of outdoor activity, such as building, or for reduced running time or suspensions in a variety of industries employing large numbers of hands. The reduction in cotton mill wages now easily affects 80,000 operatives, and future wage scales are the subject of much thought in the iron and steel industry. Cotton has weakened and wheat is on the decline. In the iron trade it is believed that the lowest point has been reached, and there is a more hopeful feeling, while statistics are bearish the curtailment of production has cut the output one-third from the top. There was no marked demand for finished products. Copper showed some improvement, a large export business having been done. Home consumers are also entering the market. Prices have advanced to 12 to 12¼c. for Lake, 11¾ to 12c. for electrolytic, 11½ to 11¾c. for cathodes and casting stock. *Bradstreet's* reports 241 business failures during the week ending December 10, against 239 the previous week, and 247 the corresponding week last year. The liabilities of commercial failures thus far reported for December amount to $5,342,094, of which $2,725,036 were in manufacturing, $1,970,883 in trading, and $646,175 in other commercial lines.

MOTORS FOR SILK MILLS.—The Northern Engineering Company, 95 Liberty Street, New York, has recently secured a contract for a number of motors to be installed in the silk mills of Stehli Brothers. The High Point (N. C.) mills, operated by that concern, will be equipped with eleven motors of various sizes. Nine special machines of ½-hp capacity each will be built by the Northern people themselves, while one motor of 15 hp and one of 3-hp capacity will be furnished by the Commercial Electric Company, of Indianapolis, Ind. This equipment will be utilized in the silk throwing plant. The Stehli mills at Lancaster, Pa., are to have seven 10-hp Commercial motors and two of 15-hp capacity and of same manufacture. The Northern Engineering Company has has taken orders for two 10-hp Commercial motors for installation in the Auger & Simon Silk Dyeing Company's plant at Paterson, N. J. The Carteret (N. J.) plant of Bery Moore, manufacturer of paints, is to be equipped with one 30-kw Commercial generator with switchboard. This outfit is intended for lighting. Large wiring contracts have also been taken lately, especially in Paterson, N. J., where the company reports it has some $40,000 worth of work on hand. Among the wiring contracts is one for the Colt Building and the Danforth Free Public Library. In New York substantial wiring orders have also been received, one of the principal coming from the Knickerbocker Chocolate Company, 1,133 Broadway.

NOVEMBER FOREIGN TRADE.—The Bureau of Statistics report of the country's foreign commerce in November shows the largest monthly exports on record, with the exception of October, 1900, when they amounted to $163,389,680. Last November they were $160,455,590. The excess of exports is also the second largest in the country's history, the excess in October, 1900, being $92,758,646, while last month's was $83,393,784. The nearest approach to last month's excess (with the exception of October, 1900) was in December, 1898, when exports exceeded imports to the amount of $82,711,455. Comparing with October, November's exports do not show any very substantial increase, but imports fell off about $4,870,000, to which is due the larger excess that November shows. Over last year, however, November's exports show a very substantial increase, while imports corespondingly fell off, causing an advance in the excess of $43,580,000. The increase in exports was entirely due to agricultural shipments, which advanced $34,800,000, which, in turn, was caused by a very heavy increase in cotton exports. Non-agricultural shipments were only $450,000 above last year. Be this as it may, it is an excellent showing of the country's ability to maintain a large credit balance.

DETAILS OF ELECTRICAL EXPORT.—The details of electrical export show $413,458 of electrical machinery sent abroad during October, and $430,821 of electrical appliances and instruments, including telegraphs and telephones. The figures respectively for last year, on instruments, are $373,174, and on machinery, $677,623. The total of electrical machinery exported in the ten months was $4,288,551, as compared with $5,076,774 in 1902, and $4,916,656 in 1901. Electrical instruments for the ten months were $4,001,863, as compared with $3,447,280 in 1902 and $1,322,034 in 1901. The total in the two groups for the ten months this year is $8,290,414, as compared with $8,524,054 in 1902. In view of lower prices, these figures show how remarkably well electrical export trade has held up this year; and it will be seen that it is running along at the handsome rate of about $10,000,000 per annum.

BIDS IN NEW ZEALAND.—The Tramway Board, Christchurch, New Zealand, invite for tenders for the complete installation of an electric tramway system in that city. Tenders are returnable March 17, 1904. Specifications and schedules may be obtained on payment of a fee of £3 for section, or £25 for the complete set, from the office of the agent general for New Zealand, in London. The sections are as follows: A. Power house equipment, steam plant. B. Power house equipment, electrical plant. C. Steel stack. D. Traveling crane. E. Cooling tower. F. Car bodies. G. Car trucks. H. Car motors. I. Compressed air brakes. J. Equipment of cars and sundry supplies. K. Repair shop tools. L. (1) Rails, fish plates, fish-bolts and special work. L. (2) Permanent way. M. Overhead construction. N. Emergency wagon. O. Destination boxes, tablets and staff boxes. P. Life guards.

STARK SYSTEM IN CANADA.—The Stark Electrical System, Limited, of Toronto, Canada, notifies us as follows: "A new company, the Stark T., L. & P. System, Limited (Telephone, Light & Power), capital, $1,000,000, has been formed in Toronto, Canada, to take over the Humber Light & Power Company, Limited, at Toronto Junction. The new company will operate the Stark patents, whereby telephone, telegraph, light and power service is furnished from the one plant and over the same circuit. They will greatly increase the Humber Light & Power Company's plant and will immediately commence installing a telephone service in Toronto Junction, for which town they have received a franchise. The officers of the Stark system are H. Waddington, president; A. M. Stark, vice-president and manager, and W. N. Dollar, secretary.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, of Chicago, reports an unprecedented number of switchboard shipments for the first two weeks of December. The shipments reached over 2,000 lines capacity, and consisted mostly of the well-known "express" switchboard equipments. A partial list of the shipments is given below: Stanberry, Mo., two 220-line express switchboards; Gravette, Ark., one 100-line express switchboard; Russellville, Ark., one 200-line express switchboard; Buitman, Mo., one 100-line express switchboard; Sabetha, Kans., one 100-line express switchboard; Nicholsville, Ky., one 300-line express switchboard; Rushville, Mo., one 100-line express switchboard; Clark, S. Dak., one 100-line express switchboard.

100-TON CRANE.—The extensive new railroad shops of the Southern Pacific Railroad Company, at East Los Angeles, Cal., have been equipped with a 100-ton overhead traveling crane manufactured by the Niles-Bement-Pond Company and equipped with Westinghouse alternating-current motors. The severe tests to which the crane was recently subjected have proved satisfactory to the Southern Pacific officials. A 95-ton locomotive was lifted by the hoisting motors, which are arranged in two 50-hp units and additional weights were piled on until the chains were broken by the strain from the motors. There are a third 50-hp induction motor and several smaller induction motors on the crane operating auxiliary hoists, etc.

FERRACUTE MACHINE WORKS.—The Ferracute Machine Company, Bridgeton, N. J., through President Oberlin Smith, says with regard to its new plant: "We have built a temporary 50 by 100-ft. building over part of the ruins of our former works and are running several new machines together with some of the old ones that have been repaired. We have also rented a small machine shop near by and have built a temporary blacksmith shop. With this extemporized plant we are running about half of our usual force, but hope to get into a new fire-proof building after a few months."

RUBBER-COVERED WIRE.—Reports of all kinds are current in electrical circles as to the proposed pool in rubber-covered wire, exclusive of armored and lead-covered. A number of the large insulated-wire manufacturers are interested, it is said, in this movement, which has been on foot since October; but it cannot be learned that the matter has been brought to a finish yet. The idea is to check unhealthy competition and ruinous price-cutting.

BIG OMAHA CONTRACT.—A large contract has been let to the John F. Kelly Engineering Company, Singer Building, New York City, for a plant of 15,000 hp for the Tremont Canal & Power Company, of Nebraska, with a capital of $4,000,000, in which several influential Westerners are interested, for power transmission purposes to Omaha and other cities.

BIDS FOR WATER WHEELS.—The Great Northern Power Company, Duluth, Minn., will receive bids for three water wheels for its power plant, the wheels to drive an equal number of generators. Wheels of the vertical type will be used. Bids for electrical machinery will be invited later.

General News.

THE TELEPHONE.

GLOBE, ARIZ.—Arrangements have been made by the Gila Valley & Globe Telephone Company to extend its line from Globe to Livingstone and there to connect with the United States government telephone line which the engineers of the geological survey will build to Phoenix.

RUSSELLVILLE, ARK.—The Russellville Telephone Company, with a capital stock of $10,000, has been incorporated by R. M. Drummond, Wm. Rowan, A. Bernard and R. C. Brown.

MALVERN, ARK.—The Malvern City Telephone Company, with a capital stock of $8000, has been chartered. The incorporators are W. H. Cooper, H. A. Butler, Louis Myers, T. P. Frisby, A. M. Duffle, M. M. Duffle, D. C. Butler and J. M. Williams.

SAN DIEGO, CAL.—The Sunset Telephone & Telegraph Company has decided to extend its line from this city across the desert to the Imperial country, near the mouth of the Colorado River. This is part of a plan to extend to Tucson and Phoenix, Ariz. Twenty miles of the line, between San Diego and Ramona will be constructed at once.

ROBERTS, ILL.—The Lyman Telephone Company, of Roberts, has been incorporated with a capital stock of $5000, by Chris. Anderson, F. S. Diller and G. W. Madden.

SAYBROOK, ILL.—The Arrowsmith Telephone Company has been incorporated; capital, $1200. The incorporators are Charles W. Hurst, James A. Taylor, Walter Johnston.

YORKTOWN, ILL.—The Hoopole, Yorktown, Tampico & Thomas Telephone Company has been incorporated; capital, $4900. Incorporators: F. E. Toy, William Thomas, Thomas Burton.

LOVINGTON, ILL.—A 150-drop Stromberg-Carlson board is operated by the Gregory Telephone Company. Mr. C. A. Gregory reports 120 subscribers and 50 miles of toll line, the subscribers paying from $15 to $24 per annum.

FRANKLIN, IND.—The Franklin Telephone Company is considering a proposition to issue bonds for improvements to the plant.

ANDERSON, IND.—The Central Union Telephone Company has leased fifteen rooms on the fifth floor of the Union block in Anderson and an entire new outfit will be installed.

COLUMBIA CITY, IND.—Five hundred farmers in Whitley County have secured a franchise for an independent telephone company in this city and county. This action is a result of a disagreement with the Home Telephone Company as to rates. The capital stock is $25,000. The officers are: President, R. R. Scott; vice-president, C. R. Stoner; secretary and superintendent of construction, John C. Pence; treasurer, C. R. Banks.

SOUTH BEND, IND.—The Home Telephone Company of this city has opened a branch exchange in North Liberty with nearly 50 telephones. The company is constructing new rural lines in German township and has already connected 40 farmers with the South Bend exchange. Early in the Spring a metallic toll line will be constructed between Bremen and Plymouth. The company is increasing its patrons at the rate of 50 per month.

PRINCETON, IND.—The directors of the Princeton Independent Telephone Company have elected officers as follows: President, R. H. Parratt; secretary, C. F. Stevens; treasurer, J. W. Ewing. The company now has connections with 2300 telephones in Gibson County, of which 550 are in Princeton, the other main exchanges being at Owensville with 420 subscribers; Fort Branch and Hambstadt 400 each, and Frisco with 320. New exchanges are being installed at Patoka and Hazleton.

BLOOMFIELD, IA.—The Citizens' Mutual Telephone Company has been incorporated here.

PALMER, IA.—Rural telephone lines are projected to Pomeroy, Pocahontas and to the Lizard settlement. Mr. P. E. Tall is interested.

DES MOINES, IA.—The American Telegraph & Telephone Company, which was recently incorporated in Waterloo for $1,000,000, is now constructing a line between Waterloo and this city.

HOPKINSVILLE, KY.—The Hopkinsville Home Telephone Company, of Christian County, has been incorporated with a capital stock of $100,000.

JACKSON, MICH.—The Oceana Telephone Company has increased its capital stock to $200,000.

CANANDAIGUA, MICH.—The Northwestern Telephone Company has been incorporated with a capital stock of $1400.

LAKE CITY, MICH.—The Swaverly Telephone Company, of Kalkaska, has sold its system in Missaukee County. A new company will be organized to operate the plant. Many improvements are contemplated.

ANN ARBOR, MICH.—The Washtenaw Home Telephone Company has filed a trust mortgage with the Luzerne County Trust Company of Wilkesbarre, Pa., to secure an issue of $250,000 in bonds. The company is planning to build an exchange and expects to start with about 1200 subscribers.

FARIBAULT, MINN.—The City Council has granted a franchise to the Tri-state Telephone Company giving the latter the right to carry its lines through this city.

ALBANY, MO.—The Albany Telephone Company is a mutual enterprise. The rates for business houses is $1.50 per month, and for private residences $1. The company employs apparatus of American make, the switchboard having 400 drops, 300 of which are wired. Mr. J. B. Foster is secretary.

KANSAS CITY, MO.—The work of reconstructing the system of the Missouri & Kansas Telephone Company has been completed. Within the past eighteen months this work has required an expenditure of $750,000. The recent fire in the exchange in this city cost the company nearly $250,000. The reconstructed system is modern throughout.

BUFFALO, N. Y.—The Commercial Telephone Company has been incorporated with a capital stock of $50,000 to do business in Erie and Cattaraugus Counties.

STEELE, N. D.—Mrs. E. Allshouse has been granted a franchise for a local telephone exchange.

PORT JEFFERSON, N. Y.—The North Shore Telephone Company has been incorporated with a capital stock of $7500. The incorporators are A. B. Copley, Ralph J. Hawkins, F. H. Tuthill and Charles A. Squires.

ADA, OHIO.—The Ada Telephone Exchange Company has purchased the Dunkirk exchange. It operates an "American" 100-drop switchboard.

BRILLIANT, OHIO.—The Ohio Valley Telephone & Telegraph Company has been incorporated with a capital stock of $20,000. Directors: J. G. Gilchrist and others.

CANTON, OHIO.—The Stark County Telephone Company is installing additional switchboard and cables which will increase the capacity to 4000 lines. The company started business in March, 1902, with 1900 subscribers and now has nearly 3000.

NORTH LIMA, OHIO.—The Beaver Telephone Company is preparing to extend its system throughout Springfield township. The company has about 200 subscribers in North Lima and has connection with the lines of both the Youngstown Telephone Company and the Columbiana County Telephone Company.

CLEVELAND, OHIO.—The United States Telephone Company is planning to spend half a million dollars on improvements during the coming year. The company expects to carry its trunk lines into new territory and a great many additional wires will be strung on the trunk lines already in operation. The company now has about 18,000 miles of wire, nearly all in Ohio, and it is expected that about 8000 additional miles will be put up. Wires now running from Cleveland to Akron, Toledo, Columbus and Youngstown are leased to parties for telegraph service as well as for telephone service and the company aims to extend this double service throughout its entire territory.

WHITE LAKE, S. D.—The citizens of this place are arranging to establish a telephone system.

HURON, S. D.—The Dakota Central Telephone Company announces that it has perfected arrangements for the expenditure of $150,000 for the extensions in the southern and central portions of the state.

STANTONVILLE, TENN.—The Stantonville Telephone Company has increased its capital stock from $3000 to $10,000.

NASHVILLE, TENN.—The Roaring Fork Telephone Company has been incorporated with a capital stock of $250. Directors: J. K. Hardin, J. N. Holbrook and others.

COLUMBIA, TENN.—The Citizens' Telephone Company is run on the cooperative plan. The company operates a 400-drop board at Columbia and a 100-drop board at Mt. Pleasant, having a total of 530 subscribers. The charges are $1.95 for business service and $1 per month for residences. Mr. C. J. Porter is general superintendent.

HALLETTSVILLE, TEX.—A new telephone line is being constructed from this place to the towns of Ezzell and Creole.

SHERMAN, TEX.—The Long Distance Telephone Company has completed connection between Sherman and Oklahoma City.

EL PASO, TEX.—The Southwestern Telegraph & Telephone Company has announced through General Manager J. E. Farnsworth, of Dallas, that it contemplates expending about $100,000 in improvements of its El Paso system. It will erect an exchange building, place its wires underground, install a flash light switchboard, etc.

SMITHVILLE, TEX.—The Smithville Telephone Company has been organized here with a capital stock of $10,000. The officers are: President, H. C. Schumacher; vice-president, V. S. Robb; secretary and treasurer, J. M. Moore. The new company has acquired the telephone system which was owned by A. L. Hills & Son, and will make extensive improvements.

SAN ANTONIO, TEX.—At the annual meeting of the board of directors of the San Antonio Telephone Company, the following-named officers were elected: President, H. M. Daugherty, Columbus, Ohio; vice-president, H. M. Aubrey, San Antonio; secretary and general manager, D. A. Walker, Columbus, Ohio; superintendent, A. L. Beze, San Antonio; treasurer, Ferdinand Herff, Jr., San Antonio. It is stated that considerable rebuilding work and extensions will be made during the coming year.

SALT LAKE CITY, UTAH.—Manager D. S. Murray, of the Rocky Mountain Bell Telephone system, states that the company proposes to spend a large amount of money during the coming year in extensions and the general improvement of the system. The amount expended during the present year in improvements was $355,000.

MIDDLEBURY, VT.—The Rutland County Telephone & Telegraph Company has connections with Wallingford, Plymouth, Middletown Springs, West Pawlet and Danby, and has 118 subscribers. The company has 67 miles of toll line, its charges being $12 a year.

LONG GLADE, VA.—The owner of the exchange at this place, Mr. J. T. Ewing, informs us that it has 64 subscribers, and that a great many small exchanges will be put up in the future.

WHEELING, W. VA.—The Belmont Telephone Company has decided to make extensive improvements to its service in this vicinity.

BUCKHANNON, W. VA.—An injunction has been granted the Buckhannon Telephone Company to restrain the Buckhannon Light & Water Company from building its lines closer than 10 feet to the telephone company's wires.

HINTON, W. VA.—A line to connect Hinton and Beckley, about 26 miles, is under consideration by the West Virginia Telegraph & Telephone Company. At Hinton there are 289 subscribers. The company owns 210 miles of toll line which was practically all built in the last four years.

FAIRMONT, W. VA.—The system of the Consolidated Telephone Company embraces 13 exchanges and numbers 2200 subscribers. At Fairmont, with 500 patrons, a Kellogg board of 700 drops has been installed. A line from Fairmont to Waynesburg is under consideration. The rates are $30 and $20.

HILO, EAST HAWAII, H. I.—The Hilo & Hawaii Telephone & Telegraph Company has 347 subscribers. There are four telephone companies on the island, each in its own separate district; no conflicting of interests. The island is completely covered with the service. The rate in the Hilo district is $4 a month; in the others $6. Subscribers in any district have unlimited switching and use of telephones in any other district. The Hilo Company uses metallic circuits; the other companies grounded circuits. All of the islands are connected by wireless system of telegraphy. Mr. E. E. Richards is manager of the Hilo & Hawaii Company.

OTTAWA, ONT.—The civic telephone committee of the city of Ottawa has recommended the granting of a franchise to the new Canadian Telephone Company. The main terms of the proposed agreement are that the company shall have a franchise for 21 years; that it shall pay $2500 annually to the corporation; that the rates shall not exceed $36 for office telephones and $32 for telephones in private houses. A deposit of $5,000 is to be made by the company as a guarantee for the satisfactory carrying out of the agreement, and 40 telephones are to be given free to the city. The franchise will not be an exclusive one. Mr. F. Leonard, of New York, represented the company before the committee.

ELECTRIC LIGHT AND POWER.

BENTON, ARK.—The Electric Power & Ice Company, of Benton, has been incorporated with a capital of $5000. E. Y. Stinson, president; W. C. Caldwell, secretary.

SACRAMENTO, CAL.—The Sacramento Electric, Gas & Railway Company is stated to have secured the contract for lighting the city at $7.25 per lamp per month.

DURANGO, COL.—The Ute Land, Light, Power & Water Company has been incorporated with a capital of $100,000 by T. C. Graden, R. E. Sloan, A. L. Pace, Thos. A. Rucker and others, of Durango, as directors.

ATLANTA, GA.—It is reported that $600,000 will be expended within the next few months by H. M. Atkinson and those interested with him in improvements to the Georgia Railway & Electric Company, the Atlanta Gas Light Company and other enterprises with which these men are connected.

TALLULA, ILL.—S. J. Culbertson, of Vandalia, Mo., is interested in the construction of an electric light plant.

VENICE, ILL.—This city will be equipped with a new electric light service by the Granite City & Venice Light Company by January 1. Lights will be kept burning all night.

JOLIET, ILL.—By winning a condemnation suit, the sanitary district trustees have procured all the land needed for building the water power extension of the sanitary canal.

FAIRMOUNT, IND.—C. T. Parker, W. H. Lindsay and others are interested in the construction of an electric light plant, to cost about $150,000.

ANDERSON, IND.—The city electric light board announces that it will start the new municipal electric lighting plant Dec. 20. It has been remodelled at a cost of $80,000, and includes many improvements, among which is a steam turbine to drive the generators.

PLAINFIELD, IND.—The Public Service Company has been organized and incorporated for the purpose of building and operating an electric light plant and a water works system in this city. The company has a capital stock of $50,000. Wm. B. Vestal and Sanders Hubbard are officials.

SHOALS, IND.—A business meeting of the directors of the Indiana Hydraulic Company was held last week and plans and specifications for two dams and as many power-houses were passed on by the directors. The plan of the managers is to erect two dams in White River near this city and supply electric power for interurban railroads and for small surrounding towns from the power-houses they will erect. The directors of the company are Jerome Herff, Peru, president and manager; Joseph Andrews, J. M. Bergman, William Hart and W. A. Gallup, of Vincennes.

SALINA, KAN.—W. D. Whited, of Denver, Colo., has purchased the plant of the Salina Light, Heat and Power Company and will rebuild the entire plant. He will also construct a railway in Salina.

COVINGTON, KY.—The Suburban Electric Light Company has brought suit to prevent the city from building or operating an electric light plant of its own. The citizens have voted to issue $75,000 in bonds for the purpose of building a municipal plant.

DERIDER, LA.—The Derider Ice, Light & Water Company has been organized here with a capital stock of $50,000 for the purpose of installing an electric light, water works and ice manufacturing plant. W. O. Brice is president of the company.

ALPENA, MICH.—The Alpena Gas Light & Heat Company has been incorporated with a capital of $100,000.

ST. IGNACE, MICH.—Geo. D. Westover, of Cadillac, has submitted a proposition to install an incandescent lighting plant at St. Ignace.

MINNEAPOLIS, MINN.—The State Board of Control is preparing to expend about $10,000 in improving the heating and electric light plants at the State University.

FARIBAULT, MINN.—The Consolidated Gas & Electric Company, of this city, has been re-organized under the name of Consolidated Gas & Electric Lighting Company.

LIVINGSTON, MONT.—The electric light plant in this city was recently almost completely destroyed by fire, the loss being about $15,000, which is covered by insurance. New machinery has been ordered and will be installed as soon as possible.

JOPLIN, MO.—It is reported that about $30,000 will be expended for improving the electric light plant.

KIRKLAND, N. Y.—The Kirkland Electric Company, of Kirkland, has been incorporated with a capital of $100,000. Directors: J. F. Wood, of Clinton, and H. B. Sweet, Utica.

ALBANY, N. Y.—The State Civil Service Commission announces examinations on Jan. 9 for various positions, including an assistant electrical engineer. Application must be made before Jan. 4 to the Chief Examiner of the Commission.

LOUISBURG, N. C.—Bids are wanted Dec. 21 for $65,000 light and water bonds.

SCOTLAND NECK, N. C.—The town commissioners have closed a contract with the Standard Electric Company, of Norfolk, Va., for the installation of an electric light plant.

MANSFIELD, OHIO.—The Mansfield Railway, Light & Power Company has obtained a 25-year franchise to operate an electric lighting system in the city of Mansfield.

BARBERTON, OHIO.—The council has granted a 10-year franchise to O. C. Barber and associates to furnish electric light throughout the town. The company will erect a plant at once.

EAST LIVERPOOL, OHIO.—The American Sewer Pipe Company is installing an electric power plant in its works here for the purpose of illuminating the shops, supplying power for machinery and for operating electric drills used in mining clay.

DELHI, OHIO.—H. Platt has completed plans for the erection of a lighting plant for the purpose of furnishing power and light for the villages of Delhi, Home City and Fernbank. The matter has been under consideration for some time and the plant will now probably be built.

DELAWARE, OHIO.—The plant of the Electric Light, Heat & Power Company was damaged by fire to the extent of about $2000 recently. The fire was confined to the boiler room and some of the boilers were badly damaged. The city arc light system was interfered with for a short time. The plant will be repaired.

ATHENS, OHIO.—The Erner-Hopkins Company, Columbus, Ohio, has secured a contract for the erection of a municipal electric lighting plant at Athens, including a brick building, a 300-hp boiler, a 250-hp engine, a 150-kw generator and auxiliary equipment. The plant is to furnish 80 arc lamps and 2000 incandescents.

BRYAN, OHIO.—A new swindle is being perpetrated on farmers in Fulton County, Ohio. Two men have been soliciting business from farmers and offering to install, at a low figure, an electric light plant, that will light a house and barn for twenty years without repairs or battery renewals. A contract is signed which makes the farmer liable for almost any amount on a promissory note.

CLEVELAND, OHIO.—The Central Heat, Light & Power Company, of Cleveland, have been incorporated with $10,000 temporary capital stock by H. W. Jones, G. G. Whitcomb, H. H. Johnson, F. B. Williams and George H. Kelly. The company proposes to erect a central station in the down-town district of Cleveland to supply light and power to a number of merchants and manufacturing establishments.

GUTHRIE, O. T.—Manager Garfield, of the Electric Light Company, is in favor of constructing a new electric light plant which would probably cost about $70,000.

WYALUSING, PA.—A franchise has been granted to the Wyalusing Light & Power Company to furnish street lighting. F. N. Davis is general manager.

ORANGE, TEX.—S. C. Tremble, of Hillsboro, has acquired a large interest in the Orange Ice, Light & Water Company and it is reported that extensive improvements will be made in the electric light plant.

WARTRACE, TENN.—The question of constructing an electric light plant is under consideration here.

NEWPORT NEWS, VA.—The city authorities are considering the matter of bonding the city for $200,000 for the erection of an electric light plant.

BUCHANAN, VA.—Mr. O. E. Obersshain, president of the Batetourt Telephone Company, Buchanan, and associates are contemplating building a dam across the James River at this point to develop 2000-hp for electric light and power.

BLOOMER, WIS.—Rasmus and Christiansen, proprietors of the electric light plant here, have installed a new system and derive their power from a waterfall at Eagle Point, seven miles from town.

ALAMOGORDO, NEW MEX.—S. E. Pelphrey, who has the contract for the construction of the new electric light and power plant at this place has begun work.

WINGHAM, ONT.—The town has voted $28,000 bonds to purchase the electric light plant.

OTTAWA, ONT.—The Erie & Ontario Development Company, of Welland, Ont., has been chartered with a capital of $90,000 to develop electric and water power. Mr. D. W. Allen, of Buffalo, N. Y., is one of the promoters of this enterprise.

The Electric Railway.

HUNTSVILLE, ALA.—Dr. H. J. Reynolds, of Columbus, Ohio, is one of the promoters of an electric railway to be built between Huntsville and Nashville.

EUFAULA, ALA.—The Eufaula & Abbeville Electric Railroad Company has been incorporated at Eufaula. A line 28 miles long, between Eufaula and Abbeville, is to be constructed. The incorporators are J. B. Foy, B. B. McKenzie, R. A. Ballowe, C. A. Martin, H. C. Holleman, L. H. Braswell. A light and power plant is also proposed.

GRANGEVILLE, IDA.—A meeting has been held here at which a committee was appointed to look into the advisability of constructing an electric street railway system. Secretary Randolph, of the Lewiston & Southeastern Railroad, is the chief promotor of the project.

WOODRIVER, IDA.—The Carbonate Hill Mining Company has decided to build an electric railway from Ketchum to Stanley Basin, a distance of about 60 miles. There is a great deal of traffic between the two points, and the company expects to use the road for hauling its ore and supplies between the railroad and its mines.

SPRINGFIELD, ILL.—The Illinois Central Traction Company has been incorporated; capital, $1,000,000; to construct a road from Decatur, Macon County, to Springfield, Sangamon County, Ill. The incorporators and first board of directors are W. B. McKinley, Charles Zilly, B. R. Stephens, F. H. Hahn and H. J. Pepper, all of Champaign, Ill.

NEW ALBANY, IND.—It is announced that the Louisville & Southern Indiana Traction Company has acquired an option on the Highland Railway Company's property.

INDIANAPOLIS, IND.—The officials of the newly incorporated Columbus, Grensburg & Richmond Traction Company announce that contracts to build the line, power house and shops will be made this winter, work to begin in early spring.

MADISON, IND.—It is announced that the Southern Traction Company, of Indiana, represented by Messrs. Hubbard, Yoder and Rominger, of Indianapolis, has purchased the plant and property of the Madison Light & Railway Company, of Madison.

INDIANAPOLIS, IND.—The Indianapolis & Cincinnati Traction Company has decided to equip the line with double tracks and the third-rail system. From Indianapolis to Cincinnati in three hours is the time the officials promise to carry passengers, a schedule faster than that of the steam roads.

RUSHVILLE, IND.—The directors of the Indianapolis & Cincinnati Traction Company have decided to enlarge the power house under construction here sufficiently to give room for another battery of boilers. This will give the company much more power, making the total energy available under present plans about 4000 hp. This increase was made necessary by reason of having purchased the Shelbyville line.

CAMDEN, ME.—Editor D. N. Thayer, of the Rockland, Me., *Star*, writes under date of Dec. 3 that while the survey of the newly proposed 18-mile trolley line from Camden to Belfast has been practically completed by W. B. Getchell, chief engineer, who resides in Augusta, no estimates for the construction contracts or equipment has been asked for as yet and in fact been considered by the directors, no meeting having been held for such a purpose. It is not believed that the road can be completed or in full operation before the latter part of next year at the earliest.

PITTSFIELD, MASS.—President Gellett, of the Berkshire Street Railway Company, announces that his company is ready to build an electric railway from Pittsfield to Lenox, if suitable locations on the highway can be secured.

WILLIAMSTOWN, MASS.—The Hoosac Valley Street Railway Company has filed a petition with the Selectmen of Williamstown, asking for locations from the terminus of its present line to the Massachusetts-Vermont State line. The proposed extension is to be a part of the line to Bennington, Vt., and Troy, N. Y., and would provide street car service for Westonfield, Williams College. A petition, asking that the franchise be not granted has been circulated.

BATTLE CREEK, MICH.—The Grand Rapids & Southern Michigan Traction Company, which was incorporated last June with a capital stock of $1,300,000, will soon be prepared to consider propositions for the handling and sale of its bonds.

VIRGINIA CITY, MONT.—A company has been organized here for the purpose of building an electric railway connecting the Ruby Valley with Dillon and the Oregon Short Line. A power plant will be established somewhere along the route of the proposed line.

ST. LOUIS, MO.—Contracts have been let by the Imperial Transit Company, of St. Louis, for an equipment of 30 automobile electric busses, which, during the World's Fair period and after, are to transport passengers to and from the World's Fair grounds. The Western Electric Company will furnish the motors. The busses are to be built by the American Car Company. The new company is to be managed by Thomas M. Jenkins, formerly general manager of the St. Louis & Suburban Railway Company, who is also president of the new corporation. The company is capitalized for $600,000. The automobile busses are to be run on a "no seat, no fare" basis."

LINCOLN, NEB.—The Lincoln Traction Company's property, comprising practically the entire street car system of the city, was sold at auction Dec. 1 in foreclosure proceedings to satisfy a tax lien of the city of Lincoln. Charles A. Frueauff, a stranger, bought the property on a bid of $1,160,000.

JERSEY CITY, N. J.—The Public Service Corporation has decided to order fireproof cars for the tunnel under the Hudson River, now nearly completed. The tunnel referred to consists of two parallel tubes, each of which will accommodate a single trolley track. The entire length of the tunnel from the foot of Thirteenth Street, Jersey City, to Morton Street, on the New York side, is 9200 ft., and of this distance 5600 ft. are under water. The depth of the tunnel from the surface varies from 60 ft. at the water's edge on both sides to 100 ft. in the center. The company is sanguine that the tunnel will be ready for passengers by Jan. 1, 1905.

NEW YORK, N. Y.—The Interurban Street Railway Company has replaced the old horse cars on the Fourteenth Street lines with up-to-date cars of the electric conduit type. The change is greatly appreciated by the numerous women patrons of the roads in question, who frequent that shopping district.

MANSFIELD, OHIO.—The promoters of the proposed Mansfield & Mt. Vernon Railway are securing estimates on the cost of electrical equipment for the proposed line.

CORTLAND, OHIO.—C. G. Phillips, of Cortland, is promoting an electric railway from Jefferson to a point on the proposed Cleveland & Sharon Railway. This line, if built, will form direct connection from Cleveland to Jefferson.

DAYTON, OHIO.—The Dayton & Kenton Traction Company has completed arrangements for refinancing the project, and it is stated that a contract has been closed whereby construction work on the line will start at once.

WAUSEON, OHIO.—The Ohio Northern Traction Company, capital stock $10,000, has been incorporated by H. C. Coy, W. W. Campbell, C. E. Bennett, S. A. Wright and D. K. Shoop. The company proposes to build an electric railway from Defiance to Wauseon.

DAYTON, OHIO.—The Dayton & Germantown Traction Company has changed its name to the Dayton, Germantown & Middletown Traction Company. Considerable work has been done on the line, and it is now planned to build an extension to Middletown. J. O. Arnold is president of the company.

COLUMBUS, OHIO.—Surveys have been completed for the extension of the Columbus, New Albany & Johnstown Railway, and it is probable that construction work will be started this winter. At present Johnstown is 60 miles from Columbus by steam road. The route by the electric road will be 27 miles long.

CLEVELAND, OHIO.—A resolution has been passed by the City Council providing for the erection of seven shelter houses in various portions of the city. All of the corners are important transfer points on the lines of the Cleveland Electric Railway Company. The city erected two such shelter houses on the Public Square about a year ago.

READING, PA.—The Allentown & Reading Traction Company has secured the right of way for its new branch between Lyons and Alburtis. The construction of the line will be begun in the spring.

BLOOMSBURG, PA.—All the right of way for the Danville-Bloomsburg Electric Railway has been secured, and actual construction work will be commenced early in the spring. Contracts have been awarded and material will be delivered during the winter.

JACKSON, TENN.—Prominent citizens of Jackson have secured a charter for a railroad from Jackson City to Kansas City, Mo. The charter provides that it may be operated by steam or electricity. The capital stock is $2,000,000. The incorporators are Judge H. W. McCorry and Rush A. Persons.

MEMPHIS, TENN.—The development of the Shelby County Traction Company's project to build an interurban railway from Memphis to Collierville, a distance of 25 miles, is now on in earnest. I. B. Hudson, general manager; Lewis S. Proctor, consulting engineer, and J. A. Omberg, chief engineer, are examining the country between the two places to determine upon the most advantageous route.

RICHMOND, VA.—There is a movement on foot to build an electric railway from Richmond to Urbana, a distance of 50 miles. The proposed route is now being surveyed. John C. Robinson is interesting capital in the enterprise.

NORFOLK, VA.—The stockholders of the Chesapeake Transit Company have increased its capital to $1,000,000. The company, which operates a trolley line from Norfolk to Lynn Haven Inlet, Cape Henry and Virginia Beach, proposes to make an extensive improvement by next summer, which will include the double-tracking of the entire line, a distance of 24 miles.

WALLA WALLA, WASH.—The Northwestern Gas & Electric Company has under contemplation, it is reported, the building of an electric railway system here. An electric plant will also be erected on the Walla Walla River.

MILWAUKEE, WIS.—The Milwaukee Heat, Light & Traction Company has begun condemnation proceedings for the extension of its line from Hale's Corners to Muskego Center. This extension calls for about 6 miles of track.

GUAYMAS, MEX.—G. A. Albert, of Utica, N. Y., is at the head of a project to build an electric railway from this place across the Sierra Madras to the city of Chihuahua, Mexico, a distance of about 300 miles. He claims to have made considerable progress in the preliminary arrangements for the enterprise. It is stated that the road will pass through a rich mineral country. Application will be made to the Mexican government for a concession for the enterprise.

ST. THOMAS, ONT.—The first year's working of the electric street railway, of the city of St. Thomas, Ont., as a municipal service, has resulted in a practical balancing of the accounts. This showing, in view of the fact that the whole system has been transformed into an up-to-date one, is considered very satisfactory.

OTTAWA, ONT.—The proposed electric railway between Toronto and Ottawa, by way of Kingston, which has been in contemplation for the past two years, will soon begin to take form. The company proposes, also, to furnish cheap electricity for power purposes thereby booming manufacturing industries in the towns and cities through which its line will pass. Mr. A. E. Pard, of Boston, Mass., is interested.

MONTREAL, QUE.—An electric railway is projected on the north shore between Montreal and Ottawa. Among the promoters are: Thos. Christie, J. A. C. Ethier, F. O. Dugas, Senator Domville, Kings, N. B.; J. D. Wells, Toronto; W. A. Weir, Hon. Mr. Mathieu. A meeting of the shareholders for the purpose of electing a board of directors will be held on Jan. 12.

LEGAL.

THE LOCHE INSULATOR COMPANY, of Indianapolis, Ohio has filed a petition for an injunction against the New Lexington High Voltage Porcelain Company, of New Lexington, Ohio, claiming that the latter has infringed on certain insulator patents. The company wants an accounting and damages.

WESTERN UNION TELEPHONE ROYALTY.—The American Telephone & Telegraph Company has decided not to ask for a rehearing before the United States Court of Appeals in the Western Union Bell Telephone royalty case which was decided in favor of the plaintiff Oct. 7, last. Counsel for the American Telephone Company has notified counsel of the Western Union Telegraph Company to that effect. It appears that the American Telephone Company was given thirty days in which to petition for a rehearing, which was extended by consent of the plaintiff to Dec. 4. The next step in the case will be the appointment of an auditor by the court to determine the payment to be made by the American Telephone Company, or a petition for a writ of certiorari for a trial before the Supreme Court.

DALLAS, TEX.—T. L. Marsalis, formerly of Dallas, but now of New York City, has filed suit in the Federal Court for the northern district of Texas against the Northern Texas Traction Company owners of the Dallas & Fort Worth Interurban Railway, for one-tenth of all the stock and bonds, aggregating $3,500,000, or in lieu thereof $200,000 in money. The suit is based on contracts claimed to have been made between Marsalis and George T. Bishop and associates, a syndicate of Cleveland, Ohio, capitalists, who organized the Northern Texas Traction Company and built the interurban road. Mr. Marsalis says he was the original projector of the road and that Bishop and his associates took over the enterprise and then violated their contracts.

PERSONAL.

PRESIDENT HENRY A. BARNHART.

HENRY A. BARNHART, the newly elected president of the Inter-State Independent Telephone Association of America, is president of the Rochester Telephone Company, and editor of the *Sentinel*, at Rochester, Ind. He was born near Logansport, in 1858, and has lived in Rochester for twenty years. Mr. Barnhart has been active in state politics; has served on the Board of Control of the Northern Indiana State Prison and Northern Indiana Hospital for the Insane, and is quite prominent in state charities and corrections. His activity in the independent telephone field is well known, and has again been exemplified during the recent convention held in Chicago, where Mr. Barnhart played an important part in the proceedings and was appointed on committees dealing with vital topics before the body. He is in the prime of life and appears destined to become even more conspicuous in the social and political life of Indiana, a state which from the first has led in the independent telephone movement.

MR. GEORGE BULLOCK, president of the Bullock Electric Company, of Cincinnati, Ohio, was a visitor in New York for a few days last week.

MR. HARRY ALEXANDER, the electrical engineer, has returned to his offices in the Astor Court Building, after an extended trip around the world.

MR. A. T. RALPH, formerly of the Cincinnati, Ohio, works of the Bullock Electric Company, has been appointed assistant manager of the New York office in the St. Paul Building.

PROF. RUTHERFORD, of McGill University, one of the foremost living scientists, has written an interesting article on "The Disintegration of the Radio-active Elements" for the January number of *Harper's Magazine*.

MR. C. O. HARRIS, formerly superintendent and engineer of the Rochester, N. Y. Telephone Company, has associated himself with the sales department of the Stromberg-Carlson Telephone Mfg. Company, and is now located in Chicago.

GEN. F. V. GREENE.—It is announced from Buffalo that Gen. Francis Vinton Greene, Police Commissioner of New York City, has accepted a position with the Albright-Hayes Power Company, which is building a power plant on the Canadian side of Niagara River at Niagara Falls, and will assume his new duties on Jan. 1.

MR. W. L. FAIRCHILD, formerly vice-president and secretary of the John F. Kelly Engineering Company, 149 Broadway, New York, is now attached to the sales department of the New York offices of the Bullock Electric Manufacturing Company, of Cincinnati, Ohio.

MR. F. FENWICK, of Fenwick Freres, Paris, one of the largest handlers of American machine tools, etc., on the Continent, is now on a visit to the States. Before returning home Mr. Fenwick expects to place some substantial contracts. He has gone west, but will be in New York again early next week.

MR. ALFRED MOSELY, who headed and defrayed the expenses of an English commission that came here some months ago to study our educational system, returned to England last week on the steamship *St. Louis*. He expects good results for the effort that has been made to secure light here on the subject.

HON. JOSEPH CHOATE, U. S. Ambassador to England, delivered an address at Birmingham recently on Benjamin Franklin, which has attracted much favorable attention. It has been printed in full by the *New York Sun* and includes appropriate though not very extended reference to his work as an electrical pioneer.

MR. PETER COOPER HEWITT and Mr. S. Thomas lectured before the Technology Club of New York on Dec. 10. Mr. Thomas is a graduate of the Mass. Institute of Technology, and the local club is in flourishing condition as shown by the crowded and enthusiastic audience. The introductions were made by Mr. Calvin W. Rice.

MR. J. L. GREATSINGER, ex-president of the Brooklyn Rapid Transit Company, of New York; Peter Kimberly, the iron man of Sharon, Pa., and associates have proved up a valuable copper mine in the wilderness sixty-five miles west of Port Arthur, Ontario, and fourteen miles south of the Canadian Northern Road.

MR. JOHN W. GATES.—Mr. John W. Gates, the steel millionaire and speculator, who has an elegant Winter residence at Port Arthur, Tex., has become interested in the Beaumont, Sourlake & Port Arthur Traction Company, which proposes to construct an extensive system of interurban electric railway in this section. It will connect Port Arthur with the different oil fields.

PROF. ROBERT SIBLEY, recently graduated from the University of California, has accepted the chair of mechanical engineering at the University of Montana. Prof. Sibley founded and was first editor of the *California Journal of Technology*, published at the University of California, and was one of three students appointed to welcome President Roosevelt upon a visit last May to the University.

DR. D. C. GILMAN.—President Daniel C. Gilman, of the Carnegie Institute has notified the trustees that he proposes to resign at the end of next year. He states that he makes his purpose known now so that they may not be taken unexpectedly. Dr. Gilman was elected for five years, and has served two years. He gives as his reason for resigning his advancing years, which make the burden of his position very onerous to him.

MR. CHARLES T. YERKES is apparently looking forward to making more of a regular home in New York for he has just bought a house adjoining his own on Fifth Avenue and Sixty-eighth Street, intending to remove it and extend his residence, which will thus become one of the largest and most prominent along the Park. The other corner is occupied by Mr. W. C. Whitney and Mr. George Gould's house is on the corner of Sixty-seventh Street.

MR. H. HINE, formerly of the Stanley interests, and now president of the Guanajuato Electric Light & Power Company, Mexico, which concern recently completed the second longest power transmission system in this hemisphere, is now in New York. His visit here is made in connection with the project of the company to build a large plant at Zitacuaro for the purpose of developing power for transmission to the El Oro mines. He is a guest at the Waldorf-Astoria. Down-town he is making his headquarters at the offices of the Western banking house of William P. Bonbright & Company, 15 Wall Street.

MR. C. CURRIE.—At Canton, Ohio, on December 11, Mr. Henry Everett's private trolley car with Mr. and Mrs. Charles Currie and Dr. and Mrs. O. M. Lyon, all of Akron, as passengers, was wrecked. Dr. Lyon was gravely hurt, while Mrs. Lyon received injuries that may prove serious. The car was approaching the city at a lively rate, and the motorman applied air some distance before the switch with the Akron line was reached, but the wheels slipped on the rails, and the front trucks left the track and struck a telephone pole, knocking it down and battering in the end of the car. Mr. Currie is general manager of the Northern Ohio Traction Company, and was going to the city on a pleasure trip.

PROF. MORRIS LOEB, of the department of physics at the New York University, who is well known in New York electrical and technical circles, has sustained an irreparable loss in the death of his father, Mr. Solomon Loeb, one of the founders of the banking firm of Kuhn, Loeb & Company, and a large owner of real estate. Mr. Loeb was active in commercial and charitable work of all kinds. He was a director for many years of the Mount Sinai Hospital, and was one of the founders of the Provident Loan Society, of which he continued an active director till the time of his death. He was also a member of the American Museum of Natural History, the New York Botanical Gardens, and the Metropolitan Museum of Art.

MR. C. F. PILLSBURY, of Minneapolis, at the annual banquet of the Minneapolis Retail Dealers' Association, described the construction and operation of electric light plants. He cited figures from the statistics of plants in operation, considered the cost of production per kilowatt as compared with the price which the consumer pays, and also cited the price at which the product should be sold in order to return a fair profit on the investment. Mr. Pillsbury spoke for four hours, and later answered the questions which were asked of him. Mayor Haynes and a committee of 15 aldermen who are at work on the proposed franchise, were among the guests and manifested much interest. A vote of thanks was extended to Mr. Pillsbury for his profitable and interesting speech.

MR. JOHN W. BROOKS.—We were able to note briefly last week the fact that Mr. Julian S. Jackson had become sales agent for Pass & Seymour, Inc., in Chicago, taking the place of Mr. John W. Brooks. The latter now becomes sales manager at Solvay, N. Y., headquarters. Mr. Brooks had been representing this well known porcelain product in Chicago for nearly six years and covered from that point a territory including some eighteen states. Prior to this connection, Mr. Brooks was with the Brooks-Follis Corporation, of San Francisco, so that his acquaintance with the electrical industries is of long standing. Under the new regime he will relieve general manager Salisbury of part of the work due to the rapid growth of the concern and will of course supervise the sales agencies throughout the country. Mr. Brooks is fully equal to the new responsibilities and in his larger and even more comprehensive sphere of action will have a better opportunity to display the sterling qualities that have made him so many friends and won for him so enviable a reputation all over the west. His association with Mr. Salisbury at headquarters should prove a further step in the widespread popularisation of the P. & S. product.

MR. WALTER H. WHITESIDE, the manager of the detail and supply department of the Westinghouse Electric & Manufacturing Company, has also been made the general manager of the Sawyer-Man Electric Company and has added the duties of this new office to his former ones. Few men are better known than Mr. Whiteside in the electrical business. He has been connected with electrical trade interests for nearly twenty years and during that time has extended his acquaintanceship to every part of the country and cemented friendships wherever he went. Mr. Whiteside became a special salesman for the Westinghouse Electric & Manufacturing Company in Chicago in 1898. A year later he was sent to Washington, D. C., to take charge of sales to the Government. This led, in 1900, to his being made manager of the company's office for that district, then having its headquarters in Washington. From the Washington office he was promoted to the management of the detail and supply department of the company, with headquarters at Pittsburg. Under Mr. Whiteside's management, the business of this department has greatly increased. Additional manufacturing facilities are being provided and a continued growth is expected.

PROF. W. E. GOLDSBOROUGH, of the department of electrical engineering at Purdue University and chief of the Department of Electricity at the Louisiana Purchase Exposition, gave a talk on "Electricity as a Factor in Expositions" before the Chicago branch of the American Institute of Electrical Engineers Dec. 8. Stereopticon views illustrated the talk and served to show the increasing application of electricity in expositions. Views of the expositions held in Paris, Chicago, Atlanta, Omaha and Buffalo illustrated the progress made in each successive one and served to convey an idea of the electrical features as they will be at the St. Louis Exposition. Three colors, yellow, amethyst and green will form the basis of the color and lighting scheme at the latter. The gradations in light caused by an increase or diminution in one or more colors at the same time, will permit of the illumination of the buildings and the grounds in a manner not attempted before. Another feature of the exposition will be three cascades, the water for which will be pumped by machinery operated by three 1000-hp motors. Fifty thousand horse-power will be available for power purposes in the power plant, which will include operating exhibits of various machinery, both of foreign and domestic manufacture. In fact, processes, instead of products, will give the exhibits distinguishing character at the exposition. Various articles, such as incandescent lamps, motors, etc., will be shown in continuous process of manufacture. The exhibits, wherever possible, will show machines in operation or manufacturing apparatus. The National Bureau of Standards will have a laboratory at the exposition, and a complete corps of assistants will be present to make tests. It is therefore hoped that all awards will be made on the basis of actual excellence. Many of the details noted by Prof. Goldsborough have already been treated in these pages.

NEW INDUSTRIAL COMPANIES.

THE VALENTINE GAS ENGINE COMPANY, of Westfield, N. J., has been incorporated; capital, $50,000. Incorporators: Warren P. Valentine, Charles Bates Dana, Frank A. Clay.

THE INTERNATIONAL ENGINEERING COMPANY, of Camden, N. J., has been incorporated; capital, $100,000. Incorporators: Luther D. Lovekin, Warren D. Peck, Frederick C. Eaton.

THE REMEY ELECTRIC MANUFACTURING COMPANY, of Anderson, Ind., has increased its capital stock from $10,000 to $50,000. B. P. Remey is president and Frank I. Remey, secretary.

THE CROUSE-HINDS COMPANY, of Syracuse, N. Y., has been incorporated to manufacture machinery; capital, $450,000. Directors: H. B. Crouse, J. L. Hinds and D. F. Costello, of Syracuse.

THE GENERAL LIGHTING SUPPLY COMPANY, of Philadelphia, has been incorporated to furnish light, heat and power, and manufacture and sell lighting supplies. The capital stock is $35,000.

THE BRUCKNER TELEPHONE & ELECTRIC COMPANY, of New York; capital, $15,000, has been incorporated. Directors: F. C. Bruckner and St. S. B. Gwynn, New York, and A. E. Hoecker, Brooklyn.

THE L. S. BRUENN COMPANY, of New York City, has been incorporated with a capital stock of $25,000 to manufacture electrical appliances. The directors are L. S. Bruenn, S. S. Rich and Alexander Ungar, New York.

OBITUARY.

ADMIRAL GHERARDI.—We regret to note the death of Rear Admiral Bancroft Gherardi, at Stratford, Conn. This well-known officer, who was the nephew of Bancroft, the historian, was navigating officer of the U. S. frigate *Niagara* at the time she assisted in the first submarine cable laying work in the North Atlantic. Mr. B. Gherardi, Jr., chief engineer of the New York & New Jersey Telephone Company, is a son of the late admiral.

MR. A. J. WISE.—It is with deep regret that we note that Mr. Albert J. Wise, of the law firm of Quackenbush & Wise, and president of J. H. Bunnell & Co., manufacturers of electrical supplies, died in New York City on Dec. 10. His death was due to bronchitis following internal injuries received the week before, when he slipped and fell near his home while alighting from a trolley car. Mr. Wise was born in Lima, Ohio, Sept. 24, 1869. He took the degree of LL.B. at Yale and afterward at Columbia University. After his graduation Mr. Wise practiced law for some time in his native town, but removed to New York in 1891. In 1896 he married Miss Gertrude Bunnell, daughter of Jesse H. Bunnell, the inventor and manufacturer, whence sprang his interest in the electrical industry. He was interested in yachting, owning the fine steam yacht *Chetolah*, and was a member of the New York Yacht, Atlantic Yacht and Sea Cliff Yacht Clubs. He was also inspector of public schools for the Boroughs of Manhattan and the Bronx. His wife survives him.

EDUCATIONAL.

WORCESTER POLYTECHNIC INSTITUTE.—The high potential transformer built by the electrical engineering department of the Worcester Polytechnic Institute in 1898 under the direction of Professor Harold B. Smith, the head of the department, has recently been sold to Mr. C. S. Knowles, of Boston, and has been sent by him to New Lexington, Ohio, for installation at that place. It will be used in connection with the high voltage porcelain works in which Mr. Knowles is interested. The transformer has already been installed and is now ready for testing work. The installation was performed by Messrs. J. A. Sandford and W. T. Goddard, assistants to Professor Smith in the electrical engineering department of the Institute. This transformer has, since it was built, been an object of considerable interest in electrical engineering circles, and inquiries have been received by Professor Smith respecting the details of its construction from all parts of the United States, and also from abroad. Its capacity is 150,000 volts, with a frequency of 60, and, as is well known, this is the first transformer ever built in which so high voltage was attained which could be successfully used for commercial purposes. The transformer was from the first entirely successful, and amply fulfilled the expectations entertained by Professor Smith when he first designed it. In searching for apparatus with which the necessary testing could be done, Mr. Knowles experienced great difficulty in obtaining satisfactory estimates from the different electrical companies; hence negotiations were opened with Professor Smith which finally resulted in the purchase of the transformer belonging to the Worcester Institute. It will be replaced immediately at the Worcester Polytechnic Institute by the construction of a new transformer which will contain a number of improvements. These have been devised during the experience of the electrical engineering department in high potential work during the last five years. Mr. Sandford will remain at New Lexington where he will be engaged for some time conducting a series of experiments involving the use of high potentials.

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, sales agent for Packard lamps, Zenith "intermediate" lamps and Adams-Bagnall arc lamps, is out with a most complete line of new lamp literature. It is worth sending for by any one interested.

RADIUM.—*The Edinburgh Review's* highly important article on Radium which has been pronounced a most satisfactory and authoritative description of that element is reprinted as the leading article in *The Living Age* for December 5, occupying several pages of that interesting publication.

THE W. J. BARR MFG. COMPANY, Cleveland, Ohio, has issued a very interesting and instructive circular showing the different styles of transmitter arm which it manufactures. The illustrations are handsome half tones very clearly printed with just a word or two in reference to the superior quality of the work which the company supplies.

THE SAVAGE & LOVE COMPANY, Rockford, Ill., is bringing out a treatise on gas and gasoline engines which is contained in the catalogue of its gas engines now in the printer's hands. The catalogue of course speaks of its own engine, but contains a great deal of information in regard to gas engines in general which will be found very useful.

GRAPHITE SUGGESTIONS is the title of a handsome and interesting publication of the Joseph Dixon Crucible Company, of Jersey City, N. J. Many are the uses referred to. In the section devoted to electricity, various uses are spoken of, including graphite resistance in rods varying from 1 inch to 12 inches, as well as in other forms. A number of views show graphite made up for electrical purposes.

PANEL FUSES.—The Central Electric Company, Chicago, is sending out to the trade a circular calling attention to D. & W. panel fuses and their adaptability for use with Adams-Bagnall and other makes of arc lamps. A connector is shown by the use of which D. & W. fuses can be fitted to any arc lamp without the necessity of a fuse block. The members of the firm are enthusiastic over the increased volume of business they are doing on D. & W. material generally and state that the number of orders received is so great that they find it difficult to meet the demand.

AIR COMPRESSORS.—A new line of air compressors is described in Bulletin L-509, recently issued by the Laidlaw-Dunn-Gordon Company, of 114 Liberty Street, New York City. These compressors are fitted with Meyer steam-valve gears, permitting of an adjustable cut-off. The air ends are arranged both with poppet inlet and outlet valves and with mechanically operated inlet and poppet outlet valves, the valves in either case being placed in the head of the cylinder, permitting the body to be effectively water-jacketed. The frames of the compressors are specially heavy. The capacities listed range from 468 to 2220 cubic feet of free air per minute, and the air pressure from 80 to 100 lbs. per sq. inch. This pamphlet will be sent upon request to those interested.

THE MONTAUK FIRE-DETECTING WIRE recently proved itself remarkably efficient as a thermostat, by recording an alarm caused by an over-heated bearing in the establishment of Thomas Oakes & Company, woolen manufacturers, of Bloomfield, N. J. The low temperature at which this alarm was given enabled the employees of the company to extinguish the fire, without any serious results. This wire is practically a continuous thermostat, and can be so arranged as to give an alarm at high or low temperature, so that it can be carried through offices, stores, apartments, hotels, etc., where a temperature of 200° would mean the presence of fire, while the same circuit can be carried through the boiler and engine rooms, etc., where a temperature of 200° would not necessarily mean fire, and can be so arranged as to give the alarm in such over-heated places only when the temperature reaches the neighborhood of 400°. It can either be permanently affixed to the ceilings or walls, or it can be carried on reels on the walls, thus enabling the user to protect his goods by unreeling at night and laying the wires across his merchandise, and reeling it up in the morning. This is an invaluable adjunct to fire protection in dry goods and other stores.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 8, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

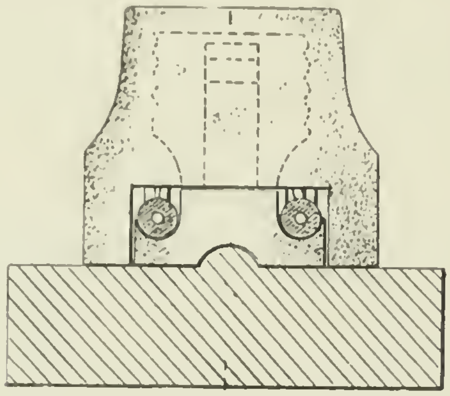
715,999. INSULATOR; Sigmund Bower, New York, N. Y. App. filed Jan. 21, 1903. A two-part insulator with an annular notched flange and a conical projection on one part, the second part fitting between the flange and projection.

746,018. HEATER FOR SWEAT BATH CABINETS; Terry O. Carman, East Liverpool, Ohio. App. filed Jan. 21, 1903. An electric heater placed under a chair to be located in a cabinet.

746,040. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed May 27, 1901. (See page 1008.)

746,047. AUTOMATIC REGULATOR; Austin R. Dodge, Schenectady, N. Y. App. filed Aug. 21, 1902. An electric motor geared to the throttle valve of an engine is controlled by a pressure gauge to automatically maintain a given steam pressure delivery to the engine.

746,050. ELECTRIC FUSE OR CUT OUT; Louis W. Downes, Providence, R. I. App. filed May 7, 1902. The fuse link is in the form of a tube, the invention extending to the construction of the end contacts and features for mounting in a tubular casing.



746,483. Electrical Receptacle.

746,051. MOLD BOX FOR CONDUIT JOINTS; Eugene L. Du Bois, New Orleans, La. App. filed May 4, 1903. A metallic strap having side flanges and adapted to be placed around a conduit joint to receive the cement.

746,065. SELECTIVE TELEPHONE SYSTEM; Amos Gagnon, Stafford Springs, Conn. App. filed Nov. 8, 1902. (See page 1008.)

746,069. ELECTRICAL SIGNALING DEVICE; Herbert C. Giles, New York, N. Y. App. filed April 24, 1903. Details of a railway signal in which the train actuates certain contacts in the roadway to operate signals in the cab of another train.

746,074. SYSTEM OF ELECTRICAL DISTRIBUTION; Josef H. Hallberg, New York, N. Y. App. filed Feb. 20, 1903. The field magnet current of a main generator is varied to give a uniform potential in the distributing circuit by varying the speed of a small motor driving a small generator, the current from which is opposed to the field exciting current of the generator.

746,095. SWITCHING APPARATUS; William Kaisling, Chicago, Ill. App. filed May 7, 1903. Means are provided whereby but one of the keys associated with a given cord circuit may be operated at a time, thus avoiding confusion in the operation of the keys on a party line system.

746,128. ELECTRIC HEATING ELEMENT; James F. McElroy, Albany, N. Y. App. filed Aug. 31, 1901. A spiral core of insulating material upon which the resistance coil is wound, is made in skeleton form to afford good circulation of air.

746,140. AUTOMATIC CURRENT CONTROLLING DEVICE; Percy R. Owens, New York, N. Y. App. filed April 18, 1903. Means for gradually increasing the potential of a battery charging current and finally cutting off the charging circuit when the battery is fully charged.

746,153. COMBINED CURB AND CONDUIT; Richard Raby, York, Pa. App. filed May 2, 1903. Details.

746,160. TROLLEY GUARD AND FINDER; William F. Reichenbach, Rochester, N. Y. App. filed June 13, 1903. Lateral arms projecting from the fork have elongated inclined rollers to receive the wire in case it becomes displaced and return it to the wheel.

746,210. TELEPHONE BRACKET; Henry S. Waite, Columbus, Ohio. App. filed Feb. 20, 1903. (See page 1008.)

746,227. ELECTRIC BATTERY; Sakizo Yai, Tokio, Japan. App. filed May 21, 1903. (See page 1008.)

746,273. AUTOMATIC CUT OUT; Charley A. Borein and Louis P. Desimone, Oakland, Cal. App. filed May 11, 1901. A shunt to a translating device contains a circuit controller which affects a main circuit controller in a second shunt around the first.

746,289. STORAGE BATTERY; Rufus N. Chamberlain, Depew, N. Y. App. filed May 13, 1901. Pipe coils conveying heating fluid from one cell to another are coupled together by insulating couplings.

746,314. TELEPHONE SWITCHING APPARATUS; Nels August Engstrom, Chicago, Ill. App. filed Nov. 10, 1902. (See page 1008.)

746,316. ELECTRIC FIXTURE TRIPOD BOX; John E. Ereanbrack, Woodstock, Ill. App. filed March 23, 1903. A box having an opening for the passage of wires and other openings to receive a tripod of a chandelier base.

746,351. TROLLEY; Frank A. Merrick, Johnstown, Pa. App. filed March 12, 1902. Strap springs carried by the wheel pass through holes in the hub and rub against the fixed axle to give good contact.

746,361. ELECTRIC LIGHTING SYSTEM; James E. McElroy, Albany, N. Y. App. filed Oct. 6, 1902. A magnet controlling the dynamo regulator, receives current from both the lamp and the battery circuit, an opposing magnet being placed in the lamp circuit only.

746,362. INSULATOR HANGER OR BRACKET; George H. McFeaters, Johnstown, Pa. App. filed Jan. 30, 1903. A clamp adapted to engage the web portion of steel beams.

746,395. UNDERRUNNING TROLLEY FOR ELECTRIC RAILWAYS; Charles A. Singer, Larchmont, N. Y. App. filed Feb. 7, 1902. Two trolley wheels are carried at the end of the pole, either of which can be thrown into service at will.

746,417. APPARATUS FOR USE IN ELECTRIC TRACTION ON THE CONDUIT SYSTEM; Edouard Vedovelli, Paris, France. App. filed April 7, 1899. Relates particularly to the construction of a conduit and to the protecting and covering of the conductor therein.

746,424. TROLLEY POLE; Thomas F. Wetton, Newark, Ohio. App. filed Aug. 29, 1903. Details.

746,436. HANGER FOR TROLLEY WIRES; Juan Antiga, Mexico, Mexico. App. filed July 1, 1903. The hanger consists of two hinged parts, the ends of the wire being attached to each part; in case the wire breaks the corresponding part is tilted and operates a circuit controller which renders the fallen wire dead.

746,437. HANGER FOR TROLLEY WIRES; Juan Antiga, Mexico, Mexico. App. filed July 1, 1903. A modification of the preceding invention.

746,450. BRUSH HOLDER; Henry K. Brooks, New York, N. Y. App. filed Feb. 24, 1903. Details.

746,463. ELECTRIC CONDUCTOR; Charles M. Clark, South Orange, N. J. App. filed Dec. 10, 1902. A switching device for telphers consisting of means for breaking the circuit through the motor when it passes in one direction and for maintaining the circuit when passing in the other direction.

746,469. ELECTRICAL WIRE SUPPORT; Beauregard Cullen, New Albany, Ind. App. filed May 20, 1903. Details of an insulator.

746,483. ELECTRICAL RECEPTACLE; Philip H. Fielding, New York, N. Y. App. filed Nov. 17, 1902. The receptacle consists of two porcelain parts, one of which carries the metallic connection and is secured to the support by a single central screw, it being prevented from twisting by a rib in the support entering a groove in the porcelain. The cover or protecting shell is held in place by spring clips.

746,490. CIRCUIT-BREAKER FOR STORAGE BATTERIES; Henry Garrett, Dallas, Tex. App. filed June 26, 1903. (See page 1008.)

746,512. ELECTRIC RAILWAY; Robert Hebner, New York, N. Y. App. filed Dec. 19, 1902. A cover plate for a third rail is built in sections which are lifted successively by a plow preceding the collector.

746,514. ELECTRIC BATTERY; Miller Reese Hutchison, Norwood, N. J. App. filed Nov. 15, 1902. (See page 1008.)

746,556. COVER FOR THIRD RAILS; Harry C. Morgan, Lagrange, Ill. App. filed May 9, 1903. The cover consists of a box in two parts hinged to a suitable support and swung open by the action of a plow carried by the car.

746,557. RECEIVER FOR WIRELESS COMMUNICATION; George Morin, Havana, Cuba. App. filed Jan. 20, 1903. The movable core of a magnet forms one terminal of the granular body; the local current traverses a coil which moves the core and causes the particles to decohere.

746,558. SYSTEM OF ELECTRICAL REGULATION; Morris Moskowitz, New York, N. Y. App. filed Jan. 21, 1903. Comprises a generator having a shunt field through which a circuit of a given current carrying capacity is established by means of resistance independent of the field, and variable means connected to shunt away a part of the current in the field circuit.

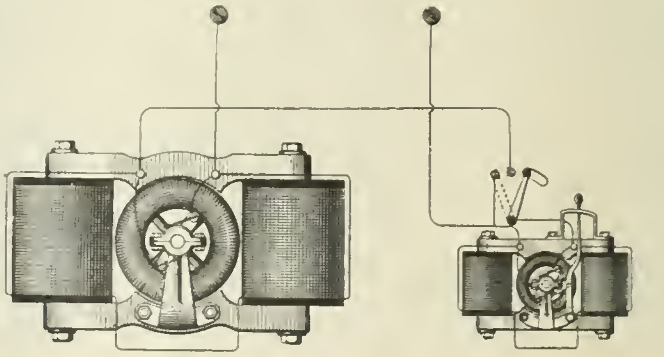
746,577. ELECTRIC SWITCH; Alvin Riverburgh, Greenfield, Iowa. App. filed March 6, 1903. A number of switches are supplied to a house depending upon the maximum number of lamps which it is desired to use at any one time; each switch can cut in any one lamp of the entire number of lamps in the house.

746,580. ELECTRICAL CONNECTION; Frank J. Russell, New York, N. Y. App. filed Aug. 13, 1903. Details.

746,587. MULTICIRCUIT CONTROLLER; William M. Scott, Philadelphia, Pa. App. filed March 10, 1902. A plurality of circuit controllers so arranged that upon abnormal conditions obtaining in any one or more of the circuits to be controlled, the entire group of controllers operates together.

746,601. ELECTRIC ARC LAMP; Marion A. Stogsdill, Indianapolis, and Edward J. Schatz, Greenfield, Ind. App. filed Dec. 20, 1902. Details of a headlight lamp.

746,604. CIRCUIT CLOSING DEVICE; Oliver B. Thompson, and William G. Midgley, Buffalo, N. Y. App. filed June 2, 1901. A thermal circuit closer for alarm circuits.



12,180.—Method of Controlling Electric Motors.

746,614. TROLLEY POLE; Edwin A. Wakefield and George W. Morse, Mechanic Falls, Me. App. filed July 8, 1903. A device to prevent the pole from flying upward when the wheel leaves the wire.

746,624. SWITCHBOARD; James B. Wood, Gate City, Va. App. filed Oct. 16, 1902. Travelers are mounted on tracks arranged above the face of the board, the travelers engaging with contacts in the face of the board beneath them.

746,628. DOWEL PIN FOR CONDUIT SECTIONS; Cornelius J. Field and Lewis J. Doolittle, Brooklyn, N. Y. App. filed July 24, 1903. The dowel pin is half of one diameter and half of another, the object being to prevent its displacement.

12,179. MEANS FOR CONTROLLING ELECTRIC MOTORS; Montgomery Waddell, New York, N. Y. App. filed Jan. 15, 1901. In place of the usual controlling resistances, a small secondary motor has its armature connected in series with the armature to be regulated and the counter-electromotive force of the secondary motor is controlled to vary the current flowing to the main motor.

12,180. METHOD OF CONTROLLING ELECTRIC MOTORS; Montgomery Waddell, New York, N. Y. App. filed Jan. 15, 1901. Relates to the subject matter of the preceding patent.

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THE CLOSING YEAR.

It must be a source and cause of general satisfaction that the year just closing has a much brighter outlook than it had at the start. The improvement is so general and so varied it is hard to signalize any one prominent condition, but it might, perhaps, suffice to say that the year which began with a foreign indebtedness of from three to five hundred million dollars has seen that burden literally wiped out. The penalty and punishment of wild speculation not only wrought financial havoc, but during part of the year lay an incubus on industry and commerce hard to be borne. But the last three months have seen a striking change, for with easier times in the money and stock market has come a decided renewal of industrial activity and confidence. Prices all around have been brought to a better level, except in the case of some raw agricultural materials, so that while one or two American products are at high prices, the lower average has stimulated export trade, and once more the high water mark has been reached. In every way the check of the past year has been a good thing, and no real prosperity has been touched by it. So far as electrical growth is concerned, the year has been an active one all around, in discovery, application and trade, as our Index for the volume concluding with this issue and appearing herewith, shows; and the forecast even by the most cautious man cannot but be cheering as to 1904. A Presidential election year never, so far as we are aware, witnesses a boom; but booms are the last thing this country wants. The best condition is that of healthy normal activity, and certainly no good reason can be seen why that should not prevail throughout the coming year. At the same time, as a people we Americans have little cause to complain of 1903.

SINGLE-PHASE TRACTION MOTORS.

It is with great pleasure that we present on another page a valuable paper on this topic from the pen of Mr. B. G. Lamme. It is a review of the present situation which can be studied with much profit, although we regret that the author did not at this time see his way clear to a definite description of the very interesting motor which he has succeeded in developing. From a theoretical standpoint, Mr. Lamme has done good service in laying stress on the essential kinship of continuous-current and alternating-current motors, grouping together as he does even ordinary series-wound motors and induction motors provided with a commutator. It is a clean, sane note of common sense rising above the Babel of discordant equations that has made alternating motor practice a region of horror to the ordinary man. He might well have gone further and remarked that given an alternating motor, it makes precious little difference in the fundamental principles of its action whether the current enters the armature by brushes or by electromagnetic induction. Mr. Lamme discusses at some length the nature of the losses incurred in direct-current and alternating-current motors, showing clearly why in the latter somewhat greater losses may be expected, and how these are, in the long run, compensated in large measure by gain in the efficiency of the regulating appliances. Of course, the question of power factor is always to the fore, but in spite of the low power factor at starting shown by the type of motor which Mr. Lamme is discussing, the very important fact remains that it appears possible to start and accelerate the car without demanding an excessive current.

This fact comes out with especial clearness in the tests of the Finzi motor, which we have recently published, where the volt-amperes during the starting and acceleration are actually plotted. It may fairly be taken for granted that if an alternating-current railway motor is thoroughly good in other respects, nobody will be scared away by a low power factor merely while the motor is starting. And at load the power factors of the motors in question are amply high, decidedly higher than those customarily found in pure induction motors. While we concur with Mr. Lamme that the art of commutation has advanced wonderfully in the past decade, we cannot agree that because a direct current of x amperes can be successfully commutated and alternating current periodically varying from $+x$ to $-x$ can also be successfully commutated. That is a question of fact, with all the data now at hand tending to show greater difficulty in dealing with the alternating current. If Mr. Lamme, Dr. Finzi, Eichberg and Winter and the rest make good in actual working service their claims of sparkless commutation they have not merely moved along with the art, but have made the greatest step forward since commutation was invented, and deserve correspondingly great credit for their success. Nothing but some little experience with motors operating under commercial conditions will tell the whole story as to sparking, but we may incidentally remark that if it is feasible to build a sparkless alternating-current railway motor it is *a fortiori* practicable to build stationary motors along the same lines, which would make material changes in the art of alternating-current distribution. Indeed, one of our English contemporaries has gone so far as to say that the Winter-Eichberg experiments very clearly indicate the near and forced retirement of the polyphase stationary motor from that part of the commercial field which it now occupies.

We are particularly interested to note that Mr. Lamme comes out boldly in favor of urban traction by alternating motors instead of relegating them to long-distance and interurban work. This is carrying the war into Africa with a vengeance, but the regulation of these alternating motors for low speeds is more efficiently accomplished than in ordinary direct-current working. Just how the comparison would stand in regular running one can hardly say off-hand, but it is reasonably clear that if the type of alternating motor concerned anywhere nearly comes up to the hopes of its friends, it is capable of giving direct-current motors a hard rub almost anywhere. Of the beneficient effect of alternating-current motors on the modern problems of distribution there is no doubt. The necessity of supplying direct current to the cars at distances compelling the transmission of alternating currents has been a dreadful incubus upon electric traction. It certainly appears that we already see the beginning of the end, and that in the future work can be conducted upon broader lines than heretofore. However well alternating motors may prove to work on urban systems, it is in the larger work that they are most needed, and it is doubtless there that they will for the present find the most useful application.

THE FLAMING ARC LAMP.

The arc lamp employing impregnated carbons has recently been coming to the front, and to a limited extent has been used in Germany on commercial circuits with satisfactory results. These arcs have beyond any doubt an enormous luminous efficiency, two or three times as great as that of ordinary arcs, with a better color quality and a somewhat lower intrinsic brilliancy. But they give a species of flaming arc, the fumes from which introduce a complication of no small import. They present in this respect a problem not unlike that of the enclosed arcs eight or ten years ago. Many ingenious attempts to avoid the difficulty have been made, but it is too early yet to look for complete success. Still the class is a promising one, well worth persistent attempts at improvement. An arc with a light of good color produced with an expenditure of less than half a watt per candle-power certainly justifies interest, and is a prize not to be passed by.

In this instance America, unfortunately, cannot count too much upon help from foreign results, for in arc lighting the lessened cost of labor abroad plays a very important part. The success of the enclosed arc in this country is a monument to the forbidding seriousness of American labor conditions. Its light is undeniably produced at considerably less efficiency than that of the open arc and its color is not altogether prepossessing, yet it so reduces the labor account that it has become an economic necessity. It has advantage in steadiness and in the distribution of light to be sure, but the lessened care is its real *raison d'être*. The arc with composite carbons has to face in this country, then, special conditions, and how far it may be possible to strike a compromise between efficiency on the one hand and an increased demand for attention on the other, remains to be seen. We are inclined to think that a commercial solution of the difficulty is attainable, and look forward to it with interest. But meanwhile electric lighting is a growing art and the output of standard arcs and incandescent lamps is increasing with great rapidity. Long after proposed new illuminants have passed into thoroughly successful use, they will have to struggle to make any serious impression on the art as a whole. Meanwhile we tender our respects to the experimenters and wish them success. It certainly is high time for improvements in efficiency, for electric lights demand yearly an enormous output of energy, a large part of which ought to be suppressed.

THE N-RAYS AND RADIOACTIVITY.

It would be hard to mention an important scientific discovery which has attracted less public attention than Blondlot's beautiful researches on the rays which he has thus named. The daily press, which is usually generous to striking discoveries, seems hardly to have learned that N-rays exist. And yet no work within a decade gives richer promise of important results. M. Blondlot's latest discovery is that radiants which give out N-rays can communicate a similar variety of radioactivity to some neutral bodies upon which the N-rays fall. The phenomenon was discovered while concentrating the rays by a quartz lens upon a phosphorescent screen, when it was found that the N-radiation persisted with the lens as a source after the original source was removed. Following up this clue, it turned out that various other substances became temporarily active after exposure to N-radiation. A sheet of lead, for example, became active on both faces after exposure to the rays, producing an effect that might easily have been mistaken for penetration of the lead by a less experienced observer. In short, a set of phenomena closely similar to so-called induced radioactivity are produced by these extraordinary N-rays, which have so commonplace an origin as a Welsbach burner, and are reflected and refracted like any other kind of radiant energy. The N-rays appear to form a connecting link between the ordinary phenomena of light and the singular effects of radioactivity which have set the scientific world agog within the last year or two. No explanation of the latter can now be regarded as complete unless it takes full account of the former and their relation to ordinary radiation. A linkage of this sort is invaluable in preparing for generalization the great mass of experimental data that has been accumulated. The complete emission spectrum of a radiating substance has thus far never been determined, and until this can be done the phenomena which belong to the radiation cannot fully be determined. The study of the N-rays has opened a new field of investigation which seems likely to yield some very important theoretical results.

Gas Power for Central Stations.

At last Friday's meeting of the American Institute of Electrical Engineers, a paper was read by Mr. J. R. Bibbins on the subject of gas engine power in central stations, in which the claim is made that gas engines are both cheaper to operate and easier to operate than steam engines for the purposes of power generation. Thirteen gas engine plants are analyzed, the largest gas engine unit having a rated full-load capacity of about 630 kw. The average size was about 230 kw. These are relatively small engines for modern power plants. The mean cost of gas is stated to have been 1.4 cent per kw-hour, although it is claimed that at a reasonable price for gas of 20 cents per 1.000 cubic feet, the cost would have been only 0.875 cent per kw-hour. It was also claimed that a test of comparative operating economy was made on a certain steam and gas station, lasting several months under commercial conditions. The cost for gaseous fuel in the gas station is given as 0.84 cent per kw-hour, while the cost for coal in the steam station is given as 1.36 cent per kw-hour, these figures thus representing a saving of no less than 39 per cent. in the cost of fuel by gas.

It is admitted that the thermic efficiency of a good gas engine is higher than that of a good steam engine, and it is also generally admitted that a gas engine of, say, 500 hp, consuming fairly cheap natural gas, is cheaper to operate than a steam engine of similar power at the ordinary price of coal; but there is very little yet known of the relative economy of large steam engines and large gas engines in this country. A gas engine is a simpler machine than a steam engine, and has fewer auxiliary parts, especially where natural gas is available. Moreover, we may expect the gas engine to supplant the steam engine in large sizes in the future. For the present, however, we must be content with the great advance that the gas engine has made in recent years up to its present moderate size. When the paper by Mr. Bibbin and the discussion thereon is printed in another issue, we shall return to this interesting subject, which lately has so rapidly come to the front.

New Light on Radium.

So much of the previous work on radium has been wildly speculative and based on undemonstrated electrical hypothesis that it is positively a great mental relief to find so clever an investigator as Sir William Ramsay settled down to an attack on the mystery along sane and systematic lines. The newspaper reports on his London lecture, on which we commented a few weeks ago, are full of speculations on the transmutation of metals and such like pleasantries, but stripping the report of useless verbiage the facts brought to light by later accounts appear to be about as follows: First, radium salts, among other things, give off spontaneously a heavy gas which possesses the radioactive properties of the parent substance. Second, this gas loses its radioactive properties and apparently disappears in a month or so. Third, in so disappearing its spectrum, in itself unidentified, fades out and is replaced by the helium spectrum. As regards this last fact, there can be no manner of doubt, for the helium spectrum is absolutely characteristic and could not be mistaken for anything else, even by the merest tyro, let alone an experienced investigator. Granted the helium, what was its actual source and its relation to radium gas and to radium itself?

Helium itself is a well-defined, stable and rather inert gas nearly as light as hydrogen, present in large amounts in the solar envelope, in a number of stars and in small quantities in a few rare minerals in volcanic regions. From these sources the atmosphere derives a meagre supply. The first matter of importance is the relation of the helium to the radioactive gas which it seems to replace. Is the latter a condensation or a compound of helium? Either hypothesis would be plausible enough, but the former would indicate new relations, the latter old and familiar, though interesting ones. On the one hand, a heavy gaseous compound of helium would be more than likely to be unstable; on the other, a complicated condensation thereof would also presumably be unstable, and in either case a change in the predominant spectrum would probably occur in the breakup of the heavy gas. The most important feature of the case is that the radium gas has in the main the radioactive properties of radium, while the helium which results has not. There is, therefore, in the phenomenon a clue to the real nature of radioactivity, since one can investigate it in a gas of definite character, giving a definite though unknown spectrum and decomposing with the evolution of a known and stable gas. One is tempted to ask whether radioactivity is not, like phosphorescence, a concomitant of decomposition. At all events, the careful study of this change in its quantitative relations is likely to throw a flood of light on the nature of radioactivity, and the relation of the hypothetical electrons to the phenomena observed. And when it is definitely decided whether radium gas is a condensation of helium—He_n; or, let us say, helium X-ide $He_n X_m$—a very long step will have been taken toward unraveling the mystery of radium itself—a consummation most devoutly to be wished, if only to deprive the yellow journal writer of the opportunity that the present lack of knowledge affords for sensational speculation.

It must be remembered that when one hears the word radium, it really means a salt of radium, generally the chloride or bromide, since no one has yet obtained enough of the precious substance to risk in attempts at reduction to the metallic form, so far as we have yet heard. In fact, the metal itself when obtained might not possess radioactive properties at all, or might only possess them in a small degree, and it might very possibly turn out that radioactivity is characteristic of the decomposition of an unstable radium salt. All this, of course, is pure speculation, but the really pertinent question is the relation of the radium-helium gas to the salt of radium (so-called), which gives it off. It has yet to be shown that radium is a chemical unit in the ordinary sense. It is quite possible for a substance to knock about for years as an element of known spectrum and atomic weight and then to be split up into two or more components, each quite characteristic chemically. Such was the case with didymium. This being so, it is certainly not impertinent to inquire whether the radium gas is a general emanation from the radium salt as a whole, or from a possible component. Comparison of the spectra will probably give some clue to the facts—about the only clue possible, until radium can be obtained in reasonable quantities. Enough has been said to indicate that the derivation of helium from radium gas gives one no proper license to talk about the transmutation of metals. That all the so-called elements are derived from some parent substance or substances is an old theory, and one which in itself is probable enough, but all the data heretofore at hand indicate that the resolution of an element into its components is unlikely to be a simple or spontaneous process. Hence, it is well to go slowly in this radium-helium affair. The demonstrated facts taken merely at their face value are interesting and important enough without indulging in speculation. We hope that Ramsay will push his investigation vigorously, for it seems far more likely to clear up the radium mystery than any other line of research which has yet been tried. It is a great pity that the material is so nearly unattainable, for its scarcity at present puts ordinary chemical methods quite out of the game and forces reliance on methods that necessarily leave many questions unanswered.

Test of Westinghouse Turbine.

On December 21 an economy test of a 1,250-kw Westinghouse steam turbine generator set for the Interborough Rapid Transit power house was made at the Westinghouse Machine Company's shops. The net results showed a steam consumption of 15 pounds per electrical horse-power with 27 in. of vacuum, and 14½ pounds, with 28 in. of vacuum; barometer reading, 30 in.; steam, dry saturated, delivered to the turbine throttle at 150 pounds gauge pressure. At the close of this economy test the automatic safety stop, with which all Wesinghouse turbines are now equipped, was tested by holding down the governor lever so that the speed of the turbine was uncontrolled. The turbine, of course, accelerated its speed immediately, and just before the rate of speed reached 10 per cent. above the normal rate, the safety stop automatically released and shut off the steam supply. This was followed by a test for regulation under extreme conditions, the full load being thrown on and off instantaneously several times. The variation in the speed of the unit between no load and full load, as indicated by the change in tone of the note given out by the generator, was barely perceptible.

December Meeting of the A. I. E E.

Four papers presented last Friday at the December meeting of the American Institute of Electrical Engineers. Two are reprinted in full elsewhere in this issue, namely, the paper by Mr. George H. Lukes, entitled, "Overhead High-Tension Distributing Systems in Suburban Districts," and that of Mr. W. C. L. Eglin, entitled, "Safeguards and Regulations in Operation of Overhead Distributing Systems." A paper was presented by Mr. J. R. Bibbins, entitled, "Gas Power for Central Stations," setting forth the advantages of operating central stations in connection with gas works, and included a number of curves of tests of gas engines and tables of operating costs and profits of the typical gas power plant equipment. We shall return to this paper in another issue.

Mr. E. J. Bechtel, in a paper entitled, "Automatic Apparatus for Regulating Generator and Feeder Potentials," described a type of such apparatus used in the station with which he is connected. These regulators are of the boosting transformer type, having a secondary winding in series with the circuit and divided into small sections which are capable of being automatically cut in or out step by step, as the conditions require, to maintain a desired voltage at the individual feeder terminals. They will regulate up to ten volts above or below that of the bus-bars. The paper includes a diagrammatical representation of the apparatus and reproductions of records.

The greater part of the discussion of the evening was on the paper by Mr. Bibbins, which is reserved to be printed in another issue with his paper. In discussing the paper by Mr. Eglin, Mr. H. M. Geer said that unnecessary blowing of fuses can be practically eliminated by a systematic method of fusing lines according to the connected load, and checking up the connected load on all fuses at regular intervals. The burning of cross arms due to leakage of current from the cases of iron cut-out boxes in wet weather may be reduced to a minimum by mounting the boxes on glass supports. Fuses should be restricted to the least heavily loaded branches, depending upon circuit-breakers or station fuses for protection from accidents on feeders or heavily loaded mains. Another class of accidents has been much diminished by first-class line construction combined with a system of regular inspection, which if made at intervals of one or two months, will often reveal prospective causes of trouble due to the erection of new buildings, stringing of wires by other companies with too little clearance, etc. Interruptions due to burnt-out transformers may be minimized by the use of lightning arresters located near the larger transformers, since troubles from overheating are very infrequent.

Mr. Geer said that a cross arm similar in dimensions to the one described by Mr. Lukes has been in use in Chicago for a number of years with excellent results. Double-petticoat glass insulators, having an outside diameter of about 4½ inches, have been used in Chicago on 4,000-volt, three-phase circuits for several years with excellent results, but the deep-groove, double-petticoat insulator used on standard 2,000-volt lines would probably serve the purpose equally well, as far as insulation is concerned. In Chicago, accidents due to lighting wires falling across telephone wires have been almost unknown.

Mr. G. T. Hanchett said that one of the most prolific causes of accidents on lines running in suburban districts is the grounding wire on trees. He has seen limbs 6 or 8 inches in diameter burned completely in two by wires, and also wires burned in two from resulting arcs. Mr. H. A. Wagner said that latest practice has shown the desirability of numerous lightning protecting devices installed away from the station, in addition to those also used in the stations and substations. In an experiment made on a railway in western Pennsylvania a lightning arrester were placed on every pole, care being taken to see that all ground and other connections were properly made. Observations made on each arrester after every storm showed that with four arresters per mile per conductor practically every lightning discharge was taken care of.

Mr. Paul M. Lincoln advocated relying only on the insulator for the line insulation. Burning out of pins can be prevented in two ways, one being to make the pin a perfect insulator and keep it so, and the other and better method to make it a conductor, as in that case the escaping current cannot generate sufficient heat to cause burning. Mr. M. P. Ryder said that his experience is that it is not safe to depend upon any wire insulation, whether of rubber or weather proof. He considered, however, that weather-proof wire is a great protection in dry weather, and saves a good deal of trouble which otherwise would occur in service, and in this he was supported by several others during the discussion. He considered that lightning arresters are not an absolute protection against lightning, and that it does not pay to use a great number of them, confining their use to the station end of the circuit and to the terminals. Ralph D. Mershon and Mr. Fremont Wilson very strongly condemned the use of weatherproof wire, and the latter criticised severely the Yonkers line of the North River Lighting Company, both on account of lack of proper lightning protection and from grounding on trees. He had noticed children taking shocks from trees, and in testing the circuit himself, he received a severe shock. Professor Sever dwelt on the danger from the crossing of high-tension wires with telephone and signal wires, and said that within a few days a 16,000-volt feeder wire at Joliet, Ill., fell across a telegraph wire and caused fires six miles in one direction and nineteen miles in the other, burning two stations to the ground and setting fire to the switchboard of the telegraph company in Joliet. He had found that there are about 260 fires on the Underwriters' records caused by the crossing of signal and telephone wires with railway and other high-power circuits.

Mr. H. G. Stott said that the grounding of any part of the secondary network, especially the neutral wire, is the best form of protection obtainable. When lightning strikes a high-tension line the oil transformer forms one of the best lightning protectors. Referring to a query why a transformer primary fuse will blow in a lightning storm, he said this is caused by the lightning jumping either between the turns of the transformers and short-circuiting the transformer, or if the secondary is grounded, jumping through the light insulation to that ground. He emphasized the desirability of concentrating all automatic apparatus in the power house or in substations. Mr. W. C. L. Eglin stated that he has experimented with many devices to keep wires from trees, but all have failed. He agreed with Mr. Mershon that weatherproof insulation is a farce, and should not be permitted, and he also agreed that the line insulation should be provided in the insulator and not in the pin, the latter being only expected to support the insulator. His experience with lightning arresters has been that in the stations they are more effective than on the line, for the reason that they are kept in better condition. Mr. Mershon concurred with several speakers who condemned the use of rubber gloves; they are an actual source of danger, as the men will depend upon the gloves and yet will not keep them in proper condition. Mr. Geer said that one point favoring the use of weatherproof wire is that in case of actions in court the fact that there is even weatherproof insulation on wire is of decided advantage to the company complained of. As to lightning protection, the results of experiments have shown that the average distance apart of arresters on the line should be about a quarter of a mile. In some cases, however, transformers have been burned out located not more than two or three hundred feet from a lightning arrester. In running through trees, some trouble may be obviated by a little trimming of the smaller limbs, or giving the wire somewhat more than normal sag, and in some cases it is advisable to use a porcelain tube about two feet long secured to a limb. Mr. Fremont Wilson cited a case where after lightning arresters had been placed a distance apart of a quarter of a mile no further damage from lightning occurred.

Telephone Spring Jacks.

As we go to press, telegraphic advices from Chicago inform us that the Western Electric suit against the North Electric Company, for infringement of Scribner and Warner patents relating to long and short springs in spring jacks for telephone switchboards has been dismissed and judgment for costs awarded against complainant.

Montreal, the Greatest Centre of Transmitted Power. IV.

(Concluded.)

By Alton D. Adams.

THE CHAMBLY POWER HOUSE.

At Chambly two sets of bus-bars are provided at the switchboard for the two-phase, 2,200-volt current from the generators. The low-tension side of the step-up transformers there may be connected with either of these two sets of bus-bars by means of motor-operated oil switches. Each of the eight main generators may be connected by its switch with either set of these bus-bars, but these generator switches are manually operated. The generator switches, like those for the transformers, are of the oil type, with a separate brick and stone compartment for each pole. To provide air under pressure for the ten air-blast transformers, four blower sets are employed, each consisting of a 40-hp, 550-volt induction motor, direct-coupled to a pair of blowers, one at each end of the motor shaft.

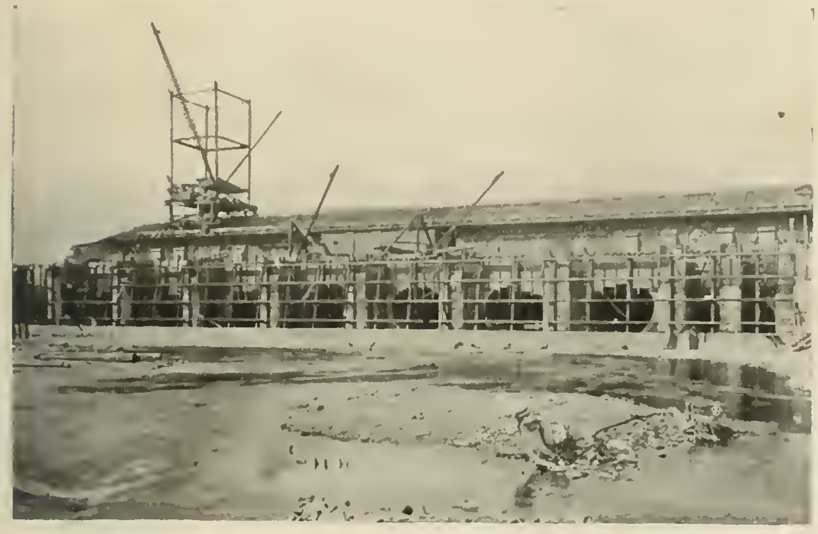

FIG. 1.—FRONT VIEW OF CHAMBLY POWER HOUSE.

Of the eight alternators at Chambly, four were made by the General Electric Company and are rated at 2,200 kw each, at 2,200 volts two-phase. The other four alternators are of the Stanley make, and each has a capacity of 2,000 kw, at 2,200 volts two-phase. All of these generators operate at a frequency of 63 cycles per second, this number of cycles having been adopted as a compromise between 60 and 66 cycles, both of which frequencies were formerly found in the water power stations that now contribute to electrical supply in Montreal. By lowering the speed of revolution a little for some generators and raising it a little for others it became possible to operate the several water power stations in multiple at 63 cycles per second. Each of the eight alternators at the Chambly station is direct-connected to the horizontal shaft of four McCormic turbine wheels mounted together. Each of these turbines is 51 in. in diameter, and under the available head of 31 ft. of water operates at about 152 r.p.m. Two exciters, rated at 300 kw and 125 volts each furnish current for the magnet coils of the alternators. Each of these exciters is direct-connected to the horizontal shaft of two 27-in. turbine wheels, which are rated at 450 hp, and operate at 250 r.p.m. under the water head of 31 ft. The set of wheels driving each main generator and each exciter is regulated in speed by a Lombard governor. Four of the above alternators, those made by the General Electric Company, have stationary armature coils and internal revolving magnets. In the case of the four Stanley alternators the armature coils are stationary, but this is also true for the single magnet coil of each machine, and the only revolving parts are the masses of iron that complete the several magnetic circuits. Eight alternators and the two exciters form a single row that extends almost the entire length of the Chambly power house, and their shafts are all parallel. As may be noted from the above, the total rated capacity of alternators at Chambly is 16,800 kw.

FIG. 2.—VIEW UP STREAM FROM POWER HOUSE.

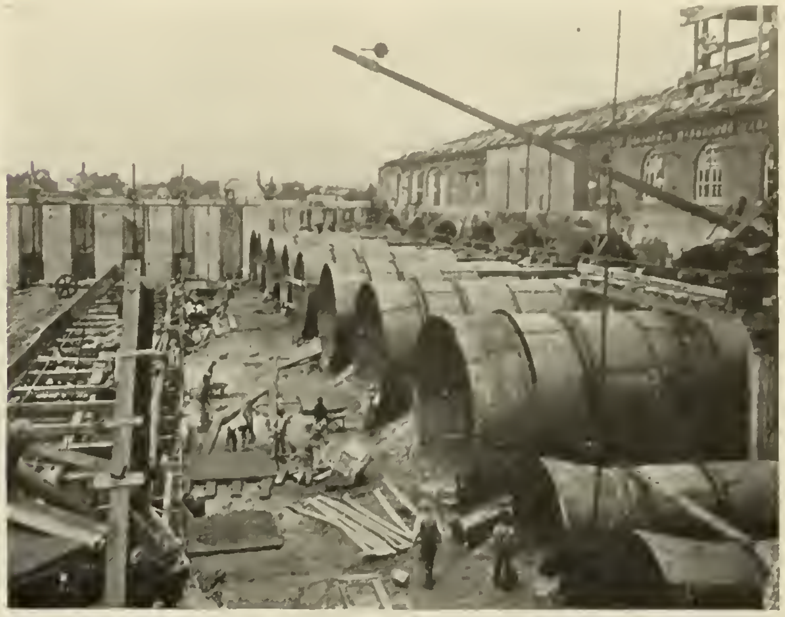

FIG. 3.—SETTING THE PENSTOCK TUBES.

FIG. 4.—VIEW DOWN STREAM FROM POWER HOUSE.

The room thus occupied by the generators is about 277 ft. long and 28 ft. wide. At nearly the same level with the generator room and on its upstream side, but separated from it by a water-tight wall of concrete 4 ft. thick, are the compartments for the horizontal turbine wheels. The shafts of the main wheels are located 17 ft. above the tail-water level, and each shaft passes into the generator room through a water-tight bulkhead of cast iron. From each pair of 51-in. turbine wheels, of which there are two pair on each shaft, a draft tube of 10 ft. 3 in. diameter passes down to the tail water. Top, bottom and sides of the wheel chambers are all of concrete, and the roof of these chambers rises on its outside to an elevation of 19.7 ft. above the floor of the generator room. The concrete floor thus formed by the roof of the wheel chambers is about 20 ft. 4 in. wide between the plane of the wall on the upstream side of the generator room and the upstream wall of the upper part of the station. This elevated floor over the wheel chambers is about 305 ft. long and carries the switchboard in its central portion and the transformers.

Underneath that particular portion of this elevated floor that is nearest to the generator room, parallel to that room, and directly over the water wheels that are nearest to the wall that separates the generator room from the wheel chembers, there is a tunnel 6 ft. wide and 6.5 ft. high. Into this tunnel, which runs beneath the switchboard and the transformers, cables between the switchboard, transformers and generators are brought. Along the top of the concrete wall that separates the generator room from the wheel chambers there is a row of steel columns that extend to the lower cord of the roof trusses. These columns serve to support a track for one end of the traveling crane, and the track for the other end of this crane is carried by steel columns along the downstream wall of the station. This crane is provided with electric motors for both hoisting and conveying purposes, and sweeps the entire generator room.

In effect the water power station at Chambly forms a part of the dam across the Richelieu River by which the head of water is maintained. This dam, considered as a whole, starts from the west side of the river in a direction approximately at right angles with the bank and continues thus until it is more than half-way across the stream. Then the dam makes a turn at approximately right angles, and continues down stream nearly parallel with the east bank for perhaps 1,000 ft. At the end of and at nearly right angles to this second part of the dam comes the power house, which extends to the east bank, and thus completes the dam. About 30 ft. of the length of the water power station rests on the bank, and the remainder of its 308 ft. of total length is built up from the bed rock of the river. Up and down stream the width of the station foundations is 82 ft., and this narrows to about 72 ft. at the floor level of the generator room and the wheel chambers. On a level with the top of the arches over the wheel chambers, whence rises the upper part of the wall on the upstream side of the station, its width shrinks to 51.5 ft. over both outside walls. The steel roof trusses span these walls and the lowest cords of these trusses are 34.5 ft. above the floor of the generator room. Foundations of this power station are of concrete up to and including the floor of the generator room on the downstream side, and up to and including the roof of the wheel chambers. These concrete wheel chambers have a total length of 42.5 ft. up and down stream, and of this length 20.5 ft. is outside of the upstream wall of the top portion of the power house. Above the concrete foundations the walls of the power house at Chambly are of brick with vertical steel columns set into them to support the roof trusses. Beneath the upstream side of the power house there are ten wheel chambers for the eight sets of large wheels and two sets of smaller ones. Beneath the downstream side of the power house there are seventeen archways through which the draft tubes of the several sets of wheels pass between the wheel chambers and the tail water.

Each pair of the 51-in. turbines has its own draft tube of 10 ft. 3 in. diameter, and each pair of 27-in. wheels has a draft tube of approximately 5 ft. diameter. There is thus one archway under the generator room for each of the larger draft tubes, and also one archway for the pair of smaller tubes.

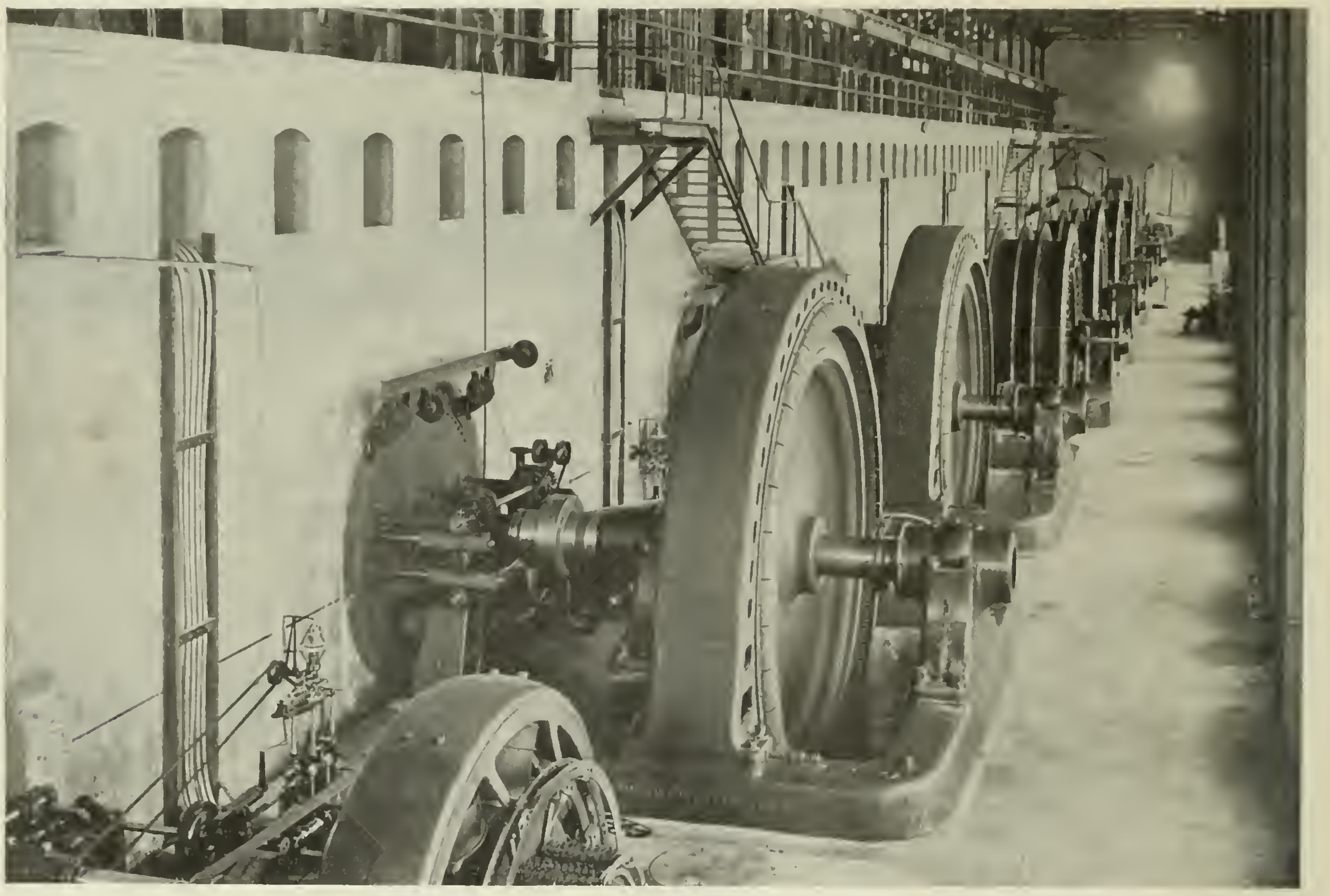

Fig. 5.—Interior View Chambly Power House.

At the upstream end of the wheel chambers is the steel rack to keep ice and other floating objects away from the wheels. This rack is 269 ft. long and has a vertical height of 23.5 ft. From the foregoing it may be seen that the flow from head to tail water is directly underneath the power house from the upstream to the downstream side. As at first constructed, the wheel chambers contained the open turbines, but this has recently been changed and a steel penstock with gate has been provided for each set of wheels. Near the river end of the power house a set of waste gates in the dam or forebay wall, through which water may be drawn off into the main channel of the river, are located. The long portion of the dam running up and down stream, as well as the shorter portion that crosses the main channel, was originally built entirely of concrete, save that small iron rods were buried at intervals in the mass to increase its strength. Results with this construction have not been entirely fortunate. Some time after the completion of the dam, that

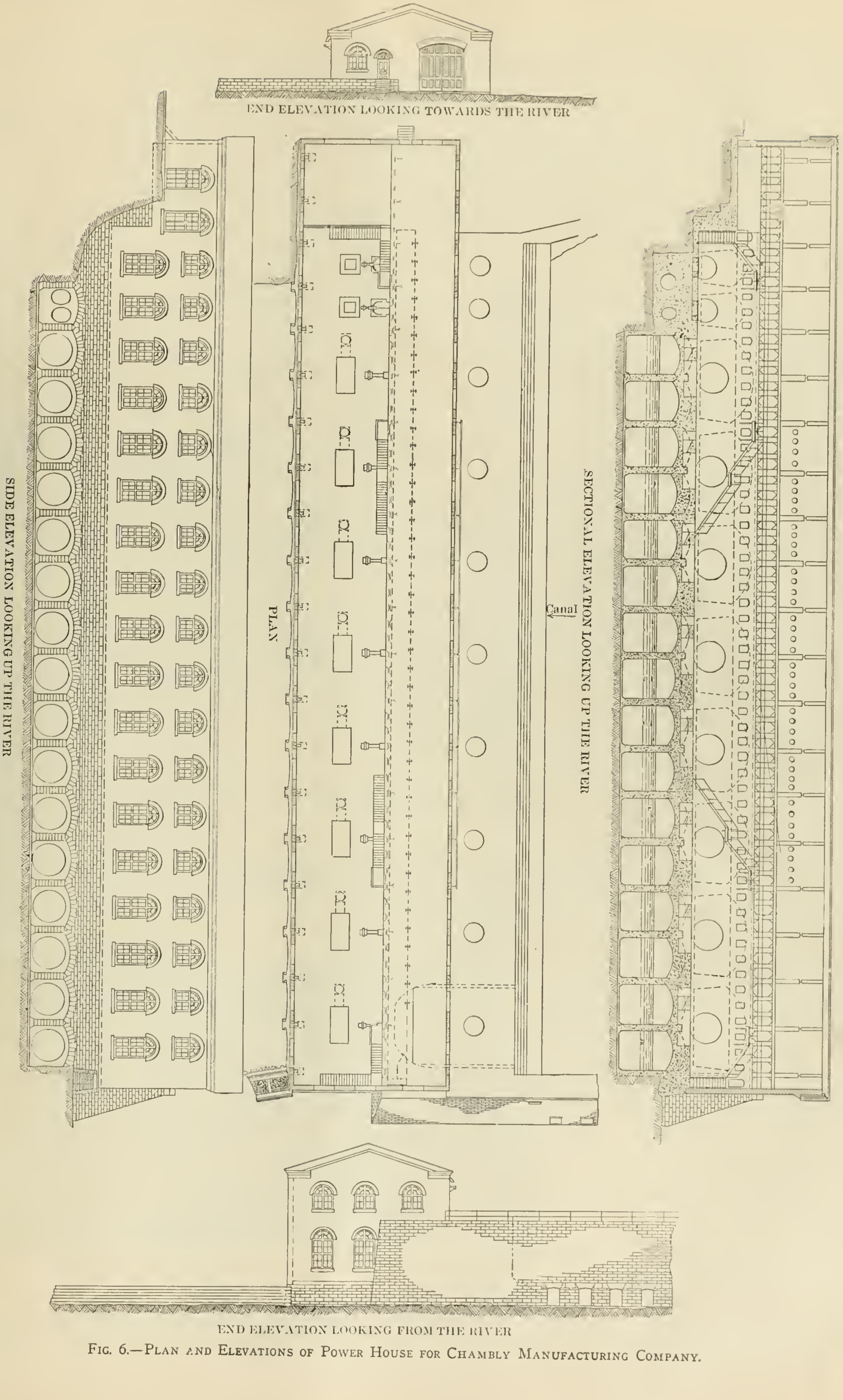
END ELEVATION LOOKING TOWARDS THE RIVER
SIDE ELEVATION LOOKING UP THE RIVER
PLAN
Canal
SECTIONAL ELEVATION LOOKING UP THE RIVER
END ELEVATION LOOKING FROM THE RIVER

Fig. 6.—Plan and Elevations of Power House for Chambly Manufacturing Company.

portion containing the waste gates, near the power station, gave way and had to be rebuilt. On December 1, 1902, that portion of the dam across the center of the main river channel broke loose and moved some rods down stream in a mass, leaving a clear gap from the bed of the river up for the escape of the water. This detached portion of the dam, bristling with the iron rods that were intended to hold it together, still stands alone in midstream, a monument to its builders. Repair of this break has only recently been completed, and meantime great loss has been sustained through inability to operate the 16,800 kw capacity of generating equipment at the power station. While a new section of dam was being constructed in the gap at midstream, a wide apron of timber and stone has been laid along the side, next to the main river channel, of that part of the dam that extends for more than 1,000 ft. up and down stream. As this very large piece of concrete dam work stands, whether from improper design or poor materials, it may fairly be said to illustrate to a conspicuous degree the way not to do it.

Lachine Rapids on the St. Lawrence River, between the Island of Mantreal and the south bank of the stream, is the site of the second water power station owned and operated by the Montreal Light, Heat & Power Company.

At this station the head of water on the wheels, about 16 feet, was obtained by an unusual construction. The St. Lawrence River at this point passes through a long series of rapids with no great fall in any one place. To render a portion of the water available for power purposes, a large breakwater, perhaps a mile in length, was constructed up and down river through the rapids between the island of Montreal and the south bank, but nearer the former. At a point nearer to the down stream than to the up-stream end of this breakwater a power station and dam was thrown across that portion of the river between the breakwater and the Montreal bank. Water in that portion of the St. Lawrence between the breakwater and the Montreal shore must obviously pass through the power station on its way down stream, and in thus passing it is made to fall through a long row of water wheels. The head of water being so small, only 16 feet, it was necessary to devise some way in which a reasonable speed of revolution could be obtained for the electric generators. The plan adopted was to use single vertical turbine wheels, and to drive each generator direct connected to a long horizontal shaft, which is in turn connected by bevel gears with the vertical shafts of six turbine wheels. As originally designed each horizontal shaft with its connected generator had a speed of 180 revolutions per minute. Each of the 51-inch vertical turbine wheels geared to this horizontal shaft had a speed of about 77 revolutions per minute.

The water-power station at Lachine Rapids was designed for twelve generators of 750 kw capa-

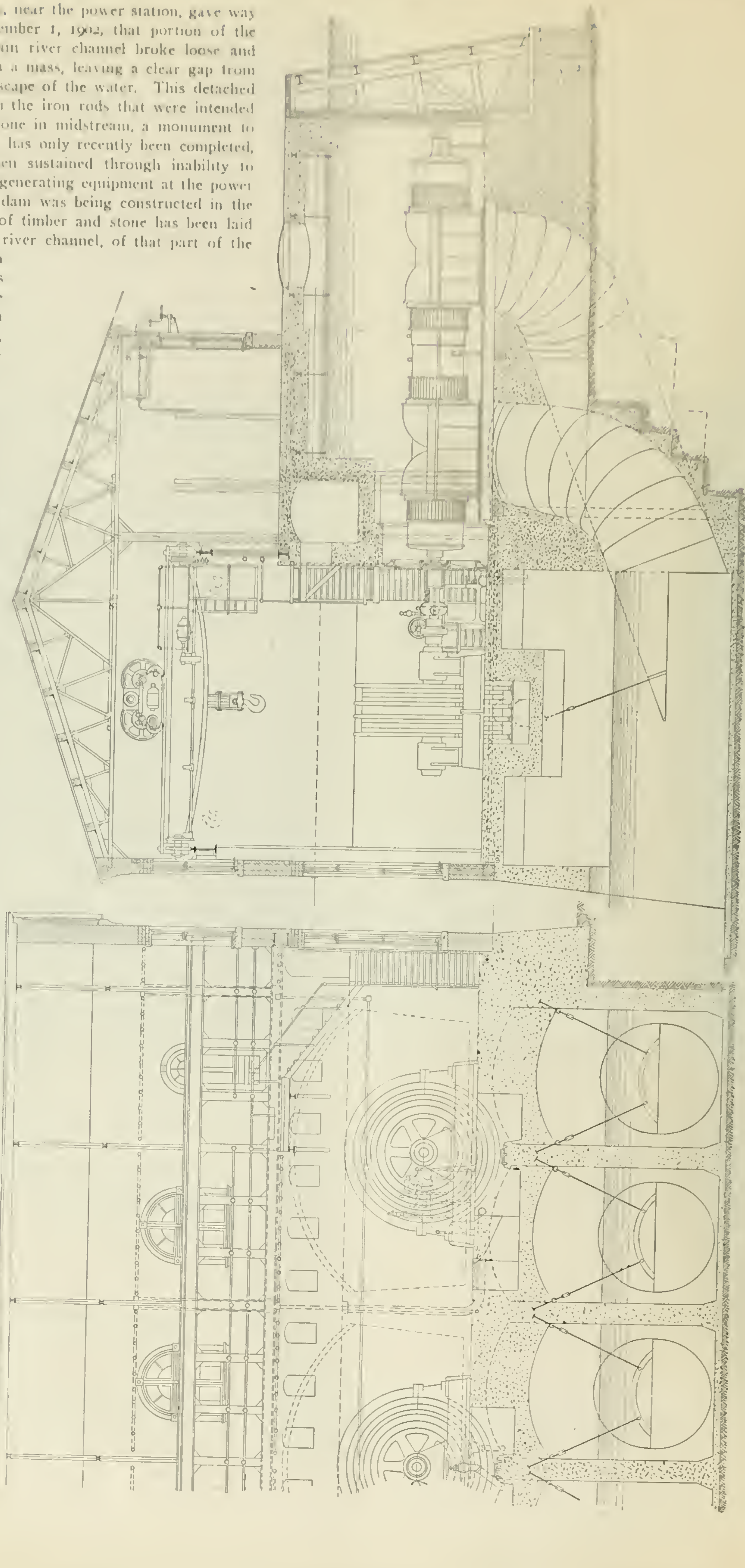

Fig. 7.—Sectional Elevation Through Wheel House and Power House

city, each, but only eight of these generators have thus far been installed. To drive twelve generators in the way stated, each having a horizontal shaft geared to six vertical wheels, it was thought desirable to arrange the generators in three groups, each group being two generators wide and two long. Between these three groups of generators and beyond each group extend their horizontal shafts, so that there are two long, parallel rows of these shafts with six shafts in each row. To house generating equipments aranged in this way requires a long, narrow building, and the power station at Lachine Rapids is accordingly 1,000 feet long and 50 feet wide in the main part. At the three points where the groups of generators are located, the width of the power station is increased to about 70 feet, and the switchboard is in one of these wider portions. Each of the alternators now installed at this power station is of General Electric make with internal revolving magnets, and is rated at 750 kw and 5,000 volts, three-phase. The original frequency of 60 cycles per second has been increased to 53 cycles by a small raise of speed, so that the Lachine plant may operate in multiple on the distribution lines in Montreal with the plant at Chambly, where the original frequency of 66 cycles per second was lowered to 63 for a like reason.

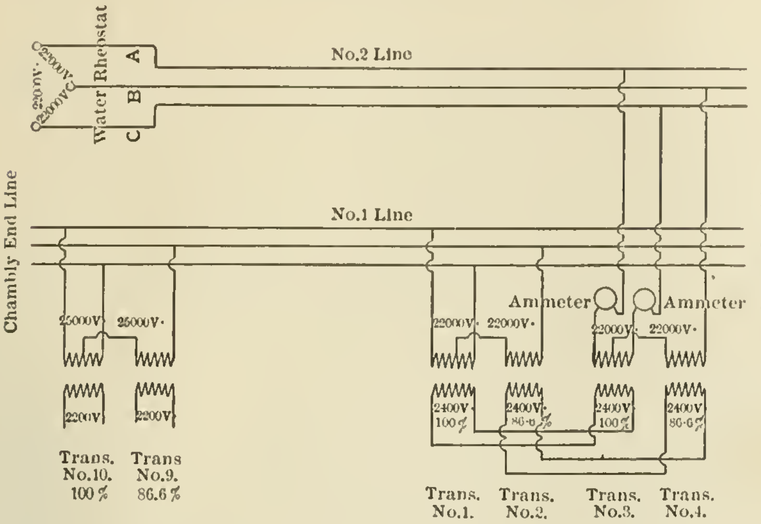

FIG. 8.—DIAGRAM OF WATER RHEOSTAT CONNECTIONS.

As may be seen from the above, the total capacity of alternators now at the Lachine station is 6,000 kw. Four exciting dynamos are provided for these alternators, each being rated at 75 kw and 90 to 175 volts. Each exciter is driven at a normal speed of 660 r.p.m. by a belt from a separate water wheel. The wide range of voltage just named was provided for at each exciter because the available head of water at the Lachine power house is subject to much variation, causing changes in the speeds of both the alternators and exciters, and these changes must be compensated for by different currents and degrees of saturation in the alternator magnets, in order to maintain a constant alternating voltage. With a view to these changes of saturation in the magnets of alternators, these magnets were so designed that at full speed and voltage their degree of saturation is below the usual figure.

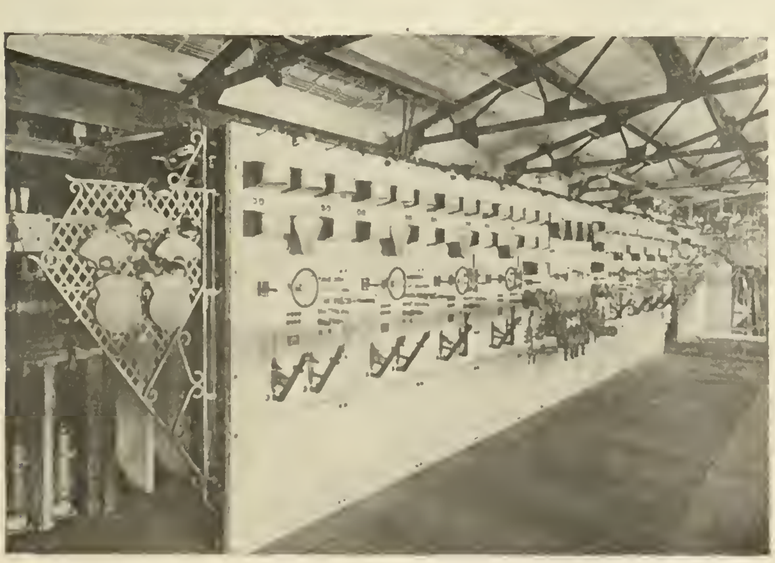

FIG. 9.—CHAMBLY SWITCHBOARD.

The distance from the Lachine power house to the sub-stations in Montreal is so short that no step-up transformers are employed to raise the voltage of 5,000 developed in the armature coils of the alternators, and energy at this pressure is delivered to overhead lines for transmission to the McCord Street and the central sub-stations. These lines are carried in large part by steel poles with wooden cross arms. In this case the steel poles are built up of structural shapes, and are erected from 100 to 125 ft. apart, as might be done with wooden poles.

Up to 1902 the transmission line between the water power plant at Chambly and the central sub-station in Montreal was operated at 12,000 volts, and in this line there were 12,000 ft. of cable in pipes and conduits under ground and under water. This 12,000 ft. of cable was all of the single-conductor type, each conductor consisting of 37 strands equal to 00 copper wire. In each cable the stranded conductor was insulated with vulcanized rubber compound to a thickness of ¼ in., and then with two layers of rubber tape. Outside of the tape came a seamless covering of lead 3/32 in. thick. This cable was installed in January, 1898, and continued in use until some time in 1902.

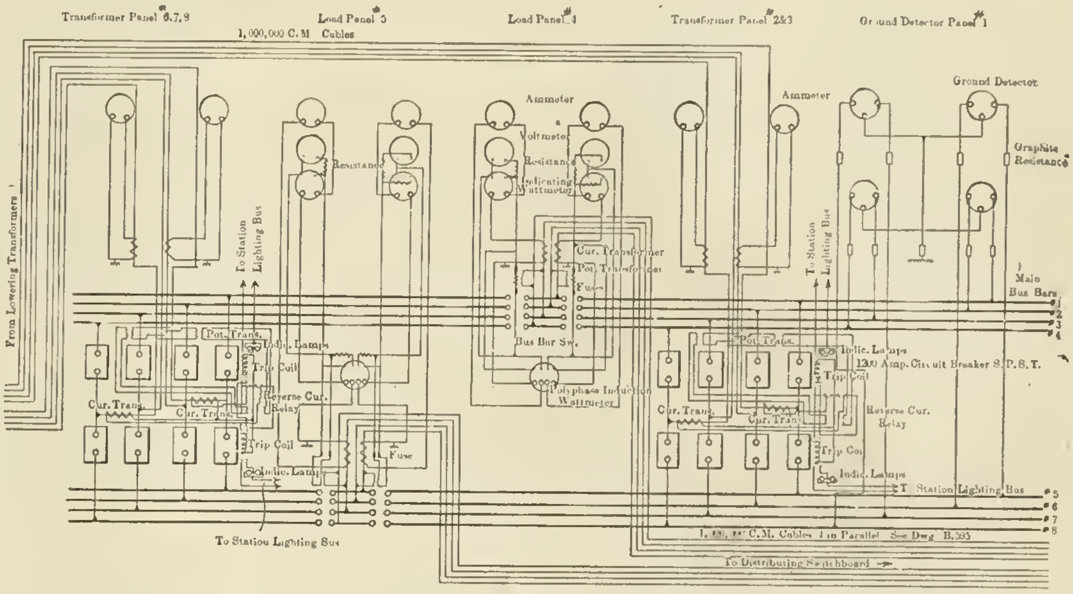

FIG. 10.—LOW-TENSION TRANSFORMER SWITCHBOARD.

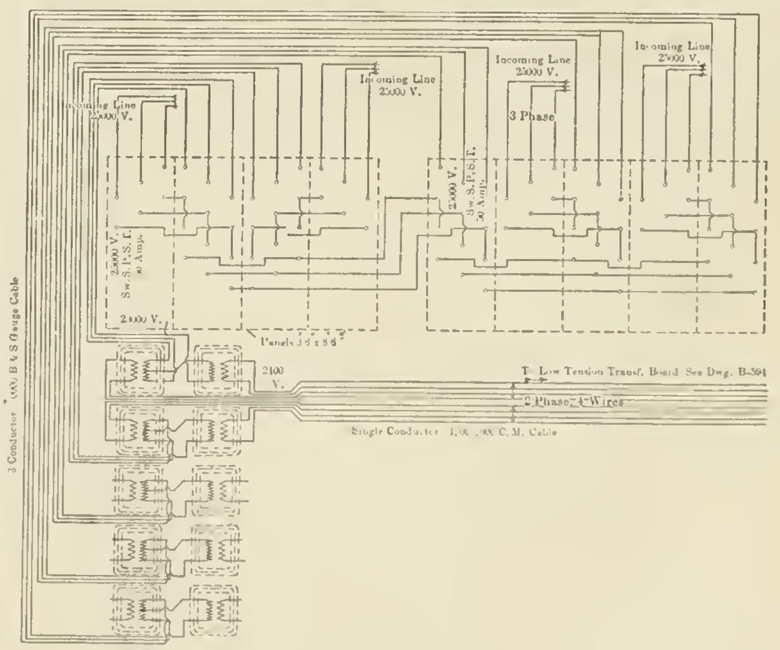
Incoming Line 23000 V.
Incoming Line 23000 V.
Incoming Line 23000 V.
Incoming Line 23000 V.
3 Phase
23000 V.
2100 V.
Panels
To Low Tension Transf. Board See Dwg. B-594
2 Phase 4 Wires
Single Conductor C.M. Cable
3 Conductor B & S Gauge Cable
10-2750 K.W. Lowering Transformers 23000 to 2100 or 1900 Volts

FIG. 11.—INCOMING LINE AND TRANSFORMER PRIMARY SELECTOR 23,000-VOLT BOARD.

The lead sheath of the cable contained 3 per cent. of tin, but had no outside coating or covering. A part of this cable was laid in creosoted wooden boxes, and a part in iron pipes. During the entire four years that this cable was in use carrying a current of 12,000 volts, two-phase, there was no failure. Furthermore, during 1½ years of this time, the only method used to protect the cable from lightning discharges was that of barbed wires strung on the poles that carried the overhead conductors, and connected to a ground wire at each pole. As the territory between Chambly and Montreal is subject to frequent and severe thunderstorms, this freedom from injury to the cables is of interest as bearing on the protection afforded by barbed wires against lightning.

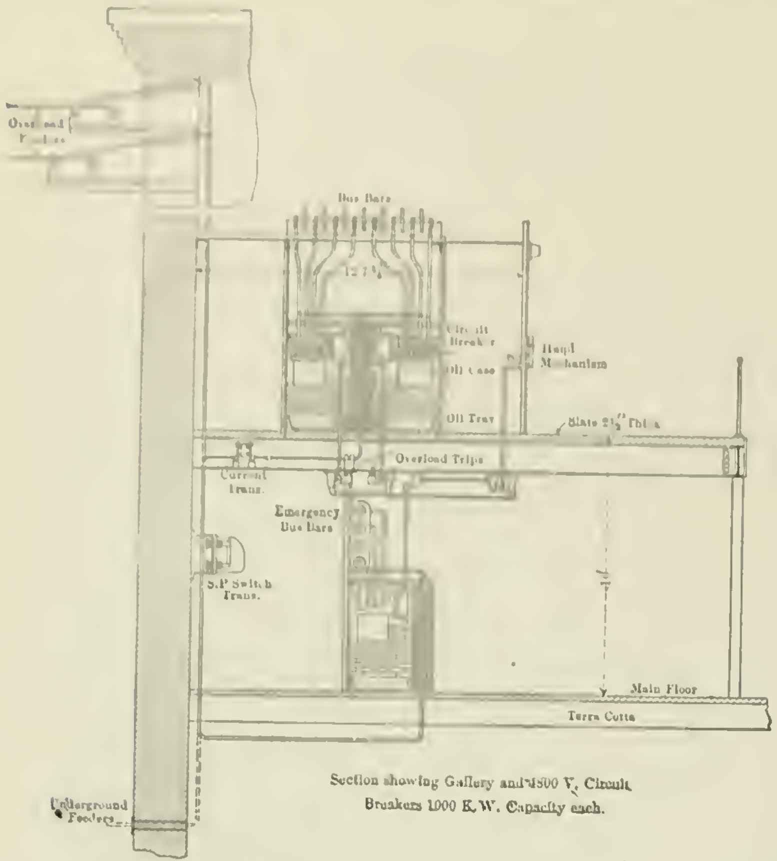

FIG. 12.—SECTION THROUGH DISTRIBUTING BOARD.

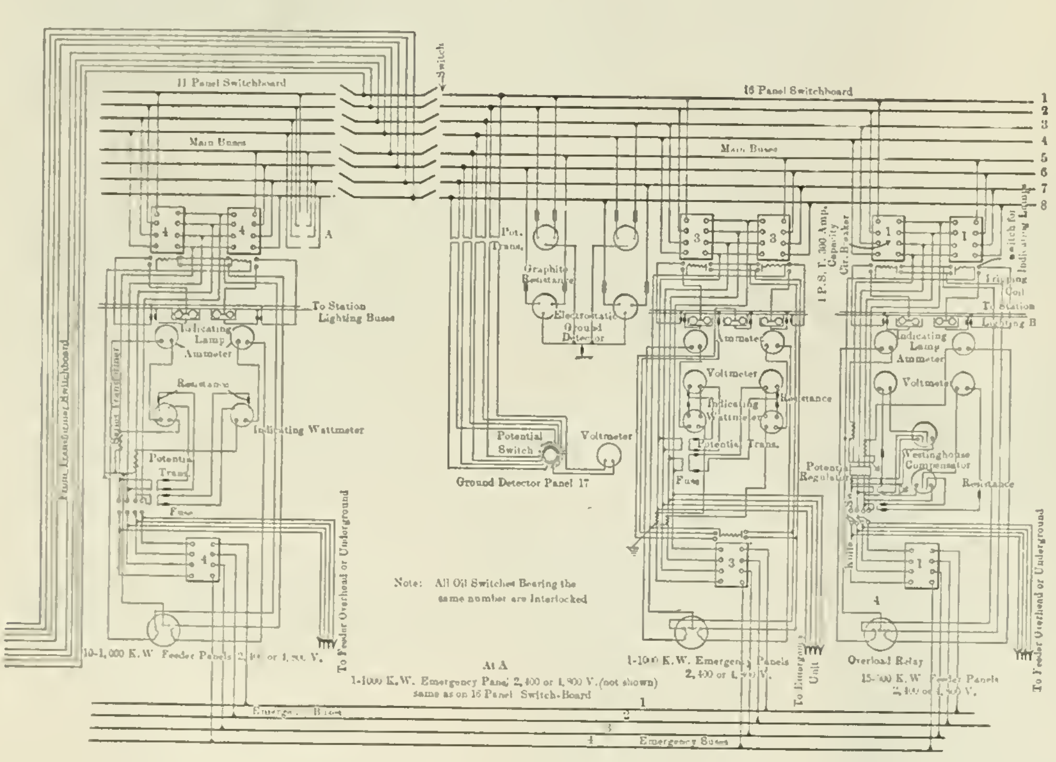

FIG. 13.—DISTRIBUTING FEEDER SWITCHBOARD.

On the 25,000-volt transmission circuits between the power house at Chambly and the central sub-station in Montreal switching is done only when there is no load. All switching of transformers under load is done with their low-tension coils, and this has given satisfactory results. No fuses are employed in these high-tension lines. Operation with a grounded neutral to protect transformers has led to no trouble with the transmission circuits themselves or with nearby telephone wires. In spite of the high voltage on this line the insulators have given no trouble by puncturing, and no arcs have started between the wires. Telephone service with its wires on the same poles with the power circuits is satisfactory, but has been found more subject to noise in wet than in dry weather, and with heavy than with light current on the line. No one has been hurt by electric shock while using a telephone. Repairs on the transmission circuits have been made at all times of day and in all kinds of weather without injury to workmen, but during such repairs no energy is sent over the wires on the poles where work is being done. The transmission line is patrolled three times a week.

For the purpose of testing the new transformers at the Chambly plant and the sub-station, and also the two 25,000 volt transmission lines, a rather novel plan was adopted. At Chambly, near the power house, three 40-ft. cedar poles were fastened together in the form of a triangle, and from each of the three corners a plate of iron 2½ in. wide, ⅛ in. thick, and several feet long was suspended in running water, so that the plates were about 50 ft. apart. The three conductors of one transmission circuit were then connected respectively to these three iron plates. At the central sub-station in Montreal the other ends of these same conductors were connected to the high-tension coils of a group of transformers. The other transmission circuit was connected to the 25,000-volt coils of a group of transformers at the Chambly power house, and to the high-tension coils of a group of transformers at the central sub-station. The 2,400-volt coils of the two groups of transformers at the sub-station were also connected. In this way energy delivered to the group of transformers at Chambly was transmitted to the sub-station, through the two groups of transformers there, and then back over the other line to the metal plates in the water at Chambly.

The foregoing facts concerning the largest electric water power system in the world have been collected through the kind co-operation of Mr. H. H. Henshaw, secretary and treasurer; Mr. P. G. Gossler, superintendent and engineer, and various employees of the Montreal Light, Heat & Power Company.

Radium Notes From England.

A special cable dispatch to the New York *Sun* of December 19 says: Discoveries are now coming thick and fast. One which unfortunately has escaped is puzzling a well known electrical investigator. He was experimenting a few weeks ago with a large vacuum tube containing, as he supposed, vapor mercury, such as he used in an electric light. He connected the battery and obtained a brilliant white light. He disconnected the battery, and to his astonishment the tube continued to shine as bright as ever. The wonderful light continued for ten days, the experimenter all the time trying to solve the mystery. Then the whole connection was accidentally broken, and all attempts thus far to reproduce it have failed.

The scientific world seems almost dumfounded at Prof. William Ramsay's discovery that the elements are, after all, transmutable. It is felt that what has been regarded as one of the foundations of science has been destroyed. Prof. Oliver Lodge now launches the following stupendous theory: "There are those who have surmised that matter is, after all, only the weapon and vehicle of mind. The way it interprets itself to our consciousness through the sense of the organs gives no clue to its nature. A motion and alteration of the configuration of the molecules of our brain are believed to accompany every act of thought. It will be, at any rate, a suggestive analogy if a material process of an essentially similar sort is found to be occurring throughout what we know as the inorganic world—the world of dead matter—and we should begin to ask, Does all this motion correspond to some universal thought or mental activity likewise?" Not the least interesting thing about the new work in radium has been this zeal exhibited in making the discovery apply to all the old and new theories in metaphysics as well as physics.

Application of Single-Phase Alternating Current for Traction and Railway Service.

By B. G. Lamme.

THE present direct-current railway system has limitations in voltage, speed control, etc., which have long been recognized by the electrical profession. Many systems have been devised with more or less success—generally with less—in order to overcome these limitations, so that the possible field for the direct-current systems could be extended. It has also been recognized by some of those familiar with the problem that a single-phase alternating current motor having the characteristics of a direct-current series motor would at once furnish a means of attaining many results now impossible with the direct-current system. Such a motor obtained, then the voltage limitation can at once be removed, as the transforming properties of alternating current can be brought into use. Also economical operation at any desired speed can readily be obtained through the same property of alternating current. Furthermore, the use of single-phase permits a single overhead wire where track return is used, thus retaining a most valuable feature of the direct-current system. It is thus evident that a motor of this character will permit the retention of most of the present advantageous features of the direct-current system, and also enables the use of other features not permissible without great complication and expense with the present direct-current system.

There has been perfected only one class of single-phase motors which possess the characteristics of the direct-current railway motor, and this one class of motors very closely resembles the direct-current machine in the general features. These motors may all be given the general name of commutator type single-phase motors, as all of them have commutators on the armature or rotating member, and the armature is provided with a direct-current type of winding. Some variations from the usual types of armature windings have been proposed, but the various direct-current types have proven most successful.

All these commutator types of motors, which have the variable speed characteristics suitable for railway service, may be broadly classified as belonging to the series type. By this we mean that the field or exciting current is in series with the armature circuit, either directly or through transformer action, either in the motor itself or outside the motor. The series type of motor can be subdivided into two classes, viz., the straight series motor, in which the current in the field wholly or partly passes through the armature, or vice versa; and those in which the field or armature forms a secondary circuit, the primary of which can be either part of the field structure of the motor, or may be outside of the motor. All these motors—whether of the straight series or of the transformer type—have the property that the field magnetism varies with the load, although not necessarily in direct proportion. Hereafter we will refer to these two types, as the straight series and the transformer types of motors. All these motors are related to a greater or less extent in their characteristics, and in many instances one type can be readily changed to the other type. In fact, by closing a single switch, we have changed a straight series motor into the transformer type with the armature closed on itself, forming a secondary circuit, with a change in performance apparently due only to the amount of material in the magnetic circuit being insufficient for the best performance as a transformer type.

In these commutator type single-phase motors, the two most important elements, besides the speed characteristics, are the efficiency and the power factor. The efficiency of such motors will usually be less than that of a direct-current railway motor of the same output. The losses in one of these alternating-current motors can be considered as made up of the following elements:

First.—Iron loss due to reversals of magnetism in armature and field at the frequency of the supply circuit.

Second.—Armature iron loss due to variations in magnetism dependant upon rotation of the armature.

Third.—Iron loss in the surface of field and armature due to the bunching of magnetic lines from the teeth of either element.

Fourth.—Losses in field windings.

Fifth.—Loss in armature windings.

Sixth.—Brush losses.

Seventh.—Friction and windage.

Comparing these losses item by item with those of a direct-current motor, we see at once that certain losses will necessarily be greater than in the direct-current motor.

First.—Iron loss due to the frequency of the supply circuit and induction in the primary element. No such loss exists in a direct-current motor, as the machine is excited by continuous current. This loss in the alternating-current motor will not be a relatively large per cent, unless the motor is worked at a very high induction, or unless the construction of the magnetic circuit is such as will allow eddy current losses. It is at once evident that the field magnetic circuit must be laminated as completely as the armature circuit, and that there are no local circuits permissible in the field structure. It is also evident that a field structure of a straight series motor will, in general, have lower losses than of the transformer type, where the field itself forms part of the transformer, as in this latter case the total induction in the field structure will generally be greater than in the series type.

Second.—Armature iron loss due to variations in magnetism dependant upon rotation of the armature. There will be a loss in the armature due to the alternating magnetism from the primary or field circuit. This can be charged against the field loss or primary loss, as maintained above. In addition to this loss, there is a loss due to the rotation of the armature in the field. This will be dependent upon speed of rotation, inductions in the core, teeth, etc., and in general will practically average the same as that of a direct-current motor of same capacity.

Third.—Iron loss in the surface of field and armature due to the bunching of magnetic lines from the teeth of either element. This is a loss which appears to some extent in the field pole face of direct-current machines, due to the bunching of the lines from armature teeth. This loss is relatively small on direct-current machines, if the poles are properly laminated and if the air gap is relatively large compared with the width of the armature slots. This loss in direct-current motors is included in the armature iron loss measurements, due to the methods generally used for determining iron loss on such motors. This loss will appear in the field surface or face of the alternating motor, and may be considerably greater than in the direct current, if a smaller air gap is used than in direct-current practice. By air gap we mean clearance from iron to iron.

If the field structure is of the slotted type, the slots being of such form as to give bunched lines, then there will also be a loss in the armature surface due to the bunching of these lines. It should be noted that the frequency of the secondary currents set up by the bunched lines from armature or field teeth is generally very high compared with the frequency of the supply circuit, or of that due to the rotation of the armature in the field. We believe that in general the loss due to the bunched lines will not be much greater in the alternating-current single-phase motor than in the direct-current, except where very small air gaps are used on the alternating-current motor.

Fourth.—Loss in field windings. This loss is very similar to that in direct-current machines, as the amount of copper in the field windings will generally be no greater than on direct-current motors of same capacity, and may even be considerably less. The straight series motor will generally have a lower copper loss than the transformer types where the field structure is used as the primary of the transformer.

Fifth.—Loss in armature windings. The loss in the armature windings will be very similar to that in a direct-current machine, as far as the working current is concerned. In addition to the working current, there may be secondary currents in the armature turns short circuited by the brushes, which still further increase the armature loss. The resultant armature loss may, therefore, be somewhat greater than on a corresponding direct-current machine, unless the normal resistance of the armature winding is reduced below that of a corresponding direct-current machine. In practice the loss in the armature winding is made practically equal to that of the direct-current machine, in order to avoid increased heating.

Sixth.—Brush losses. The brush losses due to the reversal of current in the single-phase alternating-current motors are generally somewhat greater than in a direct-current motor. Such motors are usually wound for a comparatively low voltage on the armature, and thus greater brush capacity is required than in direct-current practice. The brush losses are thus increased, due to the greater number of brushes, and in addition there may be local currents in the short-circuited coils, which may produce additional loss in the part of the brush next to the commutator. In practice this loss is evidently comparatively small, as our experience shows no signs of deterioration in the brushes in regular service. Therefore, the increased brush loss may be considered as principally due to the increased number of brushes required.

The brush loss due to the local currents in the short circuited turns can be reduced considerably by the use of very narrow brushes, a brush spanning one bar or even less. With such a brush there would be short circuiting only while the brush is bridging two bars, while at intermediate positions there would be no local current. As, in general, the commutators of such motors have a relatively large number of bars, this would mean a very thin brush, possibly less than one-quarter inch in thickness. Such brushes we consider too thin for street car purposes, as any roughness on the commutator would tend to break the brushes. In some of our very early experiences with such motors, we used brushes of one quarter-inch in thickness, but found they required entirely too much attention, and therefore they were abandoned in favor of brushes of a thickness corresponding to direct-current practice, the later designs of motors permitting the use of such brushes.

Seventh.—Friction and windage. The friction in bearings and the windage loss in such motors will be very similar to the corresponding losses in direct-current motors, but the brush friction loss will, in general, be somewhat greater, due to the increased brush capacity. Also the large number of commutator bars generally used, tends to increase brush friction to some extent.

It is evident from the above considerations that the various losses in different parts of the single-phase alternating-current motors are either equal to or greater than the losses in the corresponding direct-current motor, although no individual loss, except that due to the reversal of magnetism in the field, may be much greater than in the direct-current motor. The sum total of the slight increases make a difference of from one to five per cent in the efficiency of the motor, this difference being less with larger motors.

The frequency of the supply circuit also has a small effect on the efficiency, although the relation of the losses in the various parts is so involved that no definite figure can be given for this effect.

The losses in the single-phase motor are, to a certain extent, dependent upon the speed at which the motor is operated, with a given current and torque. Assuming a given current, with the motor running at reduced speed, we can note the effect on the losses as follows:

The iron loss due to the frequency of the supply circuit is changed but little. The iron loss due to changes in magnetism in the armature and due to bunching of lines from the teeth are very considerably decreased due to the lower armature speed. The losses in the field and armature windings are practically unchanged, and short-circuit loss in the brushes is not greatly changed. Friction losses in brushes, bearings and windage are all decreased. Therefore, at lower speed, the actual losses in the motor are considerably decreased, but not in proportion to the decrease in output of the motor. Therefore the efficiency decreases slightly with the reduction in speed with a given torque, this efficiency decreasing more rapidly the more nearly the zero speed is approached.

With changes in load, with a given voltage applied the efficiency curve has very much the same shape as the efficiency curve of a direct-current motor, starting low at light load and high speed, and rising to a maximum, and then falling off considerably at very heavy overloads.

After efficiency, the next most important consideration in the performance of such motors is the power factor. This is a feature which does not appear at all in direct-current machines, as the apparent input in such motors represents true energy. In the single-phase railway motor the apparent input in general does not all represent true energy, as a certain component of the input is required to magnetize the motor, and this component represents practically no energy. Also magnetic leakage in the alternating-motor represents a component of the apparent input which is practically wattless.

In a straight series motor a certain magnetizing current is required with a given field winding. The alternating flux through the field winding sets up alternating e.m.f.'s which lag practically 90 degrees behind the energy component of the motor, and the product of the field current by the field voltage thus represents a wattless component of the input of the motor. With increase of load, the field current increases, the induction increases, and therefore the field volts also increase. The wattless component in the field thus varies with the product of two values which are both increasing with the load. The energy supplied to the motor increases approximately in proportion to the current supplied. Therefore, the wattless component in the field increases more rapidly than the energy component. Consequently, if this were the only wattless component in the motor, the power factor would decrease with the increase of load and would be highest at no load. Other wattless components of the input are represented by the cross magnetizing effect of the armature, if such exists, and by the stray field around the windings. As these effects will also increase more rapidly than the energy component, it is therefore evident that the power factor in this type of motor will be highest at no load or at highest speed, and will decrease with the load or speed with a given voltage applied. But if the windings are so proportioned that the wattless component at the rated capacity is relatively small, then a high power factor will be obtained at the rated load and speed. At lighter loads and higher speeds the power factor would be considerably higher. Such a motor can give very high power factors at half loads with correspondingly increased speed. If the motor is operated at lower voltages, then the power factor at a given speed will be very nearly the same as when operated at the same speed at a higher voltage and higher load. Therefore, it is evident that as the speed is reduced, no matter what load is carried, the power factor will be decreased, and at start the power factor will be lowest, as the energy component in this case represents only the losses in the motor. We have tested a 100-hp motor showing 92 per cent power factor at 100 hp, and approximately 98 per cent power factor at one-half load, the voltage being the same in both cases. This question of power factor is largely a question of design, as the magnetizing or exciting compound of the input depends upon the air gap, amount of material, etc. In general, larger air gap means more exciting current.

The magnetic leakage in these motors may be relatively high, or may be comparatively low, this being to a considerable extent a function of the design of the motor, just as in all alternating-current machinery. Generally it is made as low as possible without sacrificing other important features.

If the armature cross induction in a series motor is large, due to excessive armature ampere turn per pole, small air gap, etc., the armature self-induction will be large. Increasing the number of poles will reduce the cross-magnetizing effects, but at the same time will require somewhat smaller air gap, or increased excitation. These two features are, therefore, to a certain extent balanced against each other.

There are various schemes for improving the power factor of the commutator type single-phase motors. These are generally most effective at high speeds, but at start or at very low speeds the improvement is small. In certain designs of both straight series and of the transformer type motors, the magnetizing current can be supplied in whole or in part to the armature circuit instead of the field magnetic circuit by means of brushes on the commutator. At certain speeds, this current can be supplied at a considerably reduced voltage, thus requiring a reduced magnetizing input compared with excitation applied to the field. This excitation can be supplied from the secondary of a series transformer, the primary being in circuit with the primary winding of the armature. The armature excitation will thus vary as the field excitation would normally vary, thus giving the varying field induction, and the series speed characteristics. While this arrangement is effective in improving power factor at certain speeds, yet, as a rule, this gives the least effect at the time when it is most required, viz., at start and at very low speed. This method also requires a second system of brushes on the commutator, thus spacing the brushes on the motor the same distance apart as if double the number of poles were used. For instance, a four-pole motor would have brushes spaced 45 degrees apart instead of 90 degrees. At start there should be practically the same input required for magnetizing, whether the current is supplied to the armature or to the field.

Comparing the straight series with the transformer type of motor, it should be noted that the straight series motor requires less magnetizing current, as the magnetizing current is only supplied to one element of the field. With the transformer type of motor a magnetizing field must be furnished as in the straight series, but there is also a second field set up due to the transformer action, and this also requires a magnetizing current. In other words, it may be considered that there are two magnetic fields set up, approximately 90 degrees apart, each field requiring a certain magnetizing current. These two fields may be considered as forming one resultant field of higher value than either of the components, with a magnetizing current of higher value than either component. In the series motor the transformer part of the field can be made to practically disappear, only the exciting field remaining; the resultant induction is, therefore, much less than with the transformer type, the field having an approximate average value of 70 per cent of that of the transformer motor, the magnetic circuit being reduced in proportion.

It thus appears that the straight series motor can be made to give a somewhat higher power factor than the transformer type, with the field used as a transformer, and this is obtained with somewhat less weight. This difference in power factor could be compensated for at higher speeds by some means of excitation applied to the armature through the commutator, as indicated above. But for traction service, where the least weight with great compactness of design, is desirable, it appears to us that the straight series motor possesses some advantages. The transformer type of motor with the transformer in the motor itself can be compared with the straight series motor with a separate transformer, if high voltages are to be used on the line. We consider that a number of more compact motors under a car with one separate reducing transformer forms a more suitable combination than a similar number of larger motors, each with its transformer inside itself.

There is one other method of improving the power factor on these motors, and that is by the use of resistance in series with the motors. If the voltage on the motors is controlled by the use of an external rheostat, as in common with direct-current motors, then the power factor with a given torque will be constant and independent of the speed. With a given torque the wattless component of the input of the motor is practically constant independent of the speed, and if the speed is controlled by rheostatic loss, then the energy component will also be practically constant, and the power factor can be made higher at all loads. This may appear to be a good feature to those who have not considered the problem carefully, but it is a fact that a high power factor obtained in this way represents a less desirable condition than the low power factor which would be obtained if the rheostatic method of starting were not used. With a given wattless input from the circuit, the best possible condition as regards effect on the supply system is that represented by the minimum expenditure of energy. A wattless component has a certain effect on the regulation of the system, and any improvement in power factor by increasing the energy component means that much additional effect on the supply system.

It is surprising that so many are so imbued with the idea of high-power factors that they are even willing to obtain it by increasing the losses in the apparatus, thus in reality increasing the load on the system. A high-power factor obtained by rheostatic control would represent no more advantageous condition than the use of resistance in series with an induction motor, when running, to increase its power factor. If a permanent resistance connected be parallel with an inductance motor, it will not increase the power factor of the motor itself, although any measurements of the input to the motor and resistance will show a higher power factor than that of the motor itself; but anyone can readily see the absurdity of this combination, although it does raise the power factor. The use of resistance in series with a motor in order to give higher power factor at starting would represent a similar absurdity, although it would not be as evident on the face of it.

Leaving out the question of power factor, the rheostatic method of starting and controlling the motor will, in certain instances, possess advantages over other methods, especially where the loss in the rheostat will average but a small part of the total power expended over a given period. This method of operation should not necessarily be abandoned in all cases, simply because voltage control can be obtained.

The next point, and one which is of considerable interest to the electrical fraternity at large, is the question of commutation in the commutator type of single-phase alternating-current motor. In the early times in the electrical business it was discovered that there were many things that could not be done with alternating current, and among these was the commutation of alternating current without excessive sparking. This opinion has become so well established that at the present time many engineers are very doubtful of this point. This opinion is based principally upon experiments in commutation of alternating current, mostly made many years ago, and not upon the theory of commutation itself. In many cases it was considered that the alternating current had some mysterious property which caused sparking when attempts were made to commutate it.

If we go back to the early periods we also find many things which could not be done with direct current, but which are done at the present time. I well remember the time—about thirteen years ago—when I was informed by a number of the leading engineers of that time, that it was useless to consider the construction of slotted armatures for railway generators of the then gigantic size of 200 kw. At that time the Westinghouse Company had a railway armature of this size almost completed, and this advice was very discouraging. But as the armature was so nearly ready to test, it was decided to assemble the machine and find out how badly it would work. The result of the tests was such that the Westinghouse Company immediately abandoned the surface wound type of direct-current armature in favor of the slotted type. Other companies probably had similar experiences, for the slotted type is now almost universally used. The above is merely given as an illustration that in direct-current apparatus many early opinions have been abandoned. If one of the 200-hp New York Subway motors had been attempted ten or twelve years ago, conclusions undoubtedly would have been drawn by many engineers, showing the absurdity of attempting to make high class motors of this size.

In the same way advances in the art have lead to a more complete understanding of the underlying principles of commutation among those interested in the design of commutating apparatus, although such knowledge, except in a general form, is limited to a small number of engineers. Very few of all those who handle modern direct-current generators or motors, really know why their machines commutate so much better than some of much older designs which were apparently built on the same lines.

Motor designers with a wide experience in the problem of commutation are now awakening to the fact that commutation of alternating current does not furnish a set of new and mysterious phenomena, but that the laws which apply to direct-current commutation also apply to alternating-current commutation, and that the problem is one of degree principally. If a continuous current of X amperes have its direction reversed in a coil without sparking as the coil passes under the brush, then there should be no difficulty in reversing this current if it varies periodically from X amperes to zero and up to X amperes again. The trouble is that when opinions on commutation of alternating current were originally formed it was not known how to commutate the current of X amperes.

The principal difficulty in commutation of alternating-current motors has been the presence of local secondary currents in the coils short-circuited by the brushes, such currents being due to pulsating or alternating magnetism through the short-circuited coils. Various arrangements have been tested at different times for lessening the effect of these secondary currents. Such motors are usually built with a comparatively large number of commutator bars, with a very small number of armature turns per bar, to lessen the effect in the short-circuited coil. Very narrow brushes have been tried in order that the period of short circuit may be lessened, and two or more parallel windings forming the so-called "Sandwich" type have been tried. These windings lie side by side on the core, but are practically independent of each other and connect to alternate commutator bars, or to every third bar, etc., dependent upon whether two or three parallel sets are used. With two of such parallel windings on a core a commutator brush of a width slightly less than one bar could be so placed that it would never short-circuit a coil of either winding. In this case the brush passes from one winding to the next, and breaks connection with the first winding before passing to the next bar of the first winding. With this arrangement the short-circuiting of the coils would be diminished, but the type of winding is one which we do not consider satisfactory for railway motors. We consider that this is simply transforming the trouble due to the short-circuited coil to another trouble which would in the end be just as serious, viz., the tendency of such windings to produce blackening and pitting of the commutator bars. Such an arrangement would require very thin brushes if but two parallel windings were used, while with three parallel windings the brush could have a thickness corresponding to two commutator bars.

A number of other devices have been tested at various times by different experimenters, but these are attempts to cure an existing difficulty rather than to lessen or eliminate the cause of the difficulty.

Within the past year or two there has been a great awakening to the possibilities of this problem, with the consequence that there is now a world-wide appreciation of the field of operation for commutator types of single-phase motors which will accomplish results not hitherto attainable. Single-phase motors having good commutating properties are now on the market in this country for the commercial frequency of 25 cycles per second. Higher frequency motors could probably be built with reasonably good results, but as 25 cycles has become a commercial frequency in this country, it is probable that this will become the standard for traction service for single-phase motors.

A single-phase motor having series characteristics having been obtained, it is at once evident that it opens up various methods of control hitherto not utilized in railway service. Having the motor which can be controlled in speed by variations in the voltage supplied to it, then voltage control can at once be obtained due to well-known properties of alternating current transformers. Such methods of control are dependent upon the use of alternating current, and have not been applied in railway apparatus heretofore, because there was no suitable motor on the market.

Many forms of apparatus for varying the voltage on alternating current circuits have been known and used, and most of these devices permit voltage variations with comparatively small loss in power. Therefore, with an alternating motor with the series characteristics, it is at once evident that we can obtain a traction system in which the power expended is practically proportional to the work done, and therefore the least power will be consumed at starting and at low speeds. This is an ideal condition for railway service, but has not been permissible with the direct-current system, except by great complication.

There are a number of ways in which the various single-phase commutator type of motors can be controlled in speed. With the straight series type, the voltage applied to the terminals can be varied, the field windings can be varied, commutated, etc., or the relative values of armature and field strength may be varied. Also with certain designs of motor exciting brushes may be placed on the commutator, as we have indicated before, and the voltage applied to these brushes may be varied. All these methods may be used also with the transformer types of motors.

Also by shifting the polarity of the fields to one side or the other of the normal position, the speed can be affected to a greater or less degree, and similar results can be obtained by shifting the armature brushes. The latter method we do not consider a suitable one for traction motors. Also series-parallel control can be used, if desired, just as on direct-current motors, and rheostatic control can also be used. These two methods have practically the same effect on economy as found with direct-current motors with these methods of control.

Single-phase motors of all types, in common with polyphase induction motors, have one feature which is not shared by direct-current motors, viz., there is an active voltage between the field turns. The alternating magnetic flux through the field of the alternating motor generates an e.m.f. in the field windings, just as in the case of an alternating-current transformer. In the direct-current motor the only voltage in the field coils is that represented by the current flowing against the resistance of the windings. Therefore, in a direct-current motor a short-circuit can occur between one or more turns of the field coil without disastrous effects on the motor. Those who have had a wider experience in the operation of electric railways and are familiar with the extremely high temperatures momentarily obtained under certain conditions, will appreciate the importance of this feature of the direct-current motors. If direct-current motors were so designed that short circuit between two turns due to overheating or other conditions would disable the motor so that it could not be operated, then it would be necessary to very considerably increase the dimensions of such apparatus in order to get emergency capacity. It will at once be appreciated that the alternating-current motor, with an active voltage between field turns, must be designed to stand heavy overloads without danger of short circuits between field turns. Therefore, either these motors must be designed with more margin of temperature than the direct-current practice, or the windings used must be such as will permit of more insulation between turns than is used in direct current practice. If such motors are wound for voltages corresponding to direct-current railway practice, then there is greater danger from short circuits in the field than with direct-current motors, and if the motors are wound for comparatively high voltages —say, 3,000 volts, for instance—then the danger from this source is very considerably increased, for in a 3,000-volt motor a large number of comparatively small wires must be used in each coil, and these must be well insulated from each other, and the entire winding must be well insulated from ground. Experience with alternating-current high-voltage stationary motors has shown that such motors are not nearly as safe as those wound for 200 or 400 volts, and we believe that for motors under a car, subjected to the extreme variations of traction service, the danger from short circuits and grounds will be very much greater than in the case of stationary motors. If such traction motors are wound for low voltages, say 200 volts, approximately, then heavy conductors and but a very small number of turns will be necessary on the field, and each conductor can be separately insulated both from other conductors and the ground.

Therefore, the alternating current permits the use of low-voltage motors, with the consequent advantageous construction of field coils where the conditions of operation in direct-current practice prevent the use of any lower voltage than that supplied by the line. Troubles from oil and dirt, such as frequently occur with direct current motors, will become of great importance in alternating current railway motors wound for very high voltages. We believe that, except for very special cases, it will be found safer to step down the voltage on the car by a transformer, thus supplying the motors with low voltage from the secondary circuit rather than to wind each motor so that it becomes a transformer subjected directly to the high voltage of the system. In cross-country work, where high voltage would preferably be used, the step down transformer method also furnishes additional protection from lightning, as it is well known that it is easier to insulate one transformer from lightning than to insulate two or four motors. The question of safety to the passengers and apparatus in the car also should be considered in this matter.

A large number of estimates have been made comparing the general performance, cost, etc., of equipping roads with single-phase alternating-current motors instead of direct-current motors, supplied from rotary converter sub-stations. In all these cases the advantage has appeared decidedly in favor of single-phase, except in a small number of cases where some small limiting condition was placed upon the alternating-current system. If the starts are very infrequent and the running periods long, then the gain in efficiency by elimination of the rheostatic losses at start may be more than compensated for by the slightly lower efficiency of the motors themselves. Where such conditions apply, generally high trolley voltage will be used, and there will be enough gain in efficiency in the transmission and distributing to more than balance the loss in the equipment. Furthermore, the elimination of the rotary converters will furnish a still further gain in efficiency. In estimates made up to the present time, we have, in practically all cases found higher total efficiency for the single-phase railway than for the direct-current railway with sub-stations. In cross-country work the gain in the transmission and distributing system and the rotary converters compensate for other losses. In city work where starts are very frequent and low speeds necessary at times, the gain by elimination of the rheostatic control has appeared as a very important item in the efficiency.

It thus appears that, while suburban work was once thought to be the most important field for the single-phase railway, it has now become evident that city work, where traffic is very congested in parts of the system, will prove to be one of the best fields for this system. Of course, it is recognized that for heavy railroad service, where all kinds of speeds should be obtained economically, the single-phase railway system will undoubtedly show to great advantage compared with any known direct-current system. But as considerable time will be required to equip any railroad service, it is probable that the single-phase railway system will be well tried out before there is a good opportunity to give it a thorough trial for heavy work. There is no difficulty in designing single-phase motors for sizes up to 300 hp or larger, and of sufficiently small dimensions to be used with a single reduction gear on locomotives. There is also no difficulty in designing regulating devices for controlling the power of such motors. For example, a 600-kw induction regulator manufactured by the General Electric Company has been in commercial operation at Niagara Falls for many years, and a regulator of this capacity would be sufficient to control a 2,400 hp locomotive. The induction regulator furnishes an ideal method for locomotive control, as the voltage supplied to the motors can be varied over a wide range without making or breaking the circuit.

In conclusion, we would say that the subject of the commutator type of motor is now being thoroughly studied by engineers in all the principal manufacturing companies in the world, and there is no longer any question that such motors can be built successfully for commercial service. When it is once shown that such motors are feasible and that, therefore, a new field of development is opened, there is immediately a willingness on the part of most of the manufacturing concerns to undertake the perfection of such apparatus. What is needed in any line of development is a promise of success, and it may be taken as true that success will then be obtained.

Telephone Transmitters.—II.

BY ARTHUR V. ABBOTT, C. E.

THE description of typical instruments of each of the preceding forms will now be given.

First, Single-Contact Instruments.—The first microphone was a carbon pencil leaning against a pair of carbon blocks. To make a microphonic transmitter it was essential to put this apparatus in commercial shape. This resulted in the famous Blake transmitter, invented by Francis F. Blake, of Boston, which for many years was almost solely employed by the American Bell Telephone Company, and which to-day may be seen in some localities, although the more modern solid back has almost displaced it. The Blake instrument is shown in half-tone in Fig. 5, while a section and an elevation of the transmitter mechanism is shown in Fig. 6. The Blake transmitter consisted of a small black walnut box 5 9/16 in. wide x 6 11/16 in. high and 2 13/16 in. deep, the dimensions being over all. The object of the box was to provide a receptacle for the induction coil and to protect the working parts of the transmitter from injury. The mechanism was placed inside the door of the box, the center of which was, on the outside, hollowed to a trumpet-shaped cavity, containing a hole in the center through which the sound waves could impinge upon the diaphragm. Fig. 6 gives a section through the mechanism and the elevation of the inside of the door. A heavy brass ring, *e*, was screwed to the door, which formed the foundation of the transmitter. A diaphragm of sheet iron 2⅝ in. in diameter and .013 in. thick, whose edges were covered with a rubber strap, was placed in the center of this ring, and retained in place by means of a clamp, *g*, and a rubber-tipped damping spring, *f*. Upon the foundation ring two lugs, *h* and *i*, were cast. From the upper lug, *h*, a U-shaped piece of brass was suspended by means of a german silver spring, *d*. In the lug *i* the adjusting screw, *r*, is inserted, which bears upon the U brass at *n*. The carbon button was ⅜ in. in diameter and ⅛ in. in thickness. It was made of the purest and most homogeneous carbon, free from grit and with a surface as highly polished as possible. The button was spun into a case, *c*, which may be of any convenient size sufficient to adequately hold the button, and the whole affair suspended from the upper end of the U brass by means of a small steel spring .01 of an inch thick and 9/64 in. wide, over which is slipped a rubber band to prevent vibrations. A German silver spring, *p*, about .005 in. thick and ⅛ of an inch wide armed at its lower extremity with a minute globule of platinum is placed. This spring was likewise attached to the upper end of the piece, *b*, and so adjusted that it stands in the center of the carbon button, and between the button and the diaphragm. When in proper adjustment the german silver spring should press gently against the carbon so as to follow the latter when it is pulled away for a distance of about ⅛ in. and then leave it. The steel spring is adjusted while speaking into the transmitter by varying the tension with the screw, *r*, until the listener reports the most favorable result. With the Blake transmitter commercial telephony became a possibility, and so far as clearness and fineness of articulation is concerned few, even of the most modern instruments, equal the Blake, and it is doubtful if any sensibly excel it. But the Blake, even under the most favorable circumstances, is so deficient in volume that even upon short lines, those whose hearing is in the slightest below normal, find the use of the telephone an impossibility, and upon long lines it is impractical for any.

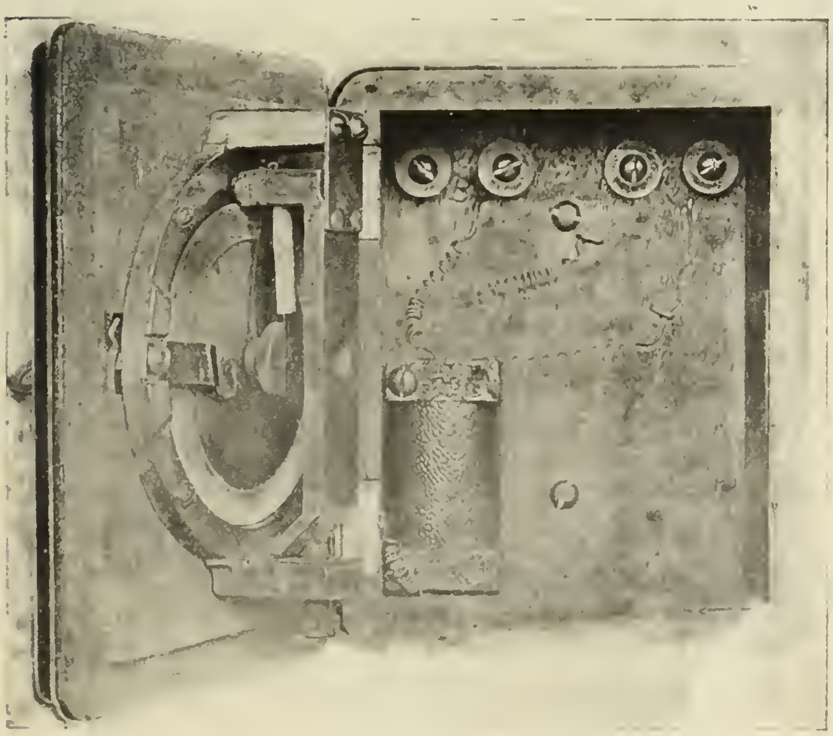

FIG. 5.—BLAKE TRANSMITTER.

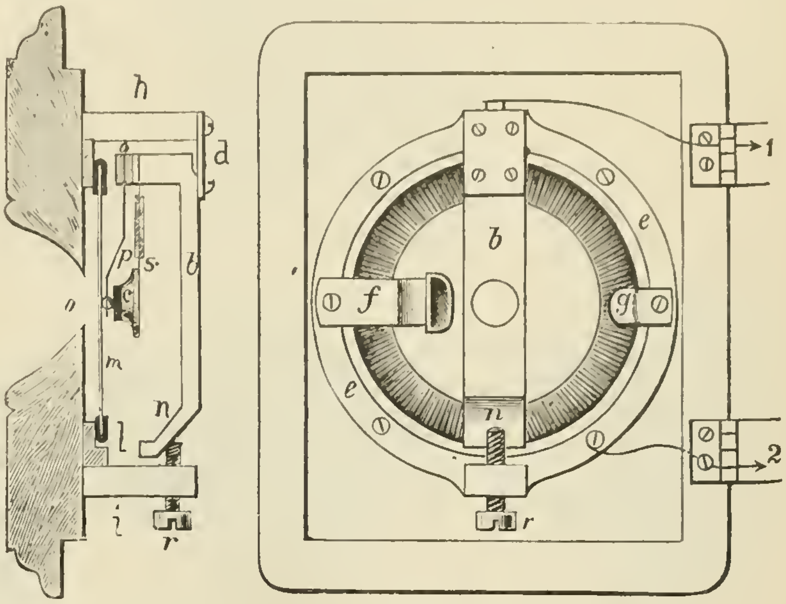

FIG. 6.—BLAKE TRANSMITTER, SECTION AND ELEVATION.

Second, The Series-Contact Transmitter.—This type of instrument is represented in Fig. 7, one form of the many instruments proposed, which should embrace several microphonic contacts in series with each other. A diaphragm, *D*, was furnished with a plunger, *M*, behind which a tube, *T*, was placed that contained a number of carbon bullets. The rest of the construction of this model is self-evident from the illustration. Transmitters of this description have not been markedly successful, and from our present conceptions of the operation of the microphone contact, one is likely to wonder at the expenditure of so much time and energy upon series contacts, for it is very obvious that if the operation of the transmitter is to be that of a valve it is either necessary to make one valve large enough to accommodate the maximum desired current or to put a number of valves in *multiple*, as it is manifestly impossible that one valve in series with another of the same capacity can transmit a greater volume than a single one is able to pass.

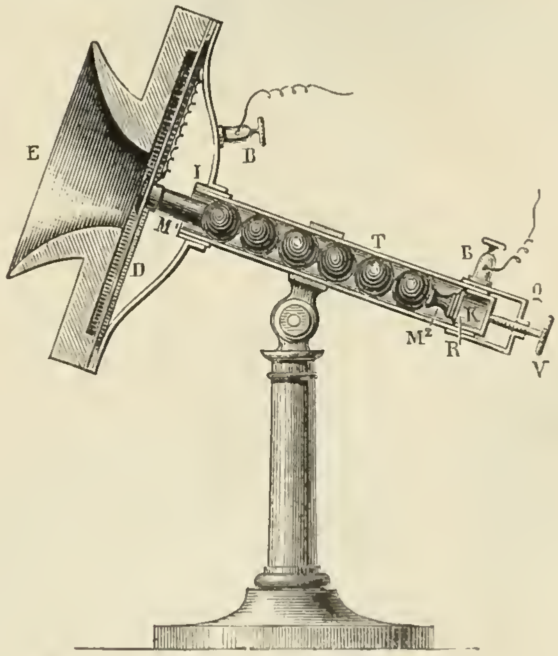

FIG. 7.—SERIES CONTACT TRANSMITTER.

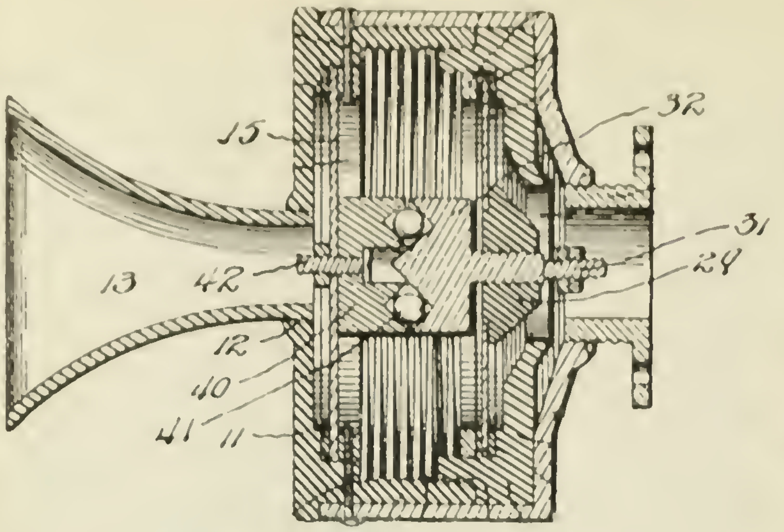

FIG. 8.—MULTIPLE CONTACT TRANSMITTER.

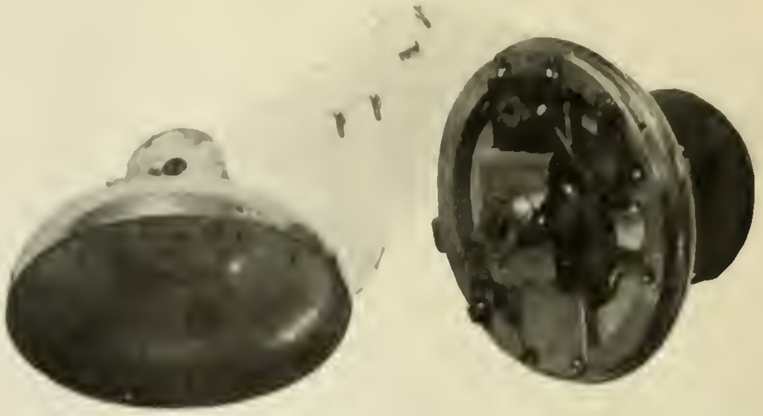

FIG. 13.—SOLID BACK WITH CASE REMOVED (SIDE VIEW).

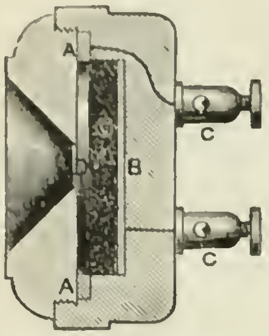

FIG. 9.—HUNNING TRANSMITTER.

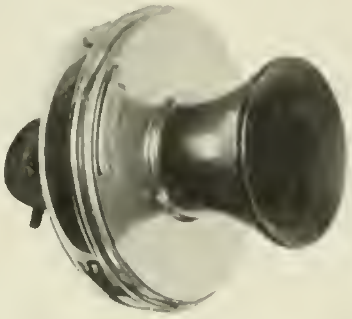

FIG. 11.—WHITE SOLID-BACK TRANSMITTER HEAD.

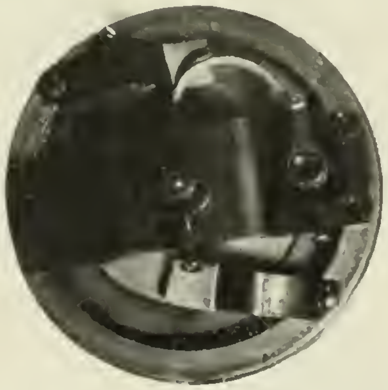

FIG. 12.—SOLID-BACK WITH CASE REMOVED.

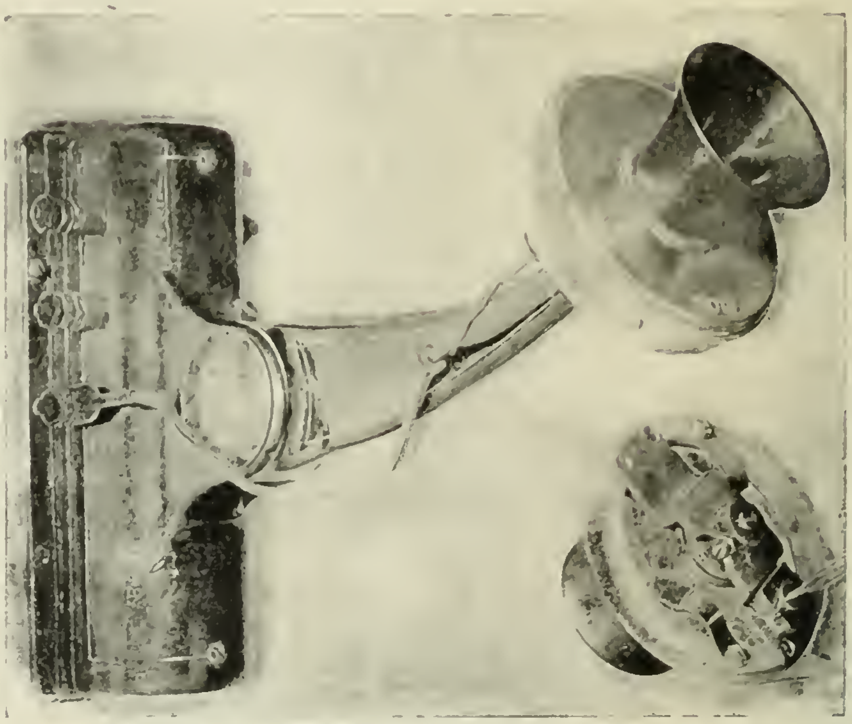

FIG. 10.—SOLID-BACK TRANSMITTER.

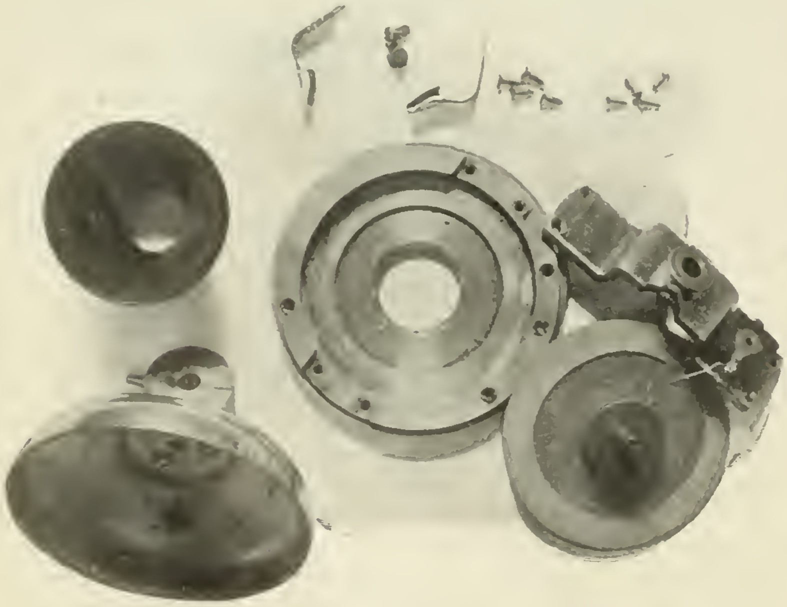

FIG. 14.—SOLID-BACK PARTLY DISSECTED.

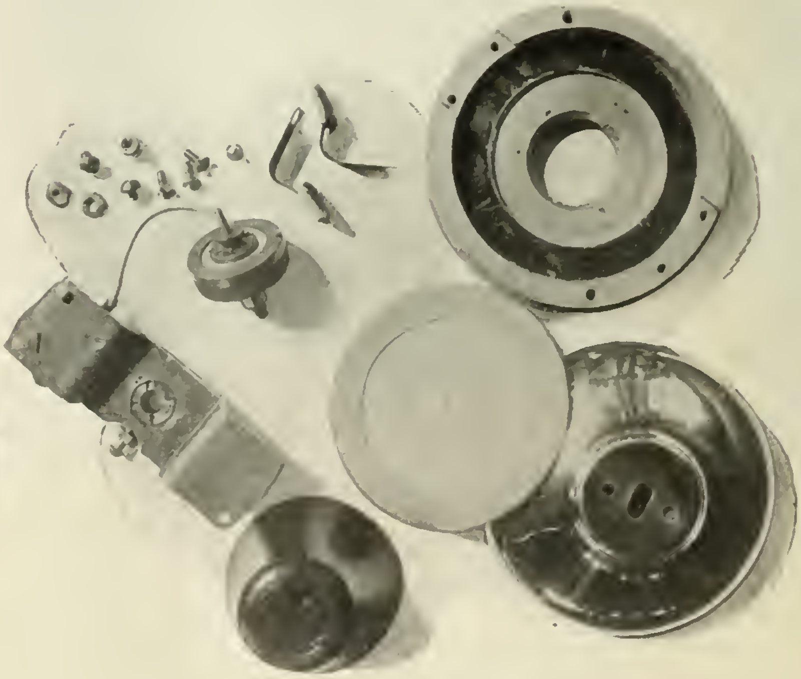

FIG. 15.—SOLID-BACK COMPLETELY DISSECTED.

TELEPHONE TRANSMITTERS.

Third, The Multiple-Contact Transmitter.—It was soon perceived that it was hopeless to expect great improvements from the series-contact instrument, and designers then turned attention to arranging contacts in multiple in order to obtain a greater volume of current without interfering with the delicacy of control. A typical instrument on the multiple-contact plan is shown in Fig. 8, and all instruments of this class are similar in general construction. There is a case, 11, provided with a mouthpiece, 13, behind which a diaphragm, 15, is situated. In the center of this diaphragm a carbon button, 40, is secured by means of a screw, 42, through the center of the diaphragm. This carbon button has a V-shaped groove cut in the face opposite the diaphragm. Upon the rear of the case, enclosing the apparatus, a second carbon button, 32, is attached which carries a similar V-shaped groove, the two buttons being adjusted with reference to each other, so that these two grooves are concentric. When the instrument is assembled a series of carbon balls, 41, about as big as No. 8 shot, are placed in the rectangular cavity formed by the V-shaped grooves. By this means quite a number of microphonic contacts in parallel may be obtained. The angles of the groove are such that the carbon balls by gravity always tend to assume the lowest position and normally lie in contact with the two buttons; thus any vibration of the diaphragm will cause a variation in pressure between many and probably all of the contacts thus provided. Multiple-contact instruments have been much more successful than the series-contact type, and at present several models are manufactured and are fairly successful.

Fourth, Multiple-Series Transmitters or Granular Instruments.—To carry the multiple-contact idea to the extreme is to provide a transmitter with a multitude of such contacts. The first, and most famous, instrument of this type is the Hunning transmitter, illustrated in Fig. 9. It was an exceedingly simple device, consisting of a case, *B*, containing a hollow receptacle, in front of which a diaphragm, *D*, was placed. This diaphragm was in the first model made of platinum, while the rear of the case was lined with a similar material, and the intervening space filled with powdered carbon, or in other words the carbon bullets of Fig. 8 were made as small as possible and as numerous as possible. This, so-called, granular instrument, has formed the foundation of all of the modern types, and has, to all intents and purposes, practically displaced every other design.

The Hunning transmitter was at once recognized as much more powerful than any of its predecessors. Unfortunately, it was afflicted with a disease, toward the remedy of which all subsequent inventors have directed their efforts with as yet but partial success. This difficulty is known as "packing" and seems to be due to the gradual settlement of the carbon granules under the inevitable jarring and vibration to which the instrument is subjected, into a compact mass at the bottom of the receptacle which holds them, and under these circumstances the contact between the granules is no longer affected by the slight change of pressure produced by the diaphragm and the instrument ceases to talk.

In some systematic investigations upon the relation between pressure and transmission, conducted at the Massachusetts Institute of Technology it was shown that the operation of a Blake transmitter depended partly upon the pressure which the springs holding the carbon button and platinum globule exerted, and partly upon the inertia of the button itself. In order to eliminate one of these factors Mr. Anthony C. White carried on an extended investigation, which resulted in the production of the *"White transmitter"*; usually known as the *"Solid Back,"* from the fact that the rear electrode, instead of being mounted upon a spring, as in the case of the Blake instrument, was made as rigid and substantial as possible. The complete White Solid Back is shown assembled in Fig. 10. Fig. 11 shows the transmitter head. In Figs. 12 and 13 the rear of the case is removed. In Figs. 14 and 15 the instrument is entirely dissected, while Fig. 16 is a full-sized sectional drawing.

There are four essential parts: A base plate, *E*, Fig. 16: This is a solid, substantial brass plate, 3¼ in. over all, in the center of which a ⅞-in. hole is cast and threaded for the reception of a funnel-shaped rubber mouthpiece. The inside of this brass plate is faced off for the reception of the diaphragm, *D*. This is now usually made of aluminum 2½ in. in diameter and .022 in. in thickness. Experience has shown that the aluminum is likely to corrode under the moisture deposited from the breath, and it is now customary to thoroughly varnish the diaphragm as a protection. The diaphragm is surrounded with a soft rubber band of sufficient width, so that it laps around the edge of the diaphragm ¼ in. This forms a cushion and affords an even bearing between the diaphragm and the face place. A piece of brass 1 in. wide and ⅛ to 3/16 in. in thickness, termed the "bridge," *M*, is substantially bolted across the front of the face plate. This metal piece is bent in the form of a U in order to afford room for the capsule which contains the granular carbon. As is shown in Figs. 14 and 15, this capsule consists of a brass cup ¾ in. in diameter and 5/16 in. deep. Upon the rear of this cup a stud projects which passes through the bridge and is secured therein by a nut, a set-screw and lock-nut. Upon the bottom of this brass cup the rear electrode is placed. This consists of a carbon disc as hard as possible, and carefully and highly polished, 21/32 in. in diameter and 1/16 in. in thickness. Over the front of this brass cup a mica diaphragm, *O*, is placed and secured by a circular ring of brass, which is screwed down on top of the diaphragm, clamping it to the front edge of the cup. This diaphragm is 27/32 in. in diameter and as thin as the mica can be readily split. The front electrode consists of a piece of carbon similar in all respects to the rear electrode. Both carbons are electroplated and soldered to their respective holders. The support for the front carbon consists in a disc-shaped piece of brass having a threaded stem, *P*. This passes through the mica diaphragm and by means of a nut, *L'*, the electrode and the mica diaphragm are clamped firmly together. Then the stem is inserted in a hole in the diaphragm and secured by means of a second nut, *R*. Two damping springs, *F*, made spring steel 11/32 in. wide, 1/100 in. thick, 1 7/16 in. long, bent to be at right angles when not in place, and tipped with rubber, are employed to check vibrations of the diaphragm, and secured by two screws to the face plate, as indicated in Figs. 12 and 13. One pole of the battery is connected to the framework, *B*, of the transmitter and current reaches the rear electrode; passing through the granular carbon it reaches the front electrode, thence to the nut, *L'*, and thence by a fine wire soldered thereto, to an insulated terminal, *S*, to which the other battery pole is attached (Fig. 12). The essential features of the White Solid Back are thus seen to be: A substantial support for the rear electrode; a capsule to contain the granular carbon between carbon electrodes, closed in such a manner as to be air-tight and moisture-proof, and to permit the freest possible motion of the front electrode; a vibrating diaphragm rigidly attached to the front electrode, so as to convey to it its motion in the freest manner; finally, the whole apparatus covered by a thin cap of spun brass, which is turned to fit against a shoulder in the face plate and secured thereto by means of four screws.

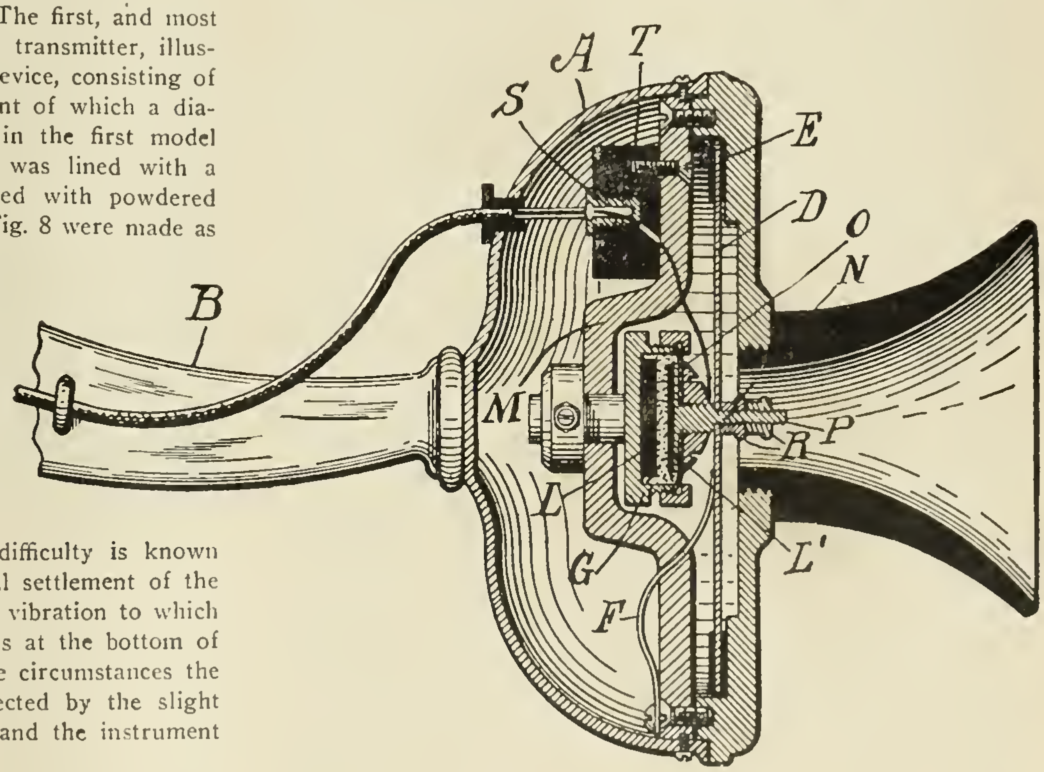

FIG. 16.—SECTION OF SOLID-BACK (FULL SIZE).

The Evolution of the Electric Railway Motor.

The New York Electrical Society had another large and successful meeting this season, on December 16, when Mr. S. T. Dodd, electrical engineer of the Stanley Electric & Manufacturing Company, who has long been connected with the railway art, contributed an admirable address on "The Evolution of the Electric Railway Motor." The lecture was freely accompanied by lantern slides, some of which had never before been made public. An abstract of the lecture follows. President Carty was in the chair, and in addition to his pithy comments, interesting remarks were made by Messrs. C. O. Mailloux and R. T. Lozier.

The early investigators of the electric railway problem—Edison, Field and others—made the mistake of attacking it from the locomotive standpoint, and consequently their efforts contributed little or nothing to the solution of the problem. The first electric street car to be driven by a motor placed under the car floor was put into operation in 1884 in Cleveland, Ohio, by the Bentley-Knight Company. A Brush arc machine was used as generator, and a machine of the same type was used as motor, the latter being connected to the car wheels by a wire rope drive. The Brush type of machine later proved itself eminently unfitted for this service, but, at that period, it was the only successful high-voltage machine, and it was believed that in this type lay the promise of the coming long-distance transmission of power. This combination of Brush machines worked reasonably satisfactorily when there was but one car on the line, but when other cars were added the generator behaved very badly, as was inevitable, since the attempt was being made to run the motors in parallel from a constant-current machine. Troubles were also experienced with the wire rope drive and with the conduit. The experiments on this road made it evident that further developments must be along one of two directions: Either the current must be supplied to the cars at a constant potential or the motors along the line must be operated in series. The Bentley-Knight Company followed the former of these alternatives in their later work.

In '85 and '86, various experiments were made by Messrs. Daft, Sprague, Van Depoele and Short. Mr. Short attempted to develop a series railway system, and built a road in Denver which was soon abandoned. To Mr. Short should be given the credit of seeing that for motors of the normal speed of that date, double-reduction spur gearing should be used. By '87 or '88, both the Bentley-Knight and the Sprague companies had developed bi-polar, series-wound motors especially for railway service, and it was about this time also that public attention began to be attracted to the work.

The years '88 and '89 were very eventful. The Sprague and Edison interests consolidated, the Bentley-Knight interests were acquired by the Thomson-Houston Company, and there appeared on the market a Westinghouse double-reduction motor and a Short double-reduction motor. It might be said that the standard railway motor at that date was bi-polar, running at a normal speed of 1,000 to 1,500 r.p.m. It was connected to the axle by double-reduction gearing, it was series-wound and, with the exception of the Short motor, was of the smooth core, drum type. The high speed of these motors was a serious disadvantage. The railway managers complained bitterly of the expense of maintaining gears and pinions. It was seen that the electric railway motor could not be a final and permanent success until some method was found of obviating this difficulty.

The Wenstrom motor of 1890 offered the solution of this difficulty. It was a multi-polar design, with slotted armature, thereby making possible the reduction of motor speed and the change to single reduction. All of the manufacturing companies were quick to appreciate its features, and they appeared on the market soon after with single-reduction motors. The Westinghouse Company then introduced what might be called the first of our modern motors, their No. 3, which, with the minor modifications introduced in their No. 12 and No. 38, remains to-day their standard type. As is apt to happen, two of the companies went to the other extreme of bringing out gearless motors. The objection to the gearless motor of that date was its weight, its rigidity, its inaccessibility and the fact that it was not adaptable to varying speeds.

The "G. E. 800" motor of 1893 was an attempt to make an absolutely enclosed and water-proof motor. With the appearance of the enclosed motor, a new problem was introduced, namely, ventilation, a factor which had previously received but little attention, and which even to-day is not always given the consideration which its importance deserves. In 1894 appeared the "G. E. 1,000," wherein they followed the lead of the Westinghouse No. 3, and had four poles, abandoning the consequent pole design. In 1895 the Walker Company brought out their No. 3, which marked a decided advance in that better provision was made for ventilation than in any previous type of motor. In 1899 the Westinghouse No. 38 introduced laminated poles. In 1896 there was a change in the character of the service demanded of railway equipments brought about by the beginning of interurban roads, and by the extension of city roads into the suburban districts, the new conditions calling for continuous service at moderate loads. In order to meet the new requirements the General Electric Company brought out their No. 52, the feature of which was the ventilated armature which has since become standard. The Walker 15 L, a 100-hp motor, which was built for the Brooklyn Elevated, and the "G. E. No. 51," illustrate the limitation imposed upon motors of the standard type when built in large sizes. This limitation called for a change in motor construction, which was met by such motors as the "G. E. No. 50," and particularly the "G. E. No. 55," built for the Nantasket Beach line and the Metropolitan and Westside Elevateds. The latter had a solid box frame, with waste packed bearings, from which the armature could be removed only by sliding it out through one end. This type has since become popular for very heavy service.

The "S. K. C." type of motor represents a still further development of the principle of motor ventilation. For the first time in a street railway motor, both ends of the armature are left open for the entrance of air into the armature, and there are ducts in the pole pieces and through the frame of the motor which register with the ducts in the armature perpendicular to the shaft. As a result of this usually good ventilation, the all-day load of this motor, Mr. Dodd said, is about 50 per cent of its hour rating (with the same heating) as compared with an all-day capacity of but 35 per cent of the hour rating for other motors of the same grade.

In the "G. E. No. 74" motor is preserved the compactness of the "G. E. No. 5" with the added advantage of increased accessibility of the armature. The "G. E. No. 69" for the New York Subway and the two makes of German motors used upon the Berlin-Zossen line are the most modern types of motors for heavy service, and in each of them it should be noted increased attention is being paid to ventilation. As is well-known, the Berlin-Zossen motors are alternating current, and mark a reversion to the gearless type discarded ten years ago.

Thus our present type of motor had grown from the stationary motor of twenty years ago. It is now a series motor, a characteristic which it inherited from the Brush motor used by the Bentley-Knight people in 1884. It is hinged upon the axle and geared to it by spur gearing, for which we are indebted to Messrs. Sprague and Short in 1886; it is a multi-polar motor, with slotted armature, which is derived from the Wenstrom motor of 1890; it has concentric fields, with salient poles, projecting inwardly from the surrounding case and the armature is series connected, so that one pair of brushes suffice for a multi-polar motor, characteristics which are derived from the Westinghouse No. 3 of 1891. It has machine-wound coils and a barrel armature, which are due to a development through the Westinghouse No. 3 ,the G. E. 800, and the Walker. It has laminated fields, which were introduced by the Westinghouse No. 38 in 1895; it has a ventilated armature for which they were indebted to the G. E. No. 52 of 1896.

At the present time, increased attention is being paid to disposing of the heated air from the interior of the motor and the ventilation of the motor for long ime service. This means that the motors of the future will have reduced weight of electrical parts, magnetic iron and conductors, and more attention will be paid to the bearings, gears and other mechanical parts. Considering the changes in motor design during the last twenty years, which he had sketched, Mr. Dodd remarked in conclusion that it would be idle to assert that they had yet reached a permanent standard type or that new motors will not be produced from year to year as new improvements are suggested and new problems confront them for solution.

Electrical Iron Smelting.

Advices from the Dominion state that the Canadian Government is looking into the subject of the electrical smelting of iron, and is sending a commissioner to Europe to study up the subject. Canada has many available iron ore deposits in the vicinity of large water powers, where coal may happen to be difficult of supply.

Electrical Equipment of the Edison Portland Cement Company.

That any plant designed under the direction of Thomas A. Edison should present unusual features is naturally taken for granted, and the presumption does not fail in the case of the great cement works which have recently been erected after his designs in the Portland cement region of Northern New Jersey. The apparatus employed is almost all absolutely new in cement making, but nevertheless is not untried for the class of work to be performed, having been adapted from similar machinery perfected by Mr. Edison at his iron ore plant at Edison, N. J. The plant is specially designed for outputs on a huge scale. The rock crushers daily handle rock in sizes as large as five tons; fine grinding on the basis of a 200-mesh sieve is done in a grinding roll which has a record of 280 barrels an hour; an air blast process of separating the fine from the coarse ground material is employed and the raw materials are burned in rotary kilns 150 ft. long and 9 ft. in diameter. An unusual arrangement of buildings exists, the particular feature of which is the subdivision of the colony into groups, each devoted to a distinct part in the process of manufacture and all more or less independent of one another. The main power for some of the groups, both electrical and mechanical, is supplied by a steam engine centrally located with respect to the group, but the entire conveying system throughout the works as well as some of the machinery, is driven by about 125 electric motors furnished with current from a central station. All of the motors were designed and built at the works of the Edison Manufacturing Company, at Orange, N. J. The electrical work is of much interest, owing to the care taken to protect the motors from dust and to the plan of controlling them to a large extent from the generating room, both of which features will be described further on.

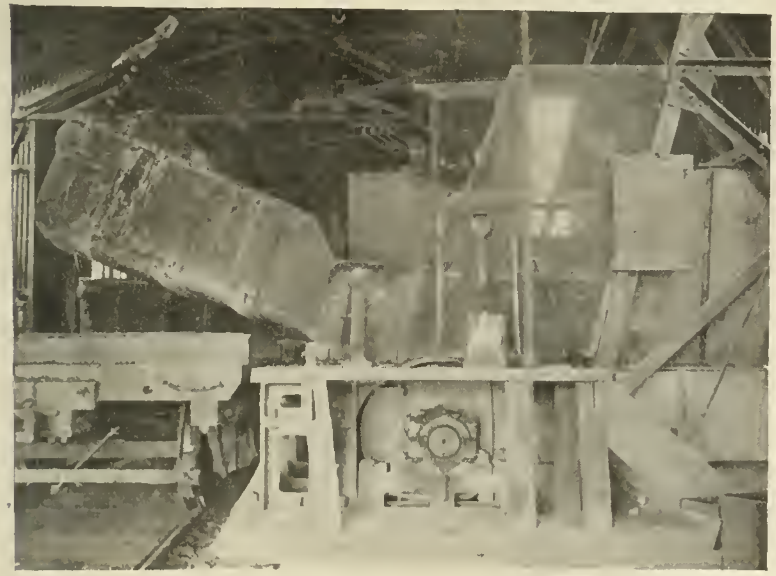
FIG. 1.—SKIP UNLOADING DEVICE.

The property of the Edison Portland Cement Company comprises about 600 acres in the valley of Pohatcong, two miles in extent and of varying width. At one end are located the works proper, on the Delaware, Lackawanna & Western Railroad, at New Village Station, near Stewartsville, N. J., and at the other, a matter of 1½ miles distant, is the quarry. A standard-gauge railway, owned by the company, connects the quarry to the plant. This comprises six groups of buildings besides the usual adjuncts, as, for example, machine shop, oil house, laboratory and office. The first group comprises the crushing plant; the second the weighing plant, where the proper mixtures of the raw materials are made; the third, the raw material grinding plant; the fourth the burning or calcining plant; the fifth the clinker grinding and cement storage plant, and the sixth the coal pulverizing plant. The two grinding and the one crushing plant take the most power and each has its own steam engine.

A feature of each group is the provision of storage capacity, so that each department can be run without absolute dependence on its neighbor; but all are interconnected by an extensive system of conveyors. The latter is arranged so that if materials are furnished faster than the apparatus can care for, excess of the material is carried automatically back to the proper storehouse. The first two groups have been designed for the full capacity of the works, 10,000 barrels per day, while the rest have largely been planned for 5,000 barrels present capacity. Space is available for practically an indefinite number of cement stock houses.

On reaching the works from the quarry the train of flat cars is hauled under a storage shed, which is an open steel frame structure with roof to protect the raw material from rain while awaiting its turn to the crushing mill. The crushing mill comprises four sets of rolls placed one above the other so that the passage of the material through them is downward by gravity; and the rock from the quarry has thus to be hauled to a point above the highest pair of crushing rolls. Accordingly, there is an incline, some 260 ft. long, extending to a floor about 50 ft. above ground and the cars are hauled up this three at a time by means of an electric hoist. The storage shed is slightly above the bottom of the incline, and under the control of a brakeman the three cars are run down to the incline by gravity. They are then attached to the end of the hoisting cable and hauled to the crushing floor, the end of the hoisting cable having a dolly car by which connections are made. The operator of the hoisting motor stands in a pulpit above the floor and by means of the large rheostat controller brings each skip in succession opposite the mouth of the hopper above the main crushing roll. The skips are placed sideways on flat cars, and the operator then starts another motor which automatically catches the handle at the far side of the skip, lifts it into position, when the rock falls into the hopper, returns the skip to the car, the hook releasing its hold from the handle, and brings the next car into position. The skip-lifting device is counterbalanced by a cube of concrete hung from the cable to which the hook is attached. The empty cars are then allowed to descend the incline and, at the proper moment the brakeman releases his three cars and they take a siding alongside the storage shed until a train is made up and the empty cars are returned to the quarry. At the same time the brakeman that has descended before him is now on his way with his train of three loaded cars.

The first pair of crushing rolls, which constitute one of the noteworthy features of the plant, are each 5 ft. in diameter and 5 ft. long and the moving parts weigh approximately 25 tons each. They take any size of stone weighing 5 tons or less, and are driven at 200 r.p.m., which corresponds to a peripheral speed of over 3,000 ft. per minute. Under the giant rolls, which are the design of Mr. Edison, there is a hopper having a capacity of 10 tons, and material is fed from it to three sets of 36-in. rolls below. These reduce the material to ¼-in. and less. The first have a fly-wheel to assist them in crushing large pieces that pass through the giants, and both the first and the second rolls are set rigidly at fixed distances between faces, while the third are held together by a set of coil springs. This plant is driven by belting through a friction brake from a 500-hp vertical cross-compound Allis engine operated condensing. The engine also drives a 100-kw General Electric generator which supplies the current for the motors in this department, an arrangement which exists in the case of the two other large power engines, in furtherance of the plan to render the departments as independent as possible. The result is that the central electric station is comparatively small to what it would otherwise be. The crusher house has a capacity of 3,000 tons per day of 20 hours, allowing for 16 hours of actual running and 4 hours of stoppages.

From the last set of rolls the crushed material falls on a belt-conveyor 24 in. wide, which carries it upward to the top of the rock dryer house. Here the material falls by gravity over screens composed of ½-in. mesh screen plates. The spalls that are rejected by the screens are delivered to another belt-conveyor, which takes them back to a point above the third set of 36-in. rolls in the crusher house. They are recrushed and returned to the dryer house. Material passing the screens falls by gravity to the dryer, which consists of a cast-iron box, 8 x 8 ft. in plan and 40 ft. high, filled with baffle plates. The top set of plates is moved slightly by a shaker mechanism to avoid clogging. As the material falls through the dryer, it comes in contact with hot gases from a group of furnaces below, the passage of the gases being accelerated by means of an 80-in. Buffalo exhauster, which delivers into a dust separator. The separator is large enough that, by the reduction of the speed, most of the dust is collected and delivered to a conveyor, which also takes the discharge from the dryer, lifting it to a transfer tower, by which it is carried into the rock stock house. The furnaces are ordinarily run with the doors above the fire pit open so that there is always a large enough volume of air, with the idea of inducing a generous flow of comparatively warm air rather than a lesser volume of gas at a very high temperature. The furnaces are operated also with a blower connected to the ash pits, to increase the draft. The exhauster is driven by a 50-hp electric motor and is in normal operation designed to pass 20,000 cu. ft. of air per minute. The dryer has a capacity of 3,000 tons per day, corresponding to 10,000 barrels of finished product.

At the transfer tower, as the material is dumped from the one conveyor to the conveyor running into the stock house, there is an automatic sampler. This comprises essentially a plate hinged like a damper, with the hinge horizontal and at the lower edge, and thrust periodically into the material as it falls from the one conveyor to the other. It catches one pound per minute.

The rock stock house is a building partly under ground and partly above, and has a storage capacity of 10,500 tons, divided into seven bins. A feature in connection with the design of the stock house is the auxiliary means provided for drying in the event that the material should remain or become wet after it is delivered from the dryer proper. This means comprises a furnace at one end of the building and of a large fan, 15 ft. in diameter, at the other end. Whenever excess moisture is present in the stored rock the fan serves to create a suction of warm air through the building from the furnaces at the other end. This fan, which is direct-connected to a 15-hp motor, is designed to pass 60,000 cu. ft. of air per minute. The second general division or group of buildings comprises the weighing and mixing house and a small rock stock house. The raw material grinding plant comprises the grinding house and adjacent engine house, the separating or blower house and the ground material store house. The raw material is fed to a set of fine grinding rolls which were designed by Mr. Edison. They are practically the same as those used by him in his ore-separating work. The rolls are 28 in. in diameter and have an 8-in. crushing face. One roll is driven from the main shaft and two others are driven from it by friction. The pressure between the rolls is obtained by means of an endless cable passing over sheaves on the ends of the two friction-driven rolls. Tension is secured in the cable by means of an air cylinder in which the pressure can be regulated at will. A remarkable fact in connection with the rolls is that the plates on them, formed into regular corrugations, last three weeks, and the life of the wire rope is about 150 hours. When the repairs made at this frequency are charged against the capacity of the rolls, however, the cost is but a fraction of a cent per ton. The grinding rolls are arranged to receive an extra roll and additional sets are to be added to bring them up to a producing capacity of 5,000 barrels of cement per day. When the house is increased in size and other rolls are installed, the producing capacity will be 10,000 barrels per day. The engine is of the same type as that in the crushing plant, but it is larger, having a rating of 750 hp. It also drives a 100-kw generator for the motors in this department.

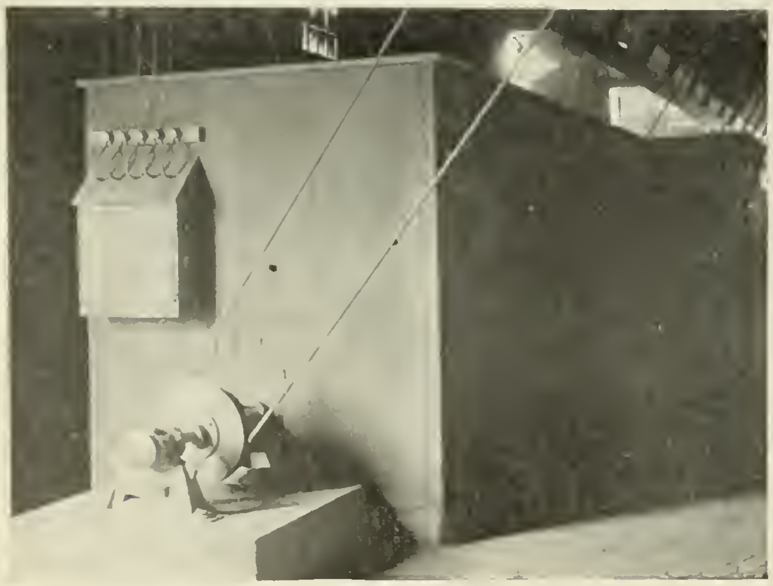

FIG. 2.—GUNNY CHAMBER FOR MOTOR PROTECTION.

The separating apparatus is another of the striking features of the works. This is located in the blower house, so called, a relatively large building, in which the finely-ground rock is distributed to the discharge ducts of some sixteen blowers and the fine material separated from the coarser by the action of the air blast assisted by baffle plates. The 10 per cent. of the material that fails to pass the 200-mesh screen is that caught by the baffles, and it is returned by conveyors to the fine grinding rolls. At present there is space for eight more blowers, and, by increasing the building along the dotted lines, the capacity of the blower house can be increased to the full 10,000 barrels.

A belt-conveyor, in this case 36 in. wide, serves to carry the discharge from the grinding rolls to a longitudinal belt conveyor in the top of the upper part of the blower house. This, by means of two S-dumps, feeds a number of chutes, one to the discharge duct from each blower. In this duct the material falls through a set of baffle plates, while the current of air is passing through it, and the air carries the dust into a large settling chamber beyond, where the dust settles at the bottom on account of the reduced velocity of the air. This chamber in each case has walls of coarse duck through which any inequalities of air pressure may be compensated without losing the ground rock, but one of the secrets of the success of this method of separating is that the air for the suction side of the fan is taken from the top of the chamber. The blower thus sets up an internal circulation and its work is mainly maintaining that circulation. Each blower, which is of Mr. Edison's design, has a blast wheel of 5 ft. and they are driven in groups by motors on the main floor of the blower house. The blowers and duck-enclosed chambers are arranged in two rows, and on each side underneath the settling chambers is a scraper conveyor which collects the separated fines. This scraper delivers to a belt-conveyor which in turn carries the fine material into the so-called chalk stock house. This has a capacity of 1,000 tons. The separated coarse material is collected under each side of baffle plates, is delivered to a belt-conveyor in the lower part of the blower house and by means of another conveyor returned to the fine grinding rolls.

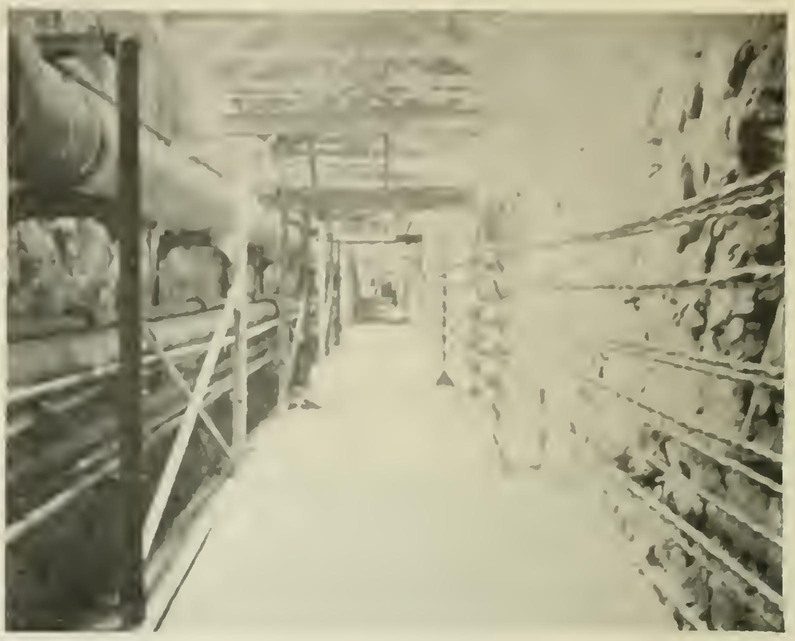

FIG. 3.—CABLE AND MAIN TUNNEL.

In the stock house a swinging type of screw conveyor is employed, known about the works as "Cæsar's wife." This consists of a truss bridge a few feet above the floor carrying an 18-in. screw conveyor held close to the floor. The bridge is pivoted at the discharge end of the conveyor, and the outer end is swung in the arc of a circle by means of a stationary rack on which it is moved by means of a pinion. At the pivoted end the bridge carries its own electric motor and operator, who is enclosed like the motors throughout the plant, as will be explained, in a house of gunny sacking.

The kiln plant comprises the so-called roaster house, a clinker crusher and a clinker stock house. Adjacent to it is the boiler house of the works and the air compressor house. The kilns have the striking proportions of 9 ft. diameter and 150 ft. length. There are at present two of them in a building 52 x 220 ft., but ground space is available for a roaster house six times as large, providing for twelve kilns. Raw ground material is fed by a scraper conveyor into two bins, one above the charging end of each kiln, and from the bottom of each bin the material is fed, as desired, by means of a 6-in. screw. Each of these is driven by an independent electric motor, so that the speed can be regulated to suit the conditions.

The crusher clinker is taken from the stock house by chutes leading to a belt-conveyor in a tunnel underneath it and in its transit the proper amount of sulphate of lime is added; it is then taken by a belt-conveyor to an elevator and thus fed into the feed rolls above the clinker grinders. The grinding rolls here are counterparts of those in the raw material grinding plant and a 750-hp engine is also required to drive it, the engine being in an adjacent building and also connected to an electric generator for the local motors.

The cement stock house has a capacity of 100,000 barrels and there is provision for additional stock houses. Between each pile in the cement house is a transverse conveyor having two 16-in. screws. This conveyor can travel from one end of the building to the other and discharges upon a longitudinal 12-in. screw conveyor at one side of the stock house. The operator of this conveyor takes his station in an enclosure at one corner of the building at the end of the 12-in. screw and can tell that "Big Cæsar" is in operation by the delivery of cement by the 12-in. conveyor. At this end the 12-in. conveyor discharges upon a belt-conveyor leading into the packing house. Here there are at present four bagging and two barreling machines of the usual type. A railroad siding is alongside, where the cars are loaded from the platform.

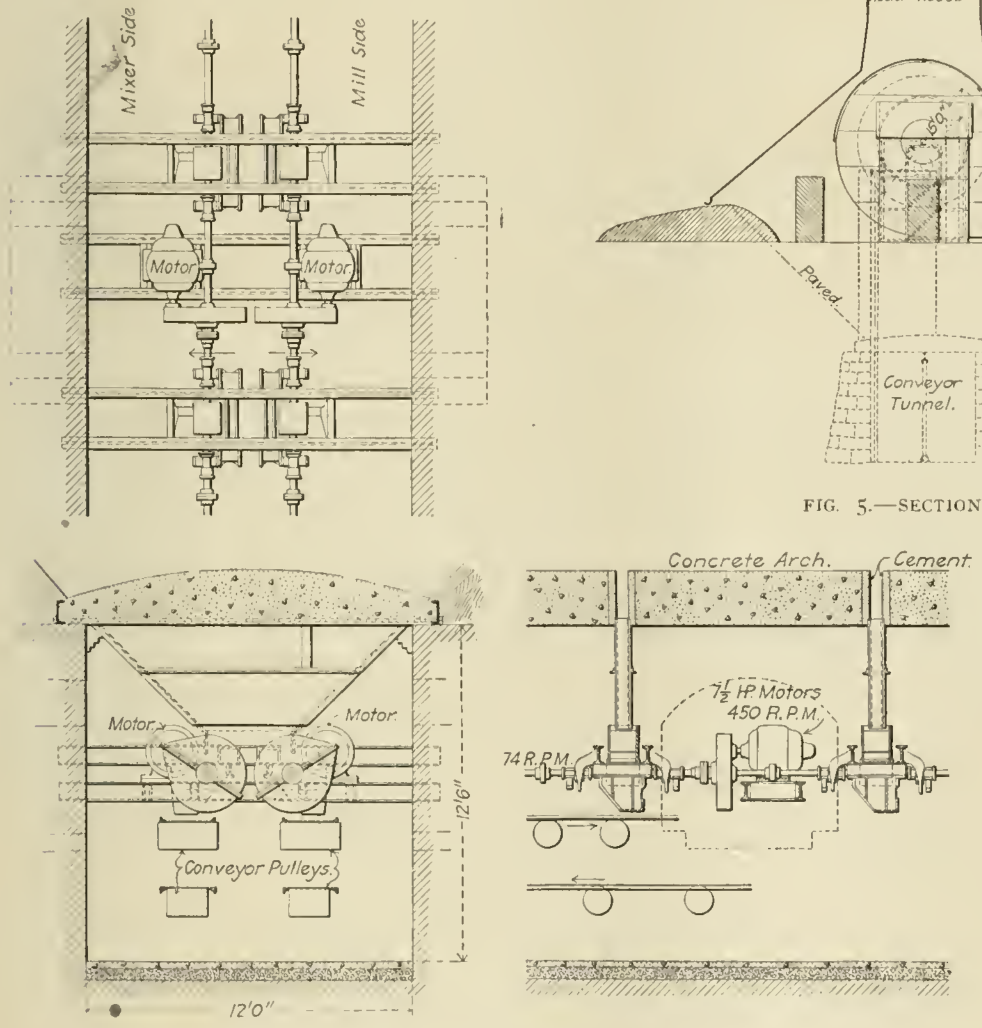

FIG. 4.—SECTION AND PLAN, CONVEYOR TUNNEL.

The belt-conveyors so extensively installed about the plant are all of a canvas type and were manufactured by the Gandy Belting Company. The belts are run at speeds of 500 ft. per minute and the inclination, where the travel is an upward one, is generally about 14°. A point of detail that might be mentioned regarding them is an enclosed type of lubricator for the bearings of the idlers, the lubricating medium being oil and not requiring attention more than once in two or three months.

The boiler plant at present consists of three Climax boilers, each having a rating of 500 hp on a 30-pound evaporation basis. Steam is conducted from the boiler plant through piping in an underground tunnel about 1,700 ft. long, which extends the length of the works and also contains the horizontal conveyors, the water and air piping and electric conduits. A feature in its construction is the provision of a roof above ground between buildings with glass skylights to admit daylight. The three main steam engines are located along the line of the tunnel. The injection water pipe for the condensers is also carried in the tunnel, but the discharge from the condensers, which are of the independent jet type of Allis make, furnished with each engine, is conducted in an open concrete trench outside of the buildings leading to a sewer, which finally discharges into a sump and is pumped back to the reservoir.

Besides the engine for the coal plant there are two horizontal engines in the engine house adjoining the grinding plant for the raw materials. These engines are Armington & Sims tandem-compound machines and each drives by belt a 200-kw General Electric direct-current generator. These units supply the current for all the motors throughout the works not connected with the generators driven by the three Allis engines, already mentioned.

A feature of control of the electric motors is that they are ordinarily all started from the central station. Three wires run to every motor, two being the regular leads and the third a conductor for separate excitation. In starting, the motors are all excited from a small generator in the central station; the main generators are then brought up to voltage and, by means of a drum switch, the separate exciting wire is cut out and the machines run self-exciting from the generator leads. By starting this way the armature currents in all the motors are dependent on that in the generator, which is being slowly brought up in speed, so that the generators are not subjected to a sudden load, as they otherwise would be if all the motors were started in the regular way. In stopping, a resistance has to be introduced in the main circuit to take care of the collapse of the fields of all the motors and this consists of an extensive bank of incandescent lamps. The lamp bank is connected across the leads, and when the main switch is opened the fields discharge through the lamp bank.

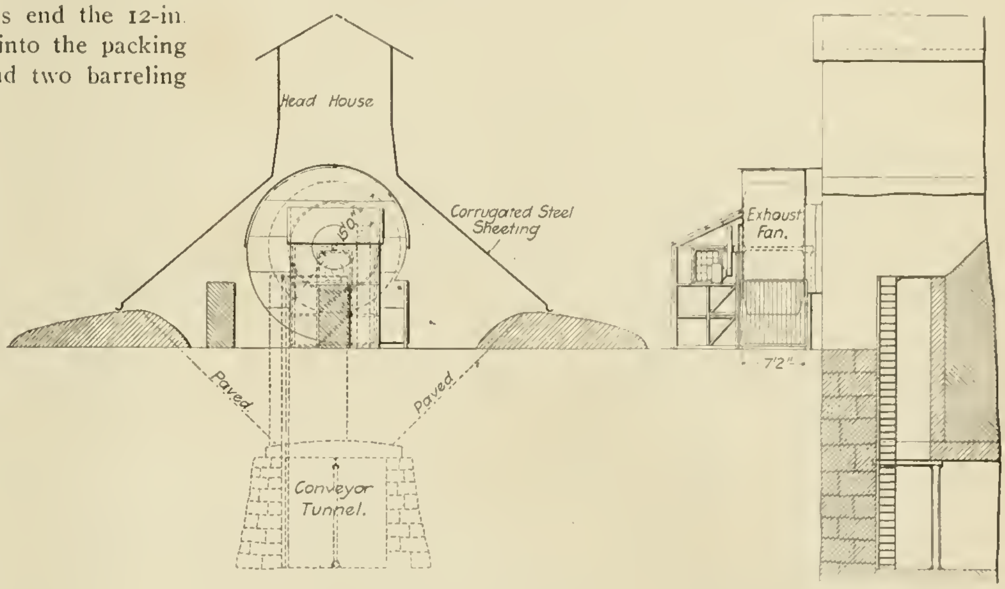

FIG. 5.—SECTIONAL VIEW, CABLE AND CONVEYOR TUNNEL.

Mention has already been made of the precaution taken to protect the motors from the dust. This is, of course, specially necessary owing to the employment of direct-current motors with their commutators. In the ordinary case the motor is enclosed in a good-sized room, the walls of which are made of gunny sacking. A self-closing door allows access to the room. A small fan of the desk type is set in one of the walls and operates to exhaust air from the room. The action of the fan induces a flow of air through the walls of the enclosure, but they do not allow dust to pass with it. The circulation of air provides for cooling and in every room a thermometer is suspended over the motor and observations are made daily by an inspector. In some places, for example, the blower house or separating plant, where dust is particularly thick, each motor house is provided with an antechamber so arranged that one must close the outer door before he can reach the inner.

The lubricating system for the works is one of the interesting points. For this purpose there is a detached oil house containing the filter, a fresh oil storage tank and a tank for the storage of the filtered oil. The steam engines are, of course, lubricated by the engine operator. Many of the conveyors are self-lubricating, as explained. The cement machinery generally, however, is so located in the midst of dust that ordinary methods of lubrication would be unsatisfactory. On that account an extensive system of oil piping has been developed, by which all bearings are oiled from the central plant. A small pump in the oil house suffices to set up the required circulation. At the different bearings the supply pipes to them are provided with a short glass sight feeds, so that the attendant at that point can be assured that his machine is getting the proper amount of lubrication. The two oil tanks in the oil house are of practically the same size, of 2,400 gallons capacity. The filtering system was designed by Mr. Edison and first used at the iron ore concentrating plant at Edison, N. J. The filter is divided into three sections, two of which with a capacity of 200 gallons per hour are in use at the same time, leaving the third as an auxiliary.

As a result of the installation of so much new apparatus about which little or nothing could be foreseen regarding possible weak points, a complete system of records of the operation of all departments has been devised. In addition a number of inspectors are employed whose duty it is to make periodical trips about the works and make recommendations for repairs or changes. A summary of the delays in the operation of the works is made at the end of each week and a copy of it is sent to Mr. Edison at his laboratory in Orange, N. J. If there is an indication that a certain piece of apparatus is performing badly, a "trouble inquiry" sheet, so-called, is sent to the plant manager and a special investigation is made. Ordinarily this inquiry sheet passes from the manager to the superintendent, who, in turn, refers it to the department head, and from him to the official, employee or inspector responsible. A reply is made on this blank and returned to Mr. Edison. It goes back with the initials of all the officials who have seen it, so that there is an unquestioned record that the trouble had been called to some one's attention.

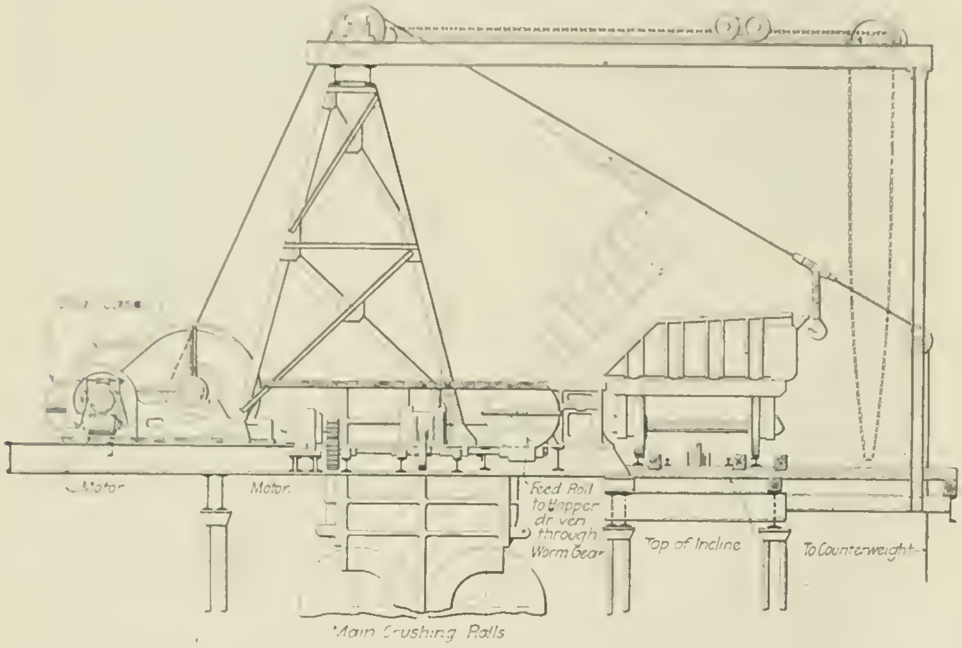

FIG. 6.—ELECTRICAL SKIP UNLOADING MACHINERY IN CRUSHING MILL.

The officers of the Edison Portland Cement Company are as follows: Mr. William H. Shelmerdine, president; Mr. W. S. Mallory, vice-president; Mr. W. S. Pilling, treasurer; Mr. T. I. Crane, secretary; Mr. Thomas A. Edison, general manager. The general offices are in Philadelphia, while Mr. Edison and Mr. Mallory are located at Orange. Messrs. Goodwelle and Warren are the electrical engineers of the plant. Every day at 4 o'clock a meeting of the heads of departments takes place in the office and the proposed schedule of operations for the following day for the different departments is discussed at that time. The relative independence of the different parts of the works makes it possible, as already stated, to shut down parts of the works temporarily if necessary for any reason.

Telegraphs in Korea.

With regard to the unsettled state of affairs in Korea, a cable dispatch from Seoul says: "Japanese telegraph operators have charge of the line from Seoul to the coast. The possibility of Japanese troops landing to preserve order is discussed, but it would only be done with the consent of the Russian Government." Another dispatch of December 21 from Tokio says: "Sixty military engineers have been dispatched to Korea to replace the civil telegraph operators attached to the Japanese telegraph lines on the peninsula. It is officially asserted that the step taken has no military significance."

Safeguards and Regulations in Operation of Overhead Distributing System.*

By W. C. L. Eglin

The distributing system can be considered as one of the integral portions of a power plant, and it should receive as careful attention as either the steam plant, hydraulic plant, or the electrical plant in the generating station or sub-station. In fact, it would appear that the transmission system has to meet more severe conditions than any other part of the entire plant, so that the safety and reliability of the service depends largely upon the amount of forethought given to the plans and to the selection of material.

When it is considered that an overhead distributing system is subjected to many varied conditions, such as the weather, extreme changes of temperature, extraordinary storms, interference from other lines, interference by building operations, excavations, fires and other casualties, and, sometimes a wilful interference by the public (not to overlook the small boy with a stone), it should be readily appreciated that all of these varying conditions must be considered in the construction of the line. There are two divisions of conditions: First, the mechanical or structural features, and, secondly, the electrical features.

The first group will include the study of the territory in which the line is to be run, width of streets, kind of buildings, height of buildings; other distributing systems, possibilities of interference with these systems; amount of power to be transmitted, and whether the system consists of a simple power transmission circuit, or one complicated with distributing mains covering the larger part of the territory occupied by the transmission system.

Also to be considered are the weather conditions: windstorms, rainstorms, sleetstorms, snowstorms, lightning-storms and changes in temperature from summer to winter. The method of erecting the conductors so that they can be properly repaired or additions made without endangering the lives of the men engaged in this work must be carefully planned. Unless these various points are all considered in the construction of the lines, no rules or safeguards for their operation will be of material benefit.

The second group includes the electrical requirements: The conductors, the insulating method of support, and the means provided to take care of any undue disturbances due to lightning or other causes on the line, such as lightning arresters, fuses, switches, etc.

SPECIFICATIONS FOR MATERIAL TO BE USED.

All of the material entering into the construction of a transmission system should be ordered under specifications which shall clearly set forth the character of the material to be used and also that all of the material will be inspected before it is used on the work, and that tests will be made of samples of all material furnished. The more general requirements are as follows:

Poles.—Poles should be as short as possible to meet the conditions and preferably made of good, sound chestnut. Southern cedar and pine poles are sometimes used when chestnut is not obtainable. It may also be necessary to use iron poles under certain conditions; but iron poles are to be avoided, principally on acount of danger to linemen and also to the short life of the pole, due to rusting. The pole should be roofed at the top to form a right angle, and gained to form a flat of about 5 inches from the attachment of the cross arms.

All poles, upon which are located devices requiring regular inspection, should be provided with steps in order to facilitate this work. Spacing of the poles should be carefully considered and should not exceed from 40 to 45 yards. End and corner poles should be braced, and at least every tenth pole throughout the line should be guyed with one-quarter-inch or three-eighths-inch stranded galvanized wire. Regular inspections, at least annually, should be made of the condition of the poles, which is most readily determined by examination at the base of the pole. When poles are used as junction poles, that is, when lines are run at right angles and attached to the same pole, special care is necessary. A separate drawing should be made of all such poles, showing the arrangement of the wires—keeping in mind the simplest possible arrangement—as a protection for the men who climb these poles. Switch-boxes, fuses, lightning arresters or transformers should not be attached to such poles, but on the first pole removed from this junction pole. Junction poles can frequently be avoided by the use of two poles making a "Y" connection of the line. By this arrangement the connections are very materially simplified.

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* A paper presented at the December meeting of the American Institute of Electrical Engineers, New York.

Cross Arms.—Cross arms should be spaced at least 24 inches between centres, the top of the first arm being one foot from the top of the pole.

Braces.—Braces should be made of galvanized iron not less than 1¼ inches by 3-16 inch thick, and about 28 inches long.

Pins.—The pins should be made of locust wood well boiled in linseed oil, and are preferable for voltages of 5,000 volts and under. For higher voltages, pins should receive special consideration.

Insulators.—The insulator on the pole line fulfils two functions, viz.: The mechanical support of the line, and the insulation. As these conditions vary over a wide range, they must be considered for each condition. This is especially so for voltages of 10,000 volts and over. The two materials of which insulators are usually made are glass and porcelain. The glass insulator is more uniform in quality of material than the porcelain, so that for lower voltages glass insulators are recommended. For higher voltages, porcelain insulators are preferred for the following reasons: Greater mechanical strength, better insulating qualities, and greater ability to withstand severe weather conditions.

Insulators of high voltages should be made up of a number of insulators cemented together so as to obtain more uniform insulation and to increase the factor of safety from defective manufacture. Before being used, each insulator for high-tension work should be tested at voltages in excess of the operating voltage.

The method of attaching the conductor to the insulator should be carefully considered; first, to see that the wires can be properly fastened to the insulator, and, secondly, to see that the strain is transmitted without a twisting or bending strain in the insulator; the only strain permitted should be in compression.

The method of distributing the wires on the pole lines depends on the number and character of the various circuits to be installed. For all voltages below 6,000 volts, the wire should be brought out of the station through long porcelain tubes, properly supported; the various circuits being grouped together but well spaced, and preferably being distributed in a single, or not more than a double row of wires. This fan effect allows the circuit to be distributed to the poles without any undue bunching, thus making each circuit easily distinguishable.

The top gain of all poles should be left vacant so that guard wires can be placed at any point on the line, should they be required. The transmission circuits which are alive twenty-four hours per day should be placed on the top arm; that is, the trunk lines should occupy the position where there will be the least liability of coming into contact with the other wires or with the men working on the poles. All other circuits should be placed below series arc circuits occupying the lower arms, the distributing series circuit being placed on the house of the lower arms on outer pin occupied by such circuits. The bottom cross-arm should be used for such secondary circuits or low-tension lines as may be required. Space should always be provided for an extra arm on the pole for the erection of a transformer. Protective devices for each circuit may be classified as follows: Circuit-breaker, fuses for branch-circuits, and lightning arresters. Also indicating instruments as follows: Voltmeter, ammeter or wattmeter, and ground-detectors.

In the arrangement of the protective devices, it is desirable to locate as many of these as possible in the station or sub-station, for the reason that they are more readily inspected and kept in perfect working order, which insures the fulfilling of their functions when required. All circuits of 200-kw. capacity or over should be protected by means of oil circuit-breakers in preference to fuses, on all voltages over 1,000 volts. These circuit-breakers should be attached to both ends of the line, when two or more feeders are used and connected to the same bus; and there should be no other circuit-breaker or fuses which are automatic in action placed at any other part of the line. Small branch circuits may be taken care of when necessary by fuse-boxes, placed upon the first pole of the branch circuit. These fuse-boxes, however, should be avoided whenever possible. This can be accomplished by making a branch-circuit about the same as the main circuit, depending entirely upon the circuit-breaker in the station to protect both lines. When small branch circuits are desired, place such fuse boxes. These preferably should be an enclosed fuse of the cartridge-type mounted on a porcelain base, the whole enclosed in a fire-proof and water-proof compartment. This is usually an iron box with a cover and rubber gasket, clamped so as to make it water-tight.

Lightning Arresters.—Lightning arresters should be installed at both ends of the line, in the station and sub-station, on each conductor. Special care should be used in their installation, and provision made that in the event of a breakdown of the lightning-arrester, current may be interrupted by means of a circuit-breaking device.

Series Arc Loop Cut-outs.—These should consist of a mechanically operated switch which closes the circuit at the point of the loop and disconnects the loop from the main line. For the use of constant-potential circuits, there may be either a fuse-box provided with solid catches or fuses depending on the conditions. All of these devices being enclosed in fire and water-proof cases.

Before considering the actions of the safety-devices, it is necessary, first, to examine the faults which may develop and the functions which the safety-devices are required to fulfil. If the condition of a wire parting is first considered, we have first the liability of the wire coming in contact with some of the other circuits; secondly, its liability to fall into the street, and, thirdly, its remainng suspended clear of all circuits and the ground.

The first condition: The effect of coming in contact with other wires, would immediately raise the voltage to the more powerful of the two circuits, so it is evident that the insulation of the other circuit must either be as good or there will be a liability of the insulation breaking down at some point on the weaker circuit. This will first be detected at the station by showing that the load is dropped from this circuit, and it demonstrates that the insulation of all circuits must be the same when placed on the same pole line, unless means are provided to take off extraordinary high voltages. This can be done by placing spark-gaps, which will relieve the high-tension from any low-tension circuits, or by grounding a point on the lower extension circuits.

Wires falling on the ground will indicate immediately in the station, on the ground detector, that there is a ground on that circuit, and instructions should be given that as soon as a ground shows on the circuit and the circuit is not carrying the load, to disconnect it.

The third condition will indicate in the station that the load is dropped and will not show a ground. The circuit should be cut off in this case also, and inspectors sent out to look after the trouble.

Fourthly, if a wire breaks and falls, crossing other wires of the same circuit, this will cause a rush of current on constant-potential circuit and immediately open the circuit-breaker. In the series arc-circuit it will cut out a portion of the circuit which will be indicated on the voltmeter, showing the necessity of regular voltmeter readings on such circuits.

Interference with Other Wires Falling or Coming in Contact with the Power-Circuits.—If these wires cross the power circuit and drop loosely on them, the effect will be to short circuit the power circuit on constant-potential circuits; the defect develops immediatley. The wires either burn off or an arc may be established which will burn off the power circuit, breaking the wires and the connection. The provision should be as the conditions shown for the breaking of a wire. A single wire may merely come in contact with one wire of a constant-potential circuit and assume the same voltage as that circuit; there will be no way of determining this at either the station or the sub-station, unless that wire was grounded and the ground indicated on the ground-detectors. In the event of this falling wire coming in contact with both sides of the series arc-circuit, a portion of the circuit will be cut out and indicated on the voltmeter at the station. Should it come in contact with only one wire of the circuit, no indication will be made at the station unless the wire be grounded. For this reason inspection should be made and all such wires changed so as to come before the power-circuit and not above it. This also demonstrates the necessity of placing protective devices on foreign wires which may come in contact with power circuits.

Lightning Storms.—The installing of efficient lightning arresters as specified may protect the apparatus at both the generating station and sub-station, but fail to protect apparatus at intervening points, particularly the transformers. It is possible that lightning may jump from primary to secondary of transformers during a severe storm. This would be indicated by the primary fuse blowing in the transformer, and after the blowing of the fuse from this cause, tests should be made of the transformer as follows:

It is essential that when a primary fuse on a transformer is blown through any cause, the secondaries should be disconnected from the transformer, and the latter tested to full line voltage between the primary and secondary coils, so as to determine that there is no breakdown in the insulation between these coils.

There are two methods by which these tests may be readily made by the linemen without removing the transformer: First, take from the station a 600-watt transformer, connect its primary for the line voltage and its secondaries for 100 watts, and connect a 50 volt lamp across the latter. Attach one primary lead of this test transformer to one secondary wire of the line transformer, and place one-ampere fuses in the primary cut-outs protecting the line transformer. Now connect the other primary lead of the test transformer, first to one and then to the other of the main primary lines. If the 50-volt lamp filament becomes red, the line transformer is defective, and should be returned to the station. Second method: If impossible to use the first method, proceed as follows: Attach a short piece of heavily-insulated rubber wire to one of the secondary wires leading from the transformer. Then place one-ampere fuses in the cut-outs, and connect the specially-insulated rubber wire first to one and then the other of the main primary lines. If the fuse blows, or a spark shows when contact is made, the transformer is defective and should be removed from the line.

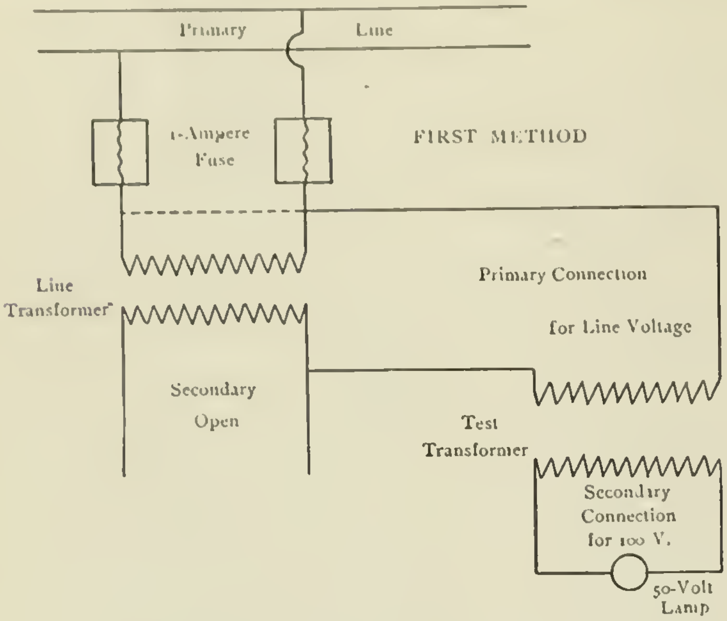

FIG. 1.

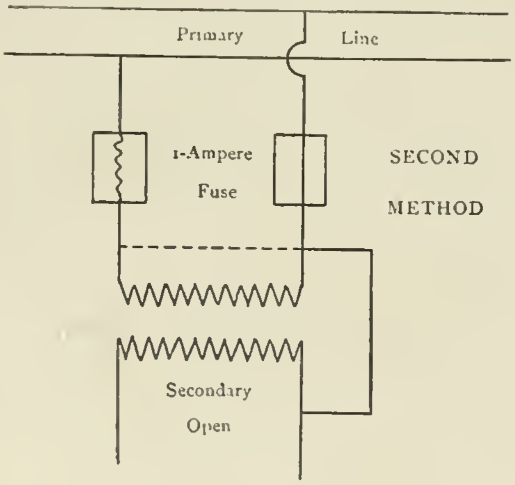

FIG. 2.

In the event of lightning arresters being placed on the pole line, all such lightning arresters should be inspected after each heavy lightning storm.

Transformers.—Transformers when supported on the poles should be hung on an extra cross arm provided for that purpose. The primary leads from the line to the fuse box and to the transformer should be insulated with rubber-covered braid, for the line voltage. Transformers should not be attached to buildings or in such locations as to be handled by unauthorized people, and when they are placed in buildings they should be put in a separate fire-proof closet or room which is controlled only by the operating plant. As it is now the general practice to use oil transformers it is unnecessary to consider dry transformers. Inspection should be made to see that the cases are properly filled with oil. This should be done by an inspection force, and not by the men erecting the transformers.

Inspection.—The greatest safeguard in a transmission line is regular inspection. Lines can with advantage be inspected daily, not only on inspection from the ground, but a regular monthly inspection of all devices attached to the line when a continued service is desired.

It may be necessary on some parts of the line to introduce cable. This should be avoided whenever possible for the reason that the conductors are brought close together at this point and static discharge is liable to puncture the insulation; so means should be provided at both ends of the cable to take care of the static. This is best arranged for by a series of gaps of the lightning arrester type. Standard lightning arresters can usually be used for this purpose. They should, however, be provided with a small fuse in series with the connection to the line so as to prevent short-circuiting the lines in case of failure of the spark-gaps.

Overhead High-Tension Distributing Systems in Suburban Districts.*

By George H. Lukes.

The problem of building up and operating a satisfactory distributing system for the suburban towns and villages surrounding a large city presents many peculiar difficulties. It is rarely the case that the engineer is given the opportunity to lay out a complete system which can be operated economically and safely with a reasonably low first cost. The problem is more often one of reconstructing existing systems, making use of as much of the old work as possible and at the same time making provision for future growth. Obstacles are usually encountered in the work. Many different interests have to be satisfied, and in some cases the engineer is compelled to use types of construction which are not desirable, but necessary under the circumstances.

The villages surrounding a large manufacturing city are of several different types. The oldest ones are located on the lines of steam railways radiating from the city, and are residential in character. As transportation facilities are improved new suburbs are started at greater distances from the city. The older ones become more thickly settled and even grow to be cities themselves. Some of the villages are made up of people of moderate means, whose houses are fairly close together. Others are built up by wealthy people who buy tracts of land and build large houses, which they occupy but four or five months in the year. Later on, the manufacturing suburb makes its appearance, consisting of a group of factories and a small business district surrounded by the houses of the workmen.

In the process of time, electric lighting plants are erected in the larger villages and their pole lines are extended in time to the smaller villages near by to supply incandescent and street lamps. A large proportion of these small plants cannot be operated at a profit, an the result is a gradual deterioration in the stations and distributing systems, resulting finally in consolidations which bring large districts under the control of one company. It then becomes necessary to tie the various systems together, operating some of the stations as peak-plants and turning others into sub-stations, thus taking advantage of the fact that the peak may occur in the summer in one village and in winter in another.

Surburban business is so scattered that the cost of underground work is prohibitive and the distribution must be made by overhead wires. Public opinion is, however, intense in its opposition to overhead construction. The suburbanite objects to the multiplicity and unsightliness of the pole lines. He is in business in the city where the agitation against overhead wires has resulted in their being placed underground, and he refuses to believe that conditions are different in the country. In many communities local action has been taken compelling the use of joint lines by the electric light and telephone companies. These have been erected and operated successfully in many cases without any great danger. Joint lines ought to be avoided if possible, and it is important that every effort be made to make the pole lines as unobtrusive as possible. The poles should be well painted with a dull color, such as a dark olive green; the wires should be kept taut and the connections made in a neat and symmetrical manner.

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* A paper presented at the December meeting of the American Institute of Electrical Engineers, New York.

An overhead distributing system must be constructed so that the service will be reliable and not subject to frequent interruptions. The voltage regulation must be as good as possible and danger to life and from fire reduced to a minimum. This can be accomplished without adopting an extremely expensive method of construction. The great proportion of accidents and interruptions are caused by defects which are very easily guarded against, provided they are looked for. It is not the intention here to lay down rules for the construction of pole lines, but to draw attention to certain points which experience has shown to be often neglected.

Main Lines and Branch Circuits.—Main lines leading from stations should be on not less than 40-foot, and preferable on 45-foot poles. This gives plenty of room for additional circuits and makes it easier to cross above telephone and telegraph lines. The branch circuits can be on shorter poles, but it is not advisable to use poles shorter than 30 feet. Where branch lines are taken off, the poles should be double-armed and buck-armed. Transformers, fuses, lightning arresters and other devices should not be installed on main lines where it can be avoided.

Poles.—In the Middle West, the poles available at present are Michigan white cedar and Idaho cedar. Michigan poles are better proportioned than Western poles, and are longer lived. Michigan poles should have a top diameter of not less than seven inches. If Western poles are used, it is well to note that eight or nine-inch tops should be specified in order to obtain proper butt diameter. Michigan poles are sorted and sold under the specifications of the Northwestern Cedarman's Association, and it is, therefore, cheaper to buy under the above specifications and sort out to suit. Poles should be shaved, roofed, and given one coat of paint in the yard. Poles are painted in order to improve their appearance, but the question of whether or not it adds to the life of the pole is an open one. In setting, particular care must be taken to select the best poles for the corners, turns and ends of the line. If the line is on a highway that curves, set as many poles in a straight line as possible and make the turns on one or two poles, which can then be properly guyed. A line that changes its direction at every pole can never be held in position. Poles should be double-armed at corners, curves and ends.

Guying.—This is one of the most important features in pole line construction, and is often neglected. Corners, junctions, and ends should be carefully guyed. Wherever the line changes in direction, even if the change is very slight, a guy should be placed. Patent guys and land anchors should be used with great caution and only on light work. The best guy is the old-fashioned one consisting of a guy-stub, set at some distance from the pole with a galvanized iron anchor rod bolted to a slug buried in the ground. Strain insulators should be inserted in the guy wire and care should be taken to make sure that the anchor rod and guy wire attached to it are grounded electrically.

Cross Arms.—The best cross arms at present are made of Southern yellow pine. They should be straight grained, well seasoned, free from knots, and purchased unpainted. They are the first part of the line to give out. The action of the sun's rays causes the arms to crack on top and they soon rot around the pin-holes. The usual method of treating is to paint them with white lead and oil, but in the West cross-arms boiled in carbolineum have been used to some extent. The matter of the proper dimensions and pin-spacing for cross-arms has not received the attention it should, and it is high time that an attempt be made to standardize 4-6 and 8-pin arms for use on circuits up to 5,000 volts. The proper 6-pin arm for such use should have approximately the following dimensions: Section, 3¼ inches by 4¼ inches; length, 8 feet; spacing, between pins about 16 inches, between pole pin about 22 inches. Cross arms for junction holes should be of special size with greater distance between pins.

Insulators.—The ordinary deep-grooved, double-petticoated insulator has proved satisfactory on 2,000-volt incandescent and 4,000-volt arc circuits. It is perhaps advisable to use triple-petticoat insulators on 4,000-volt polyphase work.

Fuse-blocks and lightning arresters are sources of trouble on pole lines. In some instances systems have been operated entirely without fuse-blocks on the outside lines, excepting, of course, the transformer blocks. The best plan is to install them on branch lines where there is a chance for trouble. Lightning arresters should be installed to protect groups of transformers and branch lines. They should be frequently inspected and the ground wires tested.

Transformers should be hung on double arms below the lowest arm. If they are of large size the arms should be extra heavy and bolted securely to the pole. Methods of bringing the primary wires down from the circuit to the transformer are various, and all are open to objections.

It is usually impossible to keep a regular arrangement of circuits upon cross-arms for the reason that as the business grows, circuits of all kinds are added. It is very desirable, however, that circuits be kept in the same relative position throughout their length in order to facilitate tracing. Houses should be, as far as possible, grouped upon three-wire secondaries which should be carried alone on the lower arm. The installation of 200-400-volt, three-wire secondaries would facilitate this work wonderfully in scattered districts. The neutrals of three-wire secondaries should be grounded on the first pole away from the transformer.

All series alternating arc lamps should be provided with absolute cut-outs and high-voltage insulators in the lowering cable. Windlasses for raising and lowering lamps should be permanently grounded and an arc lamp when suspended from span-wires should be connected so that should it fall, the lamp will not fall toward the windlass but away from it.

The importance of frequent inspection of pole lines cannot be over estimated. Old pole lines can be made very reliable, provided they are well guyed and weak points kept in repair. For inspection work, lines men of considerable experience are needed, because only long years spent in repair work gives the ability to predict where trouble is likely to occur.

Accidents caused by overhead wires are remarkably infrequent, considering the number of miles of pole lines operated. They occur most often to electric linemen, less often to telephone linemen and very rarely to citizens. Accidents to linemen can largely be prevented by employing on live work only steady and tried men and using the inexperienced men and floating linemen on new construction work. Accidents to telephone linemen are mostly the result of want of care on the part of the men themselves. Accidents to citizens can be reduced to a minimum by care in constructing and maintaining lines.

The danger from fire is in the possibility of high-voltage current reaching buildings; first, through defective transformers, and, secondly, through crosses between primaries and telephone wires. The first can be eliminated by grounding the secondary; the second can be made remote by proper co-operation between electric light and telephone companies in the erection of junction poles and substantial construction. The danger from fire is somewhat overestimated, and it is to be sincerely hoped that any restrictive regulations will not only be carefully considered before final action is taken, but worked out in actual practice to determine whether or not their enforcement would introduce risks which would more than offset any advantage gained.

Tariff Agitation in England.

The Tariff Reform League, of England, has announced the names of twenty-three persons who have accepted invitations to serve as members of the Tariff Commission referred to in a recent speech by Mr. Chamberlain at Leeds. The League also gave some particulars of the work the commission will do.

It is understood that the commission has not been packed with men committed to some particular idea, but that it is made up of men of open minds, who will study the tariff question diligently from all points of view, and who will endeavor to draft a scheme of protection satisfactory to all whose interests should be consulted. Among those who have accepted are Sir Arthur Keen, vice-president of the Institute of Mechanical Engineers and of the Iron and Steel Institute; Sir W. T. Lewis, president of the South Wales Institute of Engineers; Hon. C. A. Parsons, of steam turbine and electrical engineering fame; Sir A. Hickman, member of the Council of the Iron and Steel Institute; Mr. C. Allen, nephew of Sir Henry Bessemer, and Mr. Alfred Mosely, the millionaire educational reformer. These are good men and typical.

New Telephone Patents.

SUBSCRIBER'S CIRCUIT.

A new common battery system of subscriber's station circuit has been designed by Mr. W. W. Dean, of Chicago, in which the various parts have been arranged in a manner to suppress receiver "clicks." These clicks, so prominent and disagreeable with many central energy systems, seem to be almost wholly traceable to breaking the continuity of the receiver circuit, while highly inductive apparatus is contained therein.

In Mr. Dean's circuit, which is shown in Fig. 1, it will be noted that at the instant of breaking the receiver circuit in the commutation of the local circuit a low resistance shunt is always provided for the receiver. At the depression of the hook switch the shunt circuit, that containing the coil shown immediately above the receiver, extends around both receiver and condenser in series. The second shunt, that for the rising switch hook, is a low resistance strap directly about the receiver.

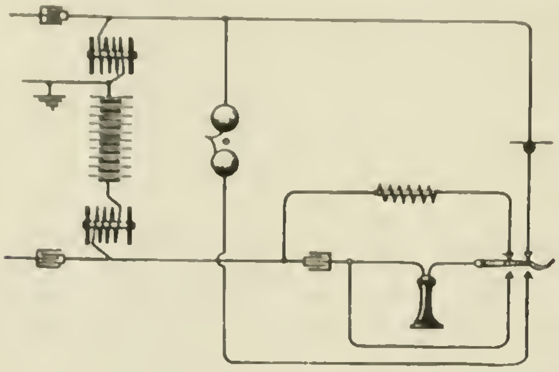
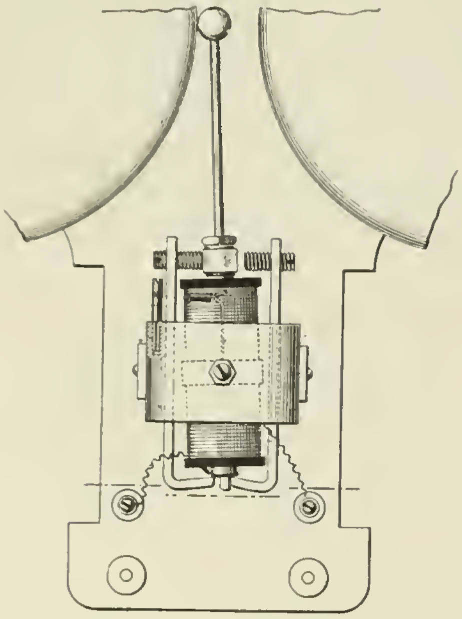


FIG. 1.—DEAN CIRCUIT.

At first thought it might seem that the first-mentioned shunt, containing an impedance coil, could not be effective. However, the requirements of the circuit permit a coil of impedance rather low compared to that of the condenser and receiver in series. Mr. Dean has recently obtained a patent for this circuit, which he has assigned to the Kellogg Switchboard & Supply Company.

POLARIZED BELL.

In Fig. 2 is shown a rather novel type of polarized bell for which a patent has been granted to Leland Moore, of Brooklyn. This bell is probably designed as a load-ringing extension bell, and in distinction to usual custom the coil forms the vibrating portion. This coil is wound in two sections, the separator serving as a seat for the trunions. Spanning the coil is a heavy permanent magnet carrying pole extensions between which the ends of the coil core vibrate. The pole extensions for one end of the core engage directly with the core and are fixed in permanent position. Those for the other end, however, carry small cylindrical pieces threaded through them, and thus providing adjustment.



MOORE PARTY LINE BELL.

When it is desired to have the bell respond to current impulses of one polarity only, as required for some party line systems, one of the screw pole tips is made non magnetic, and the coil is provided with a biasing spring, as shown in the cut.

SELECTIVE SYSTEM.

A step by step selective system has been patented by E. O. Hood, of Hingham, Mass. This system, like all others of the type, depends upon a synchronized action of the switching apparatus at all subscribers' stations. This, of course, is at once a material point against the system, even though arrangement is cleverly made to restore all switches to the normal automatically immediately after a call is made

SIGNALING MOVING TRAINS.

Another system for signaling moving trains in which a contact is maintained between the train and a stationary conductor has been recently invented by James Edgar, of England. The chief novelty lies in the use of a slotted tube beside the track within which the stationary conductor lies. This conductor is threaded through the train contact which slides along in the tube, and it makes its connection to the live wires through wide metal studs secured at intervals in the bottom of the tube.

Recent Electrochemical Developments.

COPPER REFINING.

A patent granted on December 15 to Mr. Alfred Schwartz, of New York City, relates to a novel arrangement of the electrolytic tanks in a copper refinery which is intended to provide proper circulation and an easy method of removing the slimes. The tanks are arranged in tiers above each other; below all of them there is a basin for the electrolyte in which it may be heated to any suitable temperature. From this basin the electrolyte is pumped upwards into the top of the uppermost tanks. The electrolyte flows out of these tanks at the bottom and flows then into the top of the next lower tier of tanks and so on until it finally returns to the basin at the bottom. Each of the electrolytic tanks is provided at its outlet at the bottom with a filter to retain the slimes. An automatically-controlled valve governs the outflow through this outlet. The method is quite different from that in general use in our copper refineries, where circulation is accomplished by an overflow, but is restricted in amount, in order not to disturb the slimes.

ELECTROLYTIC BLEACHING.

On December 15 a further patent concerning electrolytic bleaching was granted to Mr. Marcus Ruthenburg, who is best known by his work in the electrometallurgy of iron and steel, but is also interested in electrolytic bleaching, as was noticed in these columns some time ago. He impregnates the stuff to be bleached, for instance, paper pulp, thoroughly with an aqueous solution of sodium chloride with some addition of hydrated calcium oxide, and then sends a current through the system, thus producing anodically a bleaching agent. The bleaching effect is claimed to be greater than if the bleaching agent is made separately and the paper pulp treated with it afterwards.

ELECTRIC FURNACE METHODS.

Of four patents recently granted to Mr. P. Danckwardt, of Deadwood, South Dakota, two refer to the production of alkaline cyanides. In an electric furnace he brings to reaction a mixture of magnesium nitride, sodium fluoride and calcium carbide in an atmosphere of nitrogen. The products are sodium cyanide, calcium fluoride and magnesium. The mixture of sodium cyanide and calcium fluoride is drawn off from a tap hole, while the gases of magnesium developed combine with the nitrogen introduced into the furnace and form again magnesium nitride. This on coming into contact with a new charge of fluoride of sodium and calcium carbide will again cause the first reaction, and so on. In the second patent he produces sodium cyanide simultaneously with metallic sodium. He subjects a mixture of sodium nitrite, sodium fluoride or sulphide and calcium carbide to the heat of an electric furnace. A mixture of sodium cyanide and calcium fluoride or sulphide is drawn off from a tap hole, while the metallic sodium volatilizes and is collected in another receptacle.

A third patent relates to a method of separating valuable metals from matte or ore and consists essentially in heating a mixture of the matte or ore with limestone and carbon in an electric furnace with an exclusion of air. The amount of carbon and limestone must be chosen so that the carbide which is being formed will be just sufficient to reduce all the sulphides or arsenides of the valuable metals to be separated (like copper, lead, gold, silver, etc), but not sufficient to reduce the iron sulphide to the metallic state.

The fourth patent relates to a method of recovering zinc from sulphide ores and consists essentially in treating in the electric furnace a mixture of the ore with sodium sulphate, limestone and coke, and sufficient fluxes to slag off the impurities of the ore in the presence of a large excess of carbon. The furnace action is again carried out under exclusion of air. The furnace reaction is assumed to be as follows: First, the sodium sulphate is reduced to sodium sulphide under evolution of carbon monoxide, and as the temperature rises to the formation point of carbide, this carbide reacts with the sodium sulphide, forming calcium sulphide and metallic sodium, which latter *in statu nascendi* attacks the heavy metal sulphides, regenerating sodium sulphide and setting the heavy metals (zinc, lead, copper) free.

New York Central Electric Plans.

Details and illustrations have already been presented in these pages with regard to the plans and plant for equipping the New York City terminal and suburban lines of the New York Central Railroad Company with electricity. No authoritative statements have been given out since, but further data have become available. It is understood that the road will be equipped with third rail on the main line from Forty-second Street to Croton, and on the Harlem road from Forty-second Street to White Plains. On the New York & Putnam about five miles of the road will be thus equipped. It is quite probable that the Central may establish a new division point at Croton, thus obviating the present change of engines at Albany.

In regard to the electrical equipment of the road, so far the committee has decided upon the construction of two main power houses, one at Port Morris and the other at Yonkers. There will also be erected twelve rotary sub-stations at intervening points along the main line. The engineers estimate that the main power houses will cost one and a quarter millions each, and the smaller stations $300,000 each, bringing the cost for construction and equipment of the power stations up to $6,000,000. In addition to this, the electric locomotives, special cars, the third rail and other needed accompaniments will bring the cost of the electrical equipment of the road up to $12,000,000.

A committee is considering what connection can be made with the Subway system. Many of the directors are against a train connection with the Subway for the reason that the Central would have to install a new style of suburban passenger car which could be operated in the tunnel, as any of the existing passenger cars would be too large for this service. The depressing of the tracks in the Forty-second Street yard is now progressing in three divisions, so that traffic may not be interrupted. This and the new terminal building, if decided upon, will bring the total of expenditure required for these purposes up to $20,000,000. In addition, the extra improvements will cost about $5,000,000. It is conservatively estimated that the new terminal improvements, together with the complete electrification of the terminals, will cost $25,000,000.

American Association for the Advancement of Science.

The annual meetings of the American Association for the Advancement of Science and of the American Physical Society will be held in St. Louis, Mo., in "Convocation Week," from December 28, 1903, to January 2, 1904. The opening session of Section B will be held on Monday, after the adjournment of the general session, probably about 11 o'clock A. M., at which time the session will organize, elect committees, and transact other suitable business. On Monday at 4 o'clock, the retiring vice-president, Professor Ernest F. Nichols, will give an address on "The Infra-red Spectrum." The Section will meet on Tuesday morning and afternoon, for the reading of papers. On Wednesday, December 30, the annual business meeting of the American Physical Society will be held, and the programme will consist of papers by members of this society. A regular session will be held on Thursday morning, while the afternoon will probably be devoted to a visit to the World's Fair Grounds. If the number of papers is sufficient, the sessions will continue through Friday and Saturday. All sessions for the reading of papers will be held in Room 317 of the Central High School Building. Room 313 has been designated as the smoking room for Section B and the Physical Society, and the business session of the Physical Society will be held in this room on Wednesday. The vice-presidential address, on Monday, will be given in Room B2. The Southern Hotel will be headquarters.

A number of interesting papers are listed, and Prof. E. Rutherford is to give a popular lecture on radium. Among the papers are the following: "Hertzian Waves Since the Work of Hertz," A. D. Cole; "A Simple Alternate Current Frequency Recorder" and "Iron Losses in Loaded Transformers," E. S. Johonnot, Rose Polytechnic Institute; "The Radio-activity of Ordinary Metals," E. F. Burton; "A Possible Method of Accounting for an Electrically Charged Sun," David Todd; "On the Position of Aluminum in the Voltaic Series, and its Use as a Positive Element in a Primary Cell," and "On the Theory of the Electrolytic Rectifier," S. R. Cook; "A Spectro-photometric Study of Flourescence," and "The Phosphorescence of Organic Substances at Low Temperatures, Preliminary Note," E. L. Nichols and Ernest Merritt; "A New Form of Frequency Indicator," A. S. Langsdorf; "On the Use of Nickel in the Core of the Marconi Magnetic Detector," Arthur L. Foley; "A Remarkable Distribution of the Carbon Deposit on the Bulb of a 'Hylo' Incandescent Lamp," Arthur L. Foley; "An Absolute Determination of the Electromotive Force of the Weston Cadmium Cell," Henry S. Carhart and George W. Patterson; "The Heating Effects of the Radium Emanation," E. Rutherford and H. T. Barnes; "Does the Radio-activity of Radium Depend upon its Concentration," E. Rutherford; "On the Electrical Conductivity of Liquid Films," Lyman J. Briggs; "The Charges Given to Surfaces by the Diffusion of Ions, and the Earth's Negative Potential," John Zeleny; "On the Velocity of Light in a Magnetic Field," and "On the Effect of a Magnetic Field on the Interference of Polarized Light," John Mills.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY ON SHIPS.—Another steamship in distress has been helped out by her wireless system. A cable dispatch from London of December 19 says: "The Red Star Line steamship *Finland* left Antwerp at noon to-day, and later the wireless telegraph station near Ostend, Belgium, received a message from the operator on board saying that the steamer had gone aground near Flushing, Holland. The weather was thick. The ship is not believed to be in any danger. Assistance has been sent to her. She has about 150 cabin and 500 steerage passengers aboard."

TELEGRAPHING EXTRAORDINARY.—The London *Times* has been pushing the sales of its edition of the "Encyclopedia Britannica" in great style, and has just closed the lists. On December 18 it made a last effort to bring in the waverers and establish a record in telegraphic advertising. Thousands of persons throughout the kingdom having obtained specimen pages, etc., but not having given a final order, and had been registered carefully, and the next morning 130,000 of them received telegrams admonishing them to write then or "wire this morning, as subscriptions are coming so rapidly that immediate action is your only safe course." Hundreds of orders were received in answer to the telegrams.

MUNICIPAL TROLLEYS.—The Civic Federation of Chicago, a city which has had a big municipal electric light plant for many years, looks unfavorably upon proposed municipal trolleys. It points out that at least five years more must elapse until certain questions involving rights claimed by the companies can be settled in courts of last resort, and "five or more years of even poorer service do not present an attractive feature." It estimates the cost of necessary improvements in equipment and service at $15,000,000 or more, which must be invested by the city if it takes hold, besides such further sum as may be necessary to acquire the existing properties and on which it is hard to set limits. It naturally fails to see how the city will be able to raise this money. The success in the enterprises now within the city control does not, it says, compel the belief that higher success would crown efforts in the reconstruction and operation of the street railway systems, stating among other things that "in Chicago it costs fully 25 to 40 per cent. more to pave the streets under city administration than it does for like service under similar conditions of legitimate cost elsewhere." It therefore recommends an ordinance continuing the franchises for a limited term of years, "with a just and adequate provision for compensation."

MUNICIPAL ART.—Borough President Cantor, of Manhattan, has issued permits for the erection of two electroliers in Longacre Square, New York City, given to the city through the Municipal Art Society, which has already set one up at Fifth Avenue and Twenty-third Street.

PARIS LIGHTING.—Bartholdi has a new scheme for lighting Montmartre, Paris. The idea is to erect his tall monument in memory of the balloonists of the Siege of Paris either on the Place Pigalle or the Square Saint Pierre, and surmount the column by a large mica balloon, containing electric lamps.

CHICAGO A. I. E. E. MEETINGS.—On January 5, 1904, a meeting of the Chicago branch of the American Institute of Electrical Engineers will be held at the usual place, 1741 Monadnock Block, to discuss central station topics as suggested by the papers presented at the New York meeting, December 18, and possibly also two papers presented at the New York meeting, on November 20, which bear closely on central station work. On February 2 a special telephone meeting will be held, at which time papers and discussions on the automatic telephone exchange will be presented. All of these meetings give promise of much interest and large attendance.

ELECTRIC CLUB JOURNAL.—The Electric Club, of Wilkinsburg, Pa., will, on February 1, issue the first number of the *Electric Club Journal.* Besides printing the transactions and proceedings of the club, the *Journal* will reprint papers read before societies and conventions which are appropriate in character, but not readily available to members, and contain editorials, engineering data, descriptions of shop practice, etc. The circulation will not be restricted to club members, but the privilege of subscribing extended to those who wish to fit themselves for practical engineering. Since the educational feature of the club work comprises a weekly lecture by an engineering authority and several meetings during the week of engineering sections, the amount and the character of the original matter available for the columns of the publication should render it of much value to the general engineering public.

THE INTERSTATE COMMERCE COMMISSION, in its annual report just filed on railroads in the United States, says: "In the year ending June 30, 1903, the number of passengers killed in train accidents was 164, and of injured, 4,424; of employees killed, 895; injured, 6,440. Casualties from other causes, added to these, make totals of 321 passengers and 3,233 employees killed and 6,973 passengers and 30,004 employees injured. These numbers are larger by a considerable percentage than the corresponding numbers of the year last preceding. The report says that some railroads have willfully neglected to make correct reports of accidents on their lines. It recommends that no person under twenty-one be permitted to act as telegraph operator, as many disastrous collisions have occurred through the negligence or misconduct of youthful employees. The report says also that the block signal system should be made compulsory in order to prevent the continuance of accidents which are "a disgrace to the American people."

WINTER-EICHBERG SINGLE-PHASE RAILWAY MOTOR.—Maurice Latour, in a letter to the London *Electrician*, claims that the English patent recently issued on the Winter-Eichberg single-phase railway motor, an analysis of which patent appeared in our issue of last week, discloses that this motor is none other than his single-phase series compensated motor. It suffices, he says, to refer to the *L'Industrie Electrique*, 1902, p. 220, first column, last paragraph, where he had described very clearly the excitation by means of a single-phase alternating-current of a rotor provided with a commutator (see French patent 306,229 of December 12, 1901) when two auxiliary brushes short-circuited on one another are placed at right angles to the two brushes introducing the line current into the rotor. In addition, he says, his single-phase compensated motor of either the series or the shunt type, admits of such a simple and brief description that he could not understand the reasons for elaborating a series of claims of such a general and varied nature as those of the British patent, if the compensated single-phase motors were really intended to be covered by this patent. He considers it certain that his single-phase motor is interesting only because it is a compensated motor, and if this special quality is not desired, the simple repulsion motor suffices to obtain all speeds without the use of external resistances.

RUIN CAUSED BY BREAK OF HIGH-TENSION WIRES.—Through the breaking of a wire of the Chicago & Joliet Electric Railway, three railroad stations situated several miles apart were set on fire, while those at Lemont and Spencer were destroyed, and telegraphic communication with Joliet was almost entirely cut off. The circuit which feeds the power houses at Lemont and Summit runs from the plant of the Economy Light & Power Company at the Jackson Street dam of the drainage channel in Joliet. The pressure carried is 15,000 volts. The break occurred where the circuit passes six feet above the wires of the Santa Fé Railroad. When the contact was made, the current burned out every fuse in the Joliet office of the Western Union Telegraph Company and ended communication between Chicago and St. Louis on the Chicago & Alton Railroad; between Chicago and Kansas City on the Santa Fé and to all points west of Joliet on the Rock Island. The current entered the telegraph station on the Santa Fé at Lemont and set it on fire. The station was deserted at the time and in it were stored 500 pounds of dynamite awaiting shipment. The heroic efforts of Mayor Keig, of Romeo, and several others saved the village from destruction. In several other stations on the line of the Michigan Central, Santa Fé, Rock Island and Alton Railroads damage was done to the telegraph system and wires and instruments were rendered useless.

THE GERMAN CABLE.—Mr. R. Guenther, United States Consul-General at Frankfort, Germany, says, under date of November 5: "The contract between the German Atlantic Telegraph Company and the German Post-Office Department with reference to the construction of a second German-Atlantic cable between Borkum and New York, via the Azores, provided that the first part of this second cable between Borkum and the Azores should be completed for business at the latest at the beginning of the year 1904, and that then the German Government would pay a fixed sum of 750,000 marks ($178,500) for the year to the said company. The other agreements between the company and the German Empire become operative if the second part between the Azores and New York (the whole cable) is completed on January 1, 1905. A few days ago the first part of the cable, i. e., between Borkum and the Azores—was successfully completed, in spite of the extraordinary unfavorable conditions of the weather on the Atlantic Ocean this year. The first part of the agreement with the German Post-Office Department has, therefore, been fulfilled according to programme. Without considering the pecuniary advantage resulting to the German Atlantic Telegraph Company through this stipulated payment on the part of the Empire on account of the existence of a double cable the cable traffic between Borkum and the Azores appears secure, as the probability that both cables should be interrupted simultaneously seems very remote, and as the new cable is in a condition to handle a considerable higher amount of traffic than the first one."

ELECTRICAL TYPESETTING.—The invention of Mr. W. S. Timmis, now being shown in New York City, known as the "lithotype," is based on the idea of using aluminum plates for all printing in which lithograph stones have been employed. The claim is also made that it eliminates all setting and distribution of type as well as matrix making, stereotyping and electrotyping. The plates are only 1/32 in. thick. "As at present constructed," says the inventor, "the lithotype consists of two parts or devices operating separately. Arrangements, however, have been made to co-ordinate these parts. The first consists of a small machine comprising a keyboard similar to the ordinary typewriter keyboard, perforating device to perforate a paper ribbon or strip of any required length, and a counting device. The perforating device is operated electrically and controlled by the depression of the keys. The machine automatically takes care of the spaces between the words. The perforated slip goes directly into the second part of the combination, which operates to bring the printing member into position, so that the selected character is directly opposite the printing point. The character is then inked, the paper is moved up to the character, and the impression is taken therefrom. This action is repeated for each character until the line is completed, when the paper-carrying device returns and moves for the new line. The transfer thus obtained is now ready to be impressed on the surface of the prepared aluminum plate. The plate, with the imposed transfer, is put under pressure, the paper is washed off, the impression thus made is 'rolled up,' and then, with a few finishing touches, is ready for the press."

A RAT STARTS FIRE PANIC.—Fifteen big fire gongs were set clanging and as a consequence a number of Senators and members of Congress were brought flying to the National Hotel lobby, Washington, in various stages of disarray because a hungry rat in gnawing the insulation from an electric alarm wire, had short-circuited the same.

TAKES PICTURES WITH PITCHBLENDE.—Prof. Alja R. Crook, of Northwestern University, notes independently that there is sufficient radium in pitchblende to make it possible for a photograph to be taken by it directly. By winding tin wire around a sensitive photographic plate and wrapping the latter in several coverings of black paper to exclude the light, the radium rays from the pitchblende passed through the paper and made an impression on the sensitive plate, so that when the plate was developed it showed where the wires had been wrapped around it. Prof. Crook states that the value of the experiment lies in the proof of a new way in which to discover radium in minerals.

A. I. E. E. PHILADELPHIA MEETING.—At a meeting held December 6 at the Engineers' Club of the Philadelphia local branch of the American Institute of Electrical Engineers, Mr. Lamar Lyndon read his November paper on "The Comparative Behavior of Floating and Booster-Controlled Batteries on Fluctuating Loads." Mr. E. F. Northrup gave an abstract and discussion of Mr. Addicks' paper on "The Electrical Conductivity of Commercial Copper," and Prof. Joseph W. Richards, of Lehigh University, an interesting address on "The Energy Absorbed in Electrolysis." The discussion of the papers, which was interesting and spirited, was participated in by Messrs. Woodbridge, Blizard, Lyndon, Clauder, Hewitt, Richards, Northrup, Hodges and Sanville. After the discussion Messrs. W. L. Hodges and John Kelly showed the talking arc lamp. The experiment was very successful. A number of phonographic records were given out by the arc, as well as the human voice. The phonograph was operated and the speaking was done in a room remote from that in which the lamp was exhibited.

LETTER TO THE EDITORS.

Theories in Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs:—I regret that through indisposition I have not been able to reply earlier to Prof. Fessenden's letter in your issue of October 31 last.

I may say without further parley that I am disappointed at the bellicose attitude taken up by Prof. Fessenden, which I do not think was altogether called for by my letter in your issue of October 17, and, I fancy, he will find that in his anxiety to make out as strong a case as possible he has laid himself open to very serious criticism. The dogmatic way in which he lays down the law as though no one but himself has really studied the theory of wireless telegraphy, is amusing. He points out some imaginary blunders I have made, but which are really his own. He also makes the unwarranted and wholly erroneous assumption that I have made no experiments and infers that I am a "lucky guesser." It may surprise Prof. Fessenden to know that I have made a large number of experiments in wireless telegraphy and that I have been associated with the practice of the subject to an extent at least comparable with Prof. Fessenden's own association therewith, and for a longer period.

I have yet to learn that my contention regarding the "sliding wave" theory, viz.: that it was first published by me in May, 1899, is wrong. I contend that in this publication the propagation of waves over the surface of the earth, as opposed to space-propagated waves, was first advanced as an explanation of wireless telegraph effects. On the strength of this theory I predicted that the curvature of the earth would have little or no effect on transmission. As to the theory being a "lucky guess," I leave that to readers of the articles in question to judge. Personally, I think it was a theory logically deduced, and was, Prof. Fessenden notwithstanding, largely the result of reasoning on my own practical observations.

Prof. Fessenden says that, according to my theory, the intensity varies as the distance (I presume he means *inversely*). This would only be the case under theoretically perfect conditions. The surface traversed would have to be perfectly conducting and free from excrescences. Resistance of the surface would absorb energy and the presence of excrescences of a size comparable with the wave length and sufficiently abrupt, would reflect the waves, and also give rise to space-propagated waves with consequent dissipation of energy. Again, the strength of transmission would be largely affected by the degree of transparency of the atmosphere to these waves. Ionized air would and does absorb much of the energy from the waves, according to the degree of ionization present. Hence, Prof. Fessenden's argument on this score falls to the ground.

Quantitative measurements, especially in wireless telegraphy, may be wrongly observed or wrongly interpreted, and are equally dangerous in either case. Like statistics they must be intelligently applied or they will lead to erroneous conclusions, and this I make bold to suggest is just what Prof. Fessenden has been doing. How he can possibly argue that the intensity can vary with the square of the distance on any "sliding wave" theory under perfect conditions of transmission, is quite beyond me. When this is the case the waves are "space propagated." That is, they are spread over a spherical or roughly spherical surface and not along a simple circular belt.

I have carefully read the remarks made by Prof. Fessenden in 1899 on the sliding wave theory and published in the *Transactions* of the American Institution of Electrical Engineers for November, 1899, and fail to find that the theory there given is other than that advanced by me, but very crudely explained. I also notice that he does not even try to claim it himself, but endeavors to ascribe it to Heaviside and others.

Prof. Fessenden's main idea appears to be that the waves used are not Hertzian waves, but a new type which he was the first to recognize. This view of the case will take considerably more substantiation than Prof. Fessenden has yet given, especially in view of the fact that he has undoubtedly gone astray on the question of phase difference between magnetic and electrostatic energies in the waves, as per his British and American patent specifications. What ground has he for the statement that the Lodge waves or any true waves have electric and magnetic energies out of phase? In electric oscillations this is the case, but in traveling waves it is not and cannot be. In any true waves, whether ether waves or waves in matter, the kinetic and potential energies are equal and in phase. In fact, when we say that the magnetic and electric energies in any harmonic disturbance are equal and in phase it is simply another way of saying that the disturbance is a traveling one, i. e., a wave. Arrest a wave, or stop it traveling, and it at once becomes an "oscillation" where the electric and magnetic forces are out of phase.

Prof. Fessenden appears to be mixing up so-called "stationary waves," which are really oscillations, with true waves traveling with the velocity imposed on them by the medium in which they exist. He lays claim to have discovered a fact which was known before electric waves were discovered. He has also "discovered" several other mare's nests. He says that I have not yet recognized that no currents exist in the surface over which the waves are propagated. This is quite true, inasmuch as an electromagnetic field localized about a conductor constitutes a current in that conductor from one point of view. And I contend that Prof. Fessenden has not yet proved that this view of the matter is incorrect. He puts a "barreter" in a horizontal earthed wire and gets no result. Why? Because his "barreter" is not sensitive enough to detect the minute and momentary currents which would exist in this small section of the whole path of traverse. In other words, his "barreter" is at best but a shunt to a conductor of great size—a circular belt of the earth's surface. He then puts it in a vertical wire and gets a considerable effect. Why? Because the vertical wire collects and holds to itself the energy or some part of the energy from space a quarter length wave around itself in virtue of the wave being arrested and oscillations set up about the conductor. This point I cannot hope to make clear to Prof. Fessenden in a communication of this kind, but I can assure him he will yet learn a few facts about electric and other waves of which he is evidently not at present aware.

My experiments do not confirm Prof. Fessenden's table of relative sensitiveness of various types of receivers, and in this matter I am convinced that Prof. Fessenden's quantitative measurements have gone astray. Quantitative experiments are all very well, but they can be wrongly carried out and incorrectly interpreted, and I have little doubt that one of these factors is concerned in this case. The Marconi type of filings coherer is set down as possessing much less sensitiveness than the magnetic detector. There may sometimes be a little margin in favor of the magnetic detector, but I find that when a well-made and reliable filings coherer is connected in a *properly* *tuned and efficient* circuit with efficient transmission there is surprisingly small difference between them. I have followed all or most that has yet been published regarding Prof. Fessenden's methods and am perfectly assured that he has not yet treated the filings coherer at all fairly in this respect. Until such time as Prof Fessenden's quantitative results are fully confirmed by independent investigators I cannot accept them as correct My own investigations do not bear them out.

I cannot hope that this communication will be at all convincing to Prof Fessenden, but I do not intend at present to discuss the matter further, as I hope shortly to more fully explain my views elsewhere; but let me conclude with one note of cordial agreement. There has for some years past been an absurd notion hanging around that by shaking up the earth's potential or "wobbling" its charge, wonders in the way of wireless telegraphy can be achieved. This is a chimera, for several reasons In the first place, one would have to use a conductor extending far away out into space to shake the potential, and in the second place no use could be made of the shaking potential any more than the shaking of the potential of a hollow conducting sphere could be made use of by a person inside the sphere. The screening is just about as complete in one case as in the other.

London, England J. E. Taylor.

DIGEST
OF
Current Electrical Literature.

Dynamos, Motors and Transformers.

High Speed Direct-Current Machines.—Zinner.—An illustrated article on direct-current machines coupled directly with steam turbines. The high speed requires special devices to insure sparkless commutation. For good commutation it is advantageous to insert non-inductive resistance in the short-circuited coils in order to counteract, at least partially, the effect of the reactance voltage. For this purpose mechanical arrangements have been devised by which either in the commutator or in the brushes a sufficient amount of resistance is inserted which manifests itself fully in the short-circuited coils, but does not increase essentially the total resistance of the circuit. An arrangement of this kind by Seidener is shown in Fig. 1, in which between any two ordinary segments, 1^1 and 1^2, an auxiliary segment, h^2, is inserted. Each auxiliary segment is connected with the next main segment (according to the direction of the rotation) through non-inductive resistances, *w*, as shown in the illustration. For machines of normal speed very favorable results have been obtained with this device, but for steam turbine generators the resistance, *w*, would become too great since the reactance voltage is very high in this case. For generators running at very high speed there will, therefore, always be a larger or smaller reactance voltage, which is to be overcome by an opposite commutation e.m.f. The author comes to the conclusion that for the rational design of such machines it is necessary to produce a special field for the commutation, independent of the magnetic field, fixed in space and changing automatically in intensity with the load. This may be accomplished in two different ways: First, by producing the commutating field by means of special commutation poles, which are magnetically independent of the main field, and are excited by the armature current; a machine based on this principle and designed by Seidener is described and illustrated. Secondly, a common magnetic pole system may be used which carries, besides the regular exciting winding, another winding supplied with the armature current in such a manner that a special commutation field is produced. The most perfect example of this second principle is the Deri compensated machine, in which, besides production of the required commutating field, there is also compensation of the armature reaction. By simply displacing the brushes from the geometrical neutral zone, the Deri machine becomes a compound machine. For machines running at high speed there is danger of the production of strong additional short-circuit currents, if the commutation field is not properly designed. These currents increase the more the greater the differences between the field densities at the various points of the zone covered by the brushes. It is, therefore, necessary to try to get as flat a commutation field curve as possible within the zone of the displacement of the brushes. This can be easily accomplished by providing a special commutation tooth, as shown in Fig. 2, made of solid iron with deep radial slits. Details are given of the design of a machine of this type which, driven by a Parsons steam turbine at 3,000 revolutions, gives 510 amp. at 650 volts. The field has a two-pole shunt winding. The general arrangement of shunt winding and composition winding is shown in Fig. 2.—*Zeit. f. Elek.* (Vienna), November 29.

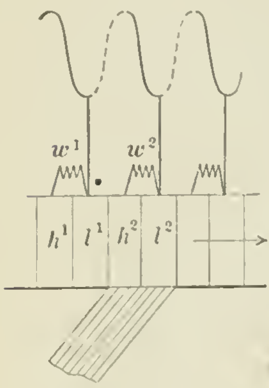


FIG. 1.

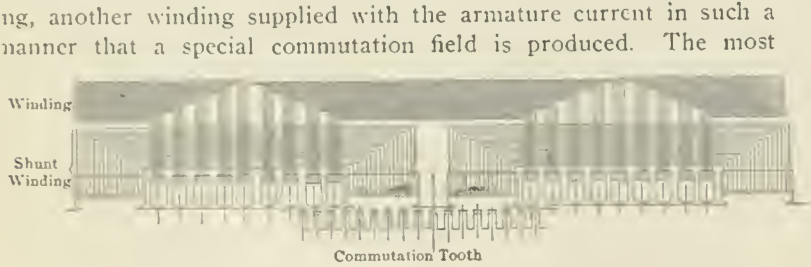


FIG. 2.

Design of Small Direct-Current Machinery.—Fynn.—A continuation of his illustrated serial. He advocates the choice of steel for the poles in order to get the shortest possible mean length of turn for the field coils, and, for the same reason, he advocates the use of round poles. Several pole constructions are discussed and illustrated. Concerning the shaft, he has found many illustrations of Fischer-Hinnen's contention that the portion of a dynamo shaft which is subject to the heaviest strain is that in the neighborhood of the commutator. The following formula gives very reliable results for ordinary sizes: The diameter in inches equals a constant multiplied by the cube root of the ratio of the normal hp to the number of revolutions per minute. The values for the constant which have been found suitable for the sizes under discussion vary from 10 for the smallest to 7.5 for the largest. In settling these values for the constant it is borne in mind that the machines, when used for crane work, with suitable altered winding, are required to exert a torque fully 2 to 2½ times the normal. Having thus settled the diameter of shaft through the commutator, he makes it at least equal to this through the armature and then steps down to the journals at each side, allowing for the necessary shoulders. In this way a shaft diameter through pulley end bush as arrived at, equal to about 0.8 of the diameter through commutator. He then discusses briefly the design of commutator and brush gear.—Lond. *Elec. Rev.*, November 27.

Dimensions of the Slots in Direct-Current Slot Armatures.—Müller.—A mathematical article in which he discusses the question how the dimensions of slots of an armature of given size must be chosen in order to make the capacity of the armature a maximum. He gives a formula for the best ratio between the breadth of slot and tooth. As a first approximation it follows from his formula that the best value of the ratio of the thickness of each tooth to the breadth of the slots is two-thirds.—*Zeit. f. Elek.*, November 29.

Automatic Motor-Starter.—An illustrated description of an automatic device made by a German company for either starting or stopping motors from a distance. A worm wheel, *R*, is attached to the lever of the starting box, shown in Fig. 3, arranged for three-phase work, and is driven by a worm, *W*, is a clockwise or counter clockwise direction, according to which of the two wheels, *S* and S_1, rotating in opposite directions, is coupled to the shaft carrying the worm, *W*. Both wheels are driven by the motor, but with different speeds; the one for starting, S_1, turns slowly, as compared with the other one, *S*, which is employed for switching off the motor. When the motor circuit is closed, the energized electromagnet, *M*, in attracting its armature against the pull of the spring, *F*, couples the worm, *W* and S_1.

The disc, *R*, begins to rotate until the pin, s_1, striking the lever, causes S_1 to become disengaged. On opening the circuit, the armature of *M* is released and the tension of the spring, *F*, is sufficient to cause the left-hand clutch to engage, connecting thereby the worm, *W*, to the pulley, *S*. The disc, *R*, is rotated until the pin, *s*, disengages the clutch. Another arrangement is also described, the chief difference between it and the above device being the adoption of a pawl and ratchet wheel instead of a clutch.—Lond. *Elec.*, December 4.

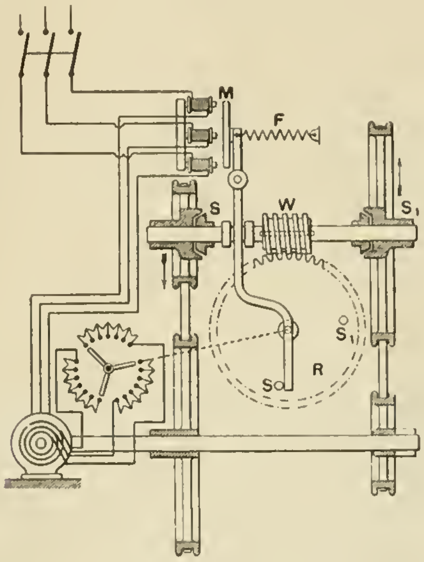


FIG. 3.—AUTOMATIC MOTOR STARTER.

Electrodynamic Condenser.—Seidener.—An illustrated article on electrodynamic condensers which, compared with electrostatic condensers, have the advantage that they may be built in the same way as synchronous motors and practically for any required voltage. They have the valuable property of being self-starting. Two arrangements of Le Blanc and Swinburne are described. The author has devised a new machine of this kind which was originally intended to produce oscillating motion for mechanical purposes by electric means. In its external principles the machine is like an induction motor, the stator being supplied with direct current. The armature has one winding which, when at rest, is perpendicular to the plane of the stator winding. When the armature winding is supplied with an alternating current the armature is set into an oscillating motion.—*Zeit. f. Elek.* (Vienna), November 22.

REFERENCE.

Compound Synchronous Alternator.—Kolben.—The first part of a full illustrated translation of his recent German article on the latest type of Heyland machines, which was abstracted in the Digest.—Lond. *Elec. Eng.*, November 27.

Lights and Lighting.

REFERENCES.

Blue Prints.—An illustrated description of the Franklin electric blue print machinery, by which prints can be made at a speed between 1 and 10 minutes. The printing is done automatically, and the action of the machine being continuous, prints of any length can be made, or one separate print after another may be obtained in rapid succession.—*Sc. Am.*, December 5.

Electric Arc.—Blondell.—A discussion of the work done by Mrs. Ayrton on the electric arc, with special references to her book on this subject.—*L'Eclairage Elec.*, December 5.

Power.

Steam Turbines and Reciprocating Engines.—Belliss, Morcom, Wilkerson, Barker and Swinton.—Several communications on the question of the superiority of the steam turbine over the reciprocating engine concerning efficiency, especially when working with superheated steam. Bellis and Morcom defend the reciprocating engine operated with superheated steam, while the others are in favor of the steam turbine. Morcom gives a table of comparison between seven plants with steam turbines and seven plants with high-speed reciprocating steam engines. The figures show that the steam turbine stations on the average are quite 50 per cent. worse than the reciprocating engine stations, not only in the consumption of fuel, but in the total cost per unit of electricity produced. Barker and Swinton show, however, that this table of comparison is wholly unfair, since the average output of the reciprocating stations given in the table is about double that of the turbine stations, and the former have, on an average, a 50-per-cent. better load factor than the latter. Barker agrees that steam turbines cannot compete with reciprocating engines as regards economy of steam, unless they are first condensing, and, secondly, of units over 200 hp. The plant of the New Castle-on-Tyne Company, now operated by steam turbines, shows a works cost less than half the most favorable similar figure of 1.24 cent per unit given by Morcom for the steam engine plant of Leeds. The cost of coal and labor at New Castle and Leeds cannot differ very greatly. So this enormous difference must be due to matters of load factor and output and probably also to some extent to a superior economy of steam turbines over reciprocating engines.—Lond. *Elec.*, November 6, 13, 20, 27, December 4.

Blast Furnace Gas Engines.—An illustrated description of the blast furnace gas power plant at the Ilseder iron works in Germany. There will be six generating sets, one of which has been installed so far. It consists of a three-phase alternator of the fly-wheel magnet type, driven by a pair of gas engines, one on each side. The engines are of the two-cycle Oechelhaeuser type, each having two pistons working in one cylinder, and moving in opposite directions at the same time. These pistons are so arranged with regard to the positions of the admission and exhaust ports which they uncover at the end of their outward stroke, that no other valves are necessary. A pump is driven by an extension of the piston rod of the back piston, and forces the gas and the air respectively into the admission ports at a pressure of a few pounds per square inch; compression takes place when the pistons approach one another on the inward stroke. Regulation of speed is effected by varying the quality of the mixture of gas and air. The alternator is driven at 125 revolutions, the voltage being 10,000 and the frequency 50 cycles per second. The irregularity factor at full load is 1/350 and the fly-wheel effect is 2,500 foot-tons. The fly-wheel shaft is connected with the two crank shafts by couplings so that either engine may be used to drive the alternator while the other is laid idle if necessary. The alternator runs perfectly in parallel with the existing steam-driven generators even when only one of the gas engines is used. The governors of the engine are electrically controlled from the switchboard to facilitate paralleling.—Lond. *Elec. Rev.*, December 4.

Electric Power for Mining.—Warren.—An illustrated description of a 2,000-hp electric power plant in Scranton for supplying power for the operation of electric locomotives, hoists, pumps, drills, lights, etc., at various coal mines of the Delaware, Lackawanna and Western Railroad. Power is transmitted by 2,300-volt alternating current to sub-stations at the mines provided with step-down transformers and synchronous converters for converting the current to 275 volts direct current for the mines. The equipment of the power plant is described and illustrated.—*Mines and Minerals*, December.

REFERENCES.

Steam Plant of Lausanne Sub-Station.—Herzog.—An article on the steam plant of the Pierre de Plan sub-station, in which the high-tension direct current (Thury system) transmitted from St. Maurice is converted for use in the lighting and traction system of Lausanne. Should, on account of an accident, no direct current arrive from St. Maurice, the converting machinery may be driven by steam engines. There are three 400-hp steam engines, which are described in connection with detail drawings.—*Zeit. f. Elek. u. Masch.*, November 16.

Gas Engines.—Gramyr.—An illustrated description of a gas engine installation, using Dowson gas, in a locomotive and machine shop in Winterthur, Switzerland. There are three gas engines of 100 hp and one of 40 hp. Illustrations are given of the installation and diagrams of the behavior of the gas engines.—*La Revue Tech.*, November 10.

Steam Trap.—Geipel and Chintz.—Two illustrated communications on the rational designs of steam traps.—Lond. *Elec.*, November 6.

Traction.

Camden & Suburban Railway.—An illustrated description of the railway system of Camden, opposite Philadelphia, which comprises various suburban extensions from 7 to 12 miles in length. The company uses a bond consisting of cast-copper plates 100 mm. x 150 mm., with two grooves for the bond wires. Above the wires is a cast-iron plate with corresponding grooves, and both plates are drawn up tight to the web of the rail with two 25-mm. bolts. T-rail is used to a large extent in the suburbs. The company has about 24 miles of telephone wires and 38 telephones at different points. Lightning arresters are used every 1,000 ft. There are several novel features in regard to the power station, among them the method of making joints and piping, and an arrangement for recovering the cylinder oil from the water of condensation. The experiment has been tried of equipping one engine with tail rods and the other without tail rods. The experience with the tail roads indicates that it is possible to work the engine equipped with them at about 10 per cent. greater capacity. The fly-wheels are all enclosed in metal housings. The switchboard is also of a novel design. Two positive bus-bars are used and the equalizer bus-bar is on the negative side of the generators. This reduces the complications on the board and also the possibility of short circuits between the equalizer and the ground. The company uses two circuit breakers in multiple on each machine before they are connected to the bus-bars and thinks this more desirable than a single circuit-breaker. The method of connecting the booster to the switchboard is also novel, as this circuit-breaker is interlocked with the circuit-breaker of the motor operating the booster.—*St. R'y Jour.*, December 5.

Testing Rail Bonds.—An illustrated description of a method of Gerhart, involving the familiar application of a double-scale millivoltmeter in conjunction with means for taking the readings over a standard length of rail and across the joint to be tested. By comparing the two readings, the resistances of the joint can be easily determined. The novelty of Gerhart's method lies in the contact bar or pole, by which contact is made with the rail for the purpose of taking the reading across the joint and across the selected rail length. This consists of an oak piece of about 6½ ft. long and 1 in. square, to one side of which are attached four cold-chisel points which form the contact points with the rail. The oak piece is slightly bow-shaped, so that when placed on the head of the rail without pressure the piece will rest upon the two outer chisel points. Pivoted to the center of this piece is an upright which forms a handle and carries at its lower end one of the four contact points. This point and the contact point at one end of the bar are connected to the top scale of the millivoltmeter. They are so placed on the rail as to measure the drop on the standard length of rail. The third and fourth contact points are used to give a reading across the joint and are connected to the bottom scale of the millivoltmeter. By placing one foot upon the horizontal piece of the bar near the center a reading across the standard length of rail is obtained on the upper scale of the voltmeter. By placing the other foot on a plunger, the remaining contact point is placed to the head of the rail and a reading across the joint on the lower scale of the voltmeter is obtained.—*Street R'y Rev.*, November 2.

REFERENCES.

Cincinnati.—A long and fully-illustrated description of the Interurban Railway and Terminal Company, of Cincinnati, which has 108 miles of track in operation. There are two power plants. One contains two 400-kw, direct-current generators and two 500-kw, 10,000-volt alternators. The other contains two 500-kw, 10,000-volt alternators. The high-tension alternating currents are transmitted to four sub-stations, provided with transformers and synchronous converters. —*St. R'y Rev.*, November 20.

Paris Traction.—Guery.—A continuation of his very long and fully-illustrated description of the electric installation of the railway Des Invalides à Versailles. High-tension, three-phase currents are transmitted over underground cables to three sub-stations, provided with transformers and synchronous converters. Each sub-station contains four 300-kw converters.—*L'Eclairage Elec.*, December 5.

Ipswich.—A note on the recently-opened tramway system of Ipswich. The power plant contains six steam-driven, direct-current generators, two of which have a capacity of 240 kw, two of 120 and two of 50 kw each. The two largest machines can be either used compound-wound for the traction load or as shunt machines for lighting. A storage battery of 248 cells, with a capacity of 400 amp.-hours, works between the outers of the three-wire system.—Lond. *Elec.*, November 27.

Third Rail and Trolley.—An editorial discussion of the relative advantages of the third rail and the trolley for high-speed roads. Under certain conditions each is preferable. Where trolley wheels run from 5,000 to 10,000 miles on a heavy interurban car, as they do in many cases, it is safe to assume that the trolley wheel is a fairly satisfactory method of obtaining current. On the other hand, there are certain points where the third rail is more advantageous.—*St. R'y Jour.*, November 21.

Motors as Emergency Brakes.—Gough.—An article in which the writer explains the connections through which motors can be used for emergency braking, with 2-motor and 4-motor equipments.—*St. R'y Jour.*, December 5.

Trackless Trolley in Scranton.—A description of an experimental line 250 meters in length, in operation in Scranton, Pa. The trolley wheels press against the wire from the inside and the trolley poles carry "bridges," which allow the trolley to pass by gaps in the trolley wire. A three-wire system can be used if desired.—*St. R'y Jour.*, November 14.

WIRES, WIRING AND CONDUITS.

Insulating Paints.—Toch.—A brief article on electric insulating paints. The materials employed in the manufacture of insulating paints and varnishes consist principally of resins in a suitable solution. The addition of a metallic element would be decidedly harmful. The principal gums that are used in making insulating varnishes are resin, asphaltum, pitch, tar, Kauri, manilla, shellac and copal. The principal solvents are turpentine, benzine, benzol, acetone, alcohol, bisulphide of carbon, linseed oil, china wood oil, and in some instances water. Resin is very largely used as a gum, but in very fine work a solution of resin alone is rather dangerous.—*Electrochem. Ind.*, December.

ELECTRO-PHYSICS AND MAGNETISM.

Dispersion of Fog by Electricity.—Lodge.—An abstract of a (British) Physical Society paper in which he describes an experiment formerly made by him in which two pieces of wire gauze, connected to the terminals of an electric machine, were placed opposite each other in a chamber, through which a current of smoke was slowly passing. Upon electrifying the pieces of wire gauze the smoke ceased passing, the dust particles cohered, hovered in the air and were either driven to the sides of the chamber or fell to the bottom. In the case of mist, the electrification of steam in a bell jar converted it into fine rain. It seems, therefore, possible that rain might be produced by the electrification of a cloud. He later tried at Liverpool to disperse fogs by discharging electricity into them. For this purpose a large mast was erected on the roof of the college building, terminating in a bundle of points, to which electricity was conveyed from a Wimshurst machine by a wire supported by specially-constructed insulators. The discharged points may be supplemented by a gas flame. Upon one occasion the discharge of electricity from the flame was sufficient to keep a clear space of 50 or 60 yards radius in the dense fog. He suggests that this means may be utilized on a large scale to mitigate the disastrous river fogs. He had suggested to erect for this purpose a series of masts for positive discharges on one side of the river and a series for negative discharges on the other side, but he does not think that the glass influence machine which was very suitable for his experiments could be put in the hands of "practical" men. He has, therefore, devised the following method of producing high-tension direct-current: A high-frequency alternator (3,000 periods per second) supplies current to a primary of an induction coil while the terminals of the secondary are connected to a Cooper Hewitt rectifier. He found that the rectifying effect is much assisted by the outside tin-foil coating which surrounds the mercury electrode and which is connected to the positive terminal of the lamp.—Lond. *Elec.*, November 20.

Storage of N-Rays.—Blondlot.—An account of some observations made in connection with N-rays. He found that on concentrating N-rays with a quartz lens for some time upon a calcium screen and then taking away the Auer burner, the increased luminosity of the screen persisted as long as the quartz lens remained. The lens, in fact, possessed a kind of invisible N-ray phosphorescence. The same effect is shown by quartz plates as well as Iceland spar, fluorspar and glass. The reflective power of metals is enhanced by exposure to N-rays. This enhanced reflective power also persists for some 10 or 20 minutes. Lead becomes active in this manner on both faces, if one of them is exposed to N-rays for several hours at a time. Aluminum, wood, paper, paraffin do not store up N-rays, and the least trace of moisture completely eliminates the effect. Dry pebbles gathered in bright sunlight give out N-rays. The effect is not quite analogous to phosphorescence.—From *Comptes Rendus,* November 9; Lond. *Elec.,* November 27.

Absorption of Cathode Rays and Molecular Theories.—Lenard.—An account of experiments concerning the absorption of cathode rays as a function of their velocity. He formulates a new theory on the constitution of matter. The ultimate constitution of the atom he calls the dynamid on account of its electric field, which deflects and arrests the electron in its passage. The dynamid may be regarded as an electric doublet whose moment may vary from one atom to the other. The atoms of the different elements are made up of different numbers of dynamids in exact proportion to their atomic weights. Every dynamid throughout the universe has the same mass, but the actual volume of the dynamids constituting a cubic meter of solid platinum is barely a cubic millimetre.—From *Ann. der Physik.,* No. 12; Lond. *Elec.,* November 27.

Induced Thorium Activity.—Von Lerch.—A description of a series of experiments made to determine the chemical behavior of the induced radioactivity shown by metals exposed for some hours to Rutherford's thorium emanation. He works on Rutherford's hypothesis, assuming that thorium gives rise to thorium rays, the latter to thorium emanation, and this again to induced thorium activity by a series of sub-atomic transformations. When metals after exposure to the emanation are dissolved in acids, the radioactivity acquired remains attached to them and reappears on precipitating them from the solution. "It may, however, be detached from the metals by electrolysis, and made to precipitate on the cathode." The author believes that the induced activity is a new element or series of elements, the main constituent having a position between copper and lead in the voltage series.—From *Ann. der Physik.,* No. 12; Lond. *Elec.,* November 27.

REFERENCES.

Photography by Electric Discharges.—An account of experiments made by Leduc in which electric discharges were directed on a sensitive plate so as to produce designs capable of furnishing motifs for ornamentation. Some photographs of very pretty ornamental patterns thus obtained are reproduced. A plate coated with gelatino-bromide of silver is placed with its non-sensitive side on a metallic leaf, which is connected with one pole of a static machine or an induction coil. The other pole is connected with a metallic point, placed on the sensitive surface.—*Sc. Am.,* December 5.

Radioactivity.—Allen.—An illustrated paper in which he describes some experiments and gives a very concise review of the subject of radioactivity.—Lond. *Eng'ing,* December 4.

Spinthariscopic Phenomena.—Tommasina.—An account of experiments which confirmed Becquerel's contention that the sparking observed in Crookes' spinthariscope is due to the cleavage of the zinc sulphide crystals provoked by the impact of α-rays.—From *Comptes Rendus,* November 9; Lond. *Elec.,* November 27.

Magnetic Storm.—Moureaux.—A report of the observations made at the Val-Joyeux Station during the magnetic storm of October 31.—From *Comptes Rendus,* November 2; Lond. *Elec.,* November 27.

Electro-Chemistry and Batteries.

Copper Refinery.—Magnus.—A fully-illustrated account of an experimental determination of contact resistances and current leakages in an electrolytic copper refinery. The power lost in contact resistances appears to be of considerable amount. In a test with 4,000 amp. and a current density of 11 amp. per sq. ft., the tank voltage was 0.230, which was made up as follows: The drop between anode and anode bus-bar, 0.0330 volt; drop between cathode and cathode bus-bar, 0.0180; drop across the electrolyte, 0.179 volt. The last figure includes the drop across the layer of slimes on the surface of the anode, which is about 0.007 volt. The actual effective energy is 77.8 per cent., the energy lost in contact and transmission being 22.1 per cent. The results of tests on tank leakages are given in a drawing.—*Electrochem. Ind.,* December.

Edison Accumulator.—A brief editorial note on Hibbert's recent paper on the Edison nickel-iron battery. It is said that the cell itself is undoubtedly an excellent one and an improvement in several respects on the old lead cell, especially on account of its excellent durability. But it is expensive, and since lead traction cells of equal capacity, weight for weight, as Edison cells, and occupying less space, are obtainable, the whole matter almost resolves itself into the question whether the increased durability is worth the extra cost.—Lond. *Elec.,* December 4.

Units, Measurements and Instruments.

Measuring the Form Factor of Alternating Currents.—Rose and Kuehns.—An illustrated account of an investigation made in the German Reichsanstalt. The form factor of an alternating-current e.m.f. is the ratio of the effective to the mean voltage. For measuring it the following arrangement may be used: With the aid of a revolving-contact disc, the number of revolutions of which per second is equal to the frequency of the alternating current, there is impressed upon the measuring instrument only one-half of the alternating-voltage wave in each period, so that voltages all of the same direction, are impressed on the instrument; while in the other half period (in which the sign of the e.m.f. is reversed) the instrument is without current. In this way a pulsating direct current is supplied to the instrument and the mean value of this pulsating direct-current voltage is equal to one-half the mean alternating-current voltage. For measuring the mean value of the pulsating direct-current voltage, a wattmeter was first used as will be described below, because it was considered unwise to use the commercial D'Arsonval voltmeter for direct current, since on account of inductive action it might have given wrong results. Comparative measurements, made afterwards with a wattmeter and a voltmeter, gave, however, identical results. If the wattmeter is used for measuring the voltage, the voltage coil is connected to the pulsating e.m.f., while the main current coil is supplied with a constant auxiliary direct current. The wattmeter is thus changed into a voltmeter and can be calibrated as such with constant auxiliary current. By dividing the effective voltage found by an ordinary alternating-current instrument, by the double mean value indicated by the wattmeter, the form factor is found.—*Elek. Zeit.,* December 3.

REFERENCES.

Cable Capacity.—Kath.—A communication in which the author refers to a recent publication of Fleming on the measurement of cable capacity and gives an account of some older mathematical investigations of his own on this subject.—Lond. *Elec.,* November 6.

Testing Rail Bonds.—See the abstract under "Traction."

Telegraphy, Telephony and Signals.

Wireless Telegraph Transmitters.—De Forest.—An article in which the author says that throughout the various attempts which have been made to approximate in wireless telegraphy, even remotely, something of the accuracy in resonance effects so well known in acoustics, sufficient attention has not been shown to the necessity for generating at the transmitter a long train of but slightly damped oscillations. The rapid damping of the transmitter oscillations are due generally to two causes: First, that from losses due to radiation from the antenna (which are considered useful and necessary), and second, from losses resulting from leakage, heat and dielectric hysteresis, which are detrimental to an extent little appreciated. Of leakages from the antenna there will always be a certain amount. Through insulation, especially at the top of the mast, and from all guy ropes, is strongly advocated. A petticoat insulator giving large and dry surface insulation, ought to intervene between antenna and its support. Mechanical reasons render it advisable to use steel guys for the mast; but if these be completely insulated from the antenna the leakage to them through damp air, and indirectly by currents induced in them, renders it necessary to cut these guys into several short lengths, connected together by strain insulators (ropes with dead eyes or porcelains) and to most carefully insulate from earth at the bottom. In damp weather rope, especially if untarred, is but little better than wire. If the air is moist or a heavy fog prevails, the invisible brush leakage from the antenna into this semi-conducting medium gives the effect of a large fictitious capacity between antenna and earth, greatly increasing its natural period of oscillation, and requiring readjustment of the constants of the closed resonator circuit if it is intended to keep this and the antenna circuits in syntony. This apparent additional capacity is largely fictitious and, as a leakage, represents a large hysteresis loss, not recoverable, but producing additional damping to the oscillation. The same phenomenon exists even to a greater degree in the condensers themselves. In any Leyden jars or glass plate condensers in air, vivid brushes are observed extending for an inch or more at the edges of the tin-foil. The correct practice calls for the suppression of all brush losses at every cost, and the employment of oil, or condensers otherwise sealed and sufficiently bulky, to give requisite safety with capacity. The Leyden jar is the element employed in wireless telegraphy which is least suited to its task. The amount of inductance existing in a battery of Leyden jars, when these are connected up as closely as possible, is surprising and little recognized. In a battery of say 10 jars connected in parallel he has found that the exact method of connection is of the utmost importance. The best arrangement is in a circle, with leads from all of the jars of exactly the same length. Otherwise there is a tendency for a series of discharges from the several jars in turn, and not from the battery as a unit. The heating of the spark-gap terminals is a proof of the losses existing in the spark. The wider the gap the greater the loss is through heating the column of air. A simple method of reducing this gap while maintaining the requisite high potentials, is to employ a series of small gaps between poles or discs of small curvature. There is nothing in a liquid dielectric, but considerable is to be said in favor of the spark in air under pressure, as reducing sparking distances and allowing an especially sudden disruptive break-down—a spark of high conductivity and slight damping. —Lond. *Elec.*, November 27.

REFERENCE.

Telegraphy and Telephony.—The quarterly summary of recent developments in telegraphy and telephony. The present installment refers to progress made during July, August and September, 1903.—*Elek. Anz.*, November 22, 26.

MISCELLANEOUS.

Finsen Light Cure.—FYFE.—An illustrated article on the Finsen light cure at the London Hospital. The following statistics have been collected at the Finsen Institute from the end of 1895 to 1902; 804 cases of lupus were treated, of which 412 were entirely cured. The number of those whose cure is nearly complete with but slight traces of the malady is 192. The cases still under treatment number 117, of which 91 show an improvement and 26 remain about stationary. The treatment was interrupted for different reasons in 83 cases, by death or other grave malady 44, and for outside reasons 23, leaving but 16 whose treatment was stopped as being unsatisfactory. In the first stages of the disease the cure is almost certain.—*Sc. Am.*, November 28.

Accounts of Municipal Plants.—WALMSLEY.—A paper on depreciation and sinking fund in municipal undertakings. The author suggests that depreciation should be charged in all undertakings liable to waste, obsolescence or supersession on terms quite sufficient to recoup or renew the assets when required, without recourse at any time to reborrowing, repairs being charged direct to revenue year by year, so as to maintain the assets in efficient condition. Longer periods should be allowed for the repayment of loans, especially in undertakings of a permanent character, where there is no risk of obsolescence. Sinking fund should be charged separately without regard to depreciation. All these matters should be settled by a conference of all corporations, so as to establish a uniform treatment of depreciation and sinking fund in all accounts.—Lond. *Elec.*, October 30.

New Books.

ONDE HERTZIANE E TELEGRAFO SENZA FILI. By Oreste Murani. Milan: Ulrico Hoepli. 341 pages, 171 illustrations. Price, 3.50 lire.

Uniform with 800 other manuals, scientific and classic, published by Ulrico Hoepli, of Milan, Italy, is the present volume, entitled "Hertzian Waves and Telegraphy Without Wires," by Oreste Murani, professor of the Physical Institute at Milan.

The object of the work, it is stated by the author in the preface, is to present a simple and at the same time a complete treatise, and in this respect it is like nearly all the other Hoepli manuals. In the arrangement of the text three divisions are made, the first part dealing with the fundamental principles of electricity and magnetism in a manner similar to the treatment of these themes in preparatory text-books on physics; the second part is devoted to electromagnetic waves and the third and last portion of the book is given over to telegraphy without wires.

The different parts are divided into chapters and these finally are classified under sub-headings. There is nothing particularly new either in mode of treatment or subject matter contained therein, but every phase of electromagnetic phenomena in any way related to the principles involved in wireless telegraphy is touched upon and explained, and even of so remote a piece of apparatus as the storage battery the author has thought it well to say a few words. In the chapter on syntonic system of radiotelegraphy—a fine synonym, by the way, for wireless telegraphy—Prof. Murani brings out the importance of selective signalling and confines his data to the Marconi, Slaby Arco and Braun systems.

In the closing chapter a review of the cruise of the Italian man-of-war, *Carlo Alberta*, with Signor Marconi on board, is given, and an all too brief a biography of the Italian inventor closes the work. Marconi, according to his compatriot, Murani, was born near Bologna in 1874, his mother, Annetta Jameson, of the well-known and well-connected Jameson family of Ireland, being his father's second wife. At Livorno the youth received his first instruction in science. Under Agusti Righi, the young man continued his studies and he was granted the use of the illustrious professor's laboratory, for it is said that Righi, even at this early date, determined that Marconi was no ordinary student. On his father's estate at Partecchio, near the Apennenes mountains, Marconi tested his first wireless telegraph, and then enlisted the sympathies of Sir William Henry Preece, of England, where wireless telegraphy may be said to have had its real beginnings. The history of both the inventor and telegraphy without wires since those memorable days are well known. From Murani's book it would seem that Marconi discovered wireless telegraphy and Righi discovered Marconi.

CONTINUOUS-CURRENT DYNAMOS AND MOTORS AND THEIR CONTROL. By W. R. Kelsey, B.Sc. New York: D. Van Nostrand Company. 440 pages, 225 illustrations. Price, $2.50.

It has been said in connection with engineering literature that most engineers who are engaged in practical work who know how to do things, have no time to write about them, and those who have time to write do not have the thorough understanding of their subject that comes only from practical experience with it. While much of the book under review gives the impression that its author belongs to the latter class, there is part of it that shows familiarity with the principles and methods explained.

The first four chapters deal with the fundamental units, principles and laws of magnets and electric currents. The next four chapters give in detail the principal methods of winding armatures, with the relative advantages and disadvantages of each. Then comes the method of calculating the dimensions of the armature core and the size and number of armature conductors, together with the I^2R, hysteresis and eddy current losses in the armature core and windings; and a numerical example of an actual design is worked out in detail. Chapters X and XI deal with the mechanical design of shafts, bearings, brushes, etc. Chapter XII treats of commutation and Chapter XIII gives the broad principles of shunt, series and compound-wound motors, but does not go into methods of design in detail. It also describes various methods of control of speed. Chapter XIV deals briefly with various special classes of machines, such as boosters, plating dynamos, etc. Chapter XV gives methods of predetermining the characteristic curves of dynamos and motors, and the XVIth and last chapter gives methods of tests for magnetic leakage, heating, efficiency, etc.

The book is in the main a compilation and its merit must be weighed on the basis of the author's judgment in deciding what to include and what to leave out, and on his ability to give clearly and briefly the important parts of the articles and books from which his information was obtained. Judged from this point of view the book is of uneven merit. In the chapters on fundamental principles of electricity and magnetism and on armature winding and design, the material is well chosen, complete and clear, as it is also in those on field magnet and mechanical design.

The chapter on commutation is rather involved, being a mixture of two methods of analysis, the one approximately correct, the other entirely incorrect. The first analysis omits the influence of the changing resistances of the brush contact surfaces, assumes that reversal is entirely accomplished by the lines of force from the pole tip, and that the injury to the commutator is caused by the current jumping across the gap between the brush and the receding segment. The fallacy of these assumptions was first pointed out in Mr. Thorburn Reed's paper on "Sparking, its Causes and Effects," read before the American Institute of Electrical Engineers, December, 1897; and the theory then set forth that the injury to the commutator is done before the segment leaves the brush is now generally accepted. The second analysis, taken from the paper by Arnold and Mie, mentioned on page 288, is based on Reid's paper and is in accordance with the now generally accepted theory. Most of the constants for practical commutator design are unfortunately based on the incorrect analysis, a fact which the author seems to recognize in his criticism of Hobart's criterion of sparking on the ground that it assumes a sine law of change of current. Hobart's criterion is, in fact, of small value, since in any well-designed machine the variation of contact resistance, which follows a straight line law, is the main factor of commutation, while Hobart's criterion does not take this variation into account at all. Messrs. Arnold and Mie's criterion given at the bottom of page 289 is correct, and the chapter as a whole would have had much more practical value if the constants and curves of their paper had been included and the other analysis omitted altogether. The remaining chapters are on the whole clear and sound.

The book is well and clearly written, shows evidences of painstaking care to avoid errors and slovenly statement, and contains a fairly complete exposition of modern methods of design, although it still leaves open the field for a book which shall give practical methods of design, with the theories on which these methods are based made subordinate.

Construction und Prüfung der Elektricitätzähler. By A. Königswerther. Hanover: Gebrüde Jänecke. 328 pages, 362 illustrations. Price, 9 marks.

This volume on the construction and testing of "recording" or electricity meters shows internal evidence of careful thought and thorough preparation, and is far removed from the catalogue compilation books that unfortunately form the major portion of the meagre literature on this important subject. A brief but meaty introductory chapter points out by simple mathematical analysis the principles on which all integrating meters must be based, the categories into which the different types must fall, and the various schemes of connection and combinations required for the measurement of energy in polyphase circuits. This is followed by a long second section extending over two hundred odd pages on the constructive details of representative instruments of each class. The classification is in itself good, being as follows: Registering instruments, i. e., true recorders making records on charts; instruments making periodic summations; true integrating meters; meters for special work such as those indicating the amount of charge left at any time in accumulators; and constructive details.

The true integrating instruments are subdivided as follows: Electrochemical class, pendulum class, motor class, induction class, oscillating class, time integrators showing the length of time that current has been consumed in a given circuit, but not the energy integral; and special types like the thermal, electro-pneumatic and others which are interesting but have not come into practical use.

The third and last section treats of testing electricity meters. In this the author has unfortunately found it necessary to confine himself to the types in common use in Germany and Austria, but much that is said is naturally applicable to our American meters as well; and the numerous specimen test record sheets, while calling in most cases for a thoroughness of investigation and tabulation that is foreign to our ordinary practice, will be found by those who, whether as makers or operators, have to do with meters in large numbers, to contain useful hints.

Some of the instruments described, notably the Aron pendulum meters, the oscillating meters whose moving element oscillates instead of rotates, and the time counters, are of a class which, while popular abroad, are not found in service here, but the volume cannot be said to suffer in interest for that reason. The chapter on constructive details is not as full as might be desired, and there are a few, but only a very few, of the minor inaccuracies that inevitably creep in in works of such scope.

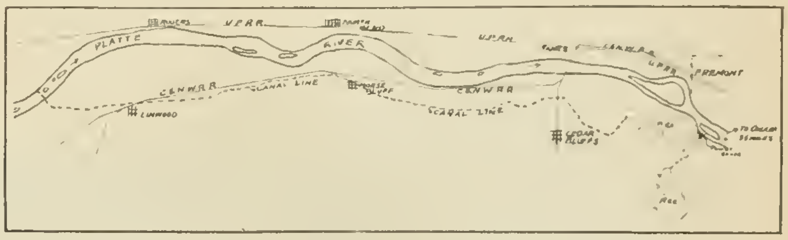
All in all, the volume is a distinctly valuable contribution to the art, and it is to be hoped that a good English translation will soon make its contents available to the many to whom it will be of interest.

Important Nebraskan Hydraulic Power Project.

A board of arbitrators, consisting of T. W. Kloman, of the John F. Kelly Engineering Company, New York, and George H. Kimball, formerly chief engineer of the Lake Shore, Michigan & Southern Railroad, appointed recently by the Fremont Canal & Power Company, of Fremont, Neb., and the Nebraska Central Irrigation Company, of Columbus, Neb., which companies were organized for the purpose of developing water power for lighting, traction and general purposes in Omaha and other adjacent cities, to decide as to which scheme was the more practicable, met in New York last week and made an award in favor of the Fremont proposition.

The Fremont Canal & Power Company is incorporated under the laws of the State of Nebraska with a capital of $4,000,000. The president of the company is W. J. C. Kenyon, general manager of the Union Stockyards, at South Omaha. L. D. Richards, a Fremont banker, is also largely interested in the enterprise. Construction work will be begun in the early spring. The contract has been let to the John F. Kelly Engineering Company, New York. The power will be used in Omaha chiefly. Other places to be supplied include Lincoln, Council Bluffs, Fremont and Columbus. The plant will have a 24-hour capacity of 15,000 hp.

It is proposed to build a diverting weir, using the entire crest for a spillway, across the Platte River, which will raise the water about two feet above its normal height, or to an elevation of 1,335 ft., United States geological survey datum. The site selected for the location of the diverting weir and headgates is about 13 miles east of Columbus, the confluence of the Loup and Platte Rivers. The dam will be a rock-filled pile dam protected by a double row of sheet piling on both the upper and down-stream forces. The headgates will consist of 20 openings 8 ft. by 6 ft. 6 in. wide, a heavy plank floor 30 ft. wide, and a pile rock-filled crib 10 ft. by 4 ft. 8 in., between each opening. The elevation at the top of the headgates will be sufficiently high to guard against floodwater. After leaving the headgates the canal is to follow an easterly course across the bottom lands of the Platte for a little more than a mile to a range of low foothills having an elevation of about 20 ft. above the Platte Valley.



MAP OF ROUTE OF CANAL.

At Morse Bluff the level of the canal will reach an elevation of about 60 ft. above the Platte River, and at this point the higher foothills or bluffs turn sharply to the south. From Morse Bluff to Cedar Bluff, a distance of 9 miles, the canal is to be located mainly either near the top or on the top of the first bench above the valley. This bench has an elevation of from 50 to 75 ft. above the Platte Valley. At the twenty-second mile the canal is to turn to the south and to flow along the foothills for about two mlies, when it will turn sharply again to the north and cross the low foothills, which divide the Silver Creek watershed from the watershed of Elm Creek, and terminate on a large reservoir to be built at Elm Creek. The canal will be 25 miles long. Especial attention is to be paid to securing the most direct alignment possible. At the headgates the level of the bottom of the canal will be the same as the level of the bottom of the Platte River. This will give a water depth of six feet in the canal at this point.

In excavation the practice in Nebraska is to cut the slopes nearly vertical in order to keep as much water off them as possible. In order to keep the water from slopes, a thorough system of ditches will be cut on the uphill side, well back from the top of the slope. On sidehill work it has been endeavored to keep the section of the low side of the canal in at least six feet of cutting.

Evaporation in the vicinity where the canal is to be built is about 40 in. annually. This amount for the area of the canal and reservoir gives 24 c.f.s. loss. Running along the foothills as the line of the canal will do, nearly all the water courses will be crossed at right angles. The larger of these water courses it is proposed to take under the canal by means of iron pipe culverts. At the smaller water courses and where the bottom of the draws crossed are below the grade of the bottom of the canal, it is proposed to lead these water courses directly into the canal. The Elm Creek reservoir is to be formed by building a dam across the mouth of Elm Creek near the point where it empties into the south branch of the Platte River. This will give a head of 125 ft. and will impound 870 acres. A draw-off culvert is to be built through the bottom of the canal and on the east side through a section of the concrete core wall. The penstocks are to be placed at such an elevation as will enable 21 ft. in the depth of the reservoir to be used. A masonry spillway is to be constructed about three-quarters of a mile west of the dam site, diverting the flood water back into the Platte River. Separated from the Elm Creek watershed by a ridge whose highest elevation is 1,365 ft., is the Pocoho watershed. A dam is to be built on this watershed. It will be about 70 ft. high and 3,100 ft. long and will impound 1,200 acres. The Pocoho watershed is very small and this reservoir is to be supplied through a canal cut between it and the Elm Creek reservoir, the level of the bottom of the canal to be such as will enable 21 ft. of this reservoir to be drawn from. The canal is calculated to deliver to the reservoir 1,000 c.f.s. This amount of water acting under a head of 125 ft. rating the water wheels at 80 per cent efficiency will give at the wheel 18,160 24-hour hp. or 36,320 12-hour hp. Taking into account the losses in generators, transformers and line, the engineers expect to be able to deliver 14,620 24 hour hp. or 29,240 12 hour hp. at Omaha.

The power house is to be located on the plateau about 400 ft. east of Elm Creek on the south bank of the south branch of the Platte River. The hydraulic installation will consist of eight 6,000-hp units. Each unit will consist of two water wheels coupled to the same shaft and running at a speed of 400 r.p.m. The penstocks are to lead directly from a concrete forebay in the Elm Creek dam and are to be 8 ft. 6 in. in diameter. The velocity of the water at full gate during times of overload will be about 10 ft. per second. Draught tubes will be used discharging directly into a concrete tailrace to be built underneath the power house. This tailrace will discharge directly into the south branch of the Platte River, whose channel will be cut back to the face of the power house.

The electrical installation will comprise eight 3,200-kw, 60-cycle generators having an overload capacity of 25 per cent., coupled directly to the water wheel shafts by means of a flexible coupling. The initial installation provides for six of these machines, one of which will be held in reserve. These five generators will have a capacity of 16,000 kw, which at times of overload can be increased to 20,000 kw. The generators are to be connected to step-up transformers raising the voltage to about 40,000 volts. This line voltage is to be again reduced at Omaha, 32 miles distant, to correspond with the voltage used in the city service. The pole line will be a double one, carried on a private right of way, and is calculated for a line loss of 7½ per cent. Two switching stations are to be installed between the power house and the sub-stations at Omaha.

The entire system is expected to be in active operation inside of two years. It will entail an expenditure of about $3,500,000.

Electric Sign Progress.

The Federal Electric Company's new porcelainized steel, sectional, lamp letter sign is the result of much study and experience, having been designed by central station men. This new sign is made up of standard size plates, each bearing a single white letter on a royal blue background, with the lamp sockets arranged in the outline of the letter. The accompanying cut of a "Drugs" sign shows the idea. The plates making up the complete sign are securely screwed to a frame of galvanized channel iron, making the construction practically water and fire proof. The cuts show a single letter "N" ready to put on the frame, and a back view of a plate wired ready to put into place. The enameling of the plates is done at such a high temperature that, when finished, the enamel is practically gloss fused into steel. This process assures an ineffaceable color and finish. That part of the plate bearing the letter is raised about two inches above the other portion. An ornamented border gives a finished appearance to the sign. The most popular method of hanging, as shown in the cut, is to use galvanized chain and turnbuskles with ornamental wall brackets.

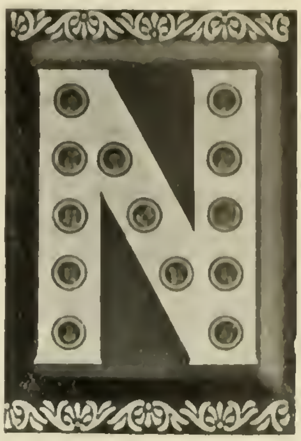


FIG. 2.—LETTER "N" PLATE.

The attractive features to central station men lie in the fact that when a sign is turned back to them the plates may be taken off and that they can be used in making up other signs. This is a cheap operation and reduces the chance of loss due to unproductive stock on hand, to a minimum.

A great many of these signs have made their appearance in Chicago this fall and are rapidly pushing their way into other cities. The writer passed through the shops of the company, at 76 Market Street, Chicago, a few days ago, and watched the simple work of construction and testing with a great deal of interest. Each sign is inspected by the city authorities and assembled to fit the requirements of the Board of Fire Underwriters.

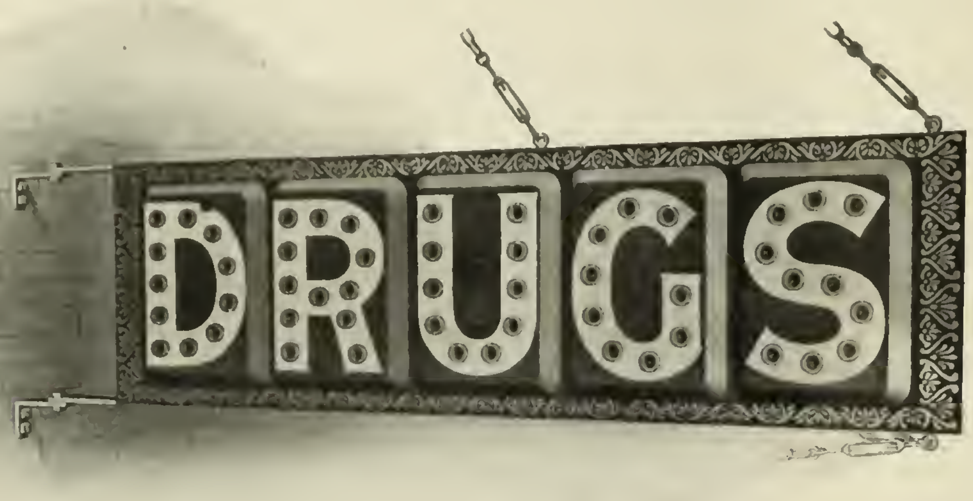


FIG. 1.—ELECTRIC SIGN.

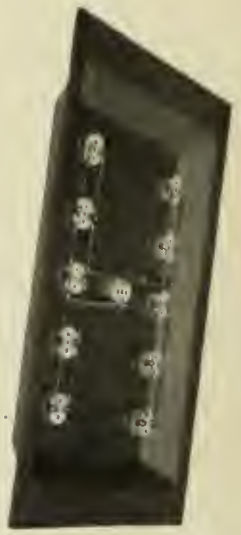


FIG. 3.—METHOD OF HANGING.

Floor Outlet Box.

In modern electrical construction work there is a growing tendency to place electric light, telephone and bell wires in iron conduit, and the need of first-class floor outlet boxes for such work has long been felt. The engineers of the General Incandescent Arc Light Company long since designed and patented a universal, interchangeable floor outlet box, at all times water-tight whether in use or not. The company has still further improved its standard floor outlet box by having all parts stamped and drawn, thus insuring a perfect fit, reducing the weight, and lessening the cost of production. This box has been approved by the National Board of Fire Underwriters.

The lower body of the outlet box, Figs. 1 and 2, is drawn from ⅛-in. cold rolled steel of the best grade, in one piece. The collar is also made of the same material in one piece. The threaded portion is arranged to give an adjustment of one inch, as shown in Fig. 1, so that the depth of the box may be lengthened from four inches to five inches, and remain perfectly level after once being set in position. The top plate is made of heavy brass. It is fastened to the iron collar, a rubber gasket being placed between, which insures a water-tight connection. The exposed portion has a polished brass finish, and the steel body is heavily japanned, inside and out.

This floor outlet box is especially adaptable in construction work for bringing wires to floor outlet boxes for connecting electric lights, electric fans, push buttons or telephones located on tables, desks, counters or show cases, as will be readily observed by referring to Fig. 2.

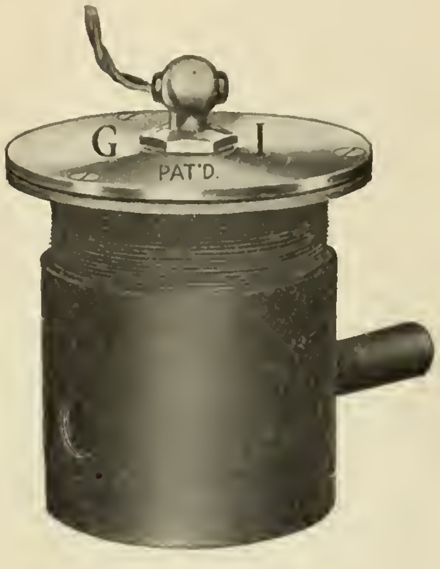


FIG. 1.—FLOOR OUTLET BOX.

Among its special features which will be appreciated by engineers and construction men are that it is strong and substantial, it will not sink in the floor when subjected to heavy weight; adjustability with respect to floor level, saving wiremen's time; adjustment can be made after a floor is laid, and it is accessible after being installed, the parts being held together by standard machine screws; it is not liable to injury for the reason that the flexible cord comes from the side of the outlet nozzle, where it cannot be stepped on and the insulation crushed or injured; it is not necessary to detach cord when floors are swept or scrubbed, and the boxes can be installed cheaply because the lower stamped body is set in the building before the floor is laid.

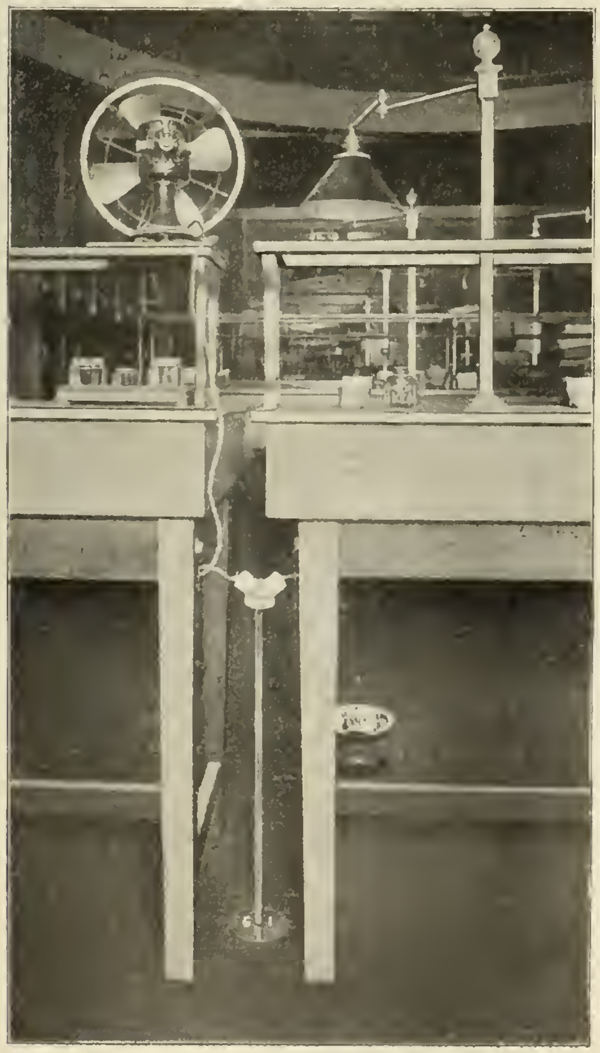
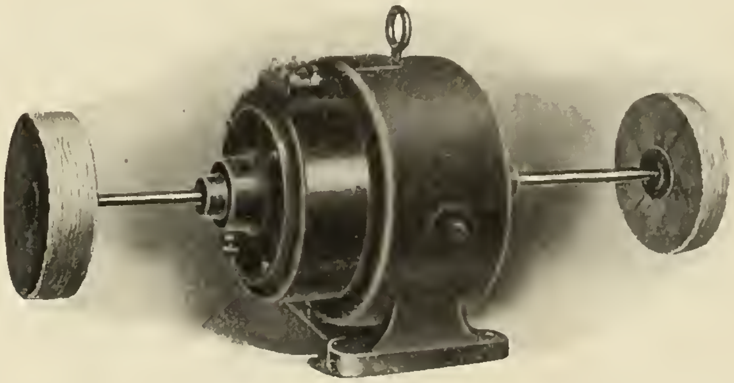


FIG. 2.—OUTLET BOX IN USE.

If it is desired not to use cords from the nozzle at floor level, one-half-in. plain iron conduit, or conduit encased in polished brass tubing, can be screwed into the ½-in. gas pipe thread in the floor plate and extended to the under side of a desk, table, counter or showcase. When placed between two or more desks or tables, as shown in Fig. 2, a two, three or four-outlet cluster can be attached to the pipe extension and connected by two or more flexible cords and attachment plugs for operating electric fans or lights on two or more desks.

Polishing and Grinding Motors.

In a great variety of industries small motors are now needed for buffing, polishing and grinding purposes, and manufacturers of silver, copper, brass and other metal wares are continually making new demands for apparatus of this character. We illustrate herewith the neat and handy appliances put on the market by the Connecticut Dynamo & Motor Company, of 526-530 West Twenty-fifth Street, New York City. As will be noted, the motors are of compact form, with unusually long shafts, which allow large and irregularly shaped pieces to be polished easily. The motors are of the bipolar type and are completely enclosed, dust and moisture-proof. The armature, field coils and working parts are completely protected from dust, moisture and other foreign substances. The armature cores are built up of laminated sheet-iron stampings mounted directly on the shaft. The winding is carefully insulated from the core, and every precaution is taken to have the insulation resistance between windings and core a maximum. The shaft projects considerably beyond the bearings and the wheels are mounted directly on the shaft. For special requirements, extra shaft extensions are provided.



POLISHING AND GRINDING MOTOR.

Each polishing motor shaft is made with a taper thread at both ends on which the buffing wheels are mounted; and each grinding motor has its extension shaft at each end fitted with check plates and clamp nuts. All the motors are supplied with automatic starting boxes, having "no-voltage" release. The motors can be had with a floor column of hollow iron casting and a cast-iron drip pan, the starting rheostat and all electrical connections being mounted inside the column, which has a door.

Large Mexican Contract for Centrifugal Pumps.

The International Steam Pump Company has just been awarded the largest contract ever placed for high-lift centrifugal pumps. The contract calls for eleven machines to be electrically operated. They will be installed in Mexican mines for drainage purposes.

Pumps of this class consist, roughly speaking, of a paddle wheel or impeller revolving at high speed in a suitable casing, the water entering at the axis and being expelled by centrifugal force at the periphery. Heretofore, however, such pumps have been used for heads of only 10 to 20 feet. The pumps now ordered will have heads ranging from 85 to 560 ft., and their capacities are to vary from 100 to 1,500 gallons per minute. The direct-connected motors will be built by the General Electric Company. They will be of various sizes up to 200 hp. The Brooklyn plant of the Henry R. Worthington branch of the International Company will manufacture the pumps. It is interesting to note that Mexico makes a continual demand on this country for hydraulic apparatus.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET. Although there was a firm tone in speculation, quietness prevailed. The standard railway stocks, together with such specialties as Brooklyn Rapid Transit and Amalgamated Copper, continued to be the chief objects of attention. United States Steel was also prominent, and advanced on the short interest in it on the news that the prices of steel products were to be maintained by the pool. The money market is easier, and on the whole the general situation is favorable. While Brooklyn Rapid Transit was conspicuous it failed to regain much of the decline it suffered during the previous week. The sales amounted to 133,500 shares, at prices ranging between 48¼ and 51⅜, the closing quotation being 50—a net gain of 1⅞ points. Met. St. Ry. did not figure to much extent in the dealings, only 6,700 shares having changed hands between 121 and 122¾, the closing figure being 121¼, a gain of ½. General Electric made a gain of 1½, closing at 165½, ex div., and was quite steady throughout the week. Westinghouse Com. closed at the highest price of the week—158⅜, which is a net gain of 6⅜ points. Western Union closed at 86 ex div. American Dist. Tel. and Ameri. Tel. & Tel. are both lower, the closing rates being 24½ and 125, respectively. Following are the closing quotations of December 21:

NEW YORK.

	Dec. 15	Dec. 21		Dec. 15	Dec 21
American Tel. & Cable	80	80	General Electric	164	164
American Tel. & Tel.	125	125⅝	Hudson River Tel.	..	..
American Dist. Tel	23	24	Metropolitan St. Ry.	121¼	122¼
Brooklyn Rapid Transit	49⅝	50⅞	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	..	N. Y. & N. J. Tel.	..	..
Electric Boat	*23	15	Marconi Tel.	..	..
Electric Boat pfd	48	40	Western Union Tel.	..	..
Electric Lead Reduction.	⅝	⅝	Westinghouse com.	155½	157
Electric Vehicle	5¾	5¼	Westinghouse pfd.	185	180
Electric Vehicle pfd	8	8			

BOSTON.

	Dec. 15	Dec. 21		Dec. 15	Dec. 21
American Tel. & Tel	125⅜	125¼	Western Tel. & Tel. pfd.	79½	*81
Cumberland Telephone	*115	*115	Mexican Telephone	1⅛	1⅞
Edison Elec. Illum.	231	220	New England Telephone	122	122
General Electric	163	165	Mass. Elec. Ry.	18½	18
Western Tel. & Tel	7½	7⅛	Mass. Elec. Ry. pfd.	76	75

PHILADELPHIA.

	Dec. 15	Dec. 21		Dec. 15	Dec. 21
American Railways	42½	43	Phila. Traction.	..	..
Elec. Storage Battery	53	54	Phila. Electric	6⅛	6
Elec. Storage Battery pfd.	53	54	Phila. Rapid Trans.	10½	9¾
Elec. Co. of America.	8	8			

CHICAGO.

	Dec. 15	Dec. 21		Dec. 15	Dec. 21
Central Union Tel	..	..	National Carbon pfd.	90	92
Chicago Edison.	..	..	Metropolitan Elev. com.	16	16
Chicago City Ry.	159¾	160	Union Traction	6	5½
Chicago Tel. Co	..	..	Union Traction pfd.	25	25½
National Carbon	20	20			

*Asked

MASSACHUSETTS ELECTRIC.—The Massachusetts Electric Companies has issued its fourth annual report, showing gross $6.333,910, net $2,178,002, and dividends of $840,232, with $1,331,147 charges, leaving a surplus of $6,623. President Gordon Abbott says: "As a result of the considerable amount of new construction done in 1902 for the purpose of connecting various existing lines, little work of that kind has been done during the past year, but very important improvements have been carried out both to the equipment and to the power houses. Thus during the fiscal year the following amounts have been expended: Cars and electrical equipment, $906,000; reconstruction of track, $468,000; power stations, $910,000; reconstruction of cars, $93,000; land, buildings and engineering, $193,000; total, $2,570,000; spent for new roadway and new tracks, $460,000. During the year 164 new cars were purchased, of which 132 were equipped, 25.5 miles of track were reconstructed with new and heavy rail, 44.8 miles of new feed wire and 2½ miles of underground feeder were built and 8,500 hp new machinery installed. Besides this the new station at Newport, with 2,100 hp of turbine generators was practically completed and the new station at Quincy Point, with room for 15,000 hp of turbine generators, was pushed forward rapidly, so that it may be expected to be ready for its electrical equipment by February 1. The sum of $145,000 has been written off to cover the release of a considerable amount of old and ineffective machinery made necessary by the new improvements. Since your trustees accepted the trust four years and a half ago, the records show that during that period, and leaving out of account all new construction, 75 miles of track have been reconstructed with either 75-pound tee or 90-pound girder rail—267 miles of new feeder wire have been strung—123 cars reconstructed and increased in size and 621 cars and new plows added, and 1,064 new motors and equipments purchased."

CHICAGO ELEVATED LINES MAKE GAINS.—The South Side, the Northwestern and the Metropolitan Railway Companies have issued November traffic reports, and all make excellent showings. In point of gains, the Alley "L" leads the list. A considerable percentage of the increase is directly attributable to the strike on the surface lines, which diverted traffic to the Alley "L" during the last two weeks in the month. From November 12 to November 25, inclusive, the average daily traffic was 206,000. This exceeded by 10 per cent. any like period during 1893, the World's Fair year. The banner day for the month was November 14, when 229,535 passengers were carried. The Northwestern Elevated made the second best showing for the month, a daily average of 71,422 passengers, as compared with 67,236 during November of last year, an increase of 6.23 per cent. In the case of the Metropolitan Elevated, the daily average for the month showed an increase of 3.5 per cent., as compared with the corresponding period of last year. The daily average this year was 114,148 passengers, as against 110,189 the previous year.

DIVIDENDS.—The regular quarterly dividend of 1¾ per cent. on the stock of the New York Metropolitan Street Railway Company will be paid January 15. The directors of the American Telephone & Telegraph Company have declared a regular quarterly dividend of 1½ per cent., and an extra of ¾ per cent, payable January 15. In accordance with the provisions of the lease of the West End Street Railway Company to the Boston Elevated Railway Company, a semi-annual dividend rental of $2 per share will be paid on West End Street Railway Company preferred stock January 1. Electric Storage Battery directors have declared a regular quarterly dividend of 1¼ per cent. on the capital stock, payable January 2. A dividend of 75c. per share has been declared on Reading Traction, payable to stock of record on December 19. The St. Joseph Railway, Light, Heat & Power Company has declared the regular quarterly dividend of 1¼ per cent. on its preferred stock.

CRANE CHRISTMAS CASH.—The Crane Company, of Chicago, will distribute $250,000 among its employes this year. The money will be divided before Christmas Day among 5,000 persons. All the men and women who have been laid off in the course of the year, whether in the company's employ now or not, will be remembered. There are about 500 of these, many of whom are now at work for other establishments. The money will be distributed on the ratio of time worked during the year. Last year Mr. Crane gave each employee 5 per cent. of his yearly wage. The amount to be distributed this year is considerably in excess of that of any previous year, partly because the company has 1,000 more employees than it had a year ago, and partly because of the prosperous conditions that have prevailed.

CONN. RAILWAY & LIGHTING.—The Connecticut Railway & Lighting Company reports as follows for the year ended June 30, 1903:

	1903.	1902.	Changes	
Gross	$1,048,259	$1,106,868	Dec.	$58,609
Expenses	819,091	668,454	Inc.	150,637
Net	$229,168	$438,414	Dec.	$209,246
Other income	180,374	167,953	Inc.	12,421
Total income	$409,542	$606,367	Dec.	$196,825
Charges, taxes, etc.	527,905	518,553	Inc.	9,352
Deficit	$118,363	Sur.$87,814	Inc.	$206,177

CHICAGO AUTOMATIC TELEPHONE.—The Automatic Telephone Company, controlled by the same interests which will operate the Illinois Tunnel Company, is to be pushed ahead as swiftly as new capital will assist it. Within the month, the officials say, the capital stock is to be increased from $3,000,000 to $5,000,000. All the new stock has been subscribed for and none will be offered in open market.

BOSTON EDISON INCREASE.—The stockholders of the Edison Electric Illuminating Company, of Boston, at a special meeting, have voted to increase the capital stock to 104,491 shares by issuing 9,500 additional shares at $200 a share, as authorized by the Gas Commissioners. The company's business grows so rapidly as to need about ten per cent. new money added to its capital every year, to provide new plant and general equipment. The price is $200 per share.

Commercial Intelligence.

THE WEEK IN TRADE.—According to reports received by the mercantile agencies, holiday and retail business is seasonably active; wholesale and jobbing trade is correspondingly quiet, and manufacturing industry is slack. Several encouraging features are noted. There is no car conjestion this year to hamper the operations of the railroads, which are handling the current excellent business offered with profitable results, as demonstrated by the fact that the gross earnings for the first half of December will probably show an aggregate gain of about 6 per cent, as compared with an increase of 4 per cent. in November. It is particularly noteworthy that these advances follow heavy gains in corresponding periods for the past eight years. Clearings show contractions at most leading centres, and failures are about normal in number. "The export trade of the country is finishing better than the earlier outlook indicated," says *Bradstreet's*, "owing to the large exports of cotton. November's export trade was the second largest month's total on record; that for eleven months exceeds a year ago by nearly $100,000,000, and points to an aggregate of exports not far from $1,458,000,000. With imports of about $1,000,000,000, the year's total foreign trade will far exceed any previous year. The reciprocity treaty with Cuba bids fair to give American cotton manufacturers an outlet not previously had for nearly $6,000,000 of goods." The iron trade is still optimistic, and makers of finished products are apparently firm in their views and prices. Machinery manufacturing is dull in the East. The metals are all strong, and building material is quite active, and is likely to so continue into the spring, judging from permits issued at leading cities. Increased expenditures for public improvements next year give hope of great engineering activity, and of large consumption of iron, steel, lumber, wire and other material. In copper there was a slight activity on export account, but later it quieted down. Purchases for home consumption were not many or large. The closing official prices were: Lake, 12⅜@12⅝c.; electrolytic, 12¼@12½c., and casting stock 12⅛@12¼c. The business failures for the week ending December 17, according to *Bradstreet's* compilation, aggregated 239, against 241 the week previous and 225 the corresponding week last year.

POWER IN BALTIMORE, MD.—It is stated from Baltimore, Md., that the completion of the great project for the electrical development of the falls of the Susquehanna River, on the Niagara plan, is now assured by the fact that Anthony N. Brady, of New York, and associates have taken over $1,000,000 stock in the United Electric & Power Company, of Baltimore, controlling the lighting of that city. Plans for the power plant at Conowingo, on the Susquehanna, have been completed, and routes for the cables to Baltimore, Havre de Grace, Elkton and other towns in Maryland, Southern Pennsylvania and Delaware have been laid out. There will be a number of changes in the directorate of the United Electric Light & Power Company by January 1. The new interests in the company have tendered the presidency to S. Davies Warfield, president of the Continental Trust Company, who conducted the negotiations with Mr. Brady. There are now five vacancies in the board of directors, and Mr. Brady, with three of his associates, will fill four of these. Mr. Brady will also become a member of the executive committee of the company, which will be increased from five to seven members. The present executive committee is composed of S. Davies Warfield, William T. Dixon, Thomas J. Hayward and Francis E. Waters. The dissolution of the syndicate holding the $2,000,000 common stock of United Electric Light & Power Company, and owning the Mount Washington Electric Light & Power Company, will mean a distribution of these securities to the new owners. The investment of the New York interests in the Susquehanna project will probably be $10,000,000. It is proposed the works can be completed in 1905 to supply 40,000 hp to Baltimore.

SOME C. & C. ORDERS.—The C. & C. Electric Company, 143 Liberty Street, New York, has taken a contract for a 75-kw, belted generator and 75-hp of motors, five in number, and varying in capacity from 5 hp to 35 hp, for installation in the Britton Leather Company tanneries, now under construction at Brewer, Me. A 30-kw, direct-connected generator has been ordered by the A. D. Granger Company, White Building, for the new Healy Building. The Illinois Southern Railway Company has requisitioned for a 25-kw generator and 25-hp of motors, for use in its Sparta (Ill.) shops. This order is a duplicate of the one received by the C. & C. people for the Chicago shops of the company. The engine will be shipped by A. L. Ide & Sons, of Springfield, Ill. The Fifth Avenue Estates will be supplied with eight slow-speed, C. & C. motors, varying from 2 hp to 15 hp, used for driving Sturtevant & Blackman ventilators in a new office building. A 75-kw, belted generator is to be used for lighting a manufacturing building now under construction in Brooklyn by Charles E. Ring, 38 South Eighth Street. Charles Wagner, 587 Hudson Street, New York, has ordered seven 5-hp, slow-speed motors for driving printing presses. A. & F. Brown Company's plant at Elizabethport, N. J., is to have further C. & C. equipment, a 100-kw, belted generator and switchboard having just been ordered for lighting and power purposes. The C. & C. Company reports that the demand for motors to be installed in small manufacturing plants in New York is picking up very materially after a lengthy stretch of dullness. A large number of orders have laready been secured and several more are expected to be closed shortly after the holidays.

ELECTRICAL INSURANCE.—With regard to the recent meeting of the electrical committee of the Underwriters' National Electric Association, Mr. C. M. Goddard informs us officially that very little was done in the way of tinkering with the code. "The most important feature which came up at this meeting was the report of the committee on standardization of enclosed fuse cut-outs. That committee reported that they had been able, through consultation with the manufacturers, to obtain an arrangement by which the different makes of such fuses shall be interchangeable, and not only that, but arranged so that it would be impossible to put a 200-amp. fuse in a 50-amp. cut-out block. There was also a report of progress from the committee on requirements relative to wiring of electric railway cars, which would indicate that through the conferences being held with a committee appointed by the American Street Railway Association, some satisfactory agreement between the parties in interest on this subject will soon be arrived at."

NEW YORK TROLLEY MATERIAL.—The Metropolitan Street Railway interests are proposing to change over to electricity next year some forty miles of horse-car line still remaining. This will require considerable new material and plant of all kinds. Mr. Paul D. Cravath, of counsel for the railway company, has sent a letter to the Mayor, in which he says that the company presents the option of having the present horse-car line in West Street continued, or else having the overhead trolley system installed, as an underground system in the street named is out of the question. He also says the road now merely is getting the view of property owners, and has made no formal application for the right to install the overhead or any other new system.

THE INTERNATIONAL TELEPHONE MFG. CO., Chicago, has, during the last few months, greatly enlarged its manufacturing plant, and completed a set of special tools and machinery for manufacturing directly from the crude material a new and improved generator-call, self-restoring drop switchboard system. It began making shipmentof this class of equipment about 60 days ago, and states that it has received, within the past month, orders for seventeen complete exchange equipments, aggregating over 4,000 lines. This, in connection with an increased demand for its long-distance country party line and village exchange telephones, has increased its business over 500 per cent.

GENERAL ELECTRIC.—An officer of the General Electric Company is quoted as saying: "The falling off in the business of the General Electric Company, such as it has been, is due to the general depression in business. We expect, however, to make for the year ending January 31 nearly as good a showing as we did last year. About six weeks ago we were about $100,00 ahead in our sales as against the previous year. The indications seem to be that for the completed year our gross receipts will be nearly as large as in 1902, and that, owing to the falling off in the price of some materials, such for instance, as copper, we shall come out very well in our net."

EXTENSIONS AT STILLWATER, MINN.—Plans and specifications are being prepared for improvements to be made to the plant of the Stillwater Gas & Electric Light Company. There is proposed a water power development of 1,000 hp, rebuilding gas works, ten miles of transmission circuits, 20-ft. dam, etc. George Mayer is secretary, and R. S. Fuertado, general superintendent, Tribune Building, Chicago, will be in charge of construction.

EQUIPMENT FOR INDIANA TRACTION.—The power house of the Northern Traction Company of Indiana, for the construction of whose system between Wabash and Marion J. G. White & Company have the contract, will be installed with two Bullock generators of 200-kw capacity each, direct-connected to Allis engines of 250 hp. Two 100-kw Bullock compound boosters, to be wound for 550 volts, have also been ordered.

BOILERS WANTED.—The Board of Water Commissioners of Dunkirk, N. Y., will on January 14, at 8 P.M., open sealed proposals for two 150-hp boilers. Bids will be received on either water-tube or return tubulars, and with or without stokers. Bids can be filed up to the hour of the meeting. Specifications and other information will be furnished by Mr. W. C. Baumgartner, the secretary of the Board.

KILBOURNE & CLARK COMPANY, Seattle, Wash., has received a contract for an electric lighting plant which is to be installed at Leavenworth, Wash.

BALL ENGINE COMPANY.—Erie, Pa., has recently sold an automatic engine to the village of Chardon, Ohio, for electric lighting purposes.

General News.

THE TELEPHONE.

PRESCOTT, ARIZ.—Yavapai County, which is nearly as large as the State of Indiana, is supplied with telephone service by the Prescott Electric Company, 450 subscribers at Prescott and 90 at Jerome. The company furnishes toll service to all the principal mining camps.

LITTLE ROCK, ARK.—The North Arkansas, Southwest & Missouri Telephone Company has been organized here with W. T. Stahl as president.

CORNING, ARK.—The opening of a line by the Corning Telephone Company to Poplar Bluff gives connection with Doniphan, Neelyville, Harville, Poplar Bluff and a number of intermediate points.

NEW LEWISVILLE, ARK.—There has been an increased demand for telephone service during the last few months made upon the Walnut Hill Telephone Company. There are 115 subscribers, and 25 miles of toll line. Another toll line will shortly be erected.

MENA, ARK.—Mr. J. M. Davis, secretary and treasurer of the Kizer Telephone Company, reports a probable increase from 275 to 400 subscribers. A Kellogg 300-drop board is operated, and there are about 150 miles of toll line. A minimum charge of 25c. is made for toll service.

ARKADELPHIA, ARK.—The Arkadelphia Telephone Company is at present leasing its equipment from the Southwestern Telephone & Telegraph Company, but it is planned to put in an independent exchange. The company has 180 subscribers, 175 miles of toll line, and contemplates building 25 more miles.

LITTLE ROCK, ARK.—The North Arkansas, South Missouri & Indian Territory Telephone Company has been organized with the following officers: President, W. T. Stahl, Siloam Springs; vice-president, W. T. McCormick, Prairie Grove; secretary, K. G. Comfort, Westville, I. T.; treasurer, H. O. Beeson, Pipeville, Mo.

DENVER, COL.—The Colorado Telephone Company has recently inaugurated a system whereby ranchmen and residents of 238 Colorado towns are notified every morning of the weather conditions and probabilities. This will be a safeguard to the farmers in taking care of their vines and fruit trees when a storm is threatened. Seventeen towns in New Mexico are receiving a similar service.

SHARON, CONN.—The Sharon Telephone Company has 210 subscribers who pay $16 for residence and $18 per annum for business service. "American" apparatus is used. About twenty subscribers have recently been acquired.

GAINSBORO, GA.—The Gainsboro Telephone Company, a long-distance concern with headquarters at Carrollton, Ga., has bought the plant of the Hogansville, Ga., company and several short lines, valued at about $2500.

SAYBROOK, ILL.—The Arrowsmith Telephone Company has been incorporated with a capital stock of $1200. Directors: C. W. Hurst and others.

FLANAGAN, ILL.—The Flanagan Telephone Company has been incorporated; capital, $800. Incorporators: H. F. Mette, J. H. Linneman, D. W. Halen.

CARTHAGE, ILL.—The East Carthage Telephone Company has been incorporated. Capital, $21000. Incorporators: O. W. Cuter, C. Wright, Samuel Curry.

YORKTOWN, ILL.—The Hoopole, Yorktown, Tampico & Thomas Telephone Company has been incorporated with a capital of $4000. Directors: F. E. Toy, Wm. Thomas and Thomas Burton.

FLANAGAN, ILL.—A new Stromberg-Carlson switchboard has recently been put in at Gridley, Ill., the exchange at which place and that at Flanagan are operated by the Waldo Telephone Company, Mr. E. E. Fosdick is secretary.

METROPOLIS, ILL.—During 1903 the Metropolis Telephone Company built 25 miles of toll line and added 50 subscribers, the total now being 50 miles of toll line and 200 subscribers. A Eureka switchboard of 200 drops (150 installed) is in use at this place.

MATTHEWS, IND.—The Matthews Telephone Company has been incorporated with a capital stock of $15,000. Directors: E. W. Trook, P. E. Rudd and others.

INDIANAPOLIS, IND.—The Greene County Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $10,000. Ziba P. East, W. H. Cooper, A. L. Milam, Wm. H. Beaty and Henry W. Moore are the officials.

INDIANAPOLIS, IND.—Arrangements have been made to enable the Indianapolis weather bureau to announce the weather forecast each day at 10 o'clock to the residents of the extreme part of northern Indiana. The plan is to telephone the report to Lagrange, Shipsewana, Millersburg and Middleburg from which centers it will be distributed to all telephone patrons at the hour named. A similar service has long been in use in central and eastern Indiana.

MUNCIE, IND.—The Merchants' Association of this city held a spirited meeting recently and voted against supporting two telephone systems, agreeing to have Central Union telephones removed from their places of business. This action was taken after a conference with the Central Union officials who promptly refused to reduce rates to equal those charged by the Delaware & Madison County Company. The fight has been on for some time. The Central Union agreed to improve the service, but this was not satisfactory, hence the action of the Merchants' Association. It is asserted that the action is the entering wedge that will practically kill the Central Union's business in Muncie.

FT. WAYNE, IND.—At the annual meeting of the Home Telephone Company of this city the following were elected directors: W. L. Moellering, C. S. Bash; L. C. Hunter, Jno. B. Reuss, G. M. Hooffman, M. B. Fisher and W. A. Bohn. The stockholders approved the plan to pay the outstanding bonds $250,000 in twenty yearly installments and appropriated the required amount to pay the first installment. The company has no liabilities other than the bonded debt which will be all paid by 1918. It owns the two buildings in which the exchanges are located and now has 5000 telephones in use with 200 applications pending. There are 150 stockholders and the number of employees is 85.

INDIANAPOLIS, IND.—The plan to merge all the telephone companies affiliated with the Independent Telephone Association, as mapped out at the recent meeting at Chicago, is attracting general interest and comment in Indiana. Mr. Sherrin, general manager of the New Telephone Company, says that while his company was not represented at the meeting he does not understand that the merging pertains to the formation of one large company, but is a plan to bring the companies into a closer relationship with a view to perfecting and extending long-distance telephone service by some sort of reciprocal agreement. The movement, Mr. Sherrin thinks, does not contemplate the transfer of property or the show of money, but rather to form a community of interests in order to obtain better and wider service. He thinks such a plan practical, even though the various companies continue to operate separately as they are doing at the present time.

OAKVILLE, IA.—The Oakville Telephone Exchange Company has been organized.

POSTVILLE, IA.—The Farmers' Mutual Telephone Company has been organized with a capital stock of $3000. J. T. Henderson is president.

ALBERT CITY, IA.—The German-Swede Southern Telephone Company, Albert City, Ia., has recently completed a net work of lines in that section for a rural party line telephone system. The system is constructed with lines of the most substantial character possible and is equipped throughout with long distance telephones of the "International" bridging type.

SABETHA, KAN.—The Sabetha Telephone Company has increased its capital stock from $10,000 to $30,000.

LOUISVILLE, KY.—The Central Mississippi Telephone Company has incorporated with a capital stock of $10,000. Directors: M. H. Woodward, W. C. Wright and others.

BANGOR, ME.—The Bangor Automatic Telephone Company has been incorporated with a capital stock of $250,000.

BALTIMORE, MD.—The Maryland Telegraph & Telephone Company has opened a long-distance line from Baltimore to Hagerstown, through connection with the Frederick Telephone & Telegraph Company and the United Telephone Company of Hagerstown.

PONTIAC, MICH.—The Oakland Telephone Company is now connected with Detroit. A line from Sand Hill to the Franklin road, three miles south of Pontiac has been completed by the Co-operative Telephone Company of Detroit.

HART, MICH.—The stockholders of the Oceanic Telephone Company have voted to change the name of the company to Lake Shore Telephone Company and increase the capitalization to $200,000. This action was made necessary by the purchase of the Pere Marquette Telephone Company's property in Mason County.

KALAMAZOO, MICH.—The Citizens' Telephone Company's system will be in operation in a few months. The following named officers have been elected: President, F. F. Reed; vice-president, W. W. Olin; secretary and general manager, R. C. Parkard, of Toledo; treasurer, E. W. Bowman. The company is capitalized at $250,000. It is stated it will be financed by a large eastern trust company. At the start exchanges will be opened at Galesburg, Augusta and Richland, and toll lines will be run from the rural districts to connect with the various exchanges.

NORTHFIELD, MINN.—The Northfield Telephone Exchange Company will install a central energy switchboard.

VINELAND, N. J.—The Mutual Telephone Company, of this place, has been incorporated with a capital stock of $25,000. Harry Taylor is president.

BELLEMEAD, N. J.—The Hellsborough & Montgomery Telephone Company has been incorporated with a capital stock of $125,000. Directors: P. A. Garretson, Wm. C. Hendrickson and others.

SCHENECTADY, N. Y.—The Schenectady, Delanson & Esperance Telephone Company has been incorporated with a capital stock of $1500. The directors are L. L. Terpering, J. V. Vidder and others.

COLUMBUS, N. C.—The Columbus Telepbone Company has been re-organized and new officers elected. The property was recently bid in at public auction.

CLIFFDALE, N. C.—The Cliffdale Telephone Company, of Rutherford County, N. C., has been chartered by Edw. Thompson and others. Capital, $5000.

WAYNESVILLE, N. C.—It is proposed to change from magneto to central energy system within the next six months by the Waynesville Telephone Company; also to build 40 more miles of toll line. The subscription list has almost doubled recently, and now numbers 130 names. The charges are $12 to $24 per annum.

LUCAS, OHIO.—The system of the Monroe Telephone Company is maintained on the mutual plan. Of the present 150 subscribers one-third was added last year.

FAIRVIEW, OHIO.—Two Kellogg 100-drop boards are operated by the Union Telephone Company with its 100 subscribers. A probable increase of one-third is expected next year.

CLEVELAND, OHIO.—Pres. F. S. Dickson, of the United States Telephone Company, has completed plans for enlarging the scope of that company's business which call for the expenditure of $500,000 during the coming year.

PORTSMOUTH, OHIO.—Manager E. E. Knox, of the Portsmouth Telephone Company, says "Our system is growing fast; we have trouble to keep up with new business." An "American" 1000-drop is in operation, and there were 1278 subscribers on Sept. 28, 1903.

THE DALLES, ORE.—The Seufert & Condon Telephone Company which began operation in May, 1895, is believed to be the first independent system operated on the Pacific Coast. Since starting, the exchange has never closed day or night. In two months a Kellogg Express board will be installed. There are 500 subscribers. Mr. J. W. Condon, manager, tells us that they enjoy a continuous growth of substantial subscribers and do not encourage any others. Some new country lines are planned.

STROUDSBURG, PA.—The Monroe County Telephone Company was started by some farmers in this vicinity, and is controlled and operated by a portion of the Stroudsburg & Bushkill Telephone Company. A 10-line board is to be placed at Mt. Pocono as soon as possible to handle the service at that end, when more telephones will be added. The Stroudsburg exchange uses Kellogg instruments.

YANKTON, S. D.—The Sioux City Telephone Company will erect a plant here to cost $350,000.

MORRISTOWN, TENN.—The Citizens' Telephone Company has increased its capital from $7000 to $12,000.

RUSSELLVILLE, TENN.—The Russellville Telephone Company has been incorporated with a capital stock of $10,000. R. M. Drummond is president.

CHATTANOOGA, TENN.—A long-drawn fight has been ended at Chattanooga by the signing of a contract between the East Tennessee Telephone Company and the Hamilton Telephone Company in which the former agrees to maintain the rates prevailing before the recent advance, and the independent company agrees to surrender its franchise to the city and not to apply for another.

NAVASOTA, TEX.—The Southwestern Telegraph & Telephone Company is to spend something like $1,000,000 in improving and enlarging its service in Texas.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company is in a peculiar situation in this city. The council has recently passed an ordinance prohibiting any telephone company from erecting poles until a franchise has been obtained. The Bell Company is now operating here under a perpetual right, but it will be compelled, if it desires to erect any more poles, to obtain a franchise covering a limited period.

RURAL RETREAT, VA.—A small steady increase is reported by the Rural Retreat Telephone Company with its 125 subscribers and over 75 miles of toll line. Each subscriber pays $9 per annum.

TAZEWELL, VA.—The Tazewell Telephone Company, with 250 subscribers, using "Eureka" instruments, reports that it is constantly building. Mr. George W. St. Clair is secretary and treasurer.

PULASKI, VA.—Some twenty-five exchanges distributed over ten counties come within the system of the Virginia & Tennessee Telephone Company which uses Sumter apparatus for its 2500 subscribers.

FRANKLIN, VA.—There are about 70 subscribers to the system of the Virginia and Carolina Telephone Company, which reports a steady growth. The rates for service are $2 and $1.50.

GLOUCESTER, VA.—The Tidewater Telephone Company operates three exchanges, and numbers 265 subscribers. The trunks between exchanges are to be increased and two short party lines of eight or ten miles each are to be built.

MEHERRIN, VA.—The recently-organized Lunenburg Telephone Company is building lines from Meherrin to Lunenburg C. H., a distance of about 16 miles. If the line is found profitable the operations of the company will be extended.

BUCKHANNON, VA.—The Buckhannon Telephone Company has 500 subscribers. A 300-drop Eureka switchboard and a 100-drop Standard Telephone & Electric switchboard are installed. Cables for towns and toll line copper metallic circuits are projected. J. W. Downs is manager.

ALBEMARLE, VA.—The Albemarle Telephone Company, with its 675 subscribers, using Western Telephone Construction apparatus, reports that it is now on a paying basis and expects to have 1000 telephones in about a year and a half, which will mean a change from a magneto to a common battery system.

NORFOLK, VA.—The Southern States Telephone Company has just changed from the magneto to the common battery system and anticipates an increase in business as a result of the much superior service. It is planned to build a number of extension lines and cables. At Norfolk City there are 1320 patrons, where a 1680-drop Kellogg switchboard is used. The rates charged are $28 and $38 per annum.

BURNSVILLE, W. VA.—Three exchanges are operated by the Weston Central Telephone Company, which has 250 subscribers and 275 miles of toll line. The system has been installed for four years. The rates are $18 and $24.

CHARLESTON, W. VA.—The Charleston Home Telephone Company commenced operations in January, 1901, with 300 subscribers; it now has 1100. The company owns 350 miles of toll line, covering the Kanawha coal field, and connecting with the adjoining states. The demand for service is very great, and the company is growing at the rate of 30 to 50 subscribers a month. A 3000-drop Kellogg switchboard is installed here. The company expects to build 150 miles more of toll lines during the next few weeks.

READSTOWN, WIS.—The Readstown Telephone Company has been incorporated with a capital stock of $5000. The directors are F. M. Groves, C. W. Reeve and others.

BERLIN, WIS.—The Waushara Telephone Company operates a 200-drop board at Berlin, a 50-drop board at Wild Rose, and at Wautona a 50-drop board. Mr. A. F. Adams is secretary and manager.

PHOENIX, B. C.—The Vernon & Nelson Telephone Company has expended $10,000 recently in rebuilding and improving its service in this city.

ELECTRIC LIGHT AND POWER.

EUREKA, CAL.—The Humboldt Bay Lighting & Power Company has been reported incorporated, with a capital of $1,000,000, to construct a water power plant on the Klamath, capable of generating 3000-hp, and an auxiliary plant in East Eureka of 1500-hp. Incorporators: J. C. Bull, Jr., and Geo. Henderson, of Eureka; Ralph W. Bull, of Arcata, and others.

WASHINGTON, D. C.—John A. Moon has introduced in Congress a bill authorizing the city of Chattannoga, Tenn., or a private corporation, to construct a dam and locks on Tennessee River for the operation of an electric power plant which would cost several millions.

LOUISVILLE, GA.—Bids will be received Dec. 29 by L. R. Farmer, City Treasurer, for $20,000 light and water bonds.

MILLEDGEVILLE, GA.—The Oconee Electric Light & Power Company will expend at present time $225,000. The company will do its own work.

CHARLESTOWN, IND.—The Town Trustees have granted Clarence R. Hay a ten-year franchise for an electric light plant.

KEWANEE, ILL.—The Council has under consideration the establishing of a lighting plant in connection with the city water works.

SHELBYVILLE, ILL.—The Shelbyville Water, Heating & Lighting Company has been incorporated. Capital $50,000. Incorporators: W. H. Beam, Chas. C. Scovil and Wm. S. Middlesworth.

BALTIMORE, MD.—Anthony N. Brady, of New York, N. Y., and associates have taken over $4,000,000 stock in the United Electric Light & Power Company, of Baltimore, controlling the lighting of this city. Plans for the power plant at Conowingo, on the Susquehanna, have been completed, and routes for cables to Baltimore, Havre de Grace, Elkton and other towns in Maryland, Southern Pennsylvania and Deleware have been laid out.

EVELETH, MINN.—P. E. Dowling has petitioned for a franchise for an electric light plant.

MOORHEAD, MINN.—The Moorhead Electric Light & Power Company has been incorporated, with a capital of $50,000. E. E. Moore is reported interested.

LIVINGSTON, MONT.—The plant of the electric light company has been destroyed by fire, and will be rebuilt at once. C. S. Hefferlin is manager.

PENN YAN, N. Y.—A committee of the Board of Trustees is investigating the electric light question, with a view to establishing a municipal plant.

NEW YORK, N. Y.—The following bids for installation of electric wiring, fixtures, etc., for lighting the new Williamsburg Bridge, over East River, have been opened by Gustav Lindenthal, Commissioner of Bridges; J. C. Livingston, Jr., Company, $21,700; Commercial Construction Company, $18,000 and M. B. Foster Electric Company, $18,423.

GENEVA, N. Y.—The Geneva Power & Light Company has placed an order with the General Electric Company for $10,000 worth of new equipment for its plant in this city, to consist of 110 new street lamps of the enclosed type, one new 225-lamp alternating current dynamo for the street service and one smaller alternating current dynamo for incandescent service.

ULYSSES, N. Y.—The Ulysses Electric Light, Heat & Power Company has been incorporated at Albany with a capital stock of $23,000. The directors are Frederick C. Biggs and Ossian G. Noble, of Trumansburg, and Professor Gardner S. Williams, of Ithaca. The company purposes to erect a power house on the banks of Taughannock creek, and to operate it by water power. Work on the plant has already been begun.

BURLINGTON, N. C.—The Robinson-Humphrey Company, of Atlanta, Ga., has bought $30,000 bonds of the town of Burlington, the proceeds of which will be used for an electric lighting plant.

HENDERSONVILLE, N. C.—The Hendersonville Light & Power Company, of Hendersonville, has been incorporated with a capital of $50,000. R. M. Oates, M. D. Peden and C. H. Oates are the incorporators.

MECHANICSBURG, OHIO.—D. J. Long has secured a franchise for an electric light plant.

HAMILTON, OHIO.—The Hamilton Heating & Power Company has been incorporated by Peter Bisdorf, Ed. C. Sohngen, Fred. Schwenn, and others, with a capital of $10,000.

WILMINGTON, OHIO.—The Wilmington Water & Light Company has been incorporated with a capital of $125,000.

HELLERTOWN, PA.—The question of constructing a municipal electric light plant is under consideration here.

JOHNSTOWN, PA.—The shareholders of the Citizens' Light, Heat & Power Company have approved the proposition to increase the capital from $250,000 to $1,000,000. The purpose of the increase is to effect a consolidation of its interests with those of the Johnstown Light, Heat & Power Company.

COLUMBIA, S. C.—A controlling interest in the Columbia Electric Railway, Light & Power Company has been secured by Edwin W. Robertson and associates. The deal includes the electric lighting plant of the city.

JEFFERSON CITY, TENN.—G. A. Moody, an attorney of Jefferson City, has secured a second franchise for a lighting plant in this city. Another plant is now in operation.

ELMA, WASH.—It is stated that the White Star Milling Company will install an electric light plant of 2000 lights capacity.

BALLARD, WASH.—A. Starkey has petitioned City Council for a franchise for an electric light plant. He proposes constructing a plant to cost about $80,000.

DAUPHIN, MAN.—Applications are wanted for franchises and proposals for the installation of electric light plant and telephone system. Wm. Rintone is city clerk.

THE ELECTRIC RAILWAY.

CHICAGO, ILL.—The principal offices of the Los Angeles Traction Company have been changed from Jacksonville to Chicago.

CHICAGO, ILL.—A new traction company, the South Side Suburban Railway Company, has petitioned the Chicago council for a 20-year franchise for a double or single track road to tap the following districts: Pullman, West Pullman, Dolton, Hammond, Harvey and Chicago Heights. No compensation was mentioned, and the petition has been referred, together with frontage consents, to the committee on local transportation. The northern terminus will be at the State Street line of the Chicago City Railway Company. C. C. Heisen is president. Stephen A. Foster, vice-president, and Cornelius J. Ton, secretary.

EVANSVILLE, IND.—It is authoritatively announced that the Evansville & Newburg suburban line will be changed from a steam to an electric road, and that it will be extended to Rockville via Boonville.

PORTLAND, IND.—The Eastern Indiana Traction Company, which is to build through Portland, has let the contract for the building of its grade between Richmond and Fountain City. Work on that end of the line will begin at once. The company laid several hundred feet of track in Richmond some time ago in order to hold its franchise.

MUSCATINE, IA.—The car house of the Citizens' Railway & Light Company, with 27 cars, was burned Dec. 3. Loss, $50,000.

COUNCIL BLUFFS, IA.—The Council Bluffs, Tabor & Southern Railway Company has applied to the City Council for a franchise for the Interurban Terminal & Belt Line Company to construct terminal and belt lines.

JOPLIN, MO.—The Joplin, Neosho & Peirce City Interurban Railroad Company has been incorporated. The general offices will be in Neosho. It is incorporated for $50,000. One-half the stock has been subscribed and 10 per cent paid in. The directors are Charles Cunliff, Wm. S. Brawner, John Kimpel, John Weathers and Benjamin Cunliff, all of St. Louis.

ROME, N. Y.—The officials of the Rome City Electric Railway Company are considering the matter of extending the line through North Rome.

NEW YORK, N. Y.—The Interborough Rapid Transit Company has applied to the Rapid Transit Commission for leave to extend the subway from the terminal to Kingsbridge by an elevated railroad to Van Cortlandt Park. The length of the extension will be about a mile, and will cost about $490,000.

ITHACA, N. Y.—The State Board of Railroad Commissioners has granted a charter to the Ithaca & Cortland Traction Company. The new road will open up a rich farming country and will afford a quick means of travel between Ithaca, Dryden and Cortland. George Archer and H. L. Chandler, of Philadelphia, are directors of the company.

ONEIDA, N. Y.—The Oneida Railway Company has been granted a franchise which gives the company permission to cross the Seneca Turnpike at the head of Main Street, and to cross West Road a little further south. These crossings are part of the revived route to be followed by the company in building the extension from Oneida to Kenwood and Sherrill.

SYRACUSE, N. Y.—Upon application of the directors, the Syracuse, Lakeside & Baldwinsville Electric Railway Company has gone into bankruptcy, and William B. Rockwell has been appointed receiver. The road has a floating indebtedness of $135,000, and has been unable to pay the interest on its bonds. The immediate cause of the receivership is the action brought by Lieut.-Gov. William M. Brown, of New Castle, Pa., to recover interest on $26,000 worth of bonds. Mr. Rockwell, the receiver, is general manager of the road.

MARION, OHIO.—C. Crissinger, of Marion, is securing franchises and right of way for a road from Marion to Bucyrus. A franchise is now pending in the latter place.

BRIDGEPORT, OHIO.—The Wheeling Traction Company is planning to build a line from Bridgeport to Pasco and Barton. The road may eventually be extended to Cadiz.

ZANESVILLE, OHIO.—Surveys have been started for the line of the Perry Electric Railway, Light & Power Company, which is to extend from Zanesville to New Straightsville. It is claimed that practically all the right of way has been secured.

CLEVELAND, OHIO.—The Cleveland, Chardon & Meadville Railway Company has been incorporated in Ohio, with $25,000 capital stock, by H. A. Stahl, T. H. Hogsett, W. C. Warner, Monroe Warner and A. R. Warner. The company was incorporated last summer under the laws of Pennsylvania, and it is stated that a private right of way over the route from Chardon to Meadville has already been obtained.

COLUMBUS, OHIO.—The Columbus Railway & Light Company has given a contract for an automobile truck which will carry jacks and other equipment to render temporary aid to disabled cars, and in addition will carry four hose bridges for use at fires. The truck will have a maximum speed of 15 m. p. h., and it will respond to all fire alarms in the central portion of the city. The Columbus Company already operates an automobile tower wagon.

HARRISBURG, PA.—A charter has been granted to the Monroe & Northampton Street Railway Company, 15 miles long. It has a capital of $90,000.

LANCASTER, PA.—Nearly all the right of way between Leaman Place and Ronk's has been secured for the Lancaster & Eastern Electric Railway Company.

WAYNESBORO, PA.—The Chalmersburg, Greencastle & Waynesboro Electric Railway Company has completed its line to Greencastle, and has placed an order for a large amount of trolley wire with the Magnet Wire Company, of New York.

PITTSBURG, PA.—The Pittsburg Railways Company has secured the franchises for an extension of its lines from Avalon through the borough of Ben Avon to the Eastern limits of Emsworth. The extension will be 2½ miles long, and will require the building of a steel viaduct.

LANCASTER, PA.—A charter has been granted to the Philadelphia, Coatesville & Lancaster Passenger Railway Company, capital $40,000, to build a line 22 miles long, extending from Coatesville to Strasburg. A power house will be erected at Christiana, and the line equipped with ten four motor cars.

SCRANTON, PA.—The Scranton Railway Company will spend about $500,000, it is stated, on betterments to its system the coming year. Later in the month the board of directors will pass upon these contemplated improvements. A number of lines are to be double tracked, and a number of new cars purchased.

HARRISBURG, PA.—The Valley Traction Company has been chartered with these directors: Mr. McKennedy, George H. Stewart, Lyman D. Gilbert, Spencer C. Gilbert and Lewis S. Sadler, all of whom are interested in the Cumberland Valley Railroad Company. It is stated that the new company will control and merge the Harrisburg and Mechanicsburg, Harrisburg & West Fairview, West Fairview & Marysville and the White Hill & Mechanicsburg Electric Railway systems, and expects to get control of the system of the Cumberland Valley Traction Company, with lines in Carlisle and between Mechanicsburg and Carlisle.

YARDLEY, PA.—The Yardley, Newhope & Lambertville Street Railway has been incorporated at Harrisburg for the purpose of building a line from this borough to Newhope, opposite Lambertville, a distance of about 11 miles. The capital of the company is $100,000, and T. Sidney Cadwalader, of this place, is president. W. F. Sadler, Jr., of Trenton, N. J., is also interested. It is understood that a bridge, to cost about $50,000, will be erected in place of the wooden structure swept away in October, and that a line will be constructed from Trenton to Lambertville, and thence up the Pennsylvania side of the Delaware River to Newhope.

EDMONTON, N. W. T.—The people in this town are moving for an electric street railway, and have decided upon submitting to the people for approval a by-law to provide for the construction of a municipal system.

WALKERVILLE, ONT.—The Ontario Traction Company, Ltd., has been incorporated, with a capital stock of $50,000, to construct an electric railway in Walkerville, Ont. The incorporators are C. M. Walker, E. F. Lardore and J. H. Coburn, of Walkerville; Franklin Ohl, Willis F. Brown, of Toronto.

NEW INDUSTRIAL COMPANIES.

THE INTER-STATE MARINE TELEGRAPH COMPANY, of New York City, has been incorporated; capital, $10,000. Directors: T. J. Ryan, E. Haussner and F. E. Sharot, New York.

THE ALLIED ELECTRIC CORPORATION, with a capital stock of $1,000,000, has been incorporated in Los Angeles, Cal. The directors are M. V. McQuigg, C. W. Allen, R. C. P. Smith, K. R. Smith and J. M. Gardiner.

THE O'KANE-HULL COMPANY, of Columbus, Ohio, capital stock $25,000, has been incorporated by W. C. O'Kane, R. E. Hull, G. R. Heges, Frank M. Raymond and Ira A. Crumm. The company will manufacture electrical machinery.

THE TRACTION DEVELOPMENT & SECURITIES COMPANY, of New York City, has been incorporated with a capital stock of $200,000. The directors are S. B. Manning, Henry Oppenheimer and C. C. Marshall, of New York City.

THE IMPERIAL TRANSIT COMPANY has been incorporated at St. Louis to operate an automobile coach line between the city and the World's Fair. The company, which was incorporated by A. Levy, H. M. Dalton and H. C. Pickett, is capitalized at $600,000, full paid.

THE MONARCH INCANDESCENT LAMP COMPANY.—The stockholders of the Monarch Incandescent Lamp Company of Warren, Ohio (recently incorporated) have elected the following-named officers: C. H. Sager, president; Frank Myers, vice-president; J. F. Kistler, superintendent. The company has located its factory in Warren.

OBITUARY.

MR. T. C. FRENYEAR.—Mr. Thomas Cyprian Frenyear, sales manager of the new Canadian Westinghouse Company, died of typhoid fever at Fort William, Canada, on Dec. 10. He was a man of exemplary life, unusual business judgment and ability, and was remarkable for the clearness and force of his ideas. As an electrical engineer he was a good adviser. His is the first death in nearly five years among the higher officials of the Westinghouse Electric Company. He was the son of the Rev. T. C. Frenyear and was born on March 16, 1865, at Middletown Spa., Vt. He began his business career before he was 15 years old, in the office of the Boston Electric Company, where an uncle, Mr. W. R. Nutting, was manager. While there he entered the Latin School, doing his studying at night. Thence he went to Phillips Exeter Academy, paying his way by keeping a bookstore for students. He was graduated in 1885. He entered Harvard that autumn, but could not spare time to continue the course. He afterward entered the Boston University, but a business reverse put an end to his efforts to gain a collegiate degree. For several years after he was in the employ of the Thomson-Houston and Brush Electric Companies as salesman, with his headquarters in Buffalo. From 1892 to 1895 he was superintendent of the Cayadutta Electric Railroad. In the fall of 1895 he entered the employ of the Westinghouse Electric & Mfg. Company. He was connected with the sales office of that Company until Nov. 1, 1903, when he was placed in charge of the sales department of the new Canadian Company with headquarters in Toronto. He was married to Miss Emma L. Chase, of Exeter, on June 28, 1893. Mrs. Frenyear and three children survive him. Mr. Frenyear was a deacon and trustee of the Delaware Avenue Baptist Church, of Buffalo, and had been superintendent of the Sunday School. In announcing the death to the officials of the Westinghouse Company, Vice-president Taylor said: "The management desires to place on record its thorough appreciation of his able and loyal service and of the loss to the Westinghouse interests by the untimely removal of a young and zealous official whose future seemed so full of promise."

PERSONAL.

MR. FRANCIS BLOSSOM, of Sanderson & Porter, is back from an extended Western trip.

MR. F. S. WILLIAMSON, of Chas. H. Davis & Partners, has sailed for a trip to England.

MR. JOHN M. ANDERSON, treasurer of the Albert & J. M. Anderson Mfg. Company, of Boston, was in New York last week.

MR. W. H. HARVEY, of Memphis, Tenn., has in hand plans for a plant for the Wesson Light & Power Company, of Wesson, Miss.

MRS. FREDERICK R. SCOTT, of Richmond, Va., has donated $10,000 to the University of Virginia for an electrical engineering laboratory.

MR. JOHN G. EMERY, general manager of the Shaw Electric Crane Company of Muskegon, Mich., is in New York for a few days at the offices of Manning, Maxwell & Moore.

MR. E. W. STEVENSON, electrical engineer of the Hazard Mfg. Company, Wilkesbarre, Pa., has been spending several days for recreation, etc., in New York City, where he is very much at home.

MR. N. WINGFIELD, Augusta, Ga., is preparing plans for an electric plant at Sandersville, Ga., including three 100-hp boilers, two engines of 150 and 75-hp respectively, two generators of 50 and 100-kw respectively, piping, etc.

MR. H. C. FRICK, the steel millionaire, is reported to be prominent in the affairs of the Pittsburgh Reduction Company, which makes nearly 80 per cent of the aluminum in this country, the product being estimated at 10,000,000 pounds last year, all told.

MR. GEO. L. COLGATE, of Batavia, N. Y., well known in electric light and manufacturing circles, has been developing the project of delivering Niagara Falls power in Batavia and ten miles of the right of way has already been secured. It looks as though the scheme would be carried out.

MR. TOWNSEND WOLCOTT and Mr. R. A. Klock are referred to in high terms of praise in regard to their professional services for the department, by Gen. A. W. Greely in his annual report as Chief Signal Officer, U. S. A. Mr. Walcott is also described as "an electrical engineer of marked ability and great practicability."

MR. P. B. DELANY, the electrical engineer, who has been inventing and perfecting telegraphs all his life, states that he now has ready a perfect automatic machine telegraph capable of 3000 words per minute. He has been working on this for a long time past. Mr. Delany's work in this direction has already been noted in our columns.

MR. PETER COOPER HEWITT is the third member of the Automobile Club of America to enter for a place on the team to represent this country in the race for the Bennett International Automobile Racing Trophy in Germany next year. His entry, which was received at the Automobile Club last week, named his car as being built at the iron works at Trenton, N. J., in which Mr. Hewitt is interested, and it is presumed that it is of his own design.

PROF. D'ARSONVAL.—The Paris *Matin* the other day printed an interview with Professor d'Arsonval in which the latter declared that France, after having had the glory of discovering radium, is now in danger of being left behind by England and America for want of funds to carry on experiments. The *Matin*, therefore, has determined to come to his assistance and has presented Professor d'Arsonval with 30,000f. ($6000) for work in this direction.

MR. ALEX. HENDERSON celebrated his birthday on Dec. 21 and would have done so quietly if a number of New York friends had not invaded his privacy as a "surpise party," bent on making closer acquaintance with the loving cup presented to him a few months ago. Some thirty showed up, including Messrs. Eidlitz, Hatzel and Blackall, who voiced the sentiments of their fellow conspirators in regard to the involuntary host of the evening. Altogether a most delightful time was spent.

MR. CHAS. J. REED has requested us to announce that owing to press of professional work, it will be impossible for him to serve another term as secretary of the American Electrochemical Society, and asks that votes for this office may be cast for others. As one of the originators of the society and the guiding spirit during its life up to the present, the determination of Mr. Reed to retire from its active direction is much to be regretted, but we learn that he will under no circumstances reconsider his declination.

MR. C. W. DARLEY, ex-engineer-in-chief of the public works of the New South Wales government, who now holds the position of inspecting engineer attached to the office of the agent general for New South Wales in London, has sailed for England after several weeks' visit on this side. He came here to inspect some of the large water power and irrigation plants, and the report he will make will, it is understood, in Australian trade circles here, contain recommendations as to the placing of some substantial contracts on this side.

COMMERCIAL CABLE MEN.—The third annual staff dinner of the employees of the Commercial Cable Company took place at Shanley's on December 14. More than a hundred of the men gathered about the tables. Among those present were George G. Ward, vice-president of the company; George Clapperton, traffic manager; C. E. Merritt, assistant treasurer; J. H. Smart, superintendent of the station in this city; F. S. Austin, assistant superintendent; F. H. Dennis, chief of the Clearing House Department, and Charles C. Cuttriss, chief electrician. Telegrams were received from all the superintendents of the company and from Mr. Clarence H. Mackay, in which regrets were expressed at being unable to attend.

MR. H. M. WHITNEY, of Boston, has been to Ottawa to make a proposition to the Minister of Marine for the adoption of the Gray-Mundy electric submarine signal in Canadian waters. The United States Government, it is said, is arranging to have a commission to report upon the invention with a view of adopting it in American waters. Minister Prefontaine says: "If everything turns out as I expect it will, the next season of navigation will see these signals established all along the St. Lawrence and Atlantic Coast. Parliament has already given the department and the Government a pretty free hand in providing aids to navigation so that the St. Lawrence route may be made not only perfectly safe to mariners, but that not a vestige of complaint can be laid against it by those who are inclined to do so at present."

MR. LA RUE VREDENBURGH, who will present at the twenty-seventh convention of the National Electric Light Association, to be held in Boston, a report on advertising methods for central stations, has sent out a circular to members of the association asking them to give expressions of opinion as to the methods they have found most effective along this line; what their experience has been as to traceable results from such advertising as they have done, and requesting them to forward him for use in his report samples of advertising matter that in their opinion have been best business bringers. Mr. Vredenburgh will also make a similar request of a large number of foreign central station companies, with a view of comparing methods in this country and abroad, as well as giving the Association the benefit of any novel ideas that it would be well to adopt here. The report will have an immense practical value for all members wishing to extend their business.

BULLOCK CHANGES OF PERSONNEL.—Several personal changes in the Bullock Electric Mfg. Company have become necessary owing to the very marked demand for its apparatus. Mr. Halbert P. Hill has become connected with the Bullock Electric Mfg. Company and will take charge of their exhibit at the St. Louis Fair in 1904. Mr. Hill represented the General Incandescent interests here in New York City, and was sales manager for the Storey Company until they passed out of existence. Mr. W. L. Fairchild, late treasurer of the J. F. Kelly Engineering Company, joined the forces of the company and will operate from the New York office. Mr. A. F. Rolf, assistant to Mr. R. T. Lozier, at Cincinnati, has been transferred to the New York office as assistant district manager of that office, Mr. E. W. Goldschmidt being the district manager. Mr. Walter B. Spellmire, district manager at Atlanta, has taken the position of the vice-presidency of the A. W. Wyckoff Company, at Pittsburg, who succeed the Pittsburg Engineering Company, as representatives of Bullock interests in that territory. Mr. G. C. Henry, general manager of the Florida Electric Company takes Mr. Spellmire's place as district manager at Atlanta.

MR. GEO. WESTINGHOUSE, while in the city just previous to sailing on the *Kaiser Wilhelm* to attend the the annual meeting of the stockholders of the British Westinghouse Company, gave a most encouraging opinion regarding industrial prosperity during the coming year. During the week ending Dec. 4th, Mr. Westinghouse met at Pittsburg, twenty-three district managers from Atlanta, Dallas, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Minneapolis, Philadelphia, St. Louis, Syracuse, Seattle, Salt Lake City, San Francisco, Los Angeles, Denver, Toronto and the City of Mexico. Each manager was requested to make a report as to the industrial conditions of his territory and its probable demand for Westinghouse machinery for 1904. Thirteen reported unusual activity with probably greatly increased demands. The other nine, all but two, reported as strong a demand as during the past year with probable increase. Two only expected to hold their own or on account of local conditions, have a smaller demand. Mr. Westinghouse on these reports, had directed improvements and enlargements to provide for the demand and is exceedingly optimistic as to activity in the future. He thinks the lowest point of the ebb tide of industrial depression has been reached and that 1904 will be a year of added prosperity.

Trade Notes.

TROLLEY CAR LIGHTING.—The Kinsman Electric & Railway Supply Company, 91 Liberty St., New York City, is introducing and recommending its new Kinsman supplementary car lighting system which never leaves the car in darkness and thus prevents panics, robberies, collisions, etc.

THE CENTRAL ELECTRIC COMPANY is enthusiastically calling attention to its "I. X. L." weatherproof, slow-burning waterproof wires. These high grade wires, the company says, are unsurpassed and are meeting with a popular reception. Prospective buyers are urged to obtain prices, samples and full information concerning them from the company.

"SALUS" COMPOUND.—Those who have never heard of "Salus" compound, the new insulation for Packard transformers, are requested to write to the transformer department of the selling agents, the Electric Appliance Company, Chicago, who will give complete data on transformers and transformer insulation.

WARREN ROTARY ENGINE.—The Rotary Engine Company, 135 South Second Street, Philadelphia, has issued a handsome 16-page bulletin describing and illustrating in detail the Warren rotary steam engine. To those interested in new developments in steam engineering this pamphlet will be welcome, as it explains in detail the new principles whose application has enabled the great desideratum of a mechanically efficient rotary engine to be practically realized.

WESTINGHOUSE IN CANADA.—A circular has been issued calling attention to the Canadian Westinghouse Company, whose formation has already been frequently noted in these columns, intended to take over the Canadian business and interests of the Westinghouse Electric & Mfg. Company. It has works at Hamilton, Ohio, and sales headquarters at Toronto. The apparatus in Canada will be designed by the same engineers and made under the same system as that produced in the United States. The company will devote its energies solely to the development of business in Canada.

THE STANDARD ELECTRICAL MANUFACTURING COMPANY, Niles, Ohio, reports a gratifying increase of business this fall, which proves that "Star" lamps are steadily growing in popularity. This is particularly true of its numerous types of sign, candelabra and other decorative lamps. Instead of slighting or side-tracking this department, as is so often the case, the same painstaking care in choice of materials, construction and exhaustive testing is exercised, as in the manufacture of standard types. A liberal choice of styles and colors is allowed. All these are illustrated and described in the attractive catalogue recently issued, which can be obtained on application.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 15, 1903

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

746,337. ELECTRICALLY CONTROLLED VALVE; Oscar Junggren, Schenectady, N. Y. App. filed Nov. 15, 1902. Two electro-magnets control respectively steam passages leading to two pistons on a valve stem, one for opening the valve and the other for closing it.

746,669. CURRENT REGULATOR; George A. Cardwell, New York, N. Y. App. filed March 21, 1903. Means for varying the duration of the time intervals during which currents of predetermined strength flow through a circuit and means for diminishing the full value of the current in the circuit as the duration of the time intervals decreases, thus affording regulation without breaking the circuit.

746,671. INSULATOR; Taylor Carter, Frankfort, Ky. App. filed Sept. 12, 1903. Eccentric jaws are pivoted to an insulating block to secure the wire to the block.

746,672. ENGINE STOP; James H. Cary, Providence, R. I. App. filed July 28, 1902. An emergency stop consisting essentially of a circuit containing a relay which actuates a motor circuit to move the throttle valve.

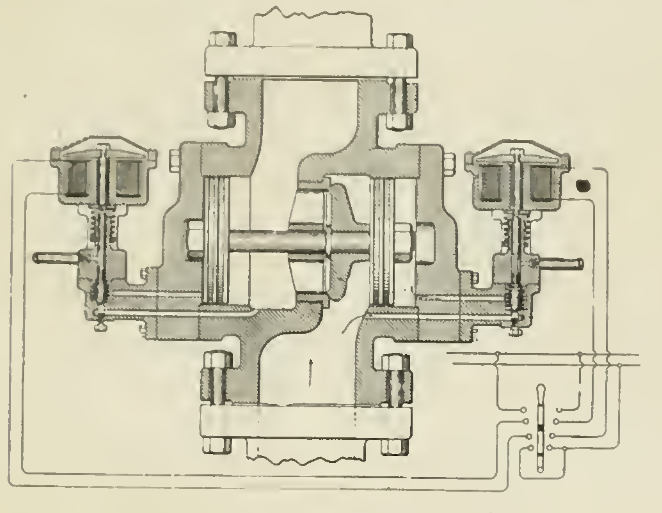
746,690. SYSTEM OF TELEGRAPHING OR TELEPHONING TO OR FROM RAILWAY VEHICLES; James Edgar, Wrexham, England. App. filed June 29, 1903. (See page 1058.)

746,695. AUTOMATIC ELECTRIC SWITCH; William S. Guthrie, Terrell, Tex. App. filed June 19, 1903. A switch for an electric sign in which levers are moved into connection with contact studs by a rotating drum carrying pins on its surface; the contact studs are spring mounted so as to yield and prevent breaking or bending of the levers.

746,697. SYSTEM OF ELECTRICAL DISTRIBUTION; Josef H. Hallberg, New York, N. Y. App. filed May 28, 1903. A system wherein current traversing the field magnets of a main generator is automatically varied to maintain a uniform potential in the distributing circuit by varying the speed of a motor in accordance with the work in the distributing circuit, said motor driving a generator which delivers a current in opposition to the exciting current of the fields of the main generator.

746,726. ELECTRICAL SIGNAL SYSTEM; Ulysses G. Merrill, Litchfield, Me. App. filed Sept. 10, 1902. Details.

746,748. APPARATUS FOR REFINING METALS; Alfred Schwarz, New York, N. Y. App. filed April 10, 1903. (See page 1058.)



746,337.—Electrically Controlled Valve.

746,751. CURRENT COLLECTING DEVICE FOR ELECTRIC RAILWAY SYSTEMS; Abraham A. Shobe and William Embley, Jerseyville, Ill. App. filed April 10, 1903. A current collector adapted to enter a conduit and being constructed to compensate for vertical movement of the car and thus constantly maintain good connection with the conductor.

746,772. ELECTRICAL SWITCH BOX APPARATUS; George L. Addenbrooke, Westminster, England. App. filed May 17, 1902. Consists of a pressure-ratio and a current-ratio set of resistances controlled by switches, combined with means for connecting them to a battery resistance, various meter circuits and a standard cell, the apparatus being used for testing.

746,775. PRODUCING APPROPRIATE PHASE RELATIONSHIP IN ALTERNATING CURRENT MEASURING OR OTHER DEVICES; Riccardo Arno, Milan, Italy. App. filed Feb. 8, 1900. Consists in energizing one set of inducing coils with the current flowing in one of the multi-phase mains and energizing the other set or sets of inducing coils by a current due to the properly proportioned amount of electromotive forces derived from currents flowing in the other mains of the multi-phase system acting through magnetic media.

746,795. PROCESS OF MANUFACTURING ALKALI CYANIDS; Paul Danckwardt, Deadwood, S. D. App. filed June 10, 1903. (See page 1058.)

746,796. PROCESS OF SIMULTANEOUSLY PRODUCING ALKALI CYANID AND ALKALI METAL; Paul Danckwardt, Deadwood, S. D. App. filed June 10, 1903. (See page 1058.)

746,797. PROCESS OF SEPARATING METALS FROM MATTE OR ORE; Paul Danckwardt, Deadwood, S. D. App. filed June 20, 1903. (See page 1058.)

746,798. PROCESS OF RECOVERING ZINC FROM SULFID ORES; Paul Danckwardt, Deadwood, S. D. App. filed Aug. 15, 1903. (See page 1058.)

746,830. ELECTRIC ARC LAMP; Thomas Hamilton-Adams, London, England. App. filed June 4, 1903. The parts of the clutch also constitute parts of the core of the solenoid, and being magnetized grip the carbon rod.

746,860. TROLLEY CATCHER; Horace R. Martin, East Bloomfield, N. Y. App. filed Aug. 7, 1903. A pneumatic apparatus for winding up the rope that retains the trolley arm in case the wheel leaves the wire.

746,903. ELECTRIC RECEIVER CLOCK; Johannes W. H. Uytenbogaart, Utrecht, Netherlands. App. filed May 6, 1903. The circuits of the permanent magnets are maintained closed while the magnets are not in use.

746,904. MAGNETO GENERATOR; George E. Wheeler, Burlington, Ia. App. filed Dec. 27, 1902. The spaces between the pole pieces above and below the armature are covered by plates to keep out the dust.

746,977. ELECTRIC RAILWAY SIGNALING SYSTEM, Charles W. Mills and William W. Piddington, Los Angeles, Cal. App. filed June 23, 1903. Details of a system wherein signals are displayed in the engineer's cab.

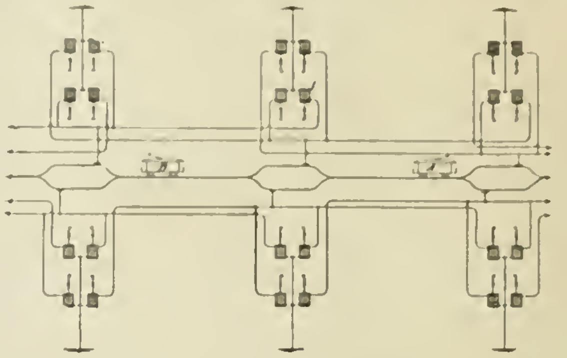
746,979. PARTY LINE BELL; Leland Moore, Brooklyn, N. Y. App. filed April 16, 1903. (See page 1058.)

747,070. SIGNALING DEVICE FOR TELEPHONE PARTY LINES; Edward Oakman Hood, Hingham, Mass. App. filed Oct. 15, 1902. (See page 1058.)

747,106. TROLLEY; Milford J. Wilson, Painesville, Ohio. App. filed Sept. 2, 1902. A construction relating to the lubrication of the bearing through a hollow axle and to the contact between the wheel and stationary parts.

747,142. RAILWAY SIGNAL; Henry M. Cogan, New York, N. Y. App. filed April 23, 1903. A signal adapted for either single or double track trolley roads, by which more than one car moving in the same direction are permitted on a block at the same time, the first car to enter setting a danger signal ahead which is not cleared until the last car leaves the block.

747,155. TROLLEY SWITCH; Lloyd E. Elwell, Los Angeles, Cal. App. filed Aug. 17, 1903. A frame having two grooves one of which is depressed and acts in conjunction with a guiding flange to direct the trolley wheel onto a branch wire.



747,142.—Railway Signal.

747,166. THERMOSTATIC CIRCUIT CLOSER; Redman W. W. Grigsby, Chrisney, Ind. App. filed June 15, 1903. A casing having a stem to be inserted in a cavity of a bearing and containing a thermostatic circuit closer to indicate excessive heat in the bearing.

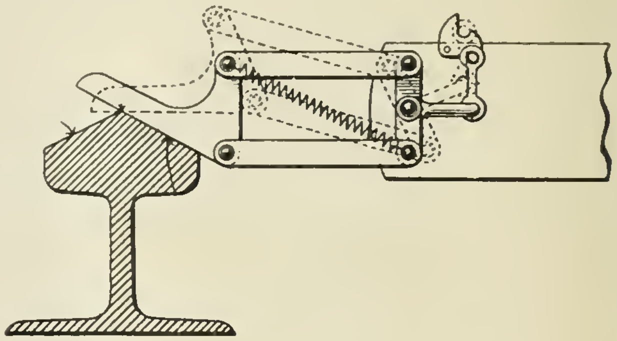
747,177. ELECTRIC RAILWAY; Maurice Hoopes, New York, N. Y. App. filed April 29, 1903. To enable the operation of third rails during the prevalence of sleet, the rail is formed with a ridge or corner from which it is easy to remove the ice by means of a blade of any character and then by shifting the shoe, to make contact with the ridge only, sufficient current will be collected by the various shoes of a train to keep up the headway.

747,185. ELECTRIC HEATER; Frederick W. Kelley and James F. McElroy, Albany, N. Y. App. filed May 17, 1897. The heater is in the form of a disk built up of spiral coils and insulating plates alternating with each other and mounted in a frame permitting of circulation of air.

747,212. DISPLAY LIGHT; Dennis J. O'Brien, San Francisco, Cal. App. filed May 20, 1902. The characters of a sign are formed by tubular lamps in which a filament is stretched, one end being fixed and the other flexibly connected with the terminals of the tube.

747,217. ELECTRIC MOTOR; Leroy S. Pfouts, Canton, Ohio. App. filed March 5, 1903. Two armatures in line with each other on independent shafts are located in the field of a single magnet, the armatures being independently geared to respective wheels of the vehicle.

747,234. BLEACHING PROCESS; Marcus Ruthenburg, Harrisburg, Pa. App. filed Feb. 14, 1903. (See page 1058.)



747,177.—Electric Railway.

747,236. POWER TRANSMISSION MECHANISM; Joseph S. Schaffer, Chicago, Ill. App. filed June 9, 1902. Two motors of high and low speed and large and small power, respectively, are mechanically connected together to drive a printing press, the controllers being constructed to start and control one motor and then cut in the other before the first is cut out.

747,277. ELECTRIC RAILWAY SYSTEM; Sivert Udstad, Aurora, Ill. App. filed Feb. 21, 1903. A cover carrying a third rail beneath it and feeders duly protected above it.

747,297. THERMOSTATIC APPARATUS; William H. Vristol, Hoboken, N. J. App. filed May 5, 1903. A combined thermostat and thermometer in which the indicator of the latter continues to operate in case the circuit controlled by the former is not effective in preventing a rise or fall of temperature beyond the limits.

747,305. ELECTRIC CLOCK; Vitalis Himmer, Jr., Bayonne, N. J. App. filed Oct. 9, 1902. Details.

747,317. LIFT; Robert F. Cary, Cricklewood, England. App. filed July 13, 1903. Details.

747,326. ELECTRIC RAILWAY SIGNALING SYSTEM; Charles W. Mills and William W. Piddington, Los Angeles, Cal. App. filed July 14, 1902. Details.

747,331. SUBSCRIBER'S TELEPHONE CIRCUIT; William W. Dean, Chicago, Ill. App. filed Dec. 23, 1903. (See page 1058.)

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